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Imaging

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists

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Women's health

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From the President

Prof Michael Permezel
President

Considerable focus is now being placed on the Joint RCOG/RANZCOG Event in Brisbane, 12–15 April 2015. Excellent scientific and social programs are seeing advance registrations breaking all previous RANZCOG records. This will be a memorable event and I encourage all College members to make every effort to attend.

FIGO 2021 Congress

RANZCOG has now been formally accepted as a bidding national society for the FIGO 2021 Congress. Both Melbourne and Sydney Convention Centres have expressed interest and will be visited by FIGO over 2–6 March 2015.

FIGO Executive Board Meeting

Completely independent of the 2021 conference bid, FIGO will be holding their Executive Board meetings in Melbourne on 29–30 May. This is an excellent opportunity to showcase not only our own College, but also the work being done by many Fellows in Indigenous Women's Health, Papua New Guinea and the Pacific.

Support for Pacific specialists

I attended a recent forum discussing the role of the Australian/New Zealand specialist medical colleges in assisting healthcare and facilitating training in the Pacific. Through our Asia Pacific and Global Women's Health Committee, RANZCOG has a number of initiatives that are supporting both training in the region and the Pacific specialist. Particularly welcome is Associate Membership of the College, which is available to our Pacific colleagues and enables ready access to College publications, e-Learning resources and a CPD program. The College House staff, Carmel Walker and Georgia James, are deserving of congratulations on their excellent work to date – however, much more can be done in the future and

I encourage all College members to consider if they might be able to contribute in some way to women's health in the region. For example, ultrasound machines are in short supply across the Pacific and a retiring Fellow or someone updating might consider donating a machine for which there is no longer any use. If you do have an ultrasound machine that you think may be suitable for donation, please contact Carmel Walker at the College.

Education and training

Procedural training

Issues around procedural training are likely to feature regularly in this column. The Board has recently approved a more detailed logging of Trainee procedural experience, particularly relating to pelvic floor and incontinence procedures. The aim is to rapidly transition to a point where Trainees can be directed to where they are most likely to receive the best training for their training needs.

e-Portfolio

Closely allied to the logging of procedural training is our intention to streamline data management within the training and education sections of the College. It is planned to have the e-portfolio ready for the New Zealand Trainee year commencing December 2015 and the Australian Trainee year commencing February 2016.

Women's Health

Hydralazine

Shortages of medicines arise from time to time owing to a breakdown in the chain of supply. The recent shortage of hydralazine was communicated to us by the Therapeutic Goods Administration (TGA) and our newsletter, *Collegiate*, was used to convey this information to the Trainees and members of the College. Until supplies are restored, we request that another suitable agent, such as labetalol, be substituted for hydralazine unless there is a contraindication such as asthma.

PGF2alpha

At the time of writing, there is an impending withdrawal of PGF2alpha by the Australian drug supplier. This is most concerning as it features in leading protocols, such as the RANZCOG and RCOG guidelines, for the management of postpartum haemorrhage. Early advice is that pharmacies may be able to import PGF2alpha using the Special Access Scheme Category A (life-saving medication), however, this is not completely clear and I will endeavour to update you in the next *Collegiate*.

Continuing professional development

Educational meetings notification

The College receives many requests from outside bodies to send an email 'blast' to all Fellows and Trainees to alert them to a particular advertised meeting or event. It is a widely held view that repeated e-blasts are probably not the preferred means of communicating educational events to Fellows and the Board remains cognisant of concerns regarding email fatigue. As a means of addressing both, the College is developing a new page on the website relating to notices from third parties. *Collegiate* will be updated to include a direct link to the relevant College webpage, providing specific details in relation to new advertised educational events. We encourage you to access this webpage via *Collegiate*; many of these meetings are extremely worthwhile, with much excellent work done by the organisers.

Selection

As stated in previous columns, selection for training in obstetrics and gynaecology remains much sought after among the 'tsunami' of medical graduates produced by our expanded medical schools. Selection for training is intensively competitive.

Some new strategies have been recommended to the Board by the Selection Committee of the College. The key issues to be addressed include a better translation of prevocational performance into the selection score through changes to referencing and increasing the numbers of Trainees training in their state/region of choice. Details of the selection process for 2015, for both New Zealand and Australia, will be updated on the College website.

Chief Executive Officer

On 16 January 2015 our Chief Executive Officer, James McAdam, left the College after 14 months in the position. James is moving on to new challenges and we wish him well for the future. The position has been advertised through an external recruitment company and a strong field of applicants has responded. I will keep the membership updated with developments regarding an appointment to this position through this column and *Collegiate*.

From the Regions

South Australia

Partnership with Indonesia

South Australia has a well-deserved reputation for excellent biomedical research, but what may not be so well recognised is the enormous effort put into outreach of our expertise. We are working to improve the health and wellbeing of pregnant women and their children in Indonesia through a collaborative partnership. For the past four years, a team of doctors, nurses and midwives have travelled to Bali each May, to share their skills and knowledge with colleagues from Sanglah Hospital, Bali's main public hospital. They take part in Annual Combined Clinical Meetings, held over several days, through which information is shared with local doctors, trainees and midwives. This is an opportunity for local staff to gain a better understanding of how to manage high-risk pregnancies.

The initiative has developed over several years, led by a team that includes A/Prof John Svigos AM and Dr Rosalie Grivell. Women in Indonesia have much higher rates of maternal and perinatal mortality than Australia and we are looking at what we can do to change some of the outcomes in a resource-poor setting. Part of this is education about the need to be more discerning about different styles of antenatal care and to identify and manage high-risk conditions, such as pre-eclampsia and intrauterine growth restriction. The relationship is mutually beneficial as the Indonesian team treat serious conditions, such as perinatal infection and advanced gynaecological cancer, which we do not commonly see in Australia.

The team also provides the hospital with equipment and, in 2011 and 2012, three Indonesian MFM Trainees undertook training rotations in Adelaide, using funding provided by AusAID. The most recent visit to Sanglah Hospital, in May 2014, was attended by 15 Women's and Children's Hospital staff, as well as colleagues from the Lyell McEwin hospital, King Edward Memorial Hospital (WA), Royal Prince Alfred Hospital (NSW) and Royal North Shore Hospital (NSW). Preparations are underway for the fifth meeting this year.

Dr James Harvey
Dr Rosalie Grivell

Tasmania

The changing landscape of training

Tasmania, an island of approximately 550 000 inhabitants, is well known for the varied geography, beautiful landscape and fabulous tourist attractions such as Cradle Mountain and Stanley in the northwest, the vineyards in Tamar Valley and Cataract Gorge in the north and MONA and Salamanca Markets in Hobart and Bruny Island in the south. Tourism and the fresh food are the major drawcards of the state. However, as far as training in our specialty is concerned, Tasmania is sometimes seen as the last outpost by many Trainees. This is clearly a myth that should be dispelled.

Core Training is provided at Royal Hobart Hospital (RHH), Launceston General Hospital (LGH) and the Northwest Regional Hospital (incorporating Burnie and the Mersey Community Hospitals). Advanced Training opportunities exist in Hobart and Launceston and in Burnie (as part of an elective year under the old scheme). The gynaecological oncologists at RHH have a Pelvic Floor Fellow (an extremely popular post) who is appointed for a year at a time. First-year Trainees start at both RHH and LGH. Trainees rotate to either LGH or Burnie Hospital as part of their rural rotation. Both LGH and Burnie are also used by other units in the mainland for the rural rotation of their Trainees. All three training centres have been assessed by the College and have training accreditation for four years.

While there are no subspecialist services apart from gynaecological oncology in Tasmania, the links between the three regions have provided good opportunities for Core Training in all the major specialty areas. RHH and LGH have always provided an excellent grounding for the more junior Trainees and both LGH and Burnie have provided more opportunities, especially in gynaecological operating for the more experienced Trainees.

These rural rotations are immensely popular. Trainees in RHH also get good exposure to the academic aspects of the discipline such as research, clinical audit and quality improvement. However, Advanced Training has been problematic until recently.

For many years, trainees in Tasmania have gone to centres in the mainland when they complete their core training. Some return to Tasmania after their FRANZCOG, but there is always a talent drain to the mainland. In recognition of this, in 2013, RHH was successful in bidding for Federal funding under the 'Training More Specialist Doctors' rescue package. With this funding, an advanced Trainee would spend year 5 in a large tertiary hospital in Melbourne and then rotate to Hobart in the final year as a senior registrar. The aim is for the senior registrar to gain significant clinical experience in a large Melbourne Hospital and return to Hobart in the final year as a transition to being a specialist. The first trainee has completed her first year under this scheme in Melbourne and joined the unit in Hobart in February 2015.

The year 2015 will see significant changes in the health system in Tasmania. The new state Government has started the Health Reforms called 'One State, One Health System, Better Outcomes' that will see one health system in Tasmania from July 2015, rather than the current three health systems. There is currently a consultation period with the publication of the Green Paper where the Role Delineation paper sets out the proposed functions of each hospital for consultation. While the restructure of the health system is unlikely to affect training, the budgetary control is likely to have an impact as the Government has set strict surgical targets for each hospital. Inevitably, with the limited funding for waiting lists, gynaecological surgery will always be seen to be at a lower priority compared to other specialties. This could have an impact on the opportunities for gynaecological surgery not only at RHH, but also in the state.

In recognition of this, the Tasmanian Training and Accreditation Committee has embarked on a review of training in Tasmania. There are opportunities to capitalise on the strengths of each unit in terms of their training provision. Links with mainland hospitals should also be strengthened and formalised, not only to use Tasmania as rural rotation, but also the major metropolitan hospitals for the Advanced Trainees to consolidate their experience before they complete their FRANZCOG training. Exciting changes are on the horizon in the 'last outpost'.

A/Prof Boon Lim

Victoria

Eventful times

Marvellous Melbourne is magical in March. Highlights include Moomba, Motor Racing, Melbourne's Food and Wine Festival and our Fashion Week, but what makes it even more impressive is the Australasian Gynaecological Endoscopy & Surgery Society (AGES) and (International Society for Gynecologic Endoscopy) ISGE Annual Congress which meets on the 4th through to the 7th of March.

AGES is now in its 25th year and, along with the ISGE, they are putting on a jam-packed program focusing on controversies and challenges in minimal invasive gynaecological surgery. This program is essential for both Trainees and Fellows who have a

keen interest in laparoscopic surgery. With recent media attention on laparoscopic myomectomy the question will be asked 'Is laparoscopic myomectomy dead?' Understanding the concerns about morecellation is paramount in providing our patients with the information required for informed consent. The President of AGES, Dr Jim Tsaltas, will explain the RANZCOG/AGES guidelines on morcellation.

International guests always flock to Melbourne's major events – and this conference doesn't fail in this regard. Dr Ornella Sizzi, from Italy, will outline the role of adenomyosis in infertility, Dr Daniel Kruschinski, from Germany, will speak on adhesion prevention at laparoscopy and Dr Howard Salvay, from the USA, will discuss single port surgery – its benefits and limitations. This conference will no doubt entertain, inform and inspire.

Dr Joseph Sgroi

Western Australia

Going 'the whole nine months'

There are always exciting initiatives coming from Western Australia, but a project of particular significance for us is, 'The Whole Nine Months', a major collaboration between the peak health bodies of our state. This aims to unite the WA healthcare community, and the women and families of our state, to achieve the goal of safely lowering the rate of preterm birth by 15 per cent over the next two years and 35 per cent over five years. The project is the brainchild of Prof John Newnham. You can read about this impressive initiative at the project website – www.thewholeninemonths.com.au – and the leadership group is keen to engage all those involved in maternity care across WA.

Safely lowering the rate of preterm birth will be achieved by combining the latest evidence-based clinical practice with educational outreach programs for healthcare practitioners and the general public. A dedicated Preterm Birth Prevention Clinic will be piloted at the King Edward Memorial Hospital, and should be up and running in early 2015. It will be underpinned by on-going discovery research and evaluation of effectiveness. The project will encourage routine measurement of cervical length at the mid-trimester morphology ultrasound, and for women with a measurement between ten and 20mm, vaginal progesterone pessaries will be prescribed. We're hoping to bring good news and results from the project over the coming term of Council.

Prof Yee Leung
Dr Donald Clark

Reflections on imaging

Dr Gillian Gibson
FRANZCOG

It is just over 50 years since Prof Ian Donald (1910–1987), a Scottish obstetrician, pioneered the use of ultrasound in medicine. His article published in the *Lancet* in 1958, 'Investigation of abdominal masses by pulsed ultrasound'[1], was a milestone in the field of imaging. A medical officer in the Royal Air Force, he drew on experience with radar during World War 2 and a lifelong interest in machines. Assisted by the research department of a local engineering firm, a device used in the Clyde shipyards to detect flaws in metal was successfully modified to image internal organs, including the gravid uterus.[2]

Today, medicine uses ultrasound to facilitate complex procedures, such as laser coagulation for treatment of twin-to-twin transfusion, through to diagnosis of ectopic pregnancy early enough to offer medical treatment, not only to prevent maternal mortality, but also potentially preserve future fertility.

Undeniably, the development in ultrasonography that has had the widest reach is imaging unborn child. It has become an integral part of antenatal care with women and families eagerly awaiting a snapshot of their expected child – so much so that as clinicians we often need to remind them finding out the gender is incidental, not the purpose of the investigation. How should we respond to our patient's question 'Is everything normal?' The reliability of a midtrimester morphology scan is reviewed in this issue (see p.21). What about the role of a routine third trimester ultrasound? Our expert also updates us on the defining role of Doppler study of the fetal brain circulation in the management of the small-for-gestational-age fetus (see p.25).

Ultrasound is also key to assessment of acute gynaecological presentations and is a pivotal investigation in refining a differential diagnosis. The advice of our expert when an ectopic pregnancy is suspected is not to rely on the pelvic ultrasound report alone. Review the images yourself and talk to your radiologist. Are you familiar with the imaging significance of the 'ring of fire', the 'bagel ring', or the location of Morrison's pouch? What risk factors in the clinical history raise the possibility of heterotrophic pregnancy?

This issue includes review of other imaging modalities that have come into increasing use as therapeutic as well as diagnostic purposes. Interventional radiology now has subspecialty status in Europe, with percutaneous drainage the commonest application and there is an evolving database on uterine fibroid embolisation. Uterine arterial embolisation has made a significant contribution to the management and prevention of catastrophic postpartum haemorrhage.

Magnetic resonance imaging (MRI) has contributed significantly to our specialty, often complementing ultrasound, to assess placenta accreta, characterise pelvic masses, stage malignancy and diagnose fetal conditions. Whereas ultrasound poses limitations for the obese patient, MRI is much less confined by the depth of field. There is an alarming reminder that breast cancer affects one in eight women in Australia by the age of 85 years. The role of risk stratification for breast screening is explored and specific indications for MRI given.

MRI and computed tomography (CT) imaging can help solve diagnostic dilemmas, but what are the safety concerns for pregnancy when such tests are unavoidable? With a background risk of childhood cancer 1:500, the table (see p.30) provided in this issue gives useful guidance to the comparative risks of various radiological modalities during pregnancy.

Originally, the *O&G* Magazine Advisory Committee, which sets the themes for each issue, had planned an issue about new surgical and radiologic tools, but soon realised the advances in imaging had made as much, if not more, impact to the practice of our specialty and thus are deserving of a whole issue.

References

1 Donald I, Macvicar J, Brown TG. Investigation of Abdominal Masses by Pulsed Ultrasound. *Lancet.* Vol. 271, No.7032:1188-1195;1958. http://dx.doi.org/10.1016/S0140-6736(58)91905-6 .
2 www.scotsman.com/lifestyle/how-clyde-shipyard-technology-created-the-ultrasound-1-2926428 .

Finding an ectopic pregnancy

The role of ultrasound in the management of ectopic pregnancy.

Dr Martin Sowter
FRANZCOG

The case fatality rate for ectopic pregnancy has fallen dramatically in the last 30 years and currently stands at about 1.7 per 10 000 cases.[1] Much of this can be attributed to earlier diagnosis through ultrasound and human chorionic gonadotrophin (hCG) measurement. However, serious morbidity and occasionally mortality does still occur.

Studies evaluating the sensitivity of transvaginal ultrasound in the diagnosis of ectopic pregnancy typically do so within an early pregnancy or acute gynaecology clinic setting and either report the sensitivity of a single scan at first presentation or as part of a diagnostic algorithm where women with an inconclusive scan are reviewed 48–72 hours later if their symptoms and hCG levels permit them to be managed as outpatients. In such a setting about 75 per cent of ectopic pregnancies will be detected on an initial transvaginal ultrasound and 85–99 per cent of ectopic pregnancies will be diagnosed on a subsequent scan before treatment.[2,3,4,5] Women without any evidence of an intrauterine or ectopic pregnancy on an initial scan are classified as having a pregnancy of unknown location (a PUL).[6] In most series, only seven to 20 per cent of these women will subsequently be found to have an ectopic pregnancy.[7] The remainder will eventually be found to have a viable or non-viable intrauterine pregnancy. In a small number of women presenting to an early pregnancy clinic, pregnancy location cannot be confirmed on subsequent scans and the management of these women with an ongoing PUL will be based on the pattern of their hCG levels and symptoms.

There are a number of reasons why an ectopic pregnancy may not be identified at an initial transvaginal ultrasound. Poor equipment, poor ultrasound technique, an increased body mass index, fibroids and other ovarian pathology can make clear visualisation of the pelvic adnexae difficult. It might also simply be that the ectopic pregnancy is too small or it is too early in the disease process for it to be visualised. Ectopic pregnancies that are not identified at an initial scan have a significantly lower hCG concentration and gestational age at the time of initial scanning than those that are seen on an initial scan.[8]

It should be emphasised that unless an intrauterine pregnancy has been clearly identified on initial abdominal scanning (and no risk factors for a heterotopic pregnancy are present) an ultrasound examination for a suspected ectopic pregnancy should always include a transvaginal scan. An inconclusive pelvic ultrasound examination that does not include transvaginal ultrasound is an incomplete investigation. The higher frequencies used in a transvaginal scan improve resolution and allow early pregnancy features to be detected up to a week earlier than an abdominal ultrasound examination.

The role of hCG in diagnosing ectopic pregnancy

The resolution of transvaginal ultrasound means, in the great majority of cases, the diagnosis of an ectopic pregnancy should be based on a positive visualisation rather than the inability to visualise an intrauterine pregnancy.[3] However, hCG levels and the so called 'discriminatory threshold' or 'discriminatory zone' (the hCG level at which a viable intrauterine pregnancy should always be seen) still have an important role in diagnosis and management. This level is typically 1500 to 2000IU/l for transvaginal ultrasound and 5000-6000IU/l for transabdominal ultrasound.[9,10] A viable intrauterine pregnancy should nearly always be seen on transvaginal ultrasound at an hCG level above the discriminatory zone with studies reporting a sensitivity of over 95 per cent for an intrauterine pregnancy at these hCG levels. It should be remembered that at an hCG level of 2000IU/l a gestation sac may only be 3–4mm in size and a non-viable intrauterine pregnancy or recent miscarriage may appear as an empty uterus at hCG levels above the discriminatory zone. The discriminatory zone will also be affected by a sonographer's experience, the quality of equipment used and patient body habitus. It should be used with caution if treatment is going to be initiated purely on the basis of the finding of an empty uterus and an hCG level above the discriminatory zone.

Endometrial appearances in ectopic pregnancy

There is no specific appearance or thickness that suggests the presence of an ectopic pregnancy. The uterine cavity will usually be empty, although in up to 20 per cent of ectopic pregnancies a 'pseudosac' will be present. This can be distinguished from an early intrauterine pregnancy because a pseudosac, which consists of fluid within the endometrial cavity, will usually develop symmetrically within the uterine cavity and lack a well-defined rim of surrounding echoes. An early intrauterine pregnancy will be intra-decidual and appear as an eccentrically placed hyperechoic ring within the endometrial cavity. Differentiating a failed intrauterine pregnancy from a pseudosac can be much more difficult, with their appearances sometimes being similar.

What does pelvic free fluid mean?

A small amount of free fluid in the pelvis is a common finding, but echogenic free fluid in the Pouch of Douglas or Morrison's pouch increases the likelihood of ectopic pregnancy significantly. Blood and clot from a ruptured ectopic or tubal miscarriage typically has a 'ground glass' appearance. However, significant quantities of free fluid may also be present following a ruptured haemorrhagic cyst. The amount and extent of free fluid seen on ultrasound scan can provide an indication of blood loss – blood in Morrison's pouch suggests that at least 500ml of blood is in the pelvis.[11] If free fluid is seen in the pelvis then it is important that an abdominal scan is also undertaken to check for possible blood in Morrison's pouch, the paracolic gutters and sub-diaphragmatic space.

Appearance of specific types of ectopic pregnancy

- Tubal pregnancy – 95 per cent of extrauterine pregnancies are in the Fallopian tube, usually in the ampullary region. An

adnexal mass that moves separately to the ovary will usually be seen. It may range in appearance from an inhomogeneous mass through to a distinct gestational sac with or without a fetal pole, yolk sac or fetal heart. The latter finding will usually be in the presence of an empty uterus and hCG level well above the discriminatory threshold. The corpus luteum can be seen as a 'ring of fire' on colour Doppler and will be on the ipsilateral side in 70–85 per cent of tubal pregnancies.[3] About 60 per cent of tubal pregnancies will appear as an inhomogeneous mass, 20 per cent will appear as a hyperechoic ring (sometimes called a 'bagel sign') and only 13–15 per cent will have an obvious gestation sac and fetal pole, with or without fetal cardiac activity.[4,8]

- Interstitial pregnancy – one to five per cent of ectopic pregnancies lie in the interstitial part of the Fallopian tube (the part of the Fallopian tube that traverses the myometrium). The gestation sac will lie outside the cavity in the interstitial area surrounded by a thin continuous rim of myometrium. An 'interstitial line' is often seen consisting of a thin echogenic line that extends from the central uterine cavity to the periphery of the interstitial sac and presumably represents the endometrial canal of the interstitial part of the Fallopian tube.[12]
- Cervical pregnancy – these occur in less than one per cent of ectopic pregnancies. The uterine cavity will appear empty and cervix may appear barrel shaped with the gestation sac or trophoblastic mass lying below the level of the internal cervical os. There may be a negative 'sliding organ sign' – in a miscarriage a gestation sac lying within the cervical canal will slide against the endocervical canal when transducer probe pressure is applied to the cervix, but an implanted cervical pregnancy will remain fixed.
- Caesarean section scar pregnancy – in women with a previous caesarean section these may make up to six per cent of all ectopic pregnancies. Appearances can be similar to a cervical pregnancy, but gestation sac or trophoblastic mass is located anteriorly at the level of the internal os covering the visible or likely site of the caesarean section scar.
- Ovarian pregnancy – this is a much rarer form of ectopic pregnancy, but will appear as a cystic structure or gestation sac within or on the ovary. The gestation sac cannot be separated from the ovary on gentle palpation.
- Abdominal pregnancy – most of these pregnancies will be the result of tubal abortion with re-implantation in the abdominal cavity, usually on the broad ligament. Rarely, a primary implantation in the abdominal cavity will occur. It is often difficult to distinguish from a tubal pregnancy on ultrasound.
- Heterotopic pregnancy – risk factors include in vitro fertilisation and super-ovulation-based fertility treatments. In women with no history of fertility treatment, the risk is less than one in 10 000 pregnancies. They may occur in between one and three per cent of women undergoing fertility treatment and should be looked for in such women presenting with early pregnancy bleeding or pain.

A final word

Always take a careful history, pinpointing if possible the exact dates of the last menstrual period, the dates of a positive pregnancy test, and dates of early pregnancy bleeding and pain. Early pregnancy transvaginal ultrasound requires a high level of operator skill and experience. Ultrasound is a dynamic investigation and, as a gynaecologist, relying on the written interpretation of ultrasound images alone will expose you to a greater risk of delayed or misdiagnosis. Where possible, review the images with your radiologist or, if your work setting permits, be present when the scan is performed so ultrasound images can be correlated with patient history, symptoms, hCG levels and examination findings.

References

1 Lewis G (ed). Saving Mother Lives: Reviewing Maternal Deaths to make Motherhood Safer – 2006-2008. The Eighth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. *BJOG.* 2011;118(suppl 1) 1-205.

2 Kirk E, Papageorghiou AT, Condous G et al. The diagnostic effectiveness of an initial transvaginal scan in detecting ectopic pregnancy. *Human Reproduction.* 2007;22:2824-2828.

3 Condous G, Okaro E, Khalid A et al. The accuracy of transvaginal sonography for the diagnosis of ectopic pregnancy prior to surgery. *Human Reproduction.* 2005;20:1404-1409.

4 Atri M, Valenti DA, Bret PM et al. Effect of transvaginal sonography on the use of invasive procedures for evaluating patients with a clinical diagnosis of ectopic pregnancy. *Journal of Clinical Ultrasound.* 2003;31:1-8.

5 Shalev E, Yarom I, Bustam M et al. Transvaginal sonography as the ultimate diagnostic tool for the management of ectopic pregnancy: experience with 840 cases. *Fertility and Sterility.* 1998;69:62-65

6 Barnhart K, van Mello NM, Bourne T et al. Pregnancy of unknown location: a consensus statement of nomenclature, definitions and outcome. *Fertility and Sterility.* 2011;95:857-866.

7 Kirk E, Condous G, Bourne T. Pregnancy of unknown location. *Best Practice and Research in Clinical Obstetrics and Gynaecology.* 2009;23:493-499.

8 Kirk E, Daemen A, Papageorghiou AT, et al, Why are some ectopic pregnancies characterized as pregnancies of unknown location at the initial transvaginal ultrasound examination? *Acta Obstet Gynecol Scand.* 2008;87:1150-1154.

9 Mol BW, Hajenius PJ, Engelsbel S et al. Serum human chorionic gonadotrophin measurement in the diagnosis of ectopic pregnancy when transvaginal ultrasonography is inconclusive. *Fertility and Sterility.* 1998;70:972-981.

10 Visconti K, Zite N. hCG in ectopic pregnancy. *Clinical Obstetrics and Gynecology.* 2012;55:410-417.

11 Braffman BH, Coleman BG, Ramchandani P, et al. Emergency department screening for ectopic pregnancy: a prospective US study. *Radiology.* 1994;190:797-802.

12 Akerman TE, Levi CS, Dashefsky SM, et al. Interstitial line: sonographic finding in interstitial corneal ectopic pregnancy. *Radiology.* 1993;189:83-87.

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Early screening

Dr Kristine Barnden
MBBS, FRANZCOG

The first trimester scan provides a large amount of clinically relevant information. As the resolution of ultrasound improves and as research into the early prediction of a variety of pregnancy complications continues, it is likely to offer ever more information to women and their carers.

The first trimester scan came into being in the early 1990s, with the introduction of nuchal translucency screening for Down syndrome. Since the mid-1990s, the first trimester screening program has incorporated maternal age, nuchal translucency and two biochemical parameters, pregnancy-associated plasma protein A (PAPP-A) and free BHCG, in generating risks for Trisomy 21 (Down syndrome), Trisomy 18 and Trisomy 13. Although many women and clinicians still view the first trimester scan predominantly as a component of Down syndrome screening, it has become apparent that a scan at 11–13+6 weeks has numerous other benefits, including accurate dating, early diagnosis and assessment of multiple pregnancy, diagnosis of a missed miscarriage, assessment of fetal anatomy and identification of uterine anomalies. Likewise, the first trimester screening program, although directed primarily at the commoner chromosomal abnormalities of Trisomy 21, 18 and 13, has been found to identify a wide range of other chromosomal abnormalities (up to 30 per cent of genetic abnormalities found on invasive testing following a high-risk screen result are 'atypical'[1]), as well as pointing to an increased risk of a number of structural abnormalities and fetal syndromes, and late pregnancy complications such as pre-eclampsia and fetal growth restriction.

The combined first trimester screen for aneuploidy

Aneuploidy (an abnormal number of chromosomes) is found in 35 per cent of miscarriages, four per cent of stillbirths and 0.3 per cent of live births at term.[2] Of those surviving to term, the commonest aneuploidy condition is Down syndrome, with an incidence of approximately 1:700 live births, followed by Trisomy 18, Trisomy 13 and abnormalities of the sex chromosomes. Down syndrome is associated with mild-to-moderate intellectual disability and a range of other potential health problems. Trisomy 13 and 18 are associated with much more severe disability, both mental and physical, and less than five per cent of babies born alive with these conditions will survive to see their first birthday. First trimester screening enables women, while still at an early stage of their pregnancy, to choose whether or not to have invasive testing to diagnose these conditions, based on their calculated level of personal risk.

Nuchal translucency describes the ultrasound appearance of an anechoic space behind the fetal neck, caused by an accumulation of subcutaneous fluid. Although measurable in almost all fetuses between 11 and 13+6 weeks, the median thickness is greater in fetuses affected by aneuploidy. A wide range of fetal conditions may lead to thickening of the nuchal translucency and underlying pathophysiological mechanisms are thought to include cardiac dysfunction, venous congestion of the head and neck, altered composition of the extracellular matrix, abnormal lymphatic drainage, anaemia, hypoproteinaemia and infection.[3] For the purposes of first trimester screening for aneuploidy, the nuchal translucency measurement must be performed by an accredited operator using a standardised technique, as described by the Fetal Medicine Foundation.[3]

PAPP-A is a large glycoprotein produced by the placenta, the main function of which in pregnancy is to enhance the bioavailability of insulin-like growth factors (IGFs) through cleavage of inhibitory binding proteins. Low levels in the first trimester are associated with Down syndrome as well as other outcomes (pre-eclampsia, fetal growth restriction) related to poor early placentation.[4]

Free BHCG is the beta subunit of human chorionic gonadotrophin, another glycoprotein derived from the placenta, which, in the first trimester of pregnancy, supports the corpus luteum. Levels between 11 and 13+6 weeks tend to be higher than the normal median in fetuses with Down syndrome and lower in those affected by Trisomy 13 and 18.

A background risk for aneuploidy is calculated using maternal age, the gestation of pregnancy and previous history of an affected pregnancy (which increases background risk by 0.6 per cent). Likelihood ratios are then calculated for NT, PAPP-A and free BHCG, based on the difference between the measured values and the normal median at that gestation. The likelihood ratios are used to adjust the background risk. Five per cent of women will have an adjusted risk greater than 1:250 and are described as 'high risk', with the option of invasive testing. As the majority of these women will have unaffected pregnancies, the test is said to have a five per cent false positive rate (some programs have a cut-off of 1:300, or an eight per cent false positive rate).

If the five per cent false positive cut off of 1:250 is used, approximately 90 per cent of fetuses with Trisomy 21 are detected. If a cut-off of 1:1000 is used, the false positive rate would be approximately 13 per cent, and about 97 per cent of Trisomy 21 fetuses would be detected.[5] Some women will not be reassured by a 'low risk' result between 1:250 and 1:1000 and their wishes for further testing should be respected.

Additional markers

Additional markers for Down syndrome, both ultrasound and biochemical, may also be incorporated into the risk assessment, and have the effect of both increasing the sensitivity and decreasing the false positive rate for a given risk cut-off. The most established of these is nasal bone; approximately 68 per cent of Down syndrome fetuses in the first trimester will have an absent nasal bone, while this is seen in only two per cent of euploid fetuses. Hence, the nasal bone is a strong marker for Down syndrome and certification in nasal bone assessment for sonologists has been available through the Fetal Medicine Foundation since 2010. The Doppler waveform of the ductus venosus, as well as maternal serum levels of placental growth factor (PlGF) and alpha feto protein (AFP) may also now be incorporated into the first trimester algorithm and evaluation of numerous other markers continues.

Getting the most out of first trimester screening

- The patient must be appropriately counselled and should understand the nature of the conditions being screened for,

the fact that the test is not diagnostic and the nature of the diagnostic options that will be offered following a high-risk result. The options of continuing or terminating an affected pregnancy should also be discussed. Many women will choose not to have screening for aneuploidy, but may still choose to have a first trimester scan for the other advantages it offers.

- All requested demographic information should be entered on the request form, as the interpretation of the biochemical assays is affected by variables such as maternal weight, smoking status, parity, ethnicity, diabetes and IVF conception.
- It has been calculated that detection rates for Down syndrome are highest (96 per cent detection for a five per cent false positive rate) when bloods are taken at ten weeks and the nuchal translucency assessed at 12 weeks.[6] Although nuchal translucency can be assessed from 11 weeks to 13+6 weeks, visualisation of fetal anatomy is also improved if the scan is deferred until after 12 weeks.
- It is usually preferable to tell women the exact calculated risk rather than to summarise as low risk or high risk, as risk results will mean different things to different people. Try to make the numbers meaningful: 'If there were 50 women your age with exactly the same blood and ultrasound results, one would be carrying a baby with Down syndrome and the other 49 would not'.
- Options for women with a high-risk result include invasive procedures such as chorionic villous sampling (CVS) (at 11–14 weeks) and amniocentesis (from 15 weeks), which are diagnostic for aneuploidy. Reassuringly, a recently published meta-analysis assessing procedure-related miscarriage risks for amniocentesis and CVS, using data collected between 2000 and 2014, found miscarriage risks above background of only 0.11 per cent for amniocentesis and 0.22 per cent for CVS.[7] Women with a high-risk result who prefer to avoid an invasive procedure, or those with an intermediate risk of 1:250 to 1:1000, may choose to use non-invasive prenatal testing (NIPT) for risk modification. Assessment for soft markers of aneuploidy at the second trimester scan, if negative, will further decrease the risk by at least two, and possibly by up to seven times.[8]
- A thickened nuchal translucency may have implications other than aneuploidy. The 95th centile for nuchal thickness (NT) is 2.1mm at 11 weeks and 2.7mm at 13+6 weeks and fetuses with a NT between the 95th and 99th centile have been found to have a marginally increased risk of cardiac anomaly, at approximately one per cent. However, for karyotypically normal fetuses, the risk of adverse outcome does not increase significantly until the NT is greater than the 99th centile (3.5mm).[9] The chance of any adverse outcome (including aneuploidy) then increases exponentially with increasing thickness, from 30 per cent for NT 3.5–4.4mm, to 85 per cent for NT >6.5mm, with complications including fetal death, major structural abnormalities (especially cardiac) and a wide range of syndromes. The finding of a thickened nuchal translucency should prompt as thorough an anatomical review as possible at the time of the first trimester scan, with particular attention to the fetal heart. Women with a NT result ≥3.5mm should be offered detailed structural scans at 16 and 20–22 weeks, and specialised fetal echocardiography should be accessed if available. Parents can be reassured that, for a karyotypically normal fetus, the risk of adverse outcome is no longer statistically increased following completion of a normal, targeted ultrasound at 20–22 weeks.
- Occasionally, a nuchal translucency may be measured at ≥3.5mm, but the aneuploidy risk will still be low; women with these results should consider invasive testing, as there remains a risk of atypical chromosomal abnormalities.[10]
- Low levels of PAPP-A have also been associated with other adverse outcomes, particularly intrauterine growth restriction. PAPP-A levels less than the first centile (0.29 MoM) have a good predictive value for intrauterine growth restriction later in pregnancy (one in six women will have fetal weight greater than fifth centile, and one in four greater than tenth centile), and serial scans for growth are worthwhile. The positive predictive value for levels between the first and fifth centile (0.29 to 0.45 MoM), on the other hand, is relatively low, with observed rates of fetal growth greater than fifth centile approximately 1.5–2-fold higher than expected.[11] Assessment of maternal risk factors, other serum analytes (BHCG greater than first centile, AFP >95 per cent), second trimester fetal growth and uterine artery Dopplers may help improve the predictive value.

Non-invasive prenatal testing

A detailed discussion of the current status and role of NIPT is beyond the scope of this article. Many women are choosing to use NIPT as their primary method of screening, with bloods being taken at about ten weeks gestation. Although this has the advantage of being a highly sensitive and specific screen with the option of CVS for a high-risk result at a relatively early stage of their pregnancy, they should be aware that, at this point in time, screening is limited to numerical abnormalities of chromosomes 13, 18, 21, X and Y. Currently, integrating the NIPT into the screening program as a second-line screen following combined first trimester screening is the more cost-effective option[12] and, if a risk cut off of 1:1000 is used, the sensitivity approaches that of NIPT as a primary test. It is also worth noting that, if the high risk result of combined testing is associated with thickened nuchal translucency (≥3.5mm), extremes of biochemical abnormality, structural abnormality or a higher overall risk (for example, >1:50), then up to a third of chromosomal abnormalities will be atypical and not detectable by NIPT and women in these circumstances should be counselled regarding the advantages of invasive testing.[10]

The first trimester scan and anatomical abnormalities

The ability to diagnose anatomical abnormalities at the time of the first trimester scan is to a large part dependent on the interest and expertise of the clinicians performing the scan. A recent meta-analysis[13] found an overall detection rate in the first trimester for major structural abnormalities of 51 per cent (62 per cent when transabdominal and transvaginal approaches were combined). This included a detection rate of 48 per cent for cardiac abnormalities and 51 per cent for brain and spine abnormalities.

Detection rates for cardiac abnormalities of over 90 per cent have been reported for targeted exams in high-risk patients.[14]

Pregnancy dating in the first trimester

Pregnancy dating is most reliable between eight and 13+6 weeks, as before eight weeks small measurement errors are likely to have a greater effect on gestational age assessment. Crown rump length (CRL) is the most precise parameter at this time, allowing accurate determination of dates to within five days in 95 per cent of cases. From 14 weeks, head circumference (HC) is the most reliable parameter for the purposes of dating the pregnancy.[15] By contrast, assessment of gestational age at the time of the routine morphology scan is only accurate to within ten days.

The importance of accurate dating is widely acknowledged, as it affects the reliability of subsequent ultrasound assessment for growth restriction, as well as decision making around both post-term pregnancies and those at the cusp of viability.

Early diagnosis and assessment of multiple pregnancy
Chorionicity is a major determinant of risk in multiple pregnancies and most modern guidelines recommend more intensive monitoring regimes for monochorionic pregnancies than dichorionic pregnancies. The 'lambda' or 'twin peak' sign describes a triangular projection of chorion extending between the membranes and is highly specific for dichorionic pregnancy. This assessment is best performed at 10–13+6 weeks and becomes less accurate with advancing gestation.

A minor discrepancy in CRL in twins is a not uncommon finding and there is some controversy as to whether the larger or smaller twin should be used for dating. More major size discrepancies in the first trimester (>11 per cent) suggest an increased risk of fetal demise or anomalies in the smaller twin.[16]

First trimester screening for aneuploidy by nuchal translucency alone or in combination with first trimester biochemistry can be performed. Dichorionic twins are given individual risks based on CRL and NT, while for monochorionic twins, presumed genetically identical, the nuchal measurement should be averaged and the same risk given for both. A discordance in nuchal translucency measurements in monochorionic twins of >20 per cent increases the risk of subsequent development of twin-to-twin transfusion syndrome.[17]

Uterine abnormalities and adnexal masses
Uterine fibroids are not uncommonly demonstrated at the time of the first trimester scan and are usually of no clinical significance. However, larger fibroids, in particular, may be associated with abdominal pain owing to degeneration, preterm labour or labour dystocia. Adnexal masses are usually benign, but may result in abdominal pain owing to rupture or torsion.

Occasionally, a uterine anomaly, such as a bicornuate or subseptate uterus, may be identified at the time of the first trimester scan. Uterine malformations have been associated with increased risks of miscarriage, preterm birth, malpresentation and fetal growth restriction, although the majority of women will have a normal outcome. 3D imaging, if available, will optimally define a suspected uterine abnormality.

A subchorionic haematoma is seen in approximately three per cent of first trimester scans. Small, asymptomatic haemorrhages do not appear to be associated with an increased risk of adverse outcome. However, a meta-analysis published in 2011 found subchorionic haemarrhages to be associated with overall increased risks of spontaneous miscarriage, preterm birth and preterm rupture of the membranes. There is also an increased risk of stillbirth and abruption, although absolute risks remain low. The greatest risk increase was for abruption, from 0.7 to 3.6 per cent. No significant increase was found in the risk of growth restriction or pre-eclampsia.[18]

Screening for pre-eclampsia
There has been immense interest in developing early predictive models for pre-eclampsia. None have been shown to have a worthwhile predictive value for identifying women at risk of late onset pre-eclampsia, but many have shown promise in predicting early (<34 weeks) pre-eclampsia. Although early pre-eclampsia is less common than late pre-eclampsia, it is associated with a substantially greater risk of maternal and perinatal morbidity and mortality. Furthermore, low dose aspirin commenced before 16 weeks gestation appears to be effective in reducing the incidence of pre-eclampsia in high-risk women, with the greatest effect being seen on early pre-eclampsia (a relative risk of 0.18 in a 2013 meta-analysis).[19] Aspirin also has the advantages of being an inexpensive drug with a good safety profile in pregnancy.

An algorithm incorporating maternal demographic factors, mean arterial blood pressure, uterine artery PI, and PAPP-A and PlGF was evaluated by Poon et al in 2009, and was found to identify 93 per cent of women destined to develop early pre-eclampsia, for a false positive rate of five per cent.[20] An Australian centre published a validation of this model (without PlGF) in 2013, which reported a 41.7 per cent detection rate for a false positive rate of five per cent, and 91.7 per cent detection rate for a false positive rate of ten per cent.[21] The same group then studied a second cohort of women, where women with an estimated risk of early pre-eclampsia of less than two per cent (ten per cent false positive risk cut off) were advised to take low-dose aspirin, 150mg at night. They were able to demonstrate a ten-fold reduction in the prevalence of early pre-eclampsia.[22]

Unfortunately, other studies which have evaluated this and similar models have had widely varying results.[23] This may be related to difficulty in teaching and maintaining quality standards in uterine artery Doppler assessment.

The Fetal Medicine Foundation Software for calculating aneuploidy risk also offers the option of calculating pre-eclampsia risk using the above algorithm, available to operators who have been credentialed in uterine artery Doppler measurement. Although a few practices in Australia are now offering pre-eclampsia screening at the time of the first trimester scan, it seems that it will be some time before the testing will be feasible on a large scale.

Algorithms for the calculation in the first trimester of risk for growth restriction and preterm birth are also available, but have not yet been widely validated.

References

1 Alamillo CM, Krantz D, Evans M et al. Nearly a third of abnormalities found after first-trimester screening are different than expected: 10-year experience from a single center. *Prenat Diagn* 2013; 33: 251-256.
2 Hassold, T. et al. To err (meiotically) is human: The genesis of human aneuploidy. *Nature Reviews Genetics* 2, 283. 2001.
3 Nicolaides KH, Heath V, Cicero S. Increased fetal nuchal translucency at 11–14 weeks. *Prenat Diagn* 2002; 22: 308-315.
4 Huynh L, Kingdom J, Akhtar S. Low pregnancy-associated plasma protein A level in the first trimester. *Canadian Family Physician*, October 2014 vol. 60 no. 10 899-903.
5 Hui L, Hyett J. Noninvasive prenatal testing for trisomy 21: challenges for implementation in Australia. *ANZJOG* 2013; 53:416-24.
6 Kagan K, Wright D, Baker A, Sahota D, Nicolaides KH. Screening for trisomy 21 by maternal age, fetal nuchal translucency thickness, free beta-human chorionic gonadotropin and pregnancy-associated plasma protein-A. *Ultrasound Obstet Gynecol* 2008; 31: 618-624.
7 Akolekar R, Beta J, Picciarelli G, Ogilvie C, D'Antonio F. Procedure-related risk of miscarriage following amniocentesis and chorionic villus sampling: a systematic review and meta-analysis. *Ultrasound Obstet Gynecol.* 2015, 45(1):16-26.
8 Agathokleous M, Chaveeva P, Poon LCY, Kosinski P, Nicolaides KH.

Meta-analysis of second-trimester markers for trisomy 21. *Ultrasound Obstet Gynecol.* 2013, 41(3): 247-261.
9 Athena P. Souka, Constantin S. von Kaisenberg, Jonathan A. Hyett, Jiri D. Sonek, Kypros H. Nicolaides, Increased nuchal translucency with normal karyotype. *Am J Obstet Gynecol.* 2005, 192, 1005-21.
10 Petersen OB, Vogel I, Ekelund C, Hyett J, Tabor A. Potential diagnostic consequences of applying non-invasive prenatal testing: population-based study from a country with existing first-trimester screening, *Ultrasound Obstet Gynecol.* 2014; 43: 265-271.
11 Goetzl L. Adverse pregnancy outcomes after abnormal first-trimester screening for aneuploidy. *Clin Lab Med.* 2010; 30(3):613-28.
12 Cuckle H, Benn P, Pergament E. Maternal cfDNA screening for Down's syndrome – a cost sensitivity analysis. *Prenat Diagn.* 2013; 33: 636-642.
13 Rossi AC, Prefumo F. Accuracy of ultrasonography at 11–14 weeks of gestation for detection of fetal structural anomalies: a systematic review. *Obstet Gynecol.* 2013; 122: 1160-1167.
14 Persico N, Moratalla J, Lombardi CM, Zidere V, Fetal Echocardiography at 11–13 weeks by transabdominal high-frequency ultrasound. *Ultrasound Obstet Gynecol.* 2011; 37: 296-301.
15 ISUOG Practice Guidelines: performance of first-trimester fetal ultrasound scan *Ultrasound Obstet Gynecol.* 2013; 41: 102-113.
16 Harper LM, Roehl KA, Odibo AO, Cahill AG. First-trimester growth discordance and adverse pregnancy outcome in dichorionic twins. *Ultrasound Obstet Gynecol.* 2013; 41(6):627-31.
17 Kagan KO, Gazzoni A, Sepulveda-Gonzalez G, Sotiriadis A, Nicolaides KH. Discordance in nuchal translucency thickness in the prediction of severe twin-to-twin transfusion syndrome. *Ultrasound Obstet Gynecol.* 2007; 29(5):527-32.
18 Tuuli MG, Norman SM, Odibo AO, Macones GA, Cahill AG. Perinatal outcomes in women with subchorionic hematoma: a systematic review and meta-analysis. *Obstet Gynecol.* 2011;117(5):1205-12.
19 Roberge S, Nicolaides KH, Demers S, Villa P and Bujold E. Prevention of perinatal death and adverse perinatal outcome using low-dose aspirin: a meta-analysis. *Ultrasound Obstet Gynecol.* 2013;41:491-499.
20 Poon LCY, Kametas NA, Maiz N, Akolekar R, Nicolaides KH. First trimester prediction of hypertensive disorders in pregnancy. *Hypertension.* 2009; 53: 812-818.
21 Park FJ, Leung CHY, Poon LCY, Williams PF, Rothwell SJ, Hyett JA. Clinical evaluation of a first trimester algorithm predicting the risk of hypertensive disease of pregnancy. *ANZJOG.* 2013; 53: 532-539.
22 Park F, Russo K, Pellosi M, Puddephat R, Walter M, Leung C, Saiid R, Rawashdeh H, Hyett J. The impact of aspirin on the prevalence of early onset pre-eclampsia after first trimester screening. *Prenat Diagn.* 2014; 34(Suppl. 1): e1–e9 DOI: 10.1111/pd.4477.
23 Oliveira N, Magder LS, Blitzer MG, Baschat AA. First-trimester prediction of pre-eclampsia: external validity of algorithms in a prospectively enrolled cohort. *Ultrasound Obstet Gynecol.* 2014; 44: 279-285.

Subspecialty National Selection 2015 (2016 entry)

The closing date for National Selection (2016 entry) applications is Tuesday 31 March 2015.

- **CU** National Selection Interviews (2016 entry) will be held on Friday 1 May.
- **CMFM** National Selection Interviews (2016 entry) will be held on Friday 15 May.
- **CREI** National Selection Interviews (2016 entry) will be held on Friday 22 May.
- **CGO** National Selection Interviews (2016 entry) will be held on Friday 29 May.
- **COGU** National Selection Interviews (2016 entry) will be held on Friday 5 June.

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Situation normal?

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The morphology scan preformed at 18–22 weeks has become a routine part of modern obstetric practice. As obstetricians, it is important that we understand what the scan involves and its limitations to respond to this question appropriately.

The Australasian Society of Ultrasound in Medicine (ASUM) has listed the anatomic structures that need to be visualised during the morphology scan (see Table 1), essentially ruling out a list of structural abnormalities. However, each scanning unit will have their own protocol and may have slightly different variations of what is visualised, documented and reported. If any abnormality is suspected or if the operator is unsure, it is recommended that the patient should be referred to a specialist service that can assess and counsel the patient appropriately.

ASUM requires that fetal number and viability are confirmed, followed by estimation of gestational age. Estimation of gestational age by biometry at this time is most accurate using the head circumference, with a margin of error +/-7 days.[2,3] This ensures growth is appropriate with prior dating, sets a baseline if there are concerns regarding growth later and guides accurate decisions around timing of delivery, for example, postdates induction of labour.[4] The position of the placenta and its relation to the internal os is examined. When a low-lying placenta is identified a follow up scan is recommended at 34 weeks, a repeat scan should only be necessary in approximately five per cent of all cases.[1] The cervix is assessed on a transabdominal scan and, if concerns are raised, a transvaginal scan is then undertaken. If a short cervix is discovered, treatment options of progesterone or cerclage may be considered.

The detection of structural abnormalities at 18–20 weeks allows parents the option of further invasive testing for chromosomal analysis or genetic testing and the option not to continue with the pregnancy in the case of major abnormalities. For parents that continue with the pregnancy, it allows time for appropriate planning for fetal therapy and ongoing monitoring. In addition, time is available for planning perinatal management with multidisciplinary team input for neonatal or palliative care.

What doesn't a normal morphology scan rule out?
It is tempting to say 'everything is normal' after a morphology scan is performed; however, not all abnormalities can be ruled out. Fetal abnormalities may be structural or functional and the underlying cause may be chromosomal, genetic, infective, teratogenic, vascular, mechanical or unknown. Ultrasound has the ability to detect structural abnormalities. Functional abnormality may be inferred from structural abnormalities, be obvious (for example, fetal akinesia syndromes), or may not be detectable by ultrasound.

The detection of chromosomal or genetic abnormalities at the morphology scan is dependent on the association with structural malformation. When there are multiple abnormalities detected on scan, the possibility of a chromosomal or genetic abnormality is considered and invasive testing with amniocentesis for karyotype or specific gene tests offered. Ultrasound alone cannot rule out a chromosomal or genetic abnormality and studies show a low detection rate even for the common aneuplodies.[5] In the majority of cases, Trisomy 13 and 18 fetuses will present with multiple abnormalities, but up to 40 per cent of Trisomy 21 fetuses may not have an abnormality detected.[6] For a genetic condition such as cystic fibrosis, the most common autosomal recessive condition in the Caucasian population, features suspicious for this such as echogenic bowel may or may not be evident on ultrasound in an affected fetus.

Why can't we say 'it's normal' after a normal scan?
In a systematic review based on 11 studies to examine the use of routine second trimester ultrasound to detect fetal anomalies, the overall prevalence of fetal anomaly was 2.09 per cent (range 0.76–2.45 per cent) and detection of fetal anomaly was 44.7 per cent (range of 15–85.3 per cent).[5] A Cochrane review of routine ultrasound before the 24th week of pregnancy, found significantly increased detection of fetal abnormalities, RR 3.46 (95 per cent CI 1.67–7.14; two trials, 387 patients).[4]

Three large, randomised studies have examined the ability of the routine morphology scan to detect fetal abnormalities; the key findings are summarised in Table 2.

The Eurofetus study was the largest and demonstrated the disparity in detection rates for different organ systems, with cardiac anomalies having the lowest rate of detection: the sensitivity for major congenital heart disease was 39 per cent in comparison to central nervous system at 88 per cent and urogenital malformations 89 per cent. The Helsinki and Radius Trials were conducted in the 1980s and we hope, with the increases in ultrasound technology and operator experience, that these detection rates would have improved.

Ultrasound is a user-dependant modality and, as such, better results are expected in more experienced hands and with better equipment. Improved detection is demonstrated in a tertiary setting.[7-9] Gestation affects the scan as fetal anatomy is better demonstrated at 22–24 weeks than 18–20 weeks. In addition, maternal body habitus plays an important role in the ability of the sonographer to detect abnormalities. Some abnormalities are subtle and may be missed even by an experienced sonographer. There are many other abnormalities that may only become evident in the third trimester, for example, some forms of skeletal dysplasias or a tracheo-oesophageal anomaly.

Table 1. ASUM checklist.[1]

1. Fetal number
2. Fetal cardiac activity
3. Gestational age
4. Fetal anatomy, including detection of malformation

Head	Falx	Diaphragm	
	Cavum septum pellucidum	Heart	
	Corpus callosum		FHMD
	Skull bones		Position
	Lateral ventricles		Axis
	Choroid plexus		4 Chambers
	Cerebellum/vermis		Intraventricular septum
	Nuchal thickness		Formaen Ovale
	Cisterna magna		Mitral Valve
Face	Orbits		Tricuspid Valve
	Nose	Great Vessels	
	Jaw		Left ventricular outflow
	Lips		Right ventricular outflow
	Nasal bone		Aortic Arch
	Profile		Ductal Arch
Abdomen		Spine	ossification centres
	Stomach/Situs		Coronal
	Kidneys		Sagittal
	Bladder		Axial
	Abdominal wall		Skin line
Umbilical cord		Extremities	
	Insertion		12 long bones
	3 vessels		hands/fingers
			feet/toes
			position of joints

5. Amniotic fluid volume
6. Placenta
   - Site
   - Distance from internal os
   - Placental myometrical interface clearly defined
7. Cervix
   - Cervix length
   - Open/closed
8. Maternal anatomy
   - Uerus
   - adnexa

What if soft markers are seen at the morphology scan?

Many practices will report on soft markers and recommend further investigations. Soft markers are ultrasound findings that may be transient and in themselves have little or no pathological significance, but are thought to be seen more commonly in fetuses with congenital abnormalities, particularity karyotypic abnormalities. They may be seen in 11–17 per cent of normal fetuses.[10] The most commonly reported soft markers include choroid plexus cysts (CPC), renal pelvic dilatation and echogenic cardiac foci (ECF). A recent fetal imaging workshop, attended by experts from obstetrics, paediatrics and radiology, recommended no follow up for CPC and ECF in the context of prior low-risk screening or non-invasive prenatal testing (NIPT), while renal pelvic dilatation >4mm should be followed up with a scan at 32 weeks and postnatally, if indicated (to detect renal abnormalities). In those that don't have a prior risk assessment, NIPT would be a reasonable next assessment option, but is not accessible to all patients owing to its cost.[11] Nuchal thickening and absent or hypoplastic nasal bone are the two markers for which genetic counselling regarding the risk of Down syndrome is recommended. Short long bones and echogenic bowel need review not only to consider the possibility of a chromosomal abnormality, but also for specific causes such as skeletal dysplasia in the case of short long bones and infection; cystic fibrosis, growth restriction, intramniotic bleeding and gastrointestinal obstruction in the case of echogenic bowel.

Detection and reporting of soft markers is controversial because this information is anxiety-provoking for patients, requires considerable time for counselling and may lead to invasive prenatal testing with an associated risk of miscarriage; however, parents should be allowed to make an informed decision.

So, what does a normal scan mean?

When counselling our patients, the emphasis should be that there is no abnormality detected within the limits of the examination. The additional variables that need to be considered are maternal body habitus, gestation at assessment, the level of expertise at the imaging practice and so forth. We need to admit no test has been devised so

Table 2. A summary of relevant studies' findings.

Study	Key findings
Eurofetus 1990–93	Rate of fetal malformation: two per cent Sensitivity for major anomalies: 73.7 per cent; minor anomalies: 45.7 per cent 55 per cent of major and 44 per cent of minor abnormalities detected before 24 weeks Rates of live birth lower in the screening population owing to uptake of termination
Helsinki 1986–87	36 per cent detection of anomalies at city hospital, 77 per cent at university hospital Reduction in perinatal mortality 4.6/1000 versus 9.0/1000 in controls Fewer fetal and neonatal deaths owing to termination of pregnancy
Radius 1987–91	Increased detection of abnormalities: 34.8 per cent versus 11 per cent in controls 16.6 per cent of abnormalities detected prior to 24 weeks No difference in perinatal outcome (strict inclusion and exclusion criteria reduce ability to generalise results)

far that rules out all structural and functional abnormalities in the fetus to allow us to say that everything is normal.

References

1 ASUM guidelines for the Mid Trimester Obstetric Scan. 2014.
2 Hadlock FP, Harrist RB, Martinez-Poyer J. How accurate is second trimester fetal dating? *J Ultrasound Med.* 1991;10(10):557-561.
3 Law RG, MacRae KD. Head circumference as an index of fetal age. *J Ultrasound Med.* 1982;1(7):281-288.
4 Neilson JP. Ultrasound for fetal assessment in early pregnancy. Cochrane Database Syst Rev. 2010;(4):CD000182.
5 Bricker, L. Garcia J. Ultrasound screening in pregnancy: a systematic review of clinical effectiveness, cost-effectiveness and women's views. *Health Technol Assess (Rockv).* 2000;4(16).
6 Papp C, Szigeti Z, Tóth-Pál E, Hajdú J, Joó JG, Papp Z. Ultrasonographic findings of fetal aneuploidies in the second trimester - Our experiences. *Fetal Diagn Ther.* 2008;23:105-113.
7 Saari-Kemppainen Aul, Karjalainen Olav, Ylostalo P, Heinonen OllP. Ultrasound Screening and Perinatal Mortality: controlled trial os systematic one-stage screening in pregnancy. *Lancet.* 1990;18:387-391. doi:10.1097/00006254-199107000-00004.
8 Ewigman,Bernard. Crane, James. Friggoletto F et al. Effect of Prenatal Ultraound Screening on Perinatal Outcome. *N Engl J Med.* 1993;329(12):821-828.
9 Grandjean H, Larroque D, Levi S. The performance of routine ultrasonographic screening of pregnancies in the Eurofetus Study. *Am J Obstet Gynecol.* 1999;181:446-454. doi:10.1016/S0002-9378(99)70577-6.
10 Breathnach FM, Fleming A, Malone FD. The second trimester genetic sonogram. *Am J Med Genet Part C Semin Med Genet.* 2007;145(1):62-72.
11 Reddy UM, Abuhamad AZ, Levine D, Saade GR. Fetal imaging: executive summary of a joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, American Institute of Ultrasound in Medicine, American College of Obstetricians and Gynecology. *Obstet Gynecol.* 2014;123(5):1070-82.

Windows to the womb

The use of ultrasound imaging in the third trimester.

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This article provides a brief overview of the use of ultrasound in the third trimester, with reference to the recently updated New Zealand MFM Network guideline for the management of suspected small for gestational age (SGA) singleton pregnancies and infants after 34 weeks gestation.[1]

Ultrasound

Ultrasound is the most commonly used imaging modality for assessing pregnancy. Although used as a diagnostic modality as early as the 1940s, the technology to acquire two-dimensional fetal images in real time was not available until the late 1970s.[2] Rapid improvements in technology have led to real-time imaging, superior image quality, Doppler evaluation of blood flow and visualisation of the baby in three dimensions.

Dating

Determining gestational age based on biometric measurements assumes the size of the fetus is consistent with its gestational age. Biological variation increases with gestation, therefore the accuracy of dating scans decline as gestation advances; from approximately three-to-eight days in the first trimester to up to 35 days in the third trimester. When calculating gestational age >24 weeks, a combination of measures rather than a single biometric measurement is superior and a repeat scan should be considered for assessment of interval growth (at a minimum of two weeks).

Anatomy and anomaly screening

Screening for fetal anomalies is an important component of routine antenatal care. Standard screening is carried out at 18–20 weeks, allowing timely detection of serious and lethal abnormalities and maximising detection rates.[3] Scanning for fetal anomalies may be required in the third trimester for women who present late in pregnancy; where anomalies are suspected or detected earlier, but the prognosis cannot be fully evaluated until the third trimester; or for conditions that may deteriorate with advancing gestation.

Growth

The majority of third-trimester ultrasound scans assess fetal growth, aiming to identify babies that are SGA (birthweight or estimated fetal weight [EFW] <10th centile) and/or have intrauterine growth restriction (IUGR), a fetus failing to reach its full growth potential. SGA and IUGR are strongly associated with an increased risk of perinatal mortality, with 40–50 per cent of normally formed stillborn babies having a birthweight <10th centile.[4] Within a population of more than 92 000 singleton pregnancies, SGA was the largest population-attributable risk for stillbirth (22 per cent). Risk of stillbirth was five-fold greater when SGA was undetected antenatally compared to cases identified before birth (32 per cent versus six per cent).[4] Identifying vulnerable babies in a timely fashion and ensuring appropriate management, including timely delivery, is crucial to reducing stillbirth.

However, routine third-trimester ultrasound scanning in an unselected population has not been shown to reduce perinatal mortality or morbidity: in a meta-analysis involving more than 27 000 pregnancies in eight randomised controlled trials, there was no difference in antenatal, obstetric or neonatal interventions or morbidity between screened and control groups.[12] Routine scanning is therefore not currently recommended; however, this is a debatable issue and further trials are awaited in which scans are performed later in the third trimester at a time when the risk of growth concerns is higher. Women with significant risk factors for SGA should be considered for serial growth scans in the third trimester (see Table 1).

Table 1. Indications for routine growth scans in third trimester and suggested scanning frequency.

Risk factor	Suggested scanning frequency
Previous SGA baby • Required preterm delivery • Delivered at term	 3-4 weekly from 24 weeks 3-4 weekly from 32 weeks
Underlying maternal medical conditions (such as hypertension, antiphosphospholipid syndrome, systemic lupus erythematosus)	3-4 weekly
Cigarette smoker	Consider scan at 36 weeks
Obesity • BMI >30 • BMI >35	 Consider scan at 36 weeks Consider 3-4 weekly from 28 weeks
Abnormal serum analytes (low PAPPA)	Consider 3-4 weekly
Twins • Dichorionic • Monochorionic	 4 weekly 2 weekly
Late onset pregnancy complications (gestational hypertension, PET, APH)	Consider 2 weekly if pregnancy ongoing

Recommendations adapted from NZMFM SGA guideline.[1] Scanning may be required from earlier gestation or more frequently if additional risks are present and should be individualised for each case. Scanning should continue to time of delivery.

All other women should have symphysis-fundal height measured and plotted on an individualised gestation-related optimum weight (GROW) chart[1] at each antenatal visit to identify others requiring growth scans. The use of GROW has been associated with a significant reduction in the number of second- and third-trimester scans required and an increase in antenatal detection of SGA babies from 29 per cent to 48 per cent.[5]

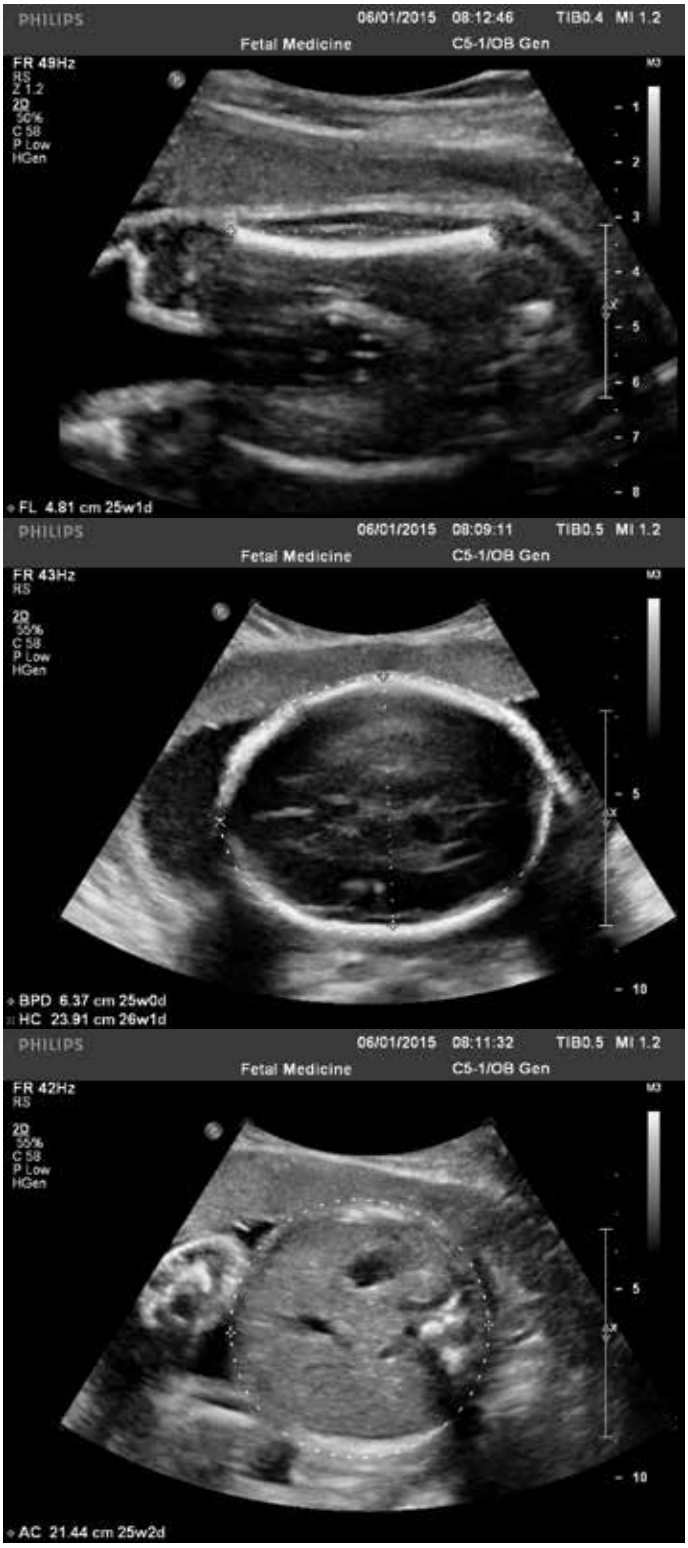

Figure 1. Standard biometry measures taken to assess fetal growth, from top: 1a. fetal femur length; 1b. fetal head measures, biparietal diameter and head circumference; 1c. fetal abdominal circumference.

The standard measurements taken to assess fetal growth are biparietal diameter, head circumference, abdominal circumference (AC) and femur length (see Figure 1a–c). A variety of formulae exist that calculate EFW using a combination of these parameters. In a comparison of 35 different formulae, 29 produced a mean absolute percentage error ≤10 per cent: no one formula can be recommended as clearly superior.[6] In Australasia, for babies weighing >1000g, the most widely accepted and used is the Hadlock C formula.[7]

All measurements should be plotted on centile charts. Individual growth parameters should be plotted on population-based ultrasound charts (such as ASUM charts)[1,8,9] and the EFW plotted on GROW charts, which use a standard, longitudinal, ultrasound-derived curve of intrauterine weight gain and adjusts for maternal variables of ethnicity, parity, height and weight.[10] The AC measurement is the most sensitive for detecting SGA and the measurement whose growth trajectory is likely to taper first. However, a number of scenarios should alert the clinician to suboptimal growth (see Table 2). All babies that are suspected to have suboptimal growth require umbilical artery (UmA) Doppler performed at the time of growth scan and, where resources permit, uterine artery (UtA) and fetal middle cerebral artery (MCA) Doppler studies should also be considered to further stratify risk (see below). Once fetal growth concerns have been identified serial scans should continue every two-to-three weeks until delivery if UmA Doppler remains normal.

Although babies that are large for gestational age (LGA) are at risk of increased morbidity and mortality, unlike SGA pregnancies, the antenatal detection of LGA pregnancies is not associated with improved maternal or perinatal outcomes. Serial scanning in a LGA pregnancy is not recommended to improve outcomes.[11]

Doppler ultrasound

Doppler ultrasound provides an assessment of blood velocity in fetal and maternal vascular territories. Doppler studies aid the assessment and management of pregnancy complications – notably SGA – but also other conditions, such as Rhesus isoimmunisation. Comparisons of flow velocity between systole and diastole provide valuable information on resistance to flow to the placenta (UmA or UtA) or redistribution of fetal circulation in response to hypoxia (MCA or ductus venosus). Systolic/diastolic ratio, resistance index (RI = systolic-diastolic/systolic flow) or pulsatility index (PI = [systolic-diastolic]/mean flow) are the main measures of resistance that may be reported. PI is the most commonly used and allows consideration of absent/reversed flow in diastole.

Umbilical artery

In cases of SGA, a reduction in diastolic relative to systolic flow is associated with adverse perinatal outcome, with absent and reversed

Table 2. Ultrasound findings suggestive of suboptimal fetal growth.[1]

Ultrasound findings
AC on population (ASUM) chart <5th centile
Discrepancy between HC and AC measures (asymmetrical growth pattern)
AC is >5th centile but is crossing centiles by >30 centiles e.g. from 50th to 20th centile
A change in AC of <5 mm over 14 days
EFW on GROW chart <10th centile
EFW on GROW chart crossing centiles with >one third reduction in EFW centile

end diastolic flow associated with a four- and ten-fold increase in perinatal mortality, respectively.[13] There is consistent evidence that monitoring the UmA Doppler in high-risk pregnancy reduces perinatal morbidity and mortality and antenatal admissions. As such, monitoring the UmA Doppler in SGA pregnancies should be the accepted clinical standard.[1,14]

Stratifying risk in the SGA baby

While the sequence of UmA Doppler waveform deterioration with progressive hypoxia is well documented in early-onset SGA, in most cases of late-onset SGA the UmA Doppler will remain normal. In these cases, perinatal morbidity is reduced compared to babies with an abnormal UmA Doppler, although these pregnancies may still suffer adverse outcomes attributable to SGA.[15,16] It is recommended that SGA babies with normal UmA Doppler are further assessed with MCA and UtA Doppler to determine if they are at higher risk of adverse outcome.[1]

Uterine artery

In the third trimester UtA Doppler is a useful adjunctive prognostic indicator. In SGA pregnancies where the UtA waveform is abnormal (in other words, increased impedance to flow indicated by an elevated PI and/or bilateral diastolic notching is present), the baby is at greater risk of preterm delivery and lower birthweight and even where the UmA is normal, the UtA Doppler predicts an increased risk of emergency caesarean delivery.[17]

Fetal middle cerebral artery

In chronic hypoxia fetal blood is redistributed to the brain, heart and adrenals: a compensatory attempt to minimise hypoxic damage to these vital organs. Redistribution of fetal blood to the brain occurs via a relative vasodilation of the cerebral vasculature and is detected as a fall in RI or PI in the MCA Doppler. In late onset SGA, a fall in the MCA Doppler PI <fifth centile occurs in up to 15 per cent of cases and predicts risk of adverse outcome independent of UmA Doppler.[15] The cerebro-placental ratio (CPR) is calculated as the ratio of UmA to MCA Doppler resistance. As the CPR is influenced by both rising UmA and falling MCA resistance, it becomes abnormal before either the MCA or UmA Doppler, and may be abnormal even if these individual components are within the normal range.[15]

Evaluation of the MCA Doppler is also an important component in the evaluation of fetal anaemia. Increasing anaemia results in reduced blood viscosity and redistribution of blood flow in favour of the brain, resulting in increased peak systolic flow in the MCA. The use of the MCA Doppler to accurately assess fetal anaemia has revolutionised the management of Rhesus isoimmunisation, which previously required amniocentesis or cordocentesis.[18]

Fetal wellbeing

Amniotic fluid volume

In the third trimester, the main determinant of amniotic fluid volume (AFV) is the balance between fetal swallowing and urination. Abnormalities of AFV should prompt a review of the fetal urinary and gastrointestinal systems, as well as consideration of premature rupture of membranes and abnormal fetal growth. Qualitative or semi-quantitative (amniotic fluid index [AFI], single deepest vertical pocket [SDVP]) measurements are commonly used. AFI has less inter-observer variability than SDVP, but results in an increased diagnosis of oligohydramnios and subsequent intervention with no demonstrable improvement in perinatal outcome.[19]

Biophysical profile

The biophysical profile (BPP) assesses four ultrasound parameters (AFV, fetal breathing, tone and gross movements) in addition to a CTG recording. Evidence is lacking that the BPP is more effective at preventing perinatal mortality than conventional monitoring.[20] The usefulness of the BPP is also limited by a high false-positive rate (50 per cent) and further research is required to elucidate whether use of the BPP with other tests (for example, Doppler studies) may improve our ability to identify compromised babies.[21]

New Zealand MFM Network guideline

The New Zealand MFM Network guideline for the management of suspected SGA singleton pregnancies and infants after 34 weeks gestation has recently (October 2014) been revised. This useful resource is available online.[1] It provides a summary of current evidence to guide best practice with algorithms and Doppler reference charts to guide individual patient care and provide frameworks for development of local guidelines.

Other

Cervical length

In women with symptoms of preterm labour, transvaginal measurement of cervical length and has a similar ability to predict delivery within 48 hours and seven days as fetal fibronectin.[22] In an analysis of 24 trials involving more than 5000 women, using a cut-off of ≤15mm appeared to be most accurate in predicting preterm birth within seven days (sensitivity 0.74 and specificity 0.89).[22]

Disorders of placentation

Placental location is defined at the time of the anomaly scan at 18–20 weeks. Where the placenta is seen to be low lying, placental position is reviewed in the third trimester to allow planning of safe delivery. In women with risk factors for a morbidly adherent placenta, the index of suspicion for placenta accreta should be high and specialist opinion sought. Ultrasound findings suggesting of accreta include loss of the normal retroplacental hypoechoic zone, presence of multiple intraplacental lacunae, loss or disruption of the serosa–bladder wall interface or a focal elevation/mass of the same echogenicity as the placenta visualised beyond the uterine serosa (indicating percreta).[23-25]

Guidance procedures

Real-time ultrasound imaging improves the safety and success of procedures such as amniocentesis and chorionic villus sampling[26] and has opened the door to more invasive techniques, such as percutaneous fetal blood sampling, fetal transfusion[27] and other fetal interventions.

Three-dimensional imaging

Three-dimensional ultrasound imaging has been available since the 1980s, however owing to poor image quality and slow processing speeds the technique was slow to be adopted.[2] Three-dimensional imaging (and real time 4D imaging) may be beneficial for assessing

Key points

- Ultrasound is the most commonly used imaging modality in pregnancy.
- Assessment of fetal growth with the aim of identifying and monitoring the SGA or IUGR baby is arguably the most important role of ultrasound scanning in the third trimester.
- Babies identified as SGA and/or IUGR should be concurrently investigated with UmA, MCA and UtA Doppler in order to further stratify risk.
- Before performing or requesting imaging, consider how results will impact on management. Avoid unnecessary investigations in low-risk pregnancies.

surface anomalies such as facial clefts and spinal defects.[28] With the provision of strikingly life-like images, there is increasing demand from families to access these scans. Concern regarding possible risks of these procedures when they are being performed without medical benefit has led to the international recommendation: 'that diagnostic ultrasound should be performed only when a medical indication exists and not solely for visualising the fetus or obtaining pictures/video clips of the fetus'.[29]

Non-indicated use

In the low-risk or unselected population, there are no proven benefits of late pregnancy ultrasound in terms of reduction in intervention or improved perinatal outcome.[12] Similarly, Doppler ultrasound of any vessel should not be used as a screening tool in unselected populations.[30]

Other imaging techniques

X-ray

X-ray of the fetus was reported as early as the 1920s. It has been used in attempts to determine viability, pregnancy dating, fetal and placental location, fetal bone anomalies, risk of obstructed labour and even to guide needle placement for in utero fetal blood transfusion.[2] It has now been superseded by technologies obtaining real-time higher quality images without the use of ionising radiation.

Computed tomography

Owing to concerns regarding ionising radiation exposure to the fetus, computed tomography (CT) is rarely used in obstetrics. However, its use in pregnancy may be indicated for emergency non-obstetric indications, such as following high-energy trauma, pulmonary embolism and abdominal pain.

Magnetic resonance imaging

Magnetic resonance imaging (MRI) uses non-ionising radiation and is deemed safe for mother and fetus. It allows evaluation of complex fetal anatomy where structures may be better visualised than with ultrasound.[2,31] It is particularly useful in assessment of the central nervous system, thorax and head and neck (allowing antenatal fetal airway assessment). MRI is also a useful adjunct in planning delivery in cases of abnormal placentation, particularly where a posterior placenta increta or percreta is suspected.[31]

Conclusion

Ultrasound is the most important imaging tool for evaluation of the fetus in the third trimester. Skill lies not only in performing these tests, but also the selection of women and babies who will benefit from them, the interpretation of scan data in context of the pregnancy and subsequent management. With ongoing use, hopefully, we will be able to use these 'windows' more effectively, as research tools to understand normal and complicated pregnancies, and clinically to improve the management and outcome of all pregnancies.

References

1 Guideline for the management of suspected small for gestational age singleton pregnancies after 34 weeks gestation. www.healthpoint.co.nz/public/new-zealand-maternal-fetal-medicine-network/?solo=otherList&index=1 updated 2014.
2 Benson CB, Doubilet PM. The history of imaging in obstetrics. *Radiology.* 2014;273(2 Suppl):S92-S110.
3 Saltvedt S, Almström H, Kublickas M, Valentin L, Grunewald C. Detection of malformations in chromosomally normal fetuses by routine ultrasound at 12 or 18 weeks of gestation: a randomised controlled trial in 39 572 pregnancies. *BJOG.* 2006;113(6):664-674.
4 Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: Population based study. *BMJ.* 2013;346:f108.
5 Gardosi J, Francis A. Controlled trial of fundal height measurement plotted on customised antenatal growth charts. *BJOG.* 1999;106(4):309-317.
6 Scioscia M, Vimercati A, Ceci O, Vicino M, Selvaggi LE. Estimation of birth weight by two-dimensional ultrasonography: A critical appraisal of its accuracy. *Obstet Gynecol.* 2008;111(1):57-65.
7 Statement on normal ultrasonic fetal measurements. www.asum.com.au/newsite/files/documents/policies/PS/D7_policy.pdf updated 2001.
8 Gestation network growth charts. www.gestation.net/growthcharts.htm updated 2014.
9 Small for gestational age fetus, investigation and management (green-top guideline no. 31). www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg31/ updated 2013.
10 Gardosi J, Mongelli M, Wilcox M, Chang A. An adjustable fetal weight standard. *Ultrasound Obstet Gynecol.* 1995;6(3):168-174.
11 Weeks JW, P. Fetal macrosomia: Does antenatal prediction affect delivery route and birth outcome? *Obstet Gynecol.* 1995;173(4):1215-1219.
12 Bricker L, Neilson JP, Dowswell T. Routine ultrasound in late pregnancy (after 24 weeks' gestation). Cochrane Database Syst Rev. 2008;(4):CD001451. doi(4):CD001451.
13 Karsdorp VHM. Clinical significance of absent or reversed end diastolic velocity waveforms in umbilical artery. *Lancet.* 1994;344(8938):1664-1668.
14 Alfirevic Z, Stampalija T, Gyte GM. Fetal and umbilical doppler ultrasound in high-risk pregnancies. Cochrane Database Syst Rev. 2013;11:CD007529.
15 Oros D, F. Longitudinal changes in uterine, umbilical and fetal cerebral doppler indices in late- onset small-for- gestational age fetuses. *Ultrasound in Obstetrics & Gynecology.* 2011;37(2):191.
16 Hernandez-andrade E. Cerebral blood flow studies in the diagnosis and management of intrauterine growth restriction. *Curr Op Obstet Gynecol.* 2013;25(2):138-144.
17 Ghidini A, Locatelli A. Monitoring of fetal well-being: Role of uterine artery doppler. *Semin Perinatol.* 2008;32(4):258-262.
18 Mari G, Deter RL, Carpenter RL, et al. Noninvasive diagnosis by doppler ultrasonography of fetal anemia due to maternal red- cell alloimmunization. *N Engl J Med.* 2000;342(1):9-14.
19 Magann EF, Sandlin AT, Ounpraseuth ST. Amniotic fluid and the clinical relevance of the sonographically estimated amniotic fluid volume: Oligohydramnios. *Journal of Ultrasound in Medicine.* 2011;30(11):1573-1585.
20 Lalor JG, Fawole B, Alfirevic Z, Devane D. Biophysical profile for fetal assessment in high risk pregnancies. Cochrane Database Syst Rev. 2008;(1):CD000038. doi(1):CD000038.
21 Figueras F, Gardosi J. Intrauterine growth restriction: New concepts in antenatal surveillance, diagnosis, and management. *Obstet Gynecol.* 2011;204(4):288-300.
22 Boots AB, Sanchez-Ramos L, Bowers DM, Kaunitz AM, Zamora J, Schlattmann P. The short-term prediction of preterm birth: A systematic review and diagnostic metaanalysis. *Am J Obstet Gynecol.* 2014;210(1):54.e1-54.e10.
23 Riteau A-S, Tassin M, Chambon G, et al. Accuracy of ultrasonography and magnetic resonance imaging in the diagnosis of placenta accreta. *PLoS ONE.* 2014;9(4).
24 Belfort MA. Placenta accreta. *Obstet Gynecol.* 2010;203(5):430-439.
25 Comstock C, Bronsteen R. The antenatal diagnosis of placenta accreta. *BJOG.* 2014;121(2):171-182.
26 Crandon AJ, Peel KR. Amniocentesis with and without ultrasound guidance. *BJOG.* 1979;86(1):1-3.
27 Berry SM, Stone J, Norton ME, Johnson D, Berghella V. Fetal blood sampling. *Obstet Gynecol.* 2013;209(3):170-180.
28 Merz E, Abramowicz JS. 3D/4D ultrasound in prenatal diagnosis: Is it time for routine use? *Clin Obstet Gynecol.* 2012;55(1):336-351.
29 Abramowicz JS, B. The safe use of non-medical ultrasound. *Ultrasound in Obstetrics and Gynecology.* 2009;33(5):617-620.
30 Goffinet F, Paris-llado J, Nisand I, Bréart G. Umbilical artery doppler velocimetry in unselected and low risk pregnancies: A review of randomised controlled trials. *BJOG.* 1997;104(4):425-430.
31 Patenaude Y, Pugash D, Lim K, et al. The use of magnetic resonance imaging in the obstetric patient. *JOGC.* 2014;36(4):349.

Safety first

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Imaging safely, particularly in pregnancy – what to consider.

The decision to refer any patient for imaging is always a balance between the probability that the imaging test will improve management and the risks associated with the test, including the risks of radiation. With pregnant or potentially pregnant patients the risks associated with ionising radiation are a major consideration.

There are two main types of risks for exposure to ionising radiation:

1. Short-term (deterministic) risk: this is from cell death and may result in skin erythema, cataracts and hair loss. This is dose dependent, in other words, both the risk and the severity of the injury increase as the radiation dose increases. Deterministic effects are rarely seen in normal diagnostic imaging as substantial radiation dose thresholds must be exceeded, but they might result after numerous CT and PET/CT scans or after lengthy interventional procedures.
2. Long-term (stochastic) risk: this is owing to DNA damage and may result in radiation-induced cancer. Although this risk increases with dose, there is no threshold to be exceeded as injury to a single cell or group of cells may be sufficient. This risk is expressed as chances per million and is derived from data collected from survivors of the atomic bombs in Japan and from others exposed to high radiation doses. It is only an estimate. The severity of the stochastic effect is independent of the radiation dose.

Pregnancy

A woman who is pregnant, is herself no more sensitive to radiation than a woman who is not pregnant. The risk to the fetus from ionising radiation depends on:

- the part of the mother's body exposed to the radiation;
- the stage of pregnancy; and
- the radiation dose received.

Short-term risk to the fetus

The short-term risk is different for a fetus compared with a child or adult because it is rapidly growing. The risks include death, slowing of normal growth, abnormal growth and being intellectually or emotionally underdeveloped. The fetus is most vulnerable to radiation-induced congenital malformations during the period of organogenesis, that is weeks three to eight after conception. From weeks eight to 15 the fetus has the highest risk of radiation-induced neurodevelopmental abnormalities.

The International Commission on Radiation Protection (ICRP) has stated that these deterministic risks are not expected to occur if the exposure is <100mGy of radiation.[1] Table 1 provides the expected dose for a fetus with different examinations. Even the highest dose examinations are well below 100mGy. Multiple examinations or multiphase scans are of more concern.

Long-term risk to the fetus

It was first demonstrated in 1956 that there is an increased incidence of leukaemia and childhood cancer in children born to mothers who received diagnostic pelvic irradiation in pregnancy.[2] The association between prenatal radiation exposure and childhood cancer is now well recognised.

Table 1 shows the additional risk of developing cancer over and above the background risk (1:500 children develop cancer [risk from birth to 14 years] with no exposure to radiation as a fetus). Even if the mother had the highest dose examination the additional risk of cancer might increase three fold, in other words, the absolute risk is still low. If a high dose examination is needed for the mother and the risk of not having it is significant then it is appropriate to perform it.

General comments

The fundamental principle in imaging any patient is to keep the radiation dose to nil, or as low as reasonably achievable (ALARA). Many clinical questions can be answered with ultrasound or magnetic resonance imaging (MRI), neither of which use ionising radiation.

There is no evidence that greyscale ultrasound has any adverse effects.[3,4] The thermal effect of pulsed Doppler ultrasound is of concern in embryos and fetuses and the British Medical Ultrasound Society has rigorous recommendations about the safety (T1 thermal and M1 mechanical) indices on machines.[4] For this reason, pulsed Doppler imaging should be used prudently generally in pregnancy and especially in early pregnancy.

MRI radiofrequency fields generate heat, but there is no evidence of adverse effects in pregnancy, although study samples are small.[5] It is unknown if higher magnet strengths (>1.5 Tesla) and prolonged imaging times may have biological effects at sensitive stages of development so it is recommended to perform fetal MRI after 18 weeks gestation whenever possible and only when the clinical benefits outweigh the potential risks.[5]

It is crucial that any woman referred for imaging is asked if she could be pregnant and this is particularly important in nuclear imaging or if the abdomen or pelvis will be exposed to radiation. If a woman is not sexually active it is safe to proceed with these tests. If a woman is sexually active and her period is not overdue it is considered safe to proceed with lower dose procedures (see Groups 1–3 in Table 1).[6]

If a woman is sexually active and is referred for a procedure that involves more than 10mGy to the uterus it is extremely important to be sure she is not pregnant and, unless it is an emergency, the examination should be delayed until the first ten days of the next menstrual cycle or until her Beta human chorionic gonadotropin (BHGC) is confirmed to be negative before proceeding.

If the woman is pregnant then the potential risk of not having the test needs to be balanced against the potential risk to the fetus.

Table 1. Typical fetal doses and risks of childhood cancer for common radiology.

Examination type	Typical Fetal dose (mGy)	Risk of childhood cancer per examination
Group 0 Ultrasound Magnetic Resonance Imaging (MRI)	0	0
Group 1: X ray skull X ray chest X ray thoracic spine Mammogram Head or neck CT CT pulmonary angiogram Lung ventilation scan	0.001-0.01 0.01-0.1	<1 in 1 000 000 1 in 1 000 000 to 1 in 100 000
Group 2: X-ray of abdomen, pelvis or hip or barium meal CT scan of the chest and upper abdomen Nuclear Medicine scans using technetium-99m including thyroid scan, lung perfusion scan, renal scan (DMSA, MAG3) or white cell scan	0.1-1.0	1 in 100 000 to 1 in 10 000
Group 3: Lumbar spine x-ray Barium enema IVP or urogram CT abdomen or lumbar spine Nuclear scans using technetium-99m: bone scan, cardiac pool scan, myocardial scan, renal scan Thallium-201 myocardial scan CT of pelvis or pelvis plus abdomen PET-CT Technetium-99m myocardial SPECT (rest – exercise protocol)	1.0-10 10-50	1 in 10 000 to 1 in 1000 1 in 1000 to 1 in 200

Note: Natural Childhood risk of cancer is 1 in 500. Advice from the UK Health Protection Agency, the Royal College of Radiologists and the College of Radiographers.

This will require close collaboration between the referring clinician and the radiologist. As mentioned, radiation risks are most significant during organogenesis: the first trimester. The central nervous system (CNS) is highly sensitive to radiation from eight to 15 weeks post-conception and doses of 100mGy may result in a decreased IQ. The CNS only becomes less sensitive to radiation after 25 weeks gestation.[7,8]

Very occasionally, a patient has an abdominal/pelvic computed tomography (CT) scan before realising she is pregnant. As organogenesis starts three-to-five weeks post-conception, the risk of malformation is not thought to be increased and the main risk is death of the conceptus and then only if the dose is more than 100mGy.[7,8] Even if the dose is less than 100mGy, it is prudent to have a medical physicist calculate the estimated dose. Unless the embryo is older than three weeks it is likely the mother can be reassured that the effect on her baby will have been minimal.

If a test using ionising radiation is essential in pregnancy then, wherever possible, dose reduction techniques – such as lowering the miliamperes or increasing the pitch with spiral CT – are important to minimise the dose to the fetus. Diagnostic studies remote from the fetus, for example, limb or chest, can be done safely at any stage of pregnancy (assuming the equipment is in proper working order). Shielding the abdomen and pelvis should be used if these areas are not being imaged. Mammography is similarly considered safe at all stages of pregnancy.[7]

Is there a pulmonary embolus?

The question of how to exclude a pulmonary embolus (PE) in a pregnant patient is a highly complex one and there is no complete agreement on the best imaging pathway.[9,10,11,12,13,14] It is generally agreed that a Doppler ultrasound of the legs is the first step.[9,11,14] If positive, the mother can be treated for the venous thrombosis/presumed PE. If negative and a chest X ray is clear, then the difficult question is whether to do a ventilation-perfusion (VQ) scan or CT pulmonary angiogram (CTPA). There is no clear consensus on this. A VQ scan will give a higher radiation dose to the fetus (see Table 2[12]) although the difference is less marked in the third trimester. A CTPA scan has a higher dose to the mother and this is of particular concern in younger women in view of the stochastic risk to the breasts, which are more radiation sensitive. In addition a CTPA scan in pregnancy is more likely to be inadequate (six to

Table 2. Radiation dose for mother and fetus.[12]

	Mother	**Fetus**
CTPA	2.2-6.0mSv	0.003-0.13mGy
V/Q scan	1.4mSv	0.6-0.8mGy

Note: Background dose is 2.5mSv per year

36 per cent), owing to the hyperdynamic circulation and limited breath holding. Repeating a CTPA scan should be only done with caution for the reasons already mentioned. There are no known mutagenic or teratogenic effects from intravenous iodinated contrast media.[11]

Other important factors to consider are the local availability of nuclear medicine studies, the age of the equipment in the medical imaging department, the rate of technically inadequate studies in the local department and, perhaps most importantly, the degree of clinical suspicion (anecdotally only two-to-four per cent of CTPAs performed are positive for a pulmonary embolus). The decision of which imaging pathway to take is therefore best made after close consultation with the local radiologist. Some departments recommend a VQ scan first, others a CTPA scan. The imaging pathway from the Western Australian Government's Diagnostic Imaging Pathways[9] suggests a CTPA first in the first and second trimesters and VQ scan first in the third trimester. MR pulmonary angiograms are in their infancy and at this stage are not widely available and have not been established as a definitive test.[10,14]

Other imaging matters

MRI is the modality of choice for staging cancer in pregnant patients although using gadolinium is not recommended as the long-term risk of gadolinium to the fetus is not yet known.[5,10]

If a woman is breastfeeding, the radiopharmaceutical from a nuclear medicine study will be distributed throughout her body and some will enter the breastmilk. To avoid exposing the infant to radiation, is it best to stop the breastfeeding for a short period after the examination. Again, close communication with the nuclear medicine specialist will determine if this is necessary and if so for how long.

Conclusion

The decision to refer a pregnant woman to radiology should be made after considering the risks of the test to both mother and fetus versus the risks of not doing the test. The potential of the test to alter management is central and consultation with a radiologist can be helpful in determining the best course of action for the patient and in ensuring that any radiation dose is as low as reasonably achievable.

References

1 ICRP, 2000. Pregnancy and Medical Radiation. ICRP Publication 84. Ann. ICRP 30 (1).

2 Giles D, Hewitt D, Stewart A, Webb J. Malignant disease in childhood and diagnostic irradiation in utero. *Lancet.* 1956 Sep 1;271(6940):447-447.

3 Abramowicz JS. Benefits and risks of ultrasound in pregnancy. *Semin Perinatol.* 2013 Oct;37(5):295-300.

4 BMUS (British Medical Ultrasound Society): Guidelines for the safe use of diagnostic ultrasound equipment. London: BMUS; 2009.

5 Bulas D, Egloff A. Benefits and risks of MRI in pregnancy. *Semin Perinatol.* 2013 Oct;37(5):301-4.

6 Insideradiology.com.au internet Sydney: Inside Radiology - Radiation risk of medical imaging during pregnancy. updated 2011 Jan 31; cited 2014 Dec 15 www.insideradiology.com.au/pages/view.php?T_id=96&ref_info#.VHZ2MdKUfHU .

7 Nguyen CP, Goodman LH. Fetal risk in diagnostic radiology. *Semin Ultrasound CT MR.* 2012 Feb;33(1):4-10.

8 iaea.org internet Vienna Austria. IAEA: Pregnancy and radiation protection in diagnostic radiology. updated 2013; cited 2014 Dec 15. Available from: https://rpop.iaea.org/RPOP/RPoP/Content/SpecialGroups/1_PregnantWomen/Pregnancyandradiology.htm .

9 imagingpathways.health.wa.gov.au internet Perth: Diagnostic Imaging Pathways– Obstetric and Gynaecological Pathways updated 2013 Oct; cited 2014 Dec 15 Available from: www.imagingpathways.health.wa.gov.au/index.php/imaging-pathways/obstetric-gynaecological .

10 Leung AN, Bull TM, Jaeschke R, Lockwood CJ, Boiselle PM, Hurwitz LM et al. American Thoracic Society documents: an official American Thoracic Society/Society of Thoracic Radiology Clinical Practice Guideline--Evaluation of suspected pulmonary embolism in pregnancy. *Radiology.* 2012 Feb;262(2):635-46.

11 Sadro CT, Dubinsky TJ. CT in Pregnancy: Risks and Benefits. *Applied Radiology.* 2013 Oct;42(10):6-16.

12 Hunsaker AR, Lu MT, Goldhaber SZ, Rybicki FJ. Imaging in acute pulmonary embolism with special clinical scenarios. *Circ Cardiovasc Imaging.* 2010(Jul); 3(4):491-500.

13 Bourjeily G, Paidas M, Khalil H, Rosene-Montella K, Rodger M. Pulmonary embolism in pregnancy. *Lancet.* 2010;375:500-12.

14 Scarsbrook AF, Evans AL, Owen AR, Gleeson FV. Diagnosis of suspected venous thromboembolic disease in pregnancy. *Clin Radiol.* 2006;61: 1-12.

Magnetic resonance

The many uses of magnetic resonance imaging in obstetrics and gynaecology.

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Ultrasound is the modality of choice for screening the fetus. Since the late 1990s, magnetic resonance imaging (MRI) has evolved as a useful modality for problem solving in selected cases in which ultrasound has identified an abnormality, or raised the possibility of an abnormality. The MRI examination should be undertaken in close collaboration with the treating obstetric team and with review of the ultrasound imaging. With the development of echo planar imaging, MRI techniques with high spatial resolution and excellent contrast resolution are now available. Rapid sequences can be obtained in order to adequately capture fetal images, without motion degradation. High spatial resolution images are required in order to assess the small anatomic structures of the fetus.

Patient safety

To date, no deleterious effects of MRI imaging of the fetus have been documented. The American College of Radiology states that pregnant patients can be accepted to undergo MRI scan at any stage of pregnancy if the risk-benefit ratio to the patient (assessed by the MRI radiologist) warrants the study be performed. Of note, MRI contrast agents should not be routinely administered to pregnant women.

Indications for fetal MRI

Most indications for fetal MRI studies involve potential central nervous system (CNS) abnormalities. These include:

1. Venticulomegaly, where MRI can confirm the presence of ventriculomegaly and identify associated anomalies such as agenesis of the corpus callosum or malformations of cortical development.
2. Posterior fossa abnormalities, such as Chiari II and Dandy Walker malformations.
3. Ischaemic and vascular abnormalities. Diffusion-weighted imaging demonstrates acute infarction. The sequelae of infarction may be evident in cases of twin-to-twin transfusion syndrome.
4. Intrauterine infection, in particular, cytomegalovirus. MRI may demonstrate volume loss and cortical malformation.
5. Spinal anomalies, including neural tube defects, caudal regression and vertebral anomalies.

MRI of the placenta

Placenta accreta has increased in incidence as the numbers of caesarean deliveries have increased. Patients with placenta previa and a history of caesarean section have a 25–50 per cent incidence of placenta accreta.[1] Ultrasound is the diagnostic standard for fetal assessment and routine examinations at 18 weeks gestation provide an opportunity to screen for abnormal placentation. On ultrasound, placental lacunae and abnormal colour Doppler are the typical features of placenta accreta. Dwyer et al have shown that ultrasound and MRI have similar accuracy in the diagnosis of placenta accreta.[2] In cases where there is uncertainty or difficulty in assessing posterior placentas, MRI has been used to provide additional information. MRI may be obtained at 1.5 or 3T. A phased array surface coil is placed over the maternal abdomen. T2 weighted sequences in axial, sagittal and coronal planes are obtained. Breath-hold techniques are used. Volumetric sequences are useful.

The typical signs of placenta accreta on MRI are uterine bulging, heterogeneous signal within the placental tissue and placental bands. Focal discontinuity in the myometrial border has been described and may be identified. The diagnosis may be difficult even with high-quality ultrasound and MRI examinations. In later pregnancy, the myometrium thins and it may be difficult to visualise at MRI, and therefore difficult to accurately assess the interface between the myometrium and placenta. MRI has particular utility in the assessment of extrauterine extension of placental tissue in cases of placenta percreta. Evidence of the placenta directly invading or distorting the bladder is highly specific for placenta percreta.

Role of MRI in characterisation of adnexal lesions

MRI is complementary to ultrasound in the localisation and characterisation of adnexal lesions. MRI helps to characterise indeterminate ovarian masses on ultrasound, giving a likelihood of malignancy which can affect the subsequent management plan.

MRI has shown good performance in delineating between benign and malignant ovarian neoplasms. The sensitivity and specificity of MRI for ovarian malignancy range from 67–100 per cent and 77–100 per cent, respectively.[3] A recent systemic review shows better performance of contrast-enhanced MRI in characterisation of indeterminate adnexal lesions compared to ultrasound.[4]

Several of the MRI features of ovarian malignancy are similar to ultrasound features (thick multiple septations, mural nodules, vascularity and ascites). The post-contrast sequence on MRI allows better distinction between non-enhancing fibrinous debris or clot from the enhancing neoplastic solid nodules, which may

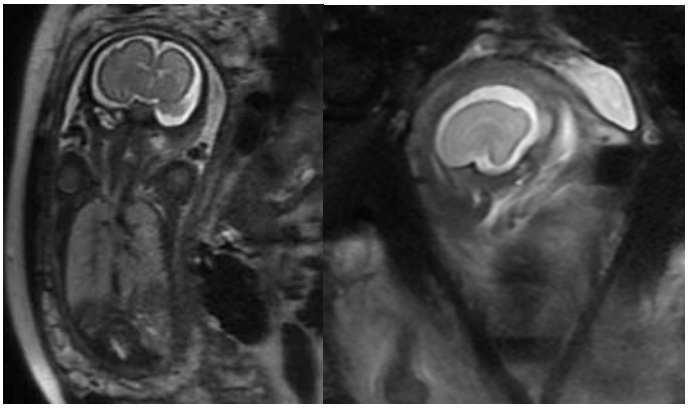

Figure 1 a. (left) coronal; and b. (right) sagittal images of a 27/40 gestation fetus, with an interhemisheric cyst identified at antenatal ultrasound. MRI demonstrates lack of normal sulcation. There is minimal infolding of the Sylvian fissures; the frontal cortex is abnormally smooth, in keeping with lissencephaly.

have a similar appearance on ultrasound. MRI also assesses the signal intensity of the ovarian mass with inference to the composition and histology of the mass. Some benign ovarian lesions (endometrioma, dermoid, fibroma, fibrothecoma and cystadenofibroma) have specific MRI appearances and can be diagnosed with high specificity and confidence.[4] The identification of these benign features on MRI could aid in the decision-making in limited surgical approach or conservative management.

An advantage of MRI over ultrasound is its larger field of view, which is not limited by lesion size or body habitus. Large cystic lesions greater than 7cm may benefit from an MRI, owing to the difficulty to assess the cyst in its entirety on ultrasound.

Novel MRI sequences, including diffusion-weighted imaging and perfusion-weighted imaging, offer potential additional tools for ovarian lesion characterisation. Their clinical role is however still being established.

Role of MRI in endometriosis

MRI is useful in the preoperative diagnosis and mapping of sites of deep invasive endometriosis (DIE) and accurate characterisation of endometriomas. MRI is limited in the assessment of superficial peritoneal implants.

DIE elicits fibrous scar formation from repeated haemorrhage. The associated endopelvic fascia scarring, particularly of the uterosacral ligament is visible on MRI. With involvement of the adjacent organs, DIE manifests as markedly T2W dark fibrous plaques with multiple T1W bright haemorrhagic areas.

The performance of MRI in the preoperative diagnosis of endometriosis is dependent on the location. The highest accuracy of MRI is in bladder endometriosis with high negative predictive value.[5] MRI can have similar performance as transvaginal ultrasound with bowel preparation in the detection of rectosigmoid endometriosis.[6] The advantage of MRI is its large field of view, which allows complete assessment of multiple pelvic sites as well as extrapelvic disease.

MRI of the uterus

Endometrial cancer size, depth and presence of myoinvasion, cervical stromal involvement and nodes can be assessed with accuracy on MRI and many centres in the UK and Europe use

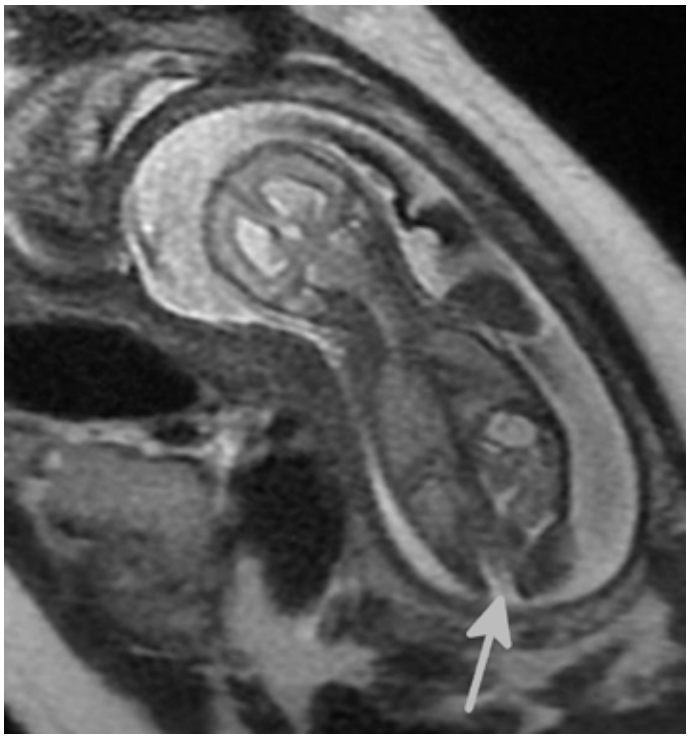

Figure 2. A 22/40 gestation fetus, with possible spinal dysraphism found on antenatal ultrasound. MRI demonstrates posterior spinal defect at the lower lumbar level (arrow), and enlarged lateral ventricles.

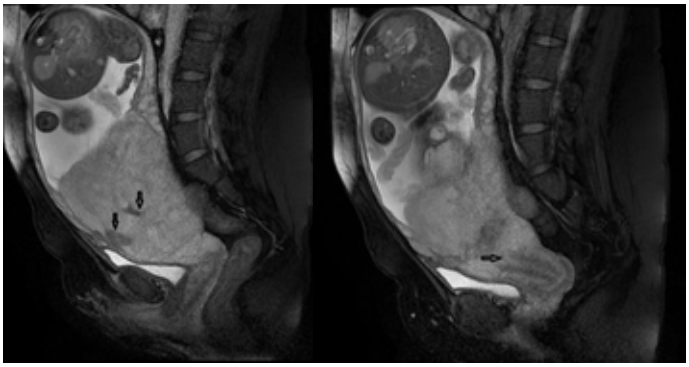

Figure 3. A 32-year-old female patient with history of LSCS, presenting with ultrasound consistent with placenta percreta: note a. (left) the intraplacental dark bands (arrows); and b. (right) low lying placenta, covering the internal os of the cervix (arrow).

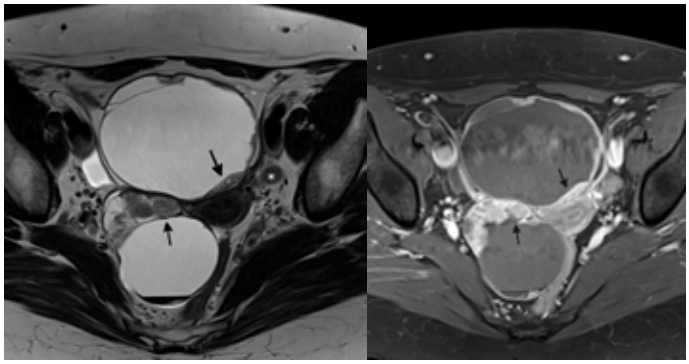

Figure 4. A 60-year-old woman with bilateral serous cystadenocarcinoma: a. (left) an axial T2 weighted image shows bilateral cystic ovarian lesions with mural nodules (arrows) as well as left obturator lymphadenopathy; b. (right) an axial T1 post-contrast image shows enhancement of the mural nodules in keeping with enhancing solid neoplastic tissue.

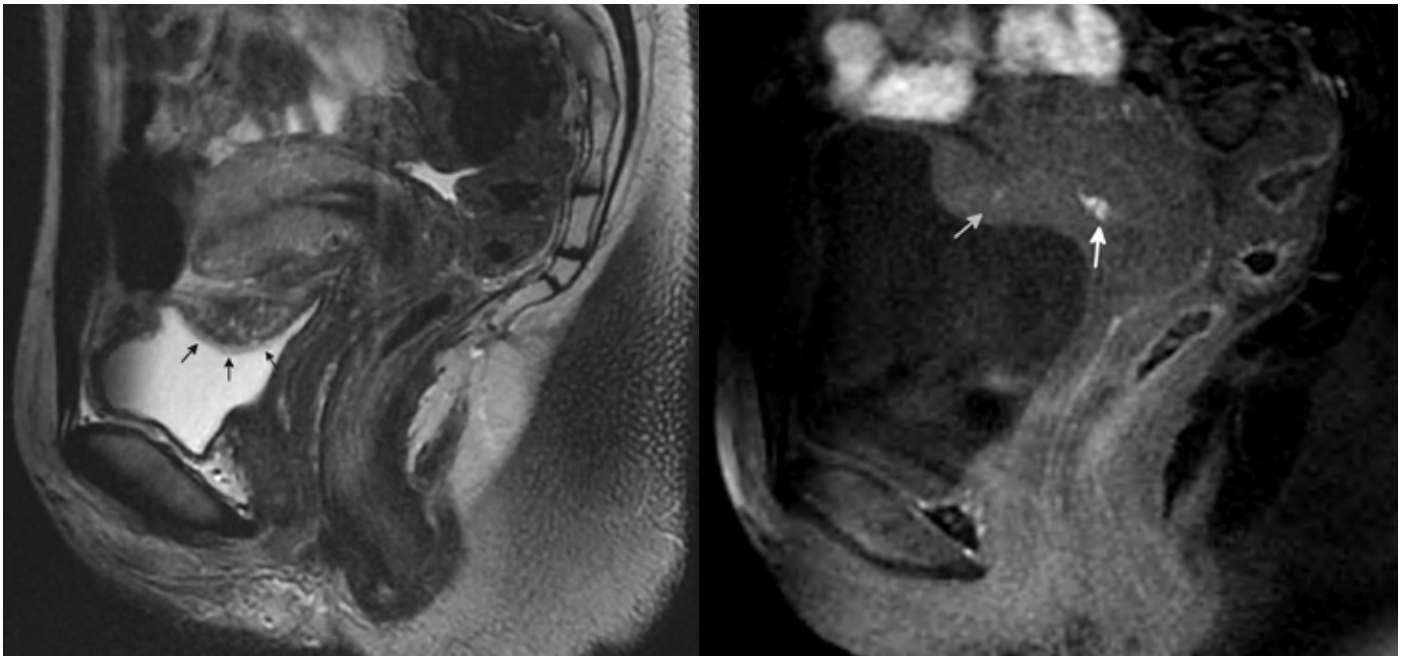

Figure 5. A 28-year-old woman with uterovesical endometriosis with bladder detrusor muscle invasion: a. (left) a sagittal T2 weighted image shows the uterovesical fold endometriosis (arrows) with small bright cystic glandular areas – the bladder mucosa is overlying the plaque and intact; b. (right) a sagittal T1 weighted image shows the T1 bright signal (arrows) associated with the endometriosis due to haemorrhage.

MRI for staging.[7] Computed tomography (CT) of the abdomen and pelvis has similar accuracy to MRI for determining lymph node involvement.[8] In Australia, where endometrial cancer is staged surgically, preoperative CT is used in preference to MRI for nodal staging, owing to cost and availability. Treatment consists of hysterectomy and, for some women, lymph node removal for staging. Stage, together with histologic subtype and grade stratify risk and treatment. Young women with early grade 1 cancer who wish to preserve their uterus may be candidates for MRI. If there is no evidence of myoinvasion or spread to cervical stroma, these women can be treated with hormone therapy. The very elderly or medically unfit may not be surgically staged and MRI may help with decisions regarding the use of brachytherapy. MRI may have a role in determining the mode of performing the hysterectomy in a low-risk patient, though parity and other clinical factors may be as relevant in determining suitability for a vaginal hysterectomy, for example, as tumour stage.

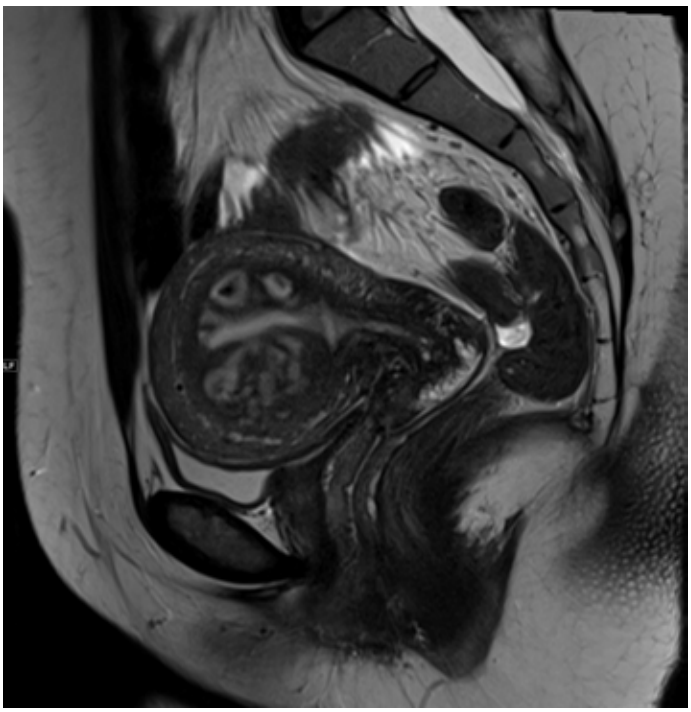

Figure 6. A 47-year-old woman with a suggested diagnosis of uterine sarcoma on CT scan. A sagittal T2 weighted image shows uniform cystic change which conforms to the junctional zone of the uterus owing to adenomyosis.

MRI can be used to differentiate leiomyoma from malignant mesenchymal tumours. Criteria such as single tumour, extra-myometrial tumour, abnormal endometrium and age can be applied using MRI or ultrasound. However, ultrasound may have limitations in discrimination of large masses. Size, MRI signal characteristics and irregular margin can suggest the diagnosis of sarcoma. MRI techniques such as diffusion-weighted imaging may show a tendency to low apparent diffusion coefficient (ADC) value of malignant mesenchymal tumours compared to leiomyoma.[9] MRI may also be helpful in differentiating a pedunculated fibroid from an adnexal mass and distinguishing a fibroid from adenomyosis.

MRI of the cervix

The current FIGO cervical cancer staging classification is based on clinical staging and does not include lymph node assessment. Clinical staging has been shown to be inaccurate with accuracy of tumour size <60 per cent and parametrial involvement 29–53 per cent compared to MRI with accuracy of 93 per cent and 88–97 per cent, respectively.[8] Therefore, MRI is used routinely in developed countries. Early disease (stage 1B and IIA) can be distinguished from advanced disease on MRI and treated surgically. MRI can define pelvic sidewall disease, bladder and rectal involvement and nodes to assist with radiotherapy planning of advanced disease.

For young women with early disease who wish to preserve fertility and who may be candidates for trachelectomy, MRI can accurately assess

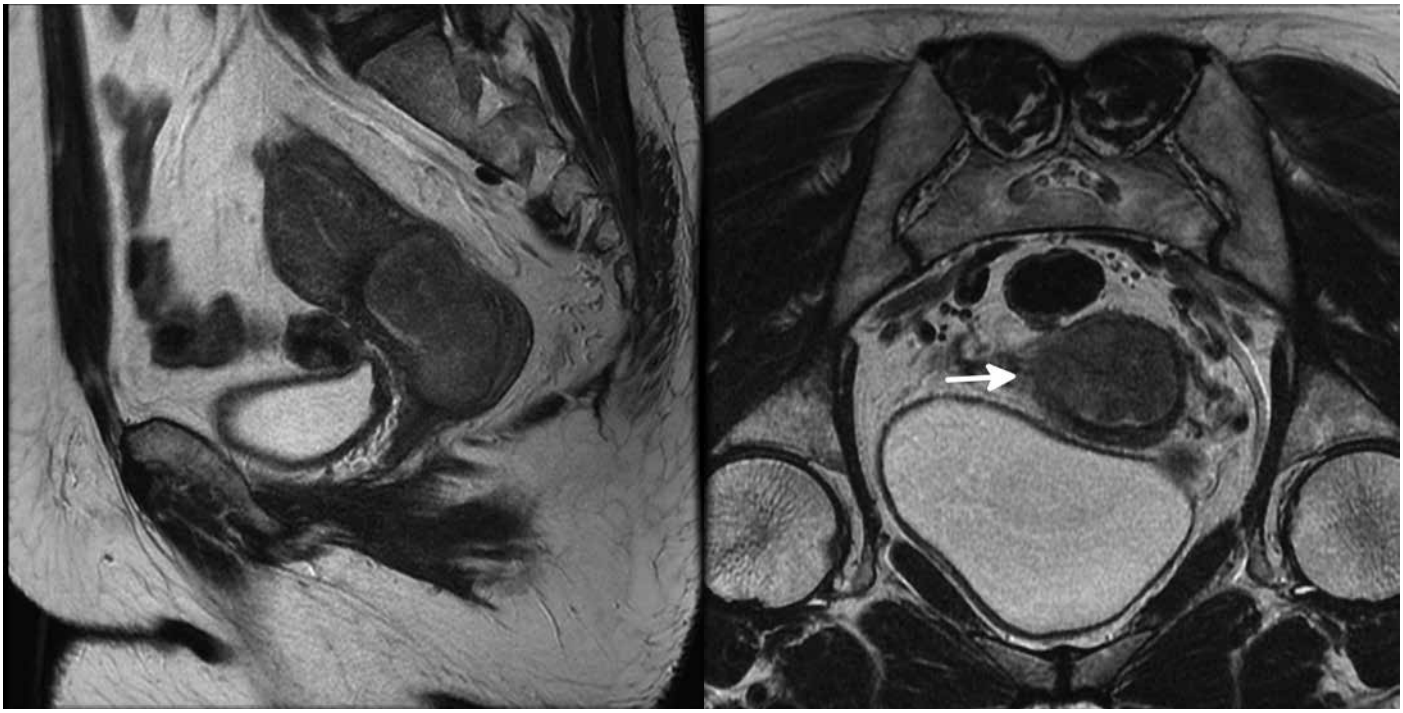

Figure 7. A 53-year-old woman with cervical cancer: a. a sagittal T2 weighted image shows a cervical mass with extension along the posterior wall of the endocervix measuring just over 4cm; and b. an oblique coronal T2 weighted image shows extension through the cervix into the parametrium with disruption of the low T2 signal cervical stroma on the right (arrow).

tumour size, distance of the tumour to the internal os and degree of cervical stromal invasion.[10] MRI can also be useful in pregnancy, assisting management and surveillance of cervical cancers.[11]

References

1 Miller DA, Chollet JA and Murphy Goodwin T. Clinical risk factors for placenta previa-placenta accreta. *Am J Obstet Gynecol.* 1997;177:1:210-214.

2 Dwyer BK, Belogolovkin V, Tran L, Rao A, Carroll I, Barth R et al. Prenatal Diagnosis of Placenta Accreta. *Journal of Ultrasound in Medicine.* 2008;27:1275-1281.

3 Griffin N, Grant LA, Sala E. Adnexal masses: characterization and imaging strategies. *Seminars in Ultrasound, CT, and MRI.* 2010;31(5):330-46.

4 Anthoulakis C, Nikoloudis N. Pelvic MRI as the "gold standard" in the subsequent evaluation of ultrasound-indeterminate adnexal lesions: a systematic review. *Gynecologic Oncology.* 2014;132(3):661-8.

5 Kruger K, Behrendt K, Niedobitek-Kreuter G, Koltermann K, Ebert AD. Location-dependent value of pelvic MRI in the preoperative diagnosis of endometriosis. *European Journal of Obstetrics, Gynecology, and Reproductive Biology.* 2013;169(1):93-8.

6 Bazot M, Lafont C, Rouzier R, Roseau G, Thomassin-Naggara I, Darai E. Diagnostic accuracy of physical examination, transvaginal sonography, rectal endoscopic sonography, and magnetic resonance imaging to diagnose deep infiltrating endometriosis. *Fertility and Sterility.* 2009;92(6):1825-33.

7 Duncan KA, Drinkwater KJ, Frost C, Remedios D, Barter S. Staging cancer of the uterus: a national audit of MRI accuracy. Clinical Radiology. 2012 Jun;67(6):523-30.

8 Freeman SJ, Aly AM, Kataoka MY, Addley HC, Reinhold C, Sala E. The revised FIGO staging system for uterine malignancies: implications for MR imaging. *Radiographics.* 2012 Oct;32(6):1805-27.

9 Bonneau C, Thomassin-Naggara I, Dechoux S, Cortez A, Darai E, Rouzier R. Value of ultrasonography and magnetic resonance imaging for the characterization of uterine mesenchymal tumors. *Acta Obstetricia et Gynecologica Scandinavica.* 2014 Mar;93(3):261-8.

10 Lakhman Y, Akin O, Park KJ, Sarasohn DM, Zheng J, Goldman DA, et al. Stage IB1 cervical cancer: role of preoperative MR imaging in selection of patients for fertility-sparing radical trachelectomy. *Radiology.* 2013 Oct;269(1):149-58.

11 Balleyguier C, Fournet C, Ben Hassen W, Zareski E, Morice P, Haie-Meder C, et al. Management of cervical cancer detected during pregnancy: role of magnetic resonance imaging. *Clinical Imaging.* 2013 Jan-Feb;37(1):70-6.

Further reading

Elsayes KM, Trout AT, Friedkin AM, Lin PS, Bude RO, Platt JF et al. Imaging of the placenta: A multimodality pictorial review. *Radiographics* 2009; 29: 1271-1391.

Interventional radiology

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Gynaecology can be one of the most rewarding areas to work in, with many opportunities to contribute to clinical care and perform interesting, complex, minimally invasive interventions. It has be a leading model for joint-speciality research, with the results producing significant benefits for patients and doctors.

Interventional radiology (IR) is changing rapidly, with sub-specialty status now recognised in Europe and North America. In Australasia, IR has introduced the European Board exit exam (EBIR) as part of a similar journey to sub-specialty status. The changes reflect the clinical role IR now plays in hospital medicine. Image-guided interventions in gynaecology, as in all specialities, often require peri-procedural clinical support by IR to facilitate treatment planning.

Percutaneous treatment of pelvic collections

Percutaneous image-guided aspiration and drainage of abdominal and pelvic collections are the most common procedures provided by IR departments. Ultrasound (US) and computed tomography (CT) are the workhorse modalities for these procedures, but fluoroscopy and magnetic resonance imaging (MRI) can be used, depending on patient pathology and department resources. Many IR departments will have standard requirements for patient preparation, including nil by mouth for two-to-four hours before, and a recent international normalised ratio (INR) of less than 1.5. These parameters can at times appear unnecessary; however, providing a reliable and timely aspiration and drainage service across all referring specialities is easiest with consistent guidelines that are simple to follow. Clinical discussion with IR about individual patient management will often allow procedures to be performed outside these guidelines.

In gynaecology, post-operative collections, tubo-ovarian abscess and, on occasion, ovarian cysts, require aspiration or drainage. Percutaneous access is usually via an anterior transabdominal approach, but transgluteal, endo-vaginal or endo-rectal approaches are also used. Endo-vaginal drainage is performed using US, with needle guide equipment to allow precise targeting of the collection and avoidance of non-target injury to bowel, blood vessels and other structures including ureters. Most procedures can be performed under conscious sedation, but in our department we prefer general anaesthesia for transvaginal procedures to improve patient tolerance and comfort. Up to 75 per cent of postoperative collections can be successfully managed with percutaneous drainage alone. In the rare circumstance where ovarian cyst aspiration is considered, recurrence of the cyst can occur in up to 60 per cent of patients and, in our practice, repeat aspiration is rarely indicated. Minor complications, including transgression of bowel or bladder, and bleeding occur in up to ten per cent of patients following drainage, but rarely result in significant morbidity.[1]

Advanced IR techniques can allow patients with challenging anatomy for image-guided percutaneous drainage to be treated. 'Hydrodissection' involves placing a small needle adjacent to bowel, or other non-target structures at risk of injury, and injecting normal saline or five per cent dextrose to push these structures away and allow access to the target lesion or collection. Hydrodissection fluid is most often opacified with contrast when performed under CT to differentiate dissection fluid from haematoma.

For patients with malignant ascites, common in ovarian and endometrial carcinoma, repeat ultrasound-guided aspiration or drainage can be required. If recurrent admissions to hospital are significantly impacting a patient's quality of life, then placement of a tunnelled drainage catheter or 'port' by IR can allow for outpatient management with community-nurse-facilitated aspiration via the port, as clinically required. IR departments now place a large number and variety of ports, including central venous access or Portacath's for chemotherapy and subcutaneous ports with catheters in malignant pleural and ascitic effusions, to allow simple needle access for repeat outpatient aspiration. The complication rates may be slightly lower and patient recovery faster, when compared to surgically placed ports.[2]

Management of acute and chronic haemorrhage

IR can provide alternative treatment options for patients with uterine and vaginal bleeding, in both acute and chronic settings. Drs Allan, Robson and Tamhame discuss this in further detail in the following article.

Uterine arterio-venous malformations (AVM) are most frequently the result of recent uterine instrumentation and likely represent traumatic myometrial arterio-venous fistulas. There is no well-established algorithm for deciding between conservative and interventional management. In our department, patients admitted with significant menorrhagia requiring transfusion or repeated admissions with anaemia are considered candidates for embolisation, as are patients with a progressive or non-involuting AVM on Doppler US after three or four menstrual cycles. We perform the initial embolisation with a temporary agent (Gelfoam), with the expectation that the majority of AVMs will occlude and re-model to normal myometrium. With this approach, recurrence of the AVM occurs in up to 15 per cent of patients, sometimes owing to ovarian-uterine collaterals and repeat embolisation can be considered with a permanent embolic agent, such as Histoacryl glue ('superglue').

Uterine artery embolisation

Uterine artery embolisation (UAE) is an established, minimally invasive treatment option for symptomatic uterine fibroids. Short-term safety and efficacy are well documented and long-term follow-up from randomised controlled trials has been published more recently.[3-5] Following successful embolisation (>99 per cent infarcted), fibroids will reduce in volume year on year through to five years and beyond. Compared with myomectomy, there is a reduced risk of new fibroids growing by year five. However, there is a price to pay for the benefits sought by choosing a minimally invasive treatment, with faster recovery and fewer major complications.[6] For fibroids that are incompletely infarcted (<90 per cent devascularisation), between 17 and 32 per cent of women

will require re-intervention in the five years following embolisation.[4,7] Hysteroscopic curettage or resection of endocavitary fibroids can be required in the first 12 months following embolisation and for women with recurrence of symptoms re-intervention with repeat embolisation, myomectomy or hysterectomy can be required. These clinical data will allow gynaecologists and IRs to inform women about realistic expectations for different uterine-preserving treatments options.

Fertility following UAE remains a controversial area, with a paucity of robust clinical data with which to guide patients.[8,9] While pregnancy following UAE has been widely reported, the impact of embolisation on fertility remains unclear. The current guidelines reflect this, advising that women who want to preserve future fertility should be offered myomectomy first where there is a reasonably low risk of hysterectomy, but for women who are not surgical candidates it is reasonable to offer UAE. To better clarify the relative impact of UAE and myomectomy on fertility, the FEMME study in the UK has been designed as a multicentre randomised trial comparing UAE with myomectomy in 650 women. The primary outcome measure is quality of life, with secondary endpoints including pregnancy outcomes, further treatment, adverse events and ovarian function. This was recruited to 94 per cent at the end of 2014, but will not look to publish outcomes until two-year follow-up data are available, so there is still some wait before this important information is available to guide doctors and patients.

Helping solve clinical problems using image-guided intervention is a real motivation for IRs, oftentimes as the last port of call, but occasionally it's worth popping in early on just to see what might be possible.

References

1 Saokar, A, Arellano, RS, Gervais, DA, Mueller, PR, Hahn, PF, & Lee, SI. (2008). Transvaginal Drainage of Pelvic Fluid Collections: Results, Expectations, and Experience. *AJR American Journal of Roentgenology.* 191(5), 1352-1358. doi:10.2214/AJR.07.3808.

2 Stokes, L. (2007). Percutaneous Management of Malignant Fluid Collections. *Seminars in Interventional Radiology.* 24(4), 398-408. doi:10.1055/s-2007-992328.

3 Ananthakrishnan, G, Murray, L, Ritchie, M, Murray, G, Bryden, F, Lassman, S, et al. (2012). Randomized comparison of uterine artery embolization (UAE) with surgical treatment in patients with symptomatic uterine fibroids (REST trial): subanalysis of 5-year MRI findings. *CardioVascular and Interventional Radiology.* 36(3), 676-681.

4 Moss JG, Cooper KG, Khaund A, Murray LS, Murray GD, Wu O, et al. Randomised comparison of uterine artery embolisation (UAE) with surgical treatment in patients with symptomatic uterine fibroids (REST trial): 5-year results. *BJOG.* 2011 Apr 12;118(8):936-44.

5 van der Kooij SM, Hehenkamp WJK, Volkers NA, Birnie E, Ankum WM, Reekers JA. Uterine artery embolization vs hysterectomy in the treatment of symptomatic uterine fibroids: 5-year outcome from the randomized EMMY trial. *AJOG.* 2010 Jan 8;203(2):105.e1-105.e13.

6 Martin, J, Bhanot, K, & Athreya, S. (2012). Complications and Reinterventions in Uterine Artery Embolization for Symptomatic Uterine Fibroids: A Literature Review and Meta Analysis. *CardioVascular and Interventional Radiology.* 36(2), 395-402.

7 Dueholm M, Langfeldt S, Mafi HM, Eriksen G, Marinovskij E. Re-intervention after uterine leiomyoma embolisation is related to incomplete infarction and presence of submucous leiomyomas. *European Journal of Obstetrics and Gynecology.* 2014 Nov 27;:1-7.

8 Torre, A, Paillusson, B, Fain, V, Labauge, P, Pelage, JP, & Fauconnier, A. (2014). Uterine artery embolization for severe symptomatic fibroids: effects on fertility and symptoms. *Human Reproduction.* 29(3), 490-501.

9 Sirkeci F, Narang L, Naguib N, Belli A-M, Manyonda IT. Uterine artery embolization for severe symptomatic fibroids: effects on fertility and symptoms. *Human Reproduction.* 2014 Aug;29(8):1832-3.

10 A randomised trial of treating fibroids with either embolisation or myomectomy to measure the effect on quality of life, among women wishing to avoid hysterectomy: the FEMME study. www.birmingham.ac.uk/research/ activity/mds/trials/bctu/trials/womens/femme/index.aspx .

RANZCOG Shan S. Ratnam Young Gynaecologist Award (YGA) 2015

RANZCOG is pleased to announce that the following members have been awarded the 2015 RANZCOG Shan S. Ratnam Young Gynaecologist Award (YGA) to attend the 24th Asian and Oceanic Congress of Obstetrics and Gynaecology (24th AOCOG 2015) to be held 2–7 June 2015, Kuching, Sarawak, Malaysia and Community Fellowship Program to be held 23 May to 1 June 2015, Malaysia:

- Dr Vinay Rane YGA for Australia
- Dr Philippa Shirley YGA for New Zealand

Congratulations Vinay and Philippa! For further information on the 24th AOCOG 2015 in Kuching Malaysia, visit: www.aocog2015.com/

The very many uses of IR

Dr Robert Allen
FRANZCR, FRCR
Radiologist

A/Prof Stephen Robson
FRANZCOG
Obstetrician and Gynaecologist

Dr Rohit Tamhane
FRANZCR
Radiologist

Over the past four decades the scope and availability of interventional radiology has increased remarkably, offering many new services to patients across many disciplines, including obstetrics and gynaecology.

It was more than half a century ago when Dr Charles Dotter, the 'father of interventional radiology', conceived the concepts of percutaneous angioplasty and vascular stent placement, successfully dilating the superficial femoral artery of a woman with severe vascular disease who refused to have an amputation for an ischaemic foot. Dotter was subsequently nominated for the Nobel Prize in medicine for his pioneering work. In the decades that have followed, percutaneous interventional techniques have revolutionised many areas of medicine and are now routinely employed to selectively ablate tumours, manage stroke and myocardial infarction, lyse thromboses in many parts of the body, and arrest haemorrhage. These interventional radiology (IR) tools now have an important role in many areas of obstetrics and gynaecology.

Placenta accreta

The incidence of placenta accreta is increasing and management of delivery in the presence of morbidly adherent placentation is associated with a high risk of massive haemorrhage and hysterectomy. There is an emerging consensus that endovascular techniques have a major role to play in this setting. About 15 years ago, Dubois' group described pre-operative placement of non-inflated balloon catheters in the hypogastric arteries. Following delivery, and before the hysterectomy, the balloons could be inflated to minimise pelvic haemorrhage. At the completion of the procedure, the balloons were deflated and, if there was ongoing bleeding, embolisation of the pelvic arteries could be performed. Variations on this theme include performing caesarean section leaving the placenta in situ and embolisation of the placental bed, thus preserving the uterus. There is no consensus on the correct technique, but use of interventional radiology allows considerable scope to tailor the management in the individual case. Overall, the use of balloon catheters is associated with good outcomes for mother and baby, with a low incidence of complications. There have been reports of iliac vessel thrombosis, but these have resolved with conservative management.

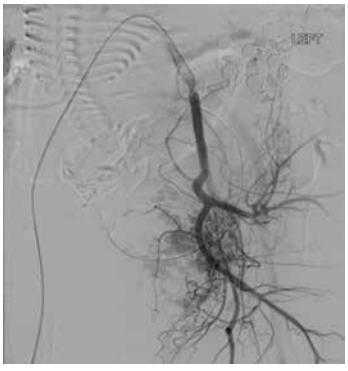

Figure 1. Angiogram in preparation for balloon placement pre-delivery.

Postpartum haemorrhage

Like placenta accreta, postpartum haemorrhage (PPH) is increasing in incidence for reasons that are not clear. However, PPH has the potential to be very serious and is one of the common causes of quite severe morbidity or maternal mortality. Multiple approaches can be used to manage PPH and interventional techniques may have a significant role in major obstetric haemorrhage and can be lifesaving. Although hysterectomy is an important part of the management of massive haemorrhage, this is obviously a sterilisation. In some cases, embolisation of bleeding vessels can allow for preservation of the uterus and possibly fertility.

Arterial embolisation is often considered after other conservative treatments, such as use of uterotonics, encirclement sutures and balloon tamponade, have been unsuccessful. Use of uterine artery embolisation has been described for at least two decades and was adopted from pre-existing management strategies for controlling haemorrhage in pelvic trauma and tumours. Typically, the interventional radiologist will sequentially and selectively catheterise the internal iliac arteries and uterine arteries. In situations of heavy bleeding, it is common to find multiple points of extravasation in the placental bed. Embolisation of the whole vascular territory is effective management in the majority of cases.

From a technical standpoint, there is often upward displacement of the arteries caused by the large uterus, markedly altering the anatomy from the non-pregnant state. A number of embolic materials can be used, but gelatine sponge is very commonly employed because of its (usually) temporary effect potentially increasing the safety of future pregnancies. Synthetic particles, such as polyvinyl alcohol (PVA) and other material may be employed, but there is some debated concern that the more permanent materials may prejudice future pregnancies.

Pelvic vascular 'congestion'

Women are commonly referred to interventional radiologists for management of so-called pelvic congestion. This is a condition that is usually characterised by long-standing pelvic pain that is not cyclic. Imaging with ultrasound and computed tomography (CT) or magnetic resonance imaging (MRI) typically reveals pelvic venous distension associated with venous valvular insufficiency. Patients are typically in their 30s or 40s and present with low back and pelvic pain often described as 'heaviness', experienced in the lower pelvis, vulva and sometimes thighs. The symptoms may be worse with prolonged standing or physical effort and straining. Occasionally, the pain is associated with intercourse or is worse following sexual activity.

Pelvic vascular congestion results from incompetent valves in the ovarian veins and this may be affected by hormonal vasomotor effects. The condition is more common in parous women, probably because of the chronic venous distension of pregnancy

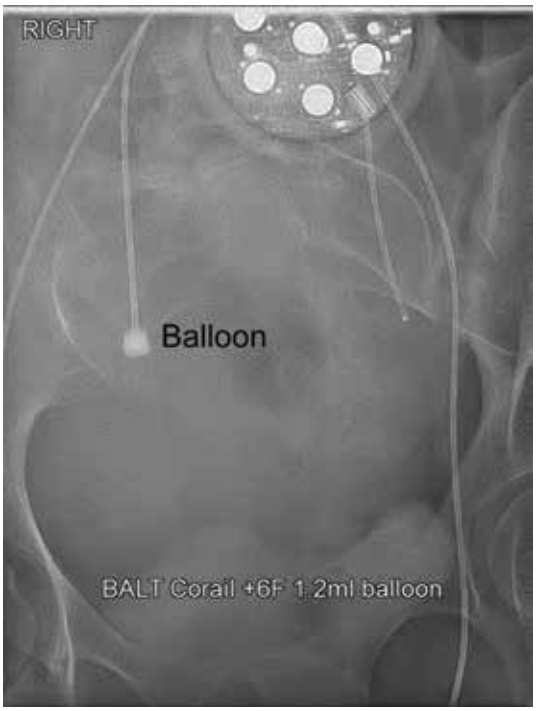

Figure 2. Balloon in uterine artery test inflation pre delivery.

renders valves in the ovarian veins incompetent. The valvular incompetence allows retrograde flow in the pelvic veins and, over time, causes development of varicosities. Imaging reveals tortuous pelvic veins of wide diameter (greater than 5mm) often with collateral flow, and there is often evidence of retrograde flow with Valsalva. There is often associated pelvic floor venous incompetence and a history of vulval and inner-thigh varicosities and/or recurrent leg varicosities is common.

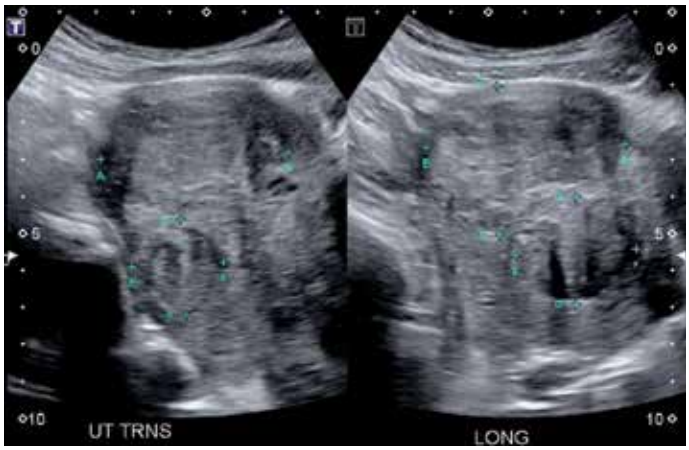

Figure 3. Ultrasound of fibroids.

The use of pelvic vein embolisation is a very effect and minimally invasive treatment for pelvic venous congestion. The left ovarian vein is incompetent most commonly, but occasionally both gonadal veins are involved. The procedure involves catheterisation of the affected gonadal vein down to the level of the uterus and occluding the full length of the vein and any parallel channels with fibred metal MRI compatible coils and foamed sclerosant. Venous access from the common femoral or the jugular vein allows both diagnosis and treatment. Complications of the procedure are relatively rare and include non-target embolisation (for example, losing a coil to the pulmonary circulation), vein perforation, thrombophlebitis in the veins, and recurrence of the varices.

Embolisation of fibroids

Benign leiomyomas, or fibroids, are very common and a uterine artery embolisation (UAE) has been shown to have a role in

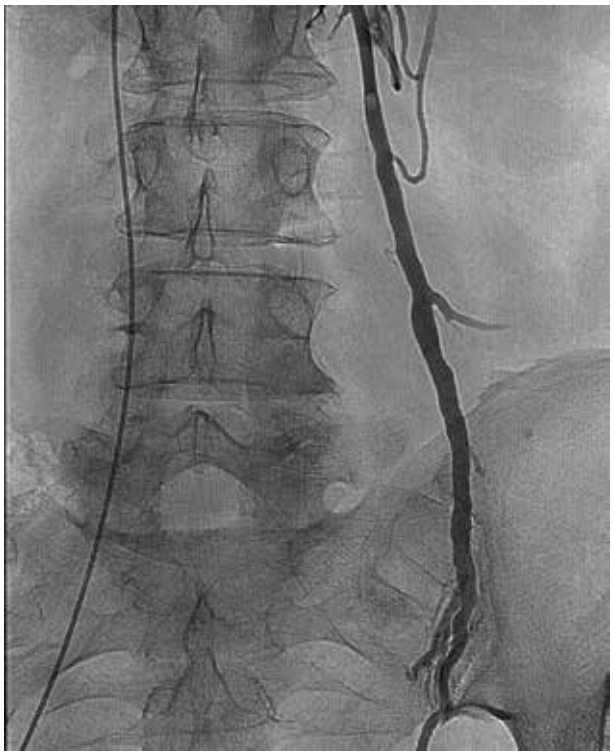

Figure 4. Angiogram showing left ovarian vein (LOV) reflux.

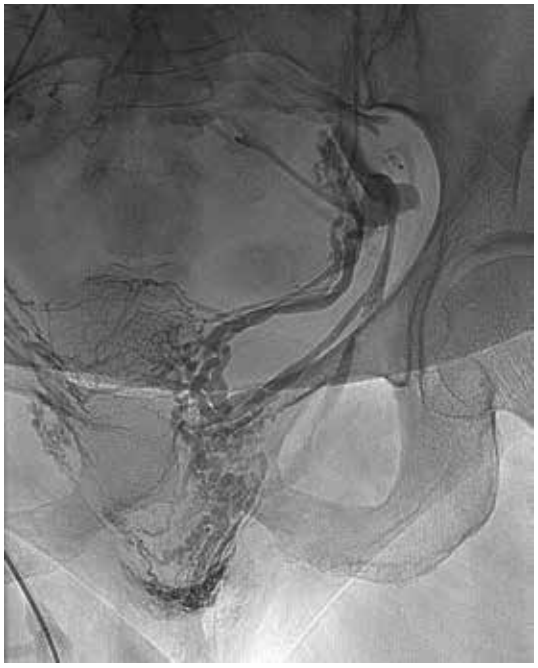

Figure 5. Reflux down LOV into peri-uterine plexus into vulva (varicose veins).

management. The advantages of UAE are reduced morbidity, compared to surgical treatments, and more rapid recovery. The technique is particularly useful for women unwilling to undergo surgery, or those who have co-morbidities that place them at particular risk for operative complications.

While fibroids are common peri- and postmenopausally, younger premenopausal women commonly develop fibroids. The technique was initially developed as a preoperative adjunct before planned myomectomy, to reduce intraoperative blood loss. However, many patients had such a good result from the UAE along that the surgery was no longer necessary. MRI provides a good method of selecting women likely to have a good result from embolisation treatment. A strong response on T2-weighted MR images predicts a good response to embolisation, whereas fibroids with a pre-existing poor blood supply and incipient necrosis show prominently on T1-weighted MR images and are likely to respond poorly to embolisation as their vascular supply is compromised already.

In a small proportion of women, the fundal portion of the uterus receives its blood supply from the ovarian vessels. The reverse is true too, and a small proportion of women will derive their ovarian blood supply from the uterine artery and not the ovarian artery. These are important considerations when considering UAE as a treatment for fibroids. The ideal patient for UAE is a premenopausal woman with menorrhagia, and it is important to rule out other conditions associated with heavy bleeding such as endometrial polyps, hyperplasia or carcinoma, and leiomyosarcoma. The effect of UAE on fertility and the course of subsequent pregnancy is not well-established, so women who wish to preserve fertility need to be very carefully counselled. The risk of the procedure inducing menopause is low, but this is an important potential complication and needs to be discussed.

There is extensive collateral flow within the myometrium and, for this reason, bilateral UAE is usually required to achieve fibroid infarction – the aim being to use the higher metabolic rate of fibroids relative to uterine muscle to result into infarction of the fibroids alone. Bilateral uterine artery catheterisation is usually achieved using a single right femoral vein approach and a size 4 or 5 French gauge catheter. Owing to the potential for arterial spasm, microcatheters are usually used to access the uterine arteries. Embolic materials must be large enough to allow small vessel collateralisation from cervical and other branches to preserve the uterine muscle and embolisation must be complete enough to deprive the fibroids of oxygen and cause infarction. PVA particles and Gelfoam were typically used when UAE was first described, but newer hydrophilic particles that reduce the risk of aggregation and allow smoother delivery are now commonly used. Assessing the degree of embolisation takes some experience and is often a matter of individual judgement.

Pain is the major acute management issue and typically begins within at the end of the procedure when uterine ischaemia is maximal, but this acute phase subsides in 12–24 hours of the procedure. This acute phase is managed by intravenous opioids, paracetamol and NSAIDs. Many institutions use a presacral block at the time of the procedure to manage this acute phase and this often obviates the need for narcotics. The routine use of antibiotics is not usually employed. Pain may continue for five to ten days after the acute phase and is managed by NSAIDs, paracetamol and oral narcotics for breakthrough episodes. A postembolisation syndrome is described with pain, fever, and a raised white cell count. This syndrome may affect as many as one-third of patients undergoing the procedure.

Complication rates from UAE for fibroids are low, although very rarely death has been reported. The potential causes of death are pulmonary embolus and infection, but the rates of complications are less than those for hysterectomy for benign disease. Non-target embolisation is largely precluded by taking microcatheters into the uterus, but damage to the ovary, resulting in premature

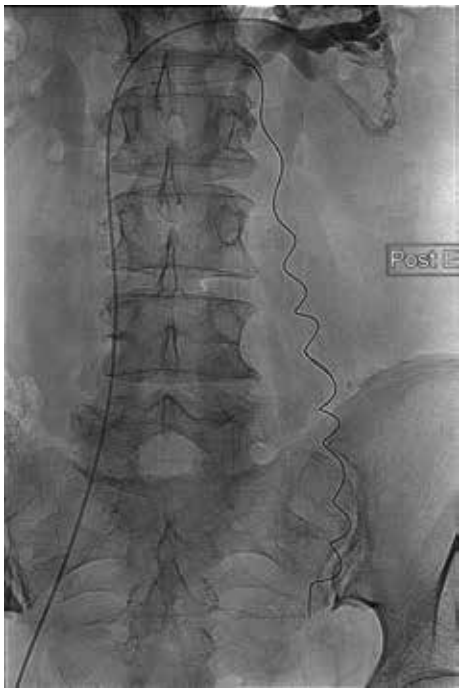

Figure 6. Embolisation of incompetent LOV for treatment of pelvic congestion and vulval varicose veins.

menopause, and damage to other organs can occasionally cause serious harm. Catheter complications are uncommon in experienced hands. The very rare transcervical expulsion of the fibroid can be a surprise for the patient and so warning should be given. The necrotic fibroid tissue can become infected occasionally necessitating hysterectomy, but this occurs very rarely.

The results of UAE are good with appropriate patient selection and an experienced interventional radiologist. Technical occlusion can be achieved in more than 90 per cent of cases, with arterial spasm or inability to access the uterine arteries as causes of failure. Symptoms of menorrhagia are often ameliorated quickly, but bulk symptoms with larger fibroids may take many months to resolve. Reduction in the size of the fibroids is achieved in the majority of cases. Failure to resolve symptoms may be owing to many factors, but if incomplete embolisation is suspected this is best assessed by contrast-enhanced MRI, which will clearly record the size, vascularity and position of fibroids.

Postoperative haemorrhage

Haemorrhagic complications of pelvic surgery are uncommon, but can be difficult to manage. Like many other types of intra-abdominal surgery, there is potential for delayed bleeding and management of women with a significant haemoperitoneum following procedures such as hysterectomy can be challenging. More recently, the use of mesh support in pelvic floor reconstruction and prolapse surgery has added an element of complexity to control of postoperative bleeding. Bleeding is this setting commonly has a large extraperitoneal component and even at laparotomy it can be very difficult to identify points of haemorrhage. As well, the repeat anaesthesia and surgery exposes a compromised patient to further risk. CT and angiography have allowed precise identification of bleeding vessels with embolisation of arterial bleeding providing a non-invasive approach for control.

CT is an essential tool for pre-intervention assessment of the bleeding postoperative patient, establishing that active bleeding is still occurring and in detailing the anatomy of the vessels involved. Angiography from a femoral approach will identify the bleeding vessel by the extravasation of contrast material. Using coaxial guiding and microcatheters the bleeding vessel is catheterised and then occluded with microcoils, glue or other embolic material. Embolisation aims to stop or reduce the rate of extravasation, allowing the normal physiologic haemostatic mechanisms – vasospasm and clotting – to come into play. Endovascular techniques can stop bleeding and help reduce tissue ischaemia and, in many cases, prevent secondary exploratory laparotomy. Complications are uncommon, but include non-target embolisation, for example gluteal ischaemia from the embolic material moving into the posterior division of the internal iliac artery. Pain and transient fever may also occur, but these are often difficult to distinguish from the postoperative course of the operation itself. The femoral access site can also bruise and requires pressure and avoidance of leg flexion for a few hours.

Conclusion

In obstetrics and gynaecology, endovascular procedures are well-established and safe, offering minimally-invasive management options in obstetric settings such as peri-operative care during caesarean section for placenta accreta and postpartum haemorrhage. The gynaecologist may also consider uterine artery embolisation for women with symptomatic uterine fibroids or in management of post-operative haemorrhage. A good working relationship with your interventional radiologist can yield great advantages for women.

Further reading

Dubois J, Garel L, Grignon A, et al. Placenta percreta: balloon occlusion and embolization of the internal iliac arteries to reduce intraoperative blood losses. *Am J Obstet Gynecol.* 1997; 176: 723-6.
Teixidor Vinas M, Chandraharan E, Moneta MV, Belli AM. The role of interventional radiology in reducing haehorrhage and hysterectomy following caesarean section for morbidly adherent placenta. *Clin Radiol.* 2014; 69: e345-51.
Lopera J, Suri R, Kroma GM. Role of interventional procedures in obstetrics and gynaecology. *Radiol Clin N Amer.* 2013; 51: 1049-66.
Muffly TM, Paraiso M, Gill AS, et al. Interventional radiologic treatment of pelvic haemorrhage after placement of mesh for reconstructive pelvic surgery. *Obstet Gynecol.* 2012; 119: 459-62.
Ananthakrishnan G, Murray L, Ritchie M, et al. Randomized comparison of uterine artery embolization (UAE) with surgical treatment in patients with symptomatic uterine fibroids (REST trial): subanalysis of 5-year MRI findings. *Cardiovasc Intervent Radiol.* 2013; 36: 676-681.

Ouch! Acute pelvic pain

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The role of imaging in the diagnostic work up of acute pelvic pain.

The initial diagnostic work up of the non-pregnant gynaecological patient with acute abdominal pain includes the taking of a thorough history, a full clinical examination, laboratory tests and imaging.

Differential diagnoses include cyst accident, dysmenorrhea, mittelschmerz, endometriosis, ovarian torsion, pelvic inflammatory disease and tubo-ovarian abscess, fibroid degeneration or torsion, or a non-gynaecological cause, such as appendicitis, constipation, diverticulitis, mesenteric adenitis or urinary tract infection.

Clinicians often request scans with one or more diagnoses in mind based on clinical findings. The role of imaging is to further delineate this differential, guiding management that may range from conservative to medical to surgical.

Ultrasound is usually the modality of choice as it is generally readily available, inexpensive and does not expose the patient to radiation.[1] In some cases, plain x-ray or cross-sectional imaging such as computed tomography (CT) or magnetic resonance imaging (MRI) may also provide further information, or help to delineate ultrasound findings.

Ovarian cyst accident
Cyst accidents refer to the rupture or haemorrhage of physiological cysts. These two conditions are generally benign and self-limiting, and their diagnosis can help to rule out other causes of acute pain and, therefore, avoid unnecessary surgery or further investigation.

Ovarian cysts are common findings on ultrasound scan. Transabdominal (TA) scans can help to characterise large cysts, while transvaginal (TV) probes allow the sonographer to get closer to the ovaries and therefore provide more detail, particularly in regard to delineating a cyst's relationship to the ovary and/or Fallopian tube.[1]

Physiological cysts are typically anechoic with thin, smooth walls and posterior acoustic enhancement.[2] Cyst rupture may be characterised by the presence of anechoic free pelvic fluid with or without a simple cyst. With haemorrhagic cyst rupture fluid is more complex, appearing echogenic, with mobile debris.

The appearances of haemorrhagic cysts vary depending on their acuity. A fresh haemorrhage will demonstrate low level, uniform echoes that over time organise and demonstrate septations and/or a retracted echogenic clot.[1,2]

As ultrasound is a dynamic technique, probe tenderness may localise pain to pathology.

Ovarian cysts (particularly large cysts) are commonly seen in cases of ovarian torsion and it is important to attempt to rule this out in the presence of acute pain. This is discussed further below.

Endometrioma
Endometrioma classically appear as lesions with homogenous, low-level internal echoes (see Figure 1). They can be multi-loculated. Hyperechoic wall foci, which appear as small 'dots' on ultrasound, are highly specific but not common.[2] In practice, endometrioma are difficult to distinguish from haemorrhagic cysts. Bilateral lesions are more likely to be endometrioma. If unsure as to whether the cyst is an endometrioma or an acute haemorrhagic cyst, a follow-up scan in six weeks will usually demonstrate resolution of a haemorrhagic cyst or persistence of an endometrioma.

If endometriosis is suspected as the cause of acute pelvic pain, ultrasound can be used to assess for endometrioma, but is insensitive for the detection of endometrial implants. Therefore, MRI is the imaging modality of choice for the detection of these endometrial deposits.

Ovarian torsion
Ovarian torsion is a gynaecological emergency that requires prompt surgical treatment. It is notoriously difficult to diagnose, with symptoms and signs varying markedly between patients.[3]

Ovarian torsion on greyscale ultrasound is associated with enlarged ovaries that may be hyper- or hypoechoic, with enlarged, peripherally displaced follicles, owing to increased interstitial pressure and impaired lymphatic and venous drainage[4] (see Figure 2). This increase in pressure also causes the release of transudate, which is seen as anechoic pelvic free fluid. Ovarian torsion is more common in the presence of ovarian cysts, particularly those greater than 5cm in diameter.[4]

A twisted vascular pedicle is diagnostic when present. This is seen as a round, anechoic structure with multiple concentric echoic stripes.[4]

Colour-flow Doppler is useful (see Figure 2). Absent arterial and/or venous flow is strongly suggestive of torsion, particularly when associated with some or all of the above findings. Flow may also be seen to be present, but abnormal when compared to the contralateral ovary.[4] Cases of intermittent torsion are common and ovarian torsion cannot be ruled out even when normal flow is documented.

Tubo-ovarian abscess
Pelvic inflammatory disease (PID) is a clinical diagnosis and may be associated with a normal pelvic ultrasound scan.[5] PID may be supported by visualisation of hydrosalpinges (fluid filled structures adjacent to the uterus), free fluid or enlarged ovaries.[5]

Tubo-ovarian abscesses (TOA) are seen on ultrasound as multiloculated complex masses with internal debris, septations, irregular thick walls and increased vascularity. They are often bilateral and tender to probe pressure. The ovaries and Fallopian tubes are often difficult to distinguish separately, with the normal tissue boundaries between the two structures becoming indiscernible, owing to purulent material, oedema and inflammation.[1]

Ultrasound may demonstrate a pyosalpinx as a thickened, distended tube, and a 'cogwheel sign' may be noted[1,5] (see Figure 3). This describes the appearance of a serpinginous tubular structure filled with echogenic fluid. The cogwheel appearance is owing to prominent endosalpingeal folds. By contrast, a hydrosalpinx is filled with anechoic (in other words, simple) fluid.

Fibroid degeneration or torsion

Fibroids are common in reproductive age women and may occasionally cause acute pain, owing to degeneration or torsion, particularly if pedunculated. Ultrasound is the initial radiological modality of choice. Fibroids appear on imaging as well defined hypoechoic solid lesions arising from or within the myometrium. On colour Doppler, they are relatively avascular when compared to the surrounding myometrium.[6]

Degeneration or torsion is suggested if the pain is reproducible by probe pressure over the fibroid. Degenerating fibroids have a more complex heterogenous appearance. Anechoic or hypoechoic cystic spaces within the fibroid are suggestive of haemorrhagic/carneous and cystic degeneration.[6] Calcification is also a feature.

Large fibroids rarely can cause bowel obstruction or hydronephrosis secondary to mass effect.[13] The role of MRI is to further define and more accurately characterise fibroids, particularly those in difficult locations.[6]

Non-gynaecological causes of pelvic pain

Appendicitis

Appendicitis generally presents with right iliac fossa pain. Specific adnexal tenderness may be present if the appendix is orientated so that its tip is in the pelvis.[7] Likewise, reactive pelvic or peritoneal inflammation may also cause adnexal tenderness.

On ultrasound, the appendix is variably seen. In appendicitis, it is most often seen on high-frequency linear transducer TA imaging, particularly using the graded compression technique.[8] Criteria for diagnosis is a distended blind ending tubular structure >6mm in diameter (see Figure 4). There is no peristalsis and it is generally non-compressible.[8] The patient is often tender to focal transducer pressure. An appendicolyth, which obstructs the lumen causing inflammation and pain, may be seen as a well-circumscribed echogenic structure with posterior acoustic shadowing (as they are often calcified).[8]

If the appendix perforates, purulent material can track into the pelvis, appearing as a complex mass separate from the ovary, although it may be difficult to delineate this on ultrasound.

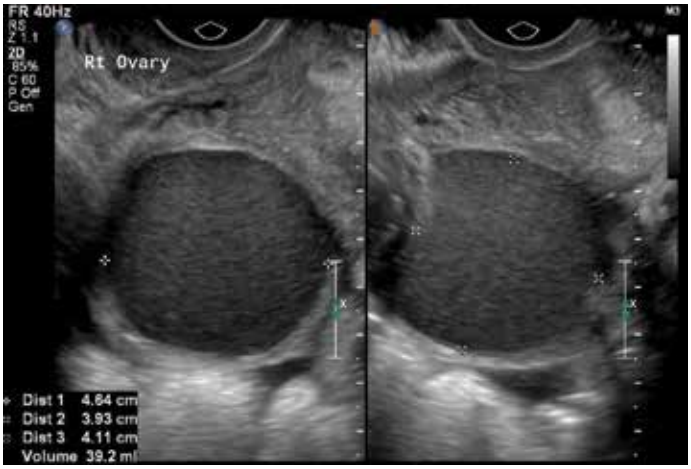

Figure 1. Endometrioma. Transvaginal ultrasound demonstrates a right ovarian lesion with homogeneous low level internal echoes. In this patient, a similar lesion was also present in the contralateral ovary.

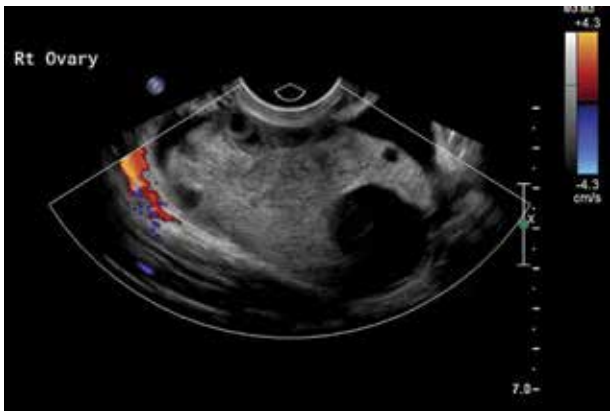

Figure 2. Ovarian torsion. Transvaginal ultrasound image demonstrating an enlarged ovary with peripherally displaced follicles, mild increased central echogenicity and absence of colour flow.

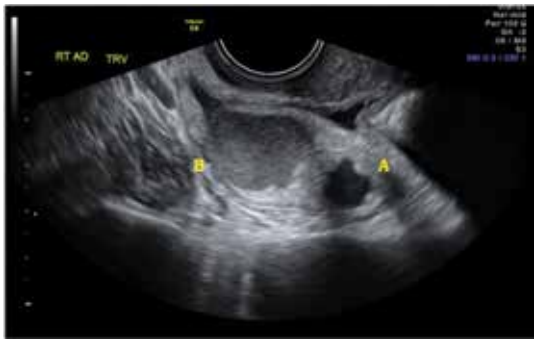

Figure 3. Pyosalpinx with 'cogwheel sign'. Transvaginal ultrasound image demonstrating two adjacent transverse sections of Fallopian tube. Note the central hypoechoic material on right with thickened endosalpingeal folds forming the cogwheel sign (A) and mixed echogenic/purulent material to the left (B).

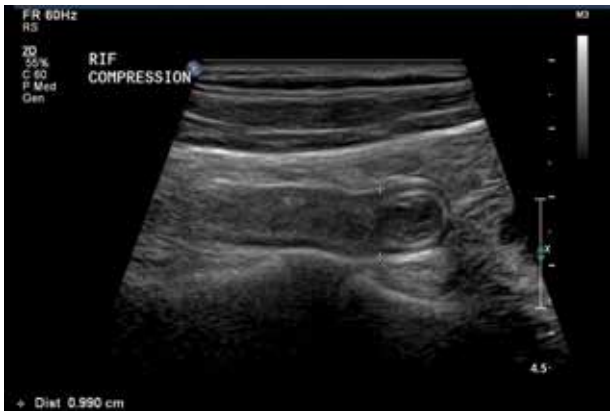

Figure 4. Appendicitis. Note the non-compressible, blind-ending, tubular structure measuring >6mm.

Transvaginal scanning to identify the ovary as separate to this inflammatory mass is beneficial.[8] Soft features, if the appendix is not visualised, include echogenic intraperitoneal fat and enlarged iliocolic or mesenteric lymph nodes.[8]

CT is superior to ultrasound in the diagnosis of acute appendicitis with higher sensitivity and specificity.[9] In patients presenting with atypical appendicitis, such as women with pelvic/lower abdominal pain, ultrasound is often the preferred modality as it is cheaper, radiation free and allows characterisation of pelvic organs.[10]

Diverticulitis

In an older gynaecological patient (usually >40 years) diverticulitis is another differential. These women typically present with left-sided pain. The pain may initially be experienced as pelvic pain, particularly if located in the sigmoid colon, hence referral to gynaecology.[11] Simple diverticulitis is a clinical diagnosis and not seen on ultrasound. CT may demonstrate the presence of a diverticula and thickening of the sigmoid colon, with inflammatory fat stranding surrounding a diverticulum.[12]

Complicated diverticulitis on CT is seen as a pericolic collection, with marked surrounding inflammation and free locules of gas.[12] In severe cases, surrounding structures such as the visceral peritoneum and ovaries may also become inflamed. Abscesses associated with diverticulitis may track into the pelvis and are differentiated from a TOA due to the visualisation of the ovary separate to the collection.

Mesenteric adenitis

Mesenteric adenitis is a diagnosis most commonly found in children, but may present in adolescents as right iliac fossa pain and therefore be referred initially to gynaecology. Ultrasound or CT demonstrates multiple (more than three) enlarged ileocolic lymph nodes with echogenic fat on ultrasound or fat stranding on CT. A normal appendix and absence of other pathology in the presence of nodal enlargement and pain is often diagnostic.[13]

Summary

This article has described the various images associated with common gynaecological and non-gynaecological causes of acute pelvic pain. Knowledge of these appearances can help the gynaecologist perform and interpret scans and, in conjunction with history, examination and laboratory testing, aid in accurate diagnosis and treatment of our population.

References

1 Lambert MJ, Villa M. Gynecologic Ultrasound in Emergency Medicine. *Emerg Med Clin N Am* 2004;22:683-696.
2 Jeong YY et al. Imaging Evaluation of Ovarian Masses. *RadioGraphics* 2000;20:1445-1470.
3 Houry D, Abbott J. Ovarian torsion: A fifteen-year review. *Annals of Emergency Medicine* 2001;38:156-159.
4 Albayram F, Hamper UM. Ovarian and Adnexal Torsion. *J Ultrasound Med* 2001;20:1083-1089.
5 Lareau SM, Beigi RH, Pelvic Inflammatory Disease and Tubo-ovarian Abscess. *Infect Dis Clin N Am* 2008;22:693-708.
6 Wilde S, Scott-Barrett S, Radiological appearances of uterine fibroids. *Indian J Radiol Imaging* 2009;19(3):222-231.
7 Hardin M, Acute Appendicitis: Review and Update. *Am Fam Physician* 1999;60(7):2027-2034.
8 Kessler N et al. Appendicitis: Evaluation of sensitivity, specificity and predictive values of US, Doppler US and laboratory findings. *Radiology* 2004;230:472-478.
9 Van Randen et al, A comparison of the Accuracy of Ultrasound and Computed Tomography in common diagnoses causing acute abdominal pain. *Eur Radiol.* 2011; 21(7): 1535-1545.
10 Lameris et al, Imaging strategies for detection of urgent conditions in patients with acute abdominal pain: diagnostic accuracy study. *BMJ* 2009;338:2431.
11 Jacobs DO, Diverticulitis. N Engl J Med 2007;357:2057-2066
12 Lameris et al, Graded compression ultrasonography and comuted tomography in acute colonic diverticulitis: Meta-analysis of test accuracy. *Eur Radiol* 2008;18:2498-2511.
13 Rao PM et al, CT diagnosis of mesenteric adenitis. *Radiology* 1997;202(1):145-149.

More than the mammogram

An overview of screening and diagnostic breast imaging in Australia.

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There are standard guidelines for population screening for breast cancer. Since its introduction, 'BreastScreen Australia has had a major impact in moderating an increasing incidence trend and in contributing to falling mortality in breast cancer.' (Australian Institute of Health and Welfare report, 2014).

With the decline in mortality, thought to be thanks to a combination of early detection from the national screening program and continued improvements in treatment, breast cancer is now considered a chronic disease rather than one of mortality.

Incidence and risk factors

Breast cancer is the most common type of cancer in Australian women, with an incidence of 27 per cent. One in eight Australian women will be diagnosed with breast cancer by the time they turn 85. The average age at diagnosis is 62 years old. Approximately 75 per cent of the women diagnosed are over the age of 50; of the remainder, the majority are aged between 40 and 50 years old. Breast Cancer Network Australia (BCNA) estimated that in 2014, 15 270 women would be diagnosed with breast cancer, which translates to approximately 42 women being diagnosed each day in 2014.

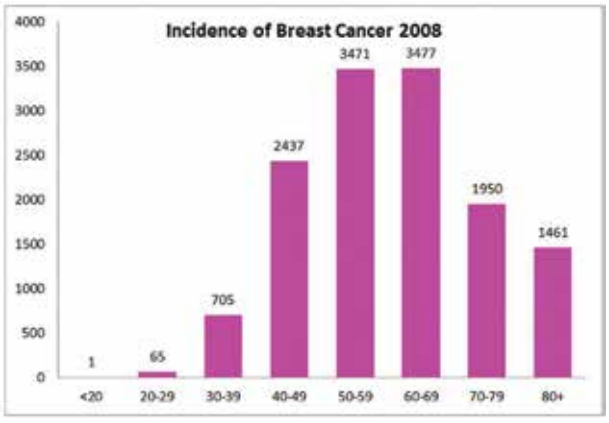

Figure 1. The incidence of breast cancer in 2008.

Known risk factors include the following: increasing age, family history, obesity, alcohol consumption, hormone-replacement therapy, no children or children after 35, no breastfeeding, early onset menarche and late onset menopause.

Recommendations for screening

Currently, the recommended national guidelines in Australia are for biennial screening 2D mammogram for asymptomatic women in the target age group of 50–74 years old (recently expanded to 74 years old, previous invitation to attend screening included 50–69 year olds).

The age at which a woman should commence with screening will depend upon her risk factors. Typically, it is considered appropriate to commence five to ten years before the age of diagnosis of a first-degree relative with breast cancer, or 50 years old, whichever is earliest. However, as 25 per cent of breast cancers occur in the under-50 age group, many women may wish to consider biennial screening from 40 years old.

> 'Breast cancer is the most common type of cancer in Australian women...One in eight Australian women will be diagnosed with breast cancer by the time they turn 85.'

The benefit of screening in this younger age group is somewhat contentious; as it is believed that biennial screening is not frequent enough given the tumour biology is typically of higher grade and thus faster growing for the two-year time interval to be of benefit.

In the UK, screening is offered from 45 years old and this is currently under consideration in Australia. The current guidelines in Australia are that a woman may attend the national BreastScreen program between 40 and 49 years old or beyond 74 years old; however, this is by patient request rather than direct invitation.

Many women lie outside the low-risk group, either owing to family history of breast or ovarian cancer, personal risk factors such as a past history of atypia on biopsy, personal history of breast cancer or having mammographic dense BIRADS 4(D) breasts.

Depending upon these factors, a woman will be classified as being at either moderate or strong risk and, accordingly, may require annual rather than biennial screening mammograms, annual breast magnetic resonance imaging (MRI) and annual clinical review with a breast examination by a breast surgeon or breast physician.

Diagnostic mammography

Women with symptoms such as a lump, nipple discharge, skin changes or new symptoms should be assessed with a diagnostic mammogram +/- supplemental ultrasound and not in a population screening program.

The distinguishing factor between screening and diagnostic imaging is that standard 4 MMG views are taken in screening. Whereas if a patient has a symptom then diagnostic views will often involve

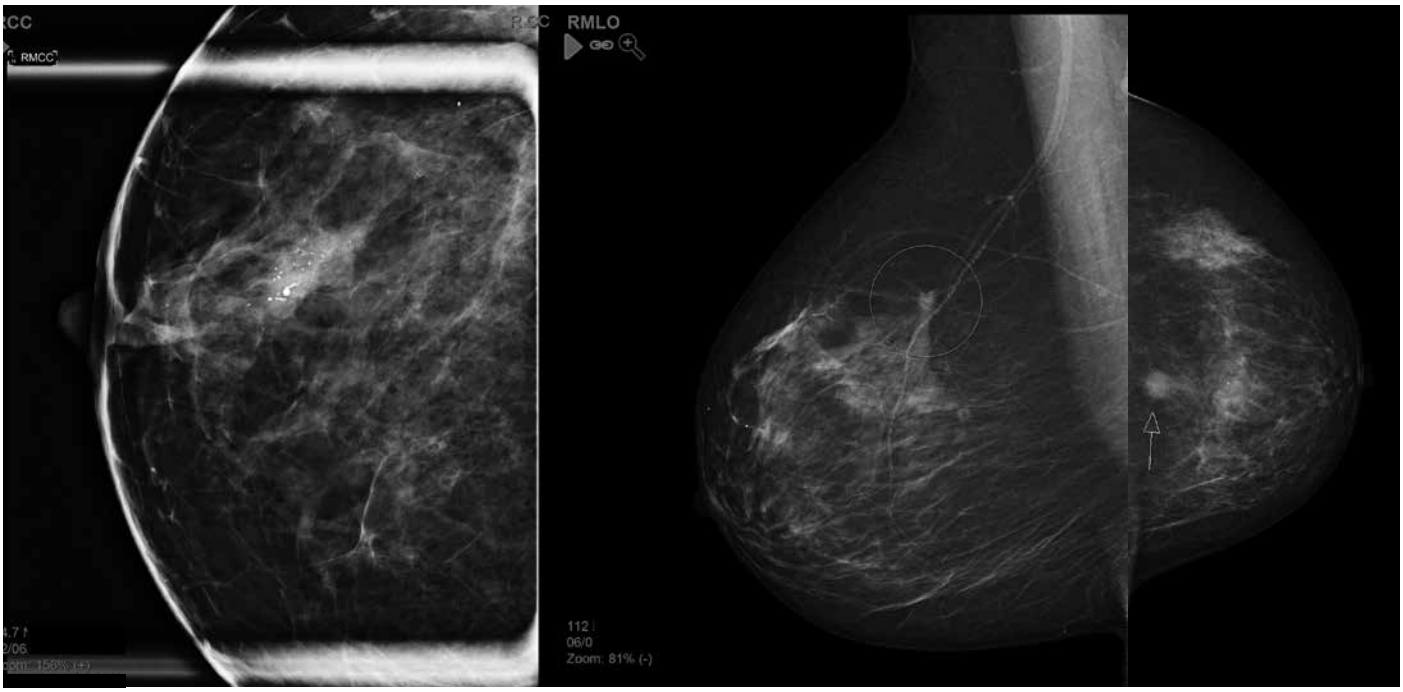

Figure 2. Examples of mammographic abnormalities. Left to right: a. casting calcifications – high-grade ductal carcinoma in situ; b. stellate – carcinoma; c. mass – carcinoma.

additional spot or localised compression to the area of concern and assessment in person by a radiologist, including other imaging such as tomosynthesis, ultrasound or recommendation for MRI. Symptomatic woman are therefore assessed outside of screening programs, either in the private radiology firms, breast clinics or public hospital breast centres.

Mammographic density classification

Research by Boyd has shown that there is an association between mammographic density and breast cancer risk. Based upon the American College of Radiology Mammographic BIRADS 5 Atlas grading score of 'A, B, C, D', where 'A' is fatty replaced breast tissue and 'D' is extremely dense, the latter is associated with an increased risk of breast cancer of four-to-six fold. This replaces the previous classification of BIRADS 1,2,3,4, which referred to quartile percentages of mammographic density.

This is a dilemma for standard mammography because, as the risk of cancer increases with mammographic density, the sensitivity of detecting the cancers on the mammogram decreases, since the cancers are hidden or camouflaged by the dense breast tissue that surrounds them. With the knowledge of risk association with mammographic density, and as an indicator of sensitivity of mammography, there is increasingly more demand for the patient and referring doctor to be informed of the mammographic density.

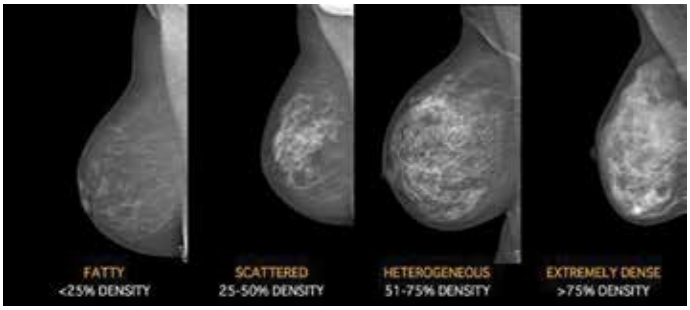

Figure 3. Representative Mammogram examples of BIRADS mammography density: BIRADS A – the breasts are almost entirely fatty; BIRADS B – there are scattered areas of fibroglandular density; BIRADS C – the breasts are heterogeneously dense, which may obscure small masses; BIRADS D – the breasts are extremely dense, which lowers the sensitivity of mammography.

Mammographic density can be assessed by subjective means, based upon the 2D mammogram, or by computer software programs as a volumetric measurement of per cent of breast density. The computer software programs assess the density using 3D imaging, which is automatically generated by the software program once the mammogram images have been taken. The ramifications of mammographic density are evolving and guidelines are, as yet, not available on when and what supplemental screening should be instituted. The available options are ultrasound, tomosynthesis and MRI, but the availability is dependant on the breast service, whether it is in the private or public system. The national screening programs do not currently have tomosynthesis or MRI.

Digital breast tomosynthesis

Standard 2D mammography has inherent limitations. It displays a 3D volume of breast tissue as a 2D image, and so two orthogonal views of each breast are standard practice. Despite this, standard 2D mammography has limitations with composite or summation shadow effects, and this is most pronounced in mammographic dense breasts.

The limitation of mammography is owing to the minimal differences in soft tissue densities between the components and structures that make up breast tissue. Cancers are typically of similar density and thus mammography relies on identifying subtle differences in density and architectural distortion in order to detect the cancer.

With standard 2D mammography, it is not uncommon to require additional spot coned compression views in an attempt to

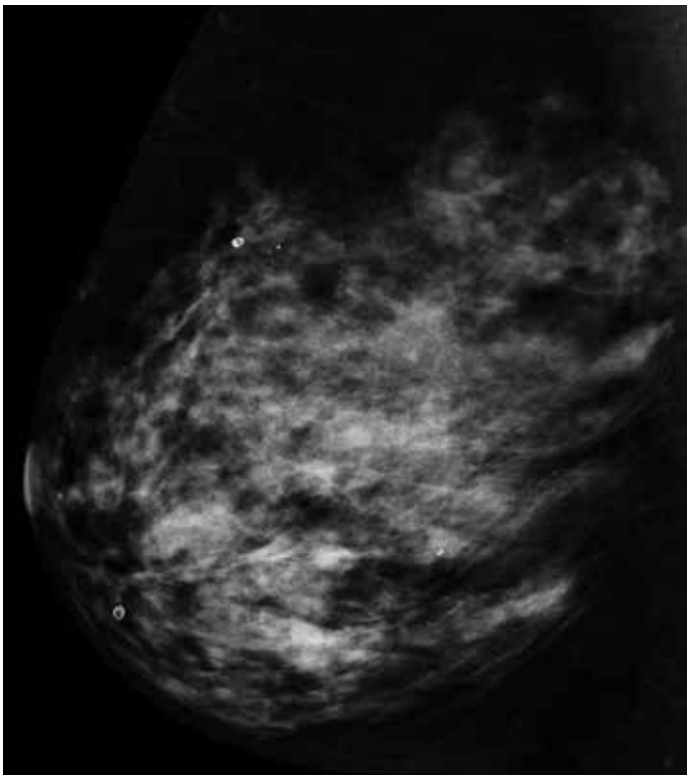

Figure 4a. Example of BIRADS D mammography density, no abnormality perceived on standard 2D mammogram or ultrasound. BIRADS D - The breasts are extremely dense, which lowers the sensitivity of mammography.

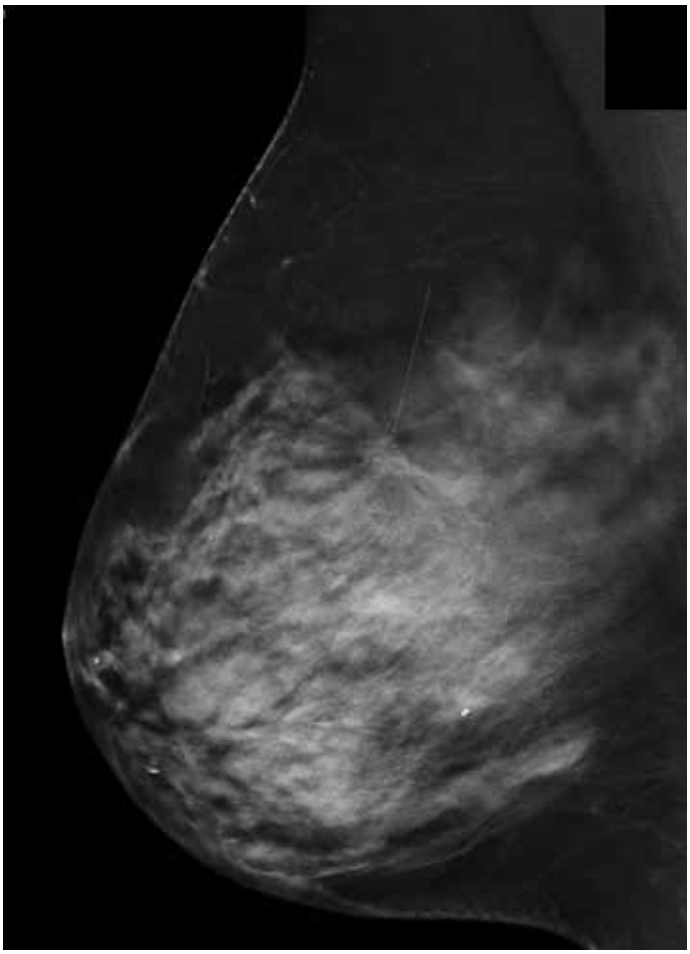

Figure 4b. Tomosynthesis MLO image of breast shown in 4a) reveals small stellate lesion with architectural distortion.

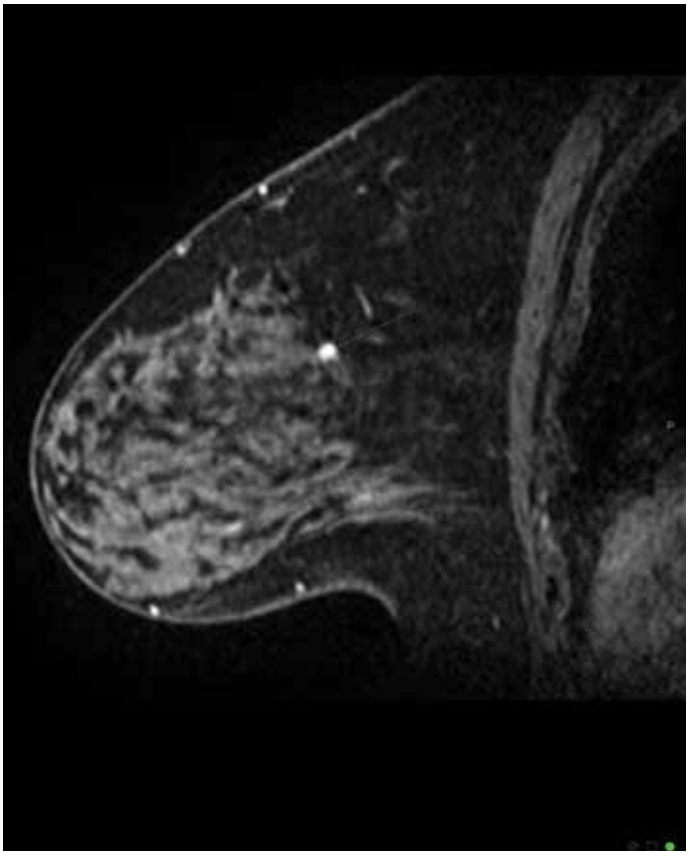

Figure 4c. MRI Magnetic Resonance Imaging sagittal view of breast shown in 4a. and b. confirms highly suspicious lesion – histopathology 12mm invasive ductal carcinoma grade 2.

determine if the apparent or real mammographic density is owing to a superimposition/summation shadow effect or indeed a real lesion, such as a cancer. The result of the compression view is to reduce overlying tissue effects and accentuate the contrast of the breast components.

Digital breast tomosynthesis (DBT) is an advanced application of digital technology. It has been developed to attempt to overcome some of the limitations of standard 2D digital mammography. Following the results of numerous trials, the implementation of tomosynthesis is gaining momentum, as a potential replacement of standard 2D mammography for screening as well as assessment of breast tissue. DBT involves a series of low dose x-rays of the breast, obtained at varied angles, creating a data set of images and a 3D mammogram. The benefit of DBT is the reduction in the overlapping tissue, superimposition and masking effect of traditional mammography.

Studies have shown that DBT:

- increases cancer detection;
- reduces recall rates for superimposition of breast tissue;
- reduces false positive rates;
- reduces the need for extra spot compression mammography; and
- reduces the need for ultrasound.

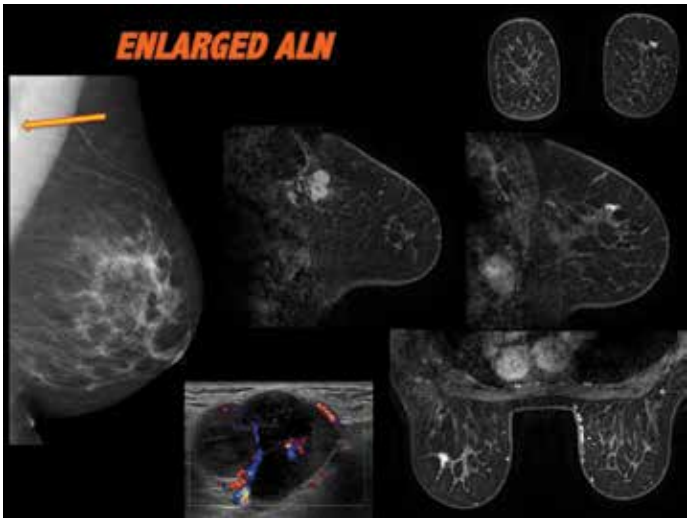

Figure 5. BIRADS B mammographic density, standard 2D MMG reveals abnormal left axillary lymph node, which appears of matted nodal mass configuration on ultrasound. Malignant on fine needle biopsy, suggestive of breast primary origin. No breast abnormality perceived on mammogram or ultrasound. MRI reveals small stellate left breast upper outer quadrant, confirmed as malignant on biopsy. Outcome: 17mm invasive lobular carcinoma grade 2 & LCIS, ER/PR +, 20/20 LN positive.

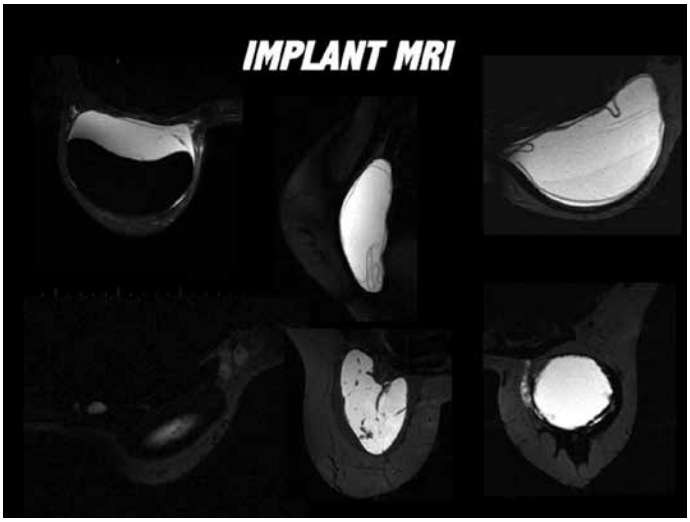

Figure 6. Examples of application of MRI evaluation of implants: a. top left – peri-implant space abacteraemic collection, implant intact; b. middle top – fully collapsed intra capsular rupture, 'linguine sign'; c. top right – dual gel silicone, minimally collapsed intracapsular rupture; d. bottom left – silicone adenopathy in axillary and internal mammary chain nodes; e. middle bottom – Poly Implant Prosthesis rupture, 'fracture pattern'; f. bottom right – extra capsular rupture.

Breast MRI

MRI is used widely for screening high-risk women and for the staging of breast cancer. The risk for breast cancer is variable and complex and, as such, some patients with certain risk factors may benefit from this form of supplemental screening. The most common group to benefit from screening MRI is women with a strong family history and gene carriers. Breast MRI is the most sensitive test available for detecting breast cancer. It does not, however, replace a mammogram, but rather is a supplement to it. The main advantage of MRI is that it is independent of breast density, unlike standard 2D mammography where the sensitivity of cancer detection reduces as mammographic density increases. It does not use ionising radiation, nor involve compression of the breast as in 2D mammography and DBT.

MRI uses principles of high spatial and temporal resolution and tumour angiogenesis. High spatial resolution allows detection of small cancers <5mm and improved characterisation of lesion morphology. To achieve this a strong magnet and high channel coil are required. High temporal resolution allows more accurate lesion kinetics, which is the evaluation of the tumour angiogenesis. Cancers release angiogenesis factor that promotes the growth of new blood vessels around tumour. These vessels are abnormal, demonstrate arterio-venous shunting and are 'leaky vessels', which show a kinetics pattern of rapid enhancement following gadolinium contrast injection.

One disadvantage of MRI is the time taken to perform the study is typically 25 minutes and requires the injection of intravenous contrast (gadolinium).

MRI is available for breast cancer screening to all women who are eligible under the Medicare guidelines and may be referred by a specialist. For those women who are not rebatable and who may still benefit from an MRI, the study may be referred by a general practitioner or specialist, as appropriate, and will be an out-of-pocket expense for the patient.

There are a number of indications where MRI may be considered that are currently not covered by the guidelines. These include: staging of breast cancer; mammographic dense breasts; moderate risk factors – family history (those not eligible for rebate), past atypia on biopsy, lobular carcinoma in situ; malignant axillary node with normal mammogram; neo-adjuvant therapy response; and unexplained symptoms.

Implant MRI

Many women have breast augmentation, either for cosmetic or reconstructive reasons. Ultrasound assessment of implant integrity is significantly limited by the ability of the sound waves to penetrate the anatomical boundaries that surround the implant and the consistency of the implant gel. Implant MRI is the gold standard in evaluating implant integrity. It allows for assessment of rupture, gel bleed phenomenon or rejection response. It is not a cancer screening study and does not involve intravenous injection.

Further reading

Boyd, N et al. Mammographic Density and the Risk and Detection of Breast Cancer: *N Engl J Med*. 2007;356:227-236.
Skaane et al. Comparison of Digital Mammography Alone and Digital Mammography Plus Tomosynthesis in a Population-based Screening Program. *Radiology*. Volume 267: Number 1 April 2013.
Houssami, N; STORM, a new dimension for mammography screening: Evidence of improved detection using integrated 2D and 3D mammography provides opportunity for Australia to lead screening trials. *MJA*. 2013;199(5)2.
Lockie, D et al; Evaluation of Digital Breast Tomosynthesis (DBT) in a Breast Screen assessment service. *Journal of Medical Radiation Sciences*. Volume 61, Issue Supplement S1, pages 63–112, Sept 2014.
Breast MRI Medicare Guidelines in Australia: www.health.gov.au/internet/main/publishing.nsf/Content/pathol-di-mri-breastmriqa .

Case reports

Endometriosis in a caesarean section scar

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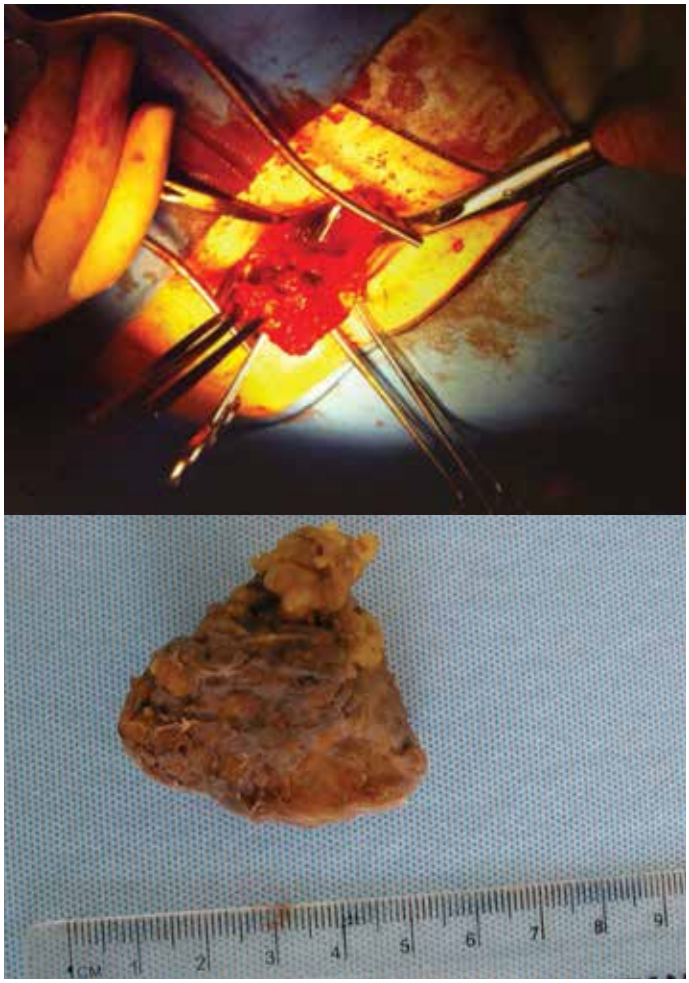
Case report
A 30-year-old woman presented to the gynaecology clinic with a painful lump in the right-hand side of a five-year-old caesarean section scar. She had first noticed this lump 18 months before, when at the gym, and since then she had felt that it had grown slightly in size and become increasingly painful. She described this pain as an ache that was worse at the time of her period. She had regular periods and at the time of the clinic was on day 23 of her cycle. She had had two previous pregnancies: one normal delivery seven years ago and one elective caesarean section five years ago for a breech presentation. She had no other gynaecological history, had had regular smears, all of which were normal. She had no relevant medical or surgical history, no relevant family history. She was a non-smoker and drank alcohol socially.

On examination, her abdomen appeared normal with a Pfannensteil scar noted. There was no obvious mass seen. On palpation her abdomen was soft and non-tender. There was a lumpy mass felt under the right lateral edge of the scar, which was irregular in nature, soft, non-tender and immobile. An MRI scan showed a 3x2.5x2cm mass anterior to the right rectus muscle indicative of scar tissue or inflammatory in nature. A biopsy was suggested to confirm the nature of the mass.

The patient was taken to theatre to perform an excision of the lump. The lump removed was 4x5cm diameter (see Figures 1–2) and, although tethered to the underlying muscle, there was no continuity with the abdominal cavity. The lump appeared to be mainly fatty tissue on initial inspection, although it was noticed that several small bluish/black dots appeared on the lump. The whole lump was excised with some surrounding fatty tissue and sent for histology. There were no postoperative complications and the patient returned home the same day. The histology report showed that the lump was benign in nature and contained endometriosis.

Discussion
Endometriosis is the presence of endometrial tissue outside the uterus and can be seen in intra- and extra-abdominal locations. Extra-pelvic endometriosis is rare, but there are reports of endometriosis in almost all locations, including kidneys, lungs and the central nervous system.[1] Previous reports of endometriosis in caesarean section scars have reported the incidence as between 0.03 and 0.4 per cent.[4] A study by Akbulut et al in 2010 reported the incidence as 0.1 per cent of women who undergo a caesarean section – a rare complication of this surgery. These lumps are often misdiagnosed when they first present, as a lipoma, abscess, suture granuloma, cyst or haematoma.



Figures 1–2. Excising the caesarean section scar lump.

The patient in the above case report presented with the typical symptoms seen in cases of scar endometriosis: a palpable mass and cyclical pain. However, it should be noted that in several studies more than half of the presentations have been non-cyclical pain.

The development of this mass of ectopic endometrial tissue in the surgical scar is most likely explained by dissemination of the endometrium or from pre-existing intraperitoneal endometriosis.[2] In this patient's case there was no known history of endometriosis so it is likely that this was caused by seeding of endometrial tissue during the caesarean section. Contamination of the wound with endometrial tissue is likely to occur often and is sometimes inevitable[2], but the cases such as the one above are rare. This suggests that there is some predisposition to the development of scar endometriosis. It is worth noting the length of time (three-and-a-half years) before symptoms became apparent. This is likely because the endometrial tissue must grow to a size large enough to cause symptoms. Other case reports have published intervals of between six months to 20 years.[3]

Although a rare event, malignant transformation of abdominal wall endometriosis is a possibility.[1] A case study by Stevens et al suggested that endometriosis in a caesarean scar can transform into metastatic adenocarcinoma.[6] Therefore, wide excision with at least 1cm margin is considered the treatment of choice, even for recurrent lesions. The MRI scan and subsequent measurements of the lesion excised show that this was achieved in our patient.

Conclusion
Endometriosis should be considered as a diagnosis in a patient presenting with a painful lump in an abdominal scar, particularly

with a history of a caesarean section, even many years after the original surgery. Careful closure and avoidance of contamination (changing gloves, needles before closure) following caesarean section may prevent scar endometriosis.

References

1 Drukala Z, Ciborowska-Zielińska B, Kubrak J, Rodgowska D. Outcome of a multimodal therapy of a recurrent adenocarcinoma arising from Caesarean section scar endometriosis-A case report. *Reports of Practical Oncology and Radiotherapy.* Volume 15, Issue 3, May–June 2010, Pages 75-77.

2 Zhao X, Lang J, Leng J, Sun D, Zhu L. Abdominal Wall Endometriomas. *International Journal of Gynecology and Obstetrics* (2005) 90, 218-222.

3 Roger KE, Shatney CH, Hodge K, McClenathan JH. Surgical scar endometrioma. *Surg Gynecol Obstet* 1993;177:243-6.

4 Nominato S N, Prates L F, Lauar I, Morais J, Maia L, Geber S. Caesarean Section greatly increases the risk of scar endometriosis. *European Journal of Obstetrics & Gynecology and Reproductive Biology* 152 (2010) 83-85.

5 Akbulut S, Sevinc MM, Bakir S, Cakabay B, Sezgin A. Scar endometriosis in the abdominal wall: a predictable condition for experienced surgeons. *Acta Chir Belg.* 2010 May-Jun;110(3):303-7.

6 Stevens EE, Pradhan TS, Chak Y, Lee YC. Malignant transformation of endometriosis in a cesarean section abdominal wall scar: a case report. *J Reprod Med.* 2013 May-Jun;58(5-6): 264-6.

Cardiac arrest during elective c-section

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Introduction

Pulmonary embolism during pregnancy and the postpartum is a rare event, but an important and potentially preventable contributor to maternal mortality in Australia. I report on a near-miss case that highlights the growing challenges of our obstetric population and the shortfalls in evidence guiding practice to avoid the same fate for the next patient.

Case report

A 30-year-old Samoan woman presented to hospital at 37+1 weeks gestation for a planned elective lower segment caesarean section (LSCS) to deliver dichorionic, diamniotic twins. She was gravida 3 para 1 with one previous LSCS. She was morbidly obese with a BMI of 54 at the time of delivery. Her antenatal course had been relatively uncomplicated. An oral glucose tolerance test was unable to be completed owing to vomiting. She was anaemic with a haemoglobin level of 99g/L despite iron supplementation. There was no significant past medical history or family history and she was a non-smoker.

An anaesthetist reviewed the patient six days pre-operatively – she had no intercurrent illness or physical complaints. On the day of surgery, bedside ultrasound showed both twins to be in a transverse lie and the patient was deemed fit for surgery. A spinal anaesthetic was administered without difficulty. LSCS was performed and both twins were delivered in good condition. As the second twin was delivered, the patient was noted to be bradycardic, presumed to be

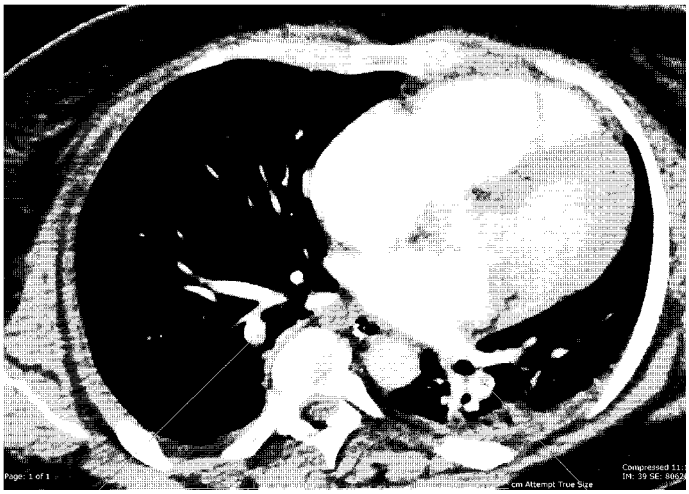

Figure 1. The computed tomography pulmonary angiogram revealed multiple bilateral pulmonary emboli.

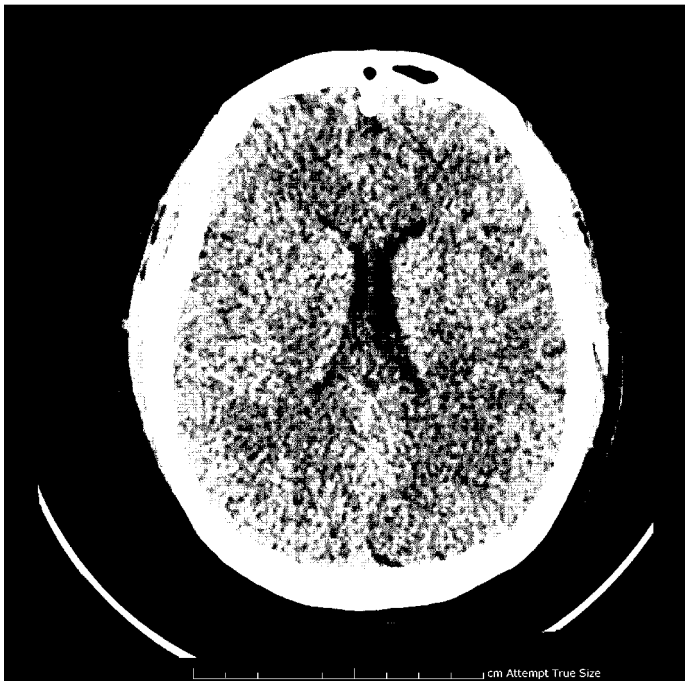

Figure 2. Computed tomography of the head, demonstrating diffuse cerebral oedema with loss of grey-white matter differentiation.

a vasovagal episode. Atropine was administered without effect and the patient became unconscious. The blood pressure was unable to be recorded, asystole was recorded on telemetry and no pulse was palpable at the abdominal aorta. CPR was commenced, adrenaline administered and the patient intubated. After two minutes, return of spontaneous circulation occurred, but eight minutes later a further minute of CPR was required before spontaneous circulation was permanently established. At this point, closure of the uterus and completion of the surgery occurred.

An urgent post-operative transthoracic echocardiogram showed impaired global systolic dysfunction, with an estimated ejection fraction of 30 per cent. The right ventricle was enlarged, with akinesia of the mid free wall (McConnell's sign, consistent with acute pulmonary embolus). Differential diagnoses included pulmonary embolism, post-cardiac-arrest myocardial stunning and peripartum cardiomyopathy. A computed tomography (CT) scan of the head and abdomen and CT pulmonary angiogram were performed. Multiple bilateral pulmonary emboli were identified (see Figure 1), as well as diffuse cerebral oedema consistent with hypoxia following cardiac

Table 1. 'Classic' risk factors for VTE.

	Current Recommendation in Australia and New Zealand*	
Risk factor	Antepartum	Postpartum
Previous VTE	Unprovoked/pregnancy-associated/recurrent provoked: prophylaxis recommended COCP-associated: prophylaxis if other risk factors present Provoked (non oestrogen-related): observation Recurrent unprovoked: therapeutic anticoagulation Any previous VTE plus antithrombin deficiency: therapeutic anticoagulation	Prophylaxis for 6 weeks
Family history of VTE# (no personal history)	No thrombophilia: observation Weak thrombophilia: observation unless other risk factors Significant thrombophilia: prophylaxis especially if other risk factors Antithrombin deficiency: intermediate/therapeutic dose LMWH	Prophylaxis for 6 weeks
Thrombophilia	Previous VTE or family history and antithrombin deficiency: recommendations as above Other: no specific recommendation	Previous VTE or family history and antithrombin deficiency: recommendations as above Other: no specific recommendation

**Recommendations consensus and not evidence based. #Family history of VTE in first degree relatives COCP, combined oral contraceptive pill. (Adapted from McLintock et al[1])*

arrest (see Figure 2). Suboptimal opacification obscured the pelvic veins, however, no obvious inferior vena caval (IVC) thrombus was seen. Serology yielded a negative thrombophilia screen.

Cardiac arrest was thus secondary to multiple bilateral pulmonary emboli. It is suspected that an asymptomatic pelvic vein thrombus became embolic following the delivery of the second twin. The patient was transferred to a tertiary facility for IVC filter placement, ongoing anticoagulation and intensive care support. She was extubated on day two and experienced a protracted recovery, complicated by poor healing of the caesarean section wound. On discharge from hospital after 66 days, the patient had residual moderate right arm weakness and some memory and attention deficits, but had otherwise returned to premorbid functioning.

Discussion

Maternal cardiac arrest is an undoubtedly alarming event every member of the obstetric team hopes never to confront. Venous thromboembolism (VTE) remains a consistent cause of direct maternal death in Australia. Lower limb venous stasis, increased procoagulant factors and vessel wall injury following venous dilatation, labour and caesarean section cause the incidence of VTE to be four- to five-fold higher than normal in pregnancy.[1]

It is widely acknowledged that there is an international paucity of robust population or randomised controlled trial (RCT) evidence regarding appropriate use of mechanical and pharmacological thromboprophylaxis. Current recommendations[1,2,3] from international bodies each advise a relatively well-defined 'expert opinion consensus' on the prevention of VTE in patients with thrombophilia, a personal or family history of VTE.[1] For the umbrella of 'other' risk factors, however, the most effective and efficient approaches are far less clear (see Tables 1 and 2). Thromboprophylaxis must be considered carefully in light of the large number needed to treat to prevent this relatively rare event, the cost at a population level of increasing widespread prophylaxis and the possible associated adverse outcomes.

When considering the patient with multiple 'other' risk factors, international guidelines suggest an individualised discussion with the woman regarding the risks and benefits of thromboprophylaxis. The RCOG recommend consideration of thromboprophylaxis antenatally in the patient with three or more risk factors (two or more if admitted to hospital) and a lower threshold postpartum.[2] A 2014 Cochrane Review of prophylaxis reported there is insufficient evidence on which to base recommendations and the small number of effects noted were from trials with poor methodological quality.[4] No studies have focused on mechanical methods of prophylaxis antepartum. Some authors caution against treading too aggressively in territory where evidence is lacking[5] – certainly the risk of preterm labour with twins and a potentially complicated LSCS with significant risk of postpartum haemorrhage in an obese patient would be deterrents. Yet one could say pulmonary embolism in this patient was not entirely surprising. VTE remains the second most common cause of direct maternal death in Australia.[6,7] Interestingly, a NSW cohort study indicated the rate of postpartum pulmonary embolism remained stable over the period 2001–06, despite a sharp increase in caesarean section rate.[8] In the UK, VTE has dropped from the first to the third most common cause of direct maternal death, which has been tentatively attributed in part to increased widespread use of thromboprophylaxis following RCOG recommendations in 2004.[9] Mortality rates may have declined, but a UK population-based cohort study of more than 400 000 pregnancies showed a significant increase in antepartum VTE, with no significant change in postpartum events following the 2004 guidelines.[10] Lack of data regarding the use of thromboprophylaxis in national audits makes evaluation difficult.

The need for RCT evidence to validate the use of VTE prophylaxis may soon become critical. A glance at the risk factors for VTE raises concern. Obesity continues to plague the Australian population and women of childbearing age are not exempt. In 2011, 20.5 per cent of women who gave birth in Australia had a BMI over 30.[11] Preliminary results from the Australasian Maternity Outcomes Surveillance System 2006–10 review report extreme obesity in 2.14/1000 Australian and 4.56/1000 New Zealand women giving birth.[12] Increasing maternal age is also problematic.[11] Concurrently, the prevalence of active medical illnesses in childbearing women is climbing. The percentage of patients with cardiac disease or hypertension in VTE-related admissions in the antepartum or postpartum period increased by more than 50 per cent over 14 years in a review of a US inpatient database.[13] Cardiac disease remains the number-one cause of indirect maternal death in Australia; it is estimated that five per cent of women under 45 years of age have cardiovascular disease.[11]

The rising use of assisted reproduction technologies (ART) may make

Table 2. 'Other' risk factors for VTE.

Risk factor	Current Recommendation in Australia and New Zealand*	
	Antepartum	Postpartum
Emergency caesarean section	Evidence suggests a synergistic effect with multiple risk factors but no specific recommendation is advised (Not applicable for risk factors specific to the postpartum)	Prophylaxis for 5+ days or until fully mobile
Elective caesarean section		Major risk factors: if ≥2 present, prophylaxis for 5+ days or until fully mobile
Postpartum infection		
BMI ≥30		
Immobilisation		
Active medical illness		
Pre-eclampsia		
Age > 35 years		Minor risk factors: if 1 major and ≥2 minor present, prophylaxis for 5+ days or until mobile; if 1 major OR 2 minor consider graduated compression stockings
Prolonged labour		
Smoking		
Postpartum haemorrhage		
Parity		No specific recommendation
Varicose veins		
Assisted reproductive therapy		
Hyperemesis gravidarum		
Multiple pregnancy		

**Recommendations consensus and not evidence based*

the insidious first trimester thromboembolic event more common. The number of cycles of ART performed in Australia and New Zealand increased by 7.8 per cent from 2010 to 2011.[15] For decades there was an associated increase in the rate of multiple pregnancy, but this has now stabilised.[11] Finally, it is well documented that the rate of caesarean section, a key risk factor for VTE, in Australia is continuing to climb, from 27 per cent in 2002 to 32 per cent in 2010.[11]

Conclusion

As discussed in the Autumn 2013 issue of *O&G Magazine*, consensus-based recommendations provide some grounding for the management of the patient with an inherited thrombophilia, personal or family history of VTE, in lieu of more concrete answers. In the murky sea of potentially cumulative 'other' risk factors for thromboembolism in pregnancy, however, the following serve as a few timely reminders:

- Assessment of an individual patient's risk of VTE should occur pre-pregnancy or as early as possible in pregnancy and be followed by an individualised discussion of the risks and benefits of thromboprophylaxis. The risk level must be re-evaluated at every hospitalisation or change in circumstances.
- All patients should be given advice to avoid prolonged immobilisation and dehydration in pregnancy.
- Vigilance in the suspicion of possible VTE in a pregnant woman cannot be undervalued. The symptoms and signs of thromboembolism may easily be confounded with those of pregnancy, making diagnosis difficult. However, the relatively low risk of investigations when compared with the risks of an undiagnosed event must be considered. A key finding of the Eighth Report of the Confidential Enquiry into Maternal Deaths in the United Kingdom was failure to investigate (often recurrent) presentations with chest symptoms prior to a terminal event.[9]
- Symptoms of thromboembolism arising in the first trimester should not be underestimated, particularly in the setting of assisted reproduction and ovarian hyperstimulation.[1,16,17]
- There is great scope for improvement in the accurate recording of, and publication on, the use of thromboprophylaxis in pregnancy on a national basis.[7]

VTE remains an important cause of maternal mortality in Australia. The increasing use of thromboprophylaxis in recent years may have played a role in potentially stabilising the rate of VTE events, particularly in the postpartum. Nevertheless, with the threat of risk factors that continue to grow in prevalence, the need for vigilance in clinical suspicion of VTE and further research into prevention define the challenges of this generation.

References

1 McLintock C, Brighton T, Chunilal S, Dekker G, McDonnell N, McRae S, et al. Recommendations for the prevention of pregnancy-associated venous thromboembolism. *ANZJOG* 2012;52(1):3-13. Epub 2011/09/29.

2 RCOG. Guideline No. 37. Reducing the risk of thrombosis and embolism during pregnancy and the puerperium. London: RCOG, 2009.

3 Bates SM, Greer IA, Pabinger I et al. Venous thromboembolism, thrombophilia, antithrombotic therapy, and pregnancy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). *Chest*. 2008;133:844S-886S.

4 Bain E, Wilson A, Tooher R, Gates S, Davis LJ, Middleton P. Prophylaxis for venous thromboembolism in pregnancy and the early postnatal period. Cochrane Database of Systematic Reviews. 2014;2:CD001689.

5 Wu P, Poole TC, Pickett JA, Bhat A, Lees CC. Current obstetric guidelines on thromboprophylaxis in the United Kingdom: evidence based medicine?. *European Journal of Obstetrics and Gynaecology and Reproductive Biology*. 2013;168:7-11.

6 Sullivan EA, Hall B, King J. Maternal Deaths in Australia 2003-2005. Maternal Deaths Series No. 3. Sydney: AIHW National Perinatal Statistics Unit, 2008.

7 Johnson S, Bonello MR, Li Z, Hilder L, Sullivan EA. Maternal Deaths in Australia 2006-2010. Maternal Deaths Series No. 4. Cat. no. PER 61. Canberra: AIHW National Perinatal Statistics Unit, 2014.

8 Morris JM, Algert CS, Roberts CL. Incidence and risk factors for pulmonary embolism in the postpartum period. *J Thromb Haemost*. 2010;8:998-1003.

9 Cantwell R, Clutton-Brock T, Cooper G et al. Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006-2008. The Eighth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom. *BJOG*. 2011;118(supp 1):1-203.

10 Sultan AA, Tata LJ, West J, Fiaschi L, Fleming KM, Nelson-Piercy C, Grainge MJ. Risk factors for first venous thromboembolism around pregnancy: a population-based cohort study from the United Kingdom. *Blood*. 2013;121(19):3953-61.

11 Li Z, Zeki R, Hilder L, Sullivan EA 2013. Australia's mothers and babies 2011. Perinatal statistics series no. 28. Cat. no. PER 59. Canberra: AIHW National Perinatal Epidemiology and Statistics Unit.

12 Sullivan EA 2012. Australasian Maternity Outcomes Surveillance System Annual Report 2010-2011. AIHW National Perinatal Epidemiology and Statistics Unit. https://npesu.unsw.edu.au/surveillance/australasian-maternity-outcomes-surveillance-system-annual-report-2010–2011 .

13 Ghaji N, Boulet SL, Tepper N, et al. Trends in venous thromboembolism among pregnancy-related hospitalizations, United States, 1994-2009. *Am J Obstet Gynecol*. 2013;209:433.e-18.

14 Laws PJ, Grayson N, Sullivan EA 2006. Australia's mothers and babies 2004. Perinatal statistics series no. 18. AIHW cat. no. PER34. Sydney: AIHW National Perinatal Statistics Unit.

15 Macaldowie A, Wang YA, Chambers GM, Sullivan EA, 2013. Assisted reproductive technology in Australia and New Zealand 2011. Sydney: National Perinatal Epidemiology and Statistics Unit, the University of New South Wales.

16 Sharma S, Monga D. Venous thromboembolism during pregnancy and the post-partum period: incidence and risk factors in a large Victorian health service. *ANZJOG*. 2008;48:44-49.

17 Greer IA. Prevention of venous thromboembolism in pregnancy. *Best Prac Res Clin Haematol*. 2003;16:261-278.

Aldo Vacca's legacy

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Assessing the true scale of one man's achievement: in memory of Aldo Vacca, 1941–2014.

I never properly met Aldo, but I knew of him, at the very least, since coming to Australia in 1997. I always thought I would meet him and now it is too late. I have a particular, enduring interest in his work. Aldo is responsible, more than anyone else, for popularising vacuum delivery in Australia and was tireless in his pursuit of this goal, until the end. It is a pity Australians don't realise how big a difference Aldo's work has made for women in Australia, and it's even worse that his great work is slowly being undone, now that his championship is lost to us.

Aldo is very much a part of the history of vacuum delivery, not just in Australia. While the use of vacuum for assisted delivery has a history going back to the 18th century[1], the first practicable device was proposed by Malmström in Sweden in 1954. By the 1960s it was popular in Germany[2], and by the time I studied in Heidelberg in the 1980s, forceps delivery was very firmly seen as a thing of the past. Progress in the UK was somewhat slower, with JA Chalmers being one of those responsible for change in the 1960s and 1970s.[3]

Aldo was the first author of a seminal study, the 'Portsmouth Operative Delivery Trial' published in 1983, while he completed his MRCOG training in the UK. The results were quite unequivocal[4] and, together with other randomised controlled trials published in the following decade [5], the data were sufficiently clear for (now Sir) Iain Chalmers, then the Head of the National Perinatal Epidemiology Unit in Oxford, to state: 'The obstetric vacuum extractor is the instrument of first choice for operative vaginal delivery.'[6]

Chalmers father and son didn't know how right they were in emphasising that forceps are so much more likely to cause maternal trauma than the vacuum. We have learned quite a bit about this issue over the last ten years, owing to technological advances allowing the non-invasive diagnosis of both anal sphincter and levator ani tears using 4D translabial ultrasound.[7] Maternal trauma is much more common than is quoted in textbooks. Anal sphincter trauma is under-diagnosed in the delivery suite, probably by a factor of four[8,9] and levator trauma is rarely diagnosed at all, even though it occurs in 15–30 per cent of vaginal deliveries.[7]

From eight studies to date, we now know that forceps delivery carries an odds ratio of about five for levator trauma compared to vacuum. In our data, the prevalence of avulsion in vacuum is about 13 per cent; after forceps it is 44 per cent. Moreover, this is not just owing to the easier deliveries being done by vacuum, as the forceps rate at my hospital was under two per cent in 2010. This means that Chalmers and Aldo were right to a much greater degree than they were aware of, and Aldo's achievement is all the more remarkable for it.

In Australia, about two-thirds of all operative vaginal deliveries are done by vacuum, which is largely Aldo's doing: forceps rates are lowest in Queensland (1.9 per cent), his home state, and highest (excepting the ACT) in Victoria (6.2 per cent), where he arguably had the least influence.[10] We have recently modelled the effect of replacing primary vacuum with forceps on the basis of imaging diagnosis of levator avulsion and OASIS in almost 500 primiparous women.[11] Such a change in practice would likely increase the prevalence of major permanent trauma by 50 per cent. Conversely, every delivery performed with vacuum rather than forceps reduces the risk of levator and sphincter trauma in primiparous women by about half, from about 80 to just over 40 per cent. Let's assume Aldo's achievement is equivalent to the difference in vacuum rates between Queensland and Victoria (about four per cent). Given an average of 250 000 deliveries per year for the last 25 years, or about 6.25 million births, one would expect that about four per cent (or 250 000 women) were affected by a change from forceps to vacuum. Assuming that 1.6 per cent (100 000) rather than 3.2 per cent (200 000) suffered major trauma, Aldo's legacy is the avoidance of about 100 000 cases of major permanent maternal trauma during these two decades.

Nobody was aware of the magnitude of his achievement when he was awarded the Medal of the Order of Australia in 2007, or when he received the RANZCOG Distinguished Service Medal in 2011. I doubt there is an obstetrician in all of Australasia, living or deceased, who has had such a beneficial impact on women's lives, an impact that will last for at least another generation or two. I very much hope that, in our irrational obsession with caesarean section rates, we are not going to undo this legacy in the near future.

References

1 Malmström T. The Vacuum Extractor: an Obstetrical Instrument and the Parturiometer: A Tokographic Device. *Acta Obstet Gynecol Scand.* 1957;36(S3):7-87.
2 Krabisch H. The application of and experiences with the Malmstroem vacuum extractor. *Zentralbl Gynaekol.* 1960;82:673-7.
3 Chalmers J. Malmström's Vacuum Extractor. *BMJ.* 1969(5672): 720.
4 Vacca A, Grant A, Wyatt G, Chalmers I. Portsmouth operative delivery trial: a comparison of vacuum extraction and forceps delivery. *BJOG.* 1983;90:110-12.
5 Johanson R, Rice C, Doyle M, Arthur J, Anyanwu L, Ibrahim J, et al. A randomised prospective study comparing the new vacuum extractor policy with forceps delivery. *BJOG.* 1993;100:524-30.
6 Chalmers J, Chalmers I. The obstetric vacuum extractor is the instrument of first choice for operative vaginal delivery. *BJOG.* 1989;96:505-9.
7 Dietz H. Pelvic Floor Trauma in Childbirth. *ANZJOG.* 2013;53:220-30.
8 Andrews A, Sultan A, Thakar R, Jones P. Occult anal sphincter injuries-myth or reality? *BJOG.* 2006;113:195-200.
9 Guzman Rojas R, Shek K, Langer S, Dietz H. Prevalence of anal sphincter injury in primiparous women. *Ultrasound Obstet Gynecol.* 2013;42(4):461-6.
10 Australian Institute of Health and Welfare. Australian Mothers and Babies 2011. Sydney: AIHW, 2013.
11 Dietz H, Caudwell-Hall J, Shek K, Langer S. The effect of replacing primary vacuum delivery with forceps. *Ultrasound Obstet Gynecol.* 2014;44(S1):95.

Q&a

Q&a attempts to provide balanced answers to those curly-yet-common questions in obstetrics and gynaecology for the broader *O&G Magazine* readership, including Diplomates, Trainees, medical students and other health professionals.

Q *'What is the role of vaginal cytology after hysterectomy?'*

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a Pap smears of the vaginal vault aim to detect invasive or pre-invasive disease of the vagina in women who no longer have a cervix. Vaginal intraepithelial neoplasia (VAIN) is much less common than cervical intraepithelial neoplasia (CIN), with an incidence of 0.2 to 0.3 per 100 000 women.[1] Vaginal cancer has an incidence of 0.7 per 100 000 women[2], making it a rare gynaecological malignancy.

A recent study on vaginal cytology in women who underwent a hysterectomy owing to gynecological malignancy, CIN 3 or benign gynecological diseases, indicated that VAIN lesions occurred in these groups at a rate of 7.1 per cent, 3.0 per cent, and 0.5 per cent, respectively.[3] Given the low prevalence of VAIN and vaginal cancer, available evidence indicates a low positive predictive value for vaginal cytology when used as a screening tool in the absence of symptoms or clinical signs.[3,4]

Hysterectomy for benign disease

Abnormal cytology is found in less than two per cent of vaginal cuff smears after hysterectomy for benign disease.[1,2,3] Collating data from more than 6000 women, Stokes-Lampard et al reported that subsequent to hysterectomy for benign indications, 1.8 per cent of women had an abnormal vaginal vault smear, 0.12 per cent had an abnormal biopsy and no cancers were identified.[2]

Current recommendations are that women who have undergone hysterectomy for benign conditions at any age, who have a history of normal Pap smears and whose cervical histology shows no dysplasia or malignant change, should not be screened for VAIN or vaginal cancer using any modality as they are at minimal risk. In women where a normal Pap smear history is not available or where histology of the hysterectomy specimen is not available, a baseline Pap smear of the vaginal vault can be performed. If this is negative, further smears are only required as indicated by symptoms.[5]

Women who have had a subtotal hysterectomy where the cervix remains in situ require ongoing cervical cytology as per national screening guidelines for the prevention of cervical cancer.[5]

Hysterectomy for cervical dysplasia

Hysterectomy for CIN is a known risk factor for the subsequent development of VAIN, with reported rates ranging from 0.9 to 6.8 per cent.[6] In a systematic review, women who underwent hysterectomy for CIN 3 had an incidence of abnormal vault smears of 14 per cent. However, less than two per cent of patients had an abnormal biopsy and only a single case of vaginal cancer was detected (0.03 per cent). 86 per cent of abnormal smears occurred within two years of hysterectomy.[2] Shockaert et al detected VAIN 2+ in 7.4 per cent of women who had Pap smears after hysterectomy for CIN 2/3 or Stage 1A 1 cervical carcinoma.[6] Women who developed VAIN 2+ after hysterectomy were significantly older than women that did not. The median interval between hysterectomy and biopsy proven VAIN 2+ was 35 months.[6] These data would indicate that these women remain at risk of VAIN following hysterectomy for high-grade cervical dysplasia, particularly in the first two years.

This risk of developing subsequent VAIN is largely determined by the adequacy of excision of the CIN or ACIS at the time of hysterectomy. If excision margins are involved with high-grade dysplasia or not adequately assessed by histology of the hysterectomy specimen, there is an increased risk of VAIN or invasive cancer in the region of the vault. Vaginal vault smears and vaginal colposcopy should continue to be performed annually, with directed biopsies if required.[5] When a high-grade lesion (CIN 2/3 or adenocarcinoma in situ) has been completely excised at hysterectomy it is reasonable for women to undergo annual vault cytology for five years and if results are normal, thereafter revert to the recommended screening interval.[5]

Women with previously treated CIN 2/3 who have subsequent normal Pap smears, negative high-risk human papillomavirus (HPV) DNA testing and have no residual disease on histology of the cervix, should continue to have vaginal cytology at the recommended screening interval until such evidence is available to indicate that clearing the HPV virus from the cervix also indicates its clearance from the vagina.[5]

Women with a history of low-grade CIN who have reverted to normal cervical cytology prior to hysterectomy do not need vaginal vault smears, unless symptomatic.

Hysterectomy for invasive cervical cancer

The vagina is a common site for recurrent cervical and the early detection of these recurrences is aimed at treating patients with potentially curative salvage therapy.

Although most guidelines suggest vaginal cytology after hysterectomy for cervical carcinoma at each follow-up visit[7,8], the effectiveness of Pap smears in this context is not well studied. Clinical symptoms and physical examination will detect the majority of recurrences with few cervical cancer recurrences being detected by vaginal cytology alone.[9,10,11] Furthermore, the interpretation of cytology can be problematic in those patients who have been treated with adjuvant radiotherapy.

In a review of 13 trials on follow up of cervical cancer, asymptomatic recurrent disease was detected using vaginal vault cytology in 0–17 per cent of cases.[12] Injumpa et al showed that the detection rate of vaginal recurrences by vaginal cytology was only 2.4 per cent, with the test having poor sensitivity.[13]

The majority of cervical cancer recurrences occur in the first two-to-three years after treatment[3] and >90 per cent have occurred by five years.[12] Li et al in their cohort of women with cervical squamous cell carcinoma, treated with hysterectomy, found that all vaginal high-grade dysplasia and recurrent squamous cell cancers were detected in the first two years of follow up.[1]

Current surveillance recommendations for women following treatment for cervical cancer include annual vaginal cytology and thorough examination of the vaginal vault to detect local recurrence and pre-invasive disease in the vagina.

The role of high-risk HPV DNA testing in women treated for invasive cervical cancer or high-grade cervical dysplasia after hysterectomy is not clear and requires further investigation.[5] With the introduction of new cervical cancer screening guidelines, based on primary HPV testing, due to take place in Australia and New Zealand, we await further monitoring data to advise on the utility of HPV-based testing in the post-hysterectomy population.

Hysterectomy for endometrial cancer

Following treatment of endometrial cancer, approximately three-to-five per cent of patients will experience a local recurrence of disease confined to the vagina and central pelvis[11,14] that may be salvaged with curative therapy. More than 80 per cent of these women will present with vaginal bleeding or have a clinically apparent lesion in the vagina.[14] Hence, a history of vaginal bleeding and careful visual examination and palpation of the vaginal vault will identify the vast majority of patients that need further evaluation for recurrent disease.

Vaginal cytology alone is ineffective at identifying vaginal recurrences in asymptomatic patients, with less than one per cent of asymptomatic vaginal recurrences are detected by routine vaginal cytology.[14,15] Finally, a significant survival advantage has not been demonstrated for patients whose recurrences are detected during routine follow-up visits compared with patients who present for internal examinations owing to the onset of symptoms.[14,15]

Hence, routine vaginal cytology in asymptomatic women under surveillance after hysterectomy for endometrial adenocarcinoma is no longer recommended.

Other high-risk populations

Women previously treated for VAIN remain at risk and should continue to have vaginal cytology post hysterectomy, every one-to-two years, dependent on patient risk factors, extent of VAIN and completeness of excision. Women with a past history of HPV-related vulval or anal dysplasia or malignancy should also continue to have vaginal cytology at one-to-two yearly intervals.

Similarly, immunocompromised women are predisposed to squamous cell malignancy of the lower genital tract and should be followed up

with vaginal cytology every two years and annually if they have a past history of lower genital tract dysplasia.

Women who were exposed to diethylstilboestrol (DES) in utero are at increased risk for clear cell cancer of the vagina and cervix and should continue to have vaginal Pap smears and careful palpation of the vaginal walls at one-to-two yearly intervals after hysterectomy.

In conclusion, vaginal cytology for vaginal cancer screening is advisable for women who have undergone total hysterectomy if they have the following characteristics:

- prior vaginal high-grade dysplasia or cancer;
- prior cervical, vulval and anal dysplasia or cancer;
- CIN 2/3 or cervical adenocarcinoma in situ diagnosed at hysterectomy;
- in utero exposure to DES; or
- immunosuppression (for example, HIV, history of solid organ or haematopoietic cell transplant).

Routine vaginal cytology is no longer recommended in asymptomatic women after hysterectomy for benign conditions or treatment of endometrial adenocarcinoma.

References

1 Li Z, Barron S, Hong W, Karunamurthy A, Zhao C. Surveillance for Recurrent Cancers and Vaginal Epithelial Lesions in Patients With Invasive Cervical Cancer After Hysterectomy: Are Vaginal Cytology and High-Risk Human Papillomavirus Testing Useful? *American Journal of Clinical Pathology.* 2013;140(5):708-14.

2 Stokes-Lampard H, Wilson S, Waddell C, Ryan A, Holder R, Kehoe S. Systematic review: Vaginal vault smears after hysterectomy for reasons other than malignancy: a systematic review of the literature. *BJOG.* 2006;113(12):1354-65.

3 Gupta S, Sodhani P, Singh V, Sehgal A. Role of vault cytology in follow-up of hysterectomized women: Results and inferences from a low resource setting. *Diagnostic Cytopathology.* 41(9):762-6.

4 Stokes-Lampard H, Stokes-Lampard H, Wilson S, Waddell C, Bentley L. Vaginal vault cytology tests: analysis of a decade of data from a UK tertiary centre. *Cytopathology (*Oxford). 22(2):121-9.

5 RANZCOG College Statement: C-Gyn 8. Cytological follow up after hysterectomy. November 2013. www.ranzcog.edu.au/doc/cytological-follow-up-after-hysterectomy.html .

6 Schockaert S, Poppe W, Arbyn M, Verguts T, Verguts J. Incidence of vaginal intraepithelial neoplasia after hysterectomy for cervical intraepithelial neoplasia: a retrospective study. *American Journal of Obstetrics and Gynecology.* 2008;199(2):113.e1-.e5.

7 National Comprehensive Cancer Network. Guidelines for cervical cancer. Available at http://www.nccn.org/professionals/physician_gls/f_guidelines.asp .

8 American Congress of Obstetricians and Gynecologists. ACOG practice bulletin: diagnosis and treatment of cervical carcinomas, number 35, May 2002. *Int J Gynaecol Obstet.* 2002;78:79-91.

9 VanNagell JR Jr, Rayburn W, Donaldson ES, et al. Therapeutic implications of patients of recurrence in cancer of the uterine cervix. *Cancer.* 1979;44:2354-2361.

10 Bodurka-Bevers D, Morris M, Eifel PJ, Levenback C, Bevers MW, Lucas KR, Wharton JT. Post therapy surveillance of women with cervical cancer: an outcomes analysis. *Gynecol Oncol.* 2000;78(2):187.

11 Santillan A, Govan L, Zahurak ML, Diaz-Montes TP, Giuntoli Ii RL, Bristow RE. Feasibility and economic impact of a clinical pathway for pap test utilization in Gynecologic Oncology practice. *Gynecologic Oncology.* 2008;109(3):388-93.

12 Elit L, Fyles AW, Devries MC, Oliver TK, Fung-Kee-Fung M, Gynecology Cancer Disease Site Group. Follow-up for women after treatment for cervical cancer: a systematic review. *Gynecol Oncol.* 2009;114(3):528.

13 Injumpa N, Suprasert P, Srisomboon J, Nimmanahaeminda K. Limited value of vaginal cytology in detecting recurrent disease after radical hysterectomy for early stage cervical carcinoma. *Asian Pacific Journal of Cancer Prevention.* 7(4):656-8.

14 Bristow RE, Purinton SC, Santillan A, Diaz-Montes TP, Gardner GJ, Giuntoli Ii RL. Cost-effectiveness of routine vaginal cytology for endometrial cancer surveillance. *Gynecologic Oncology.* 2006;103(2):709-13.

15 Steele E, Umar SA, Bomeisl P, Miedler J. Glandular cells in vaginal cytology Papanicolaou tests in patients with hysterectomy for endometrial adenocarcinoma. *Diagnostic Cytopathology.* 40(2):138-40.

Journal Club

Had time to read the latest journals? Catch up on some recent O and G research by reading these mini-reviews by Dr Brett Daniels.

Perforation with IUD insertion

Uterine perforation is a well-known complication with intrauterine device (IUD) insertion, with reported rates of around 0.3 to 2.6 per 1000 insertions.[1] This prospective cohort study followed 61 000 women who had IUDs inserted between 2006 and 2013. Approximately 43 000 women received a levonorgestrel-containing intrauterine system (LNG-IUS) and 18 000 a copper-containing IUD. Women completed a questionnaire at the time of IUD insertion and both patient and treating physician completed a second questionnaire 12 months later. More than 60 000 of the 61 000 women enrolled in the study were available for follow up. Eighty-one perforations were identified during the study, 61 in the LNG-IUS group and 20 in the copper IUD group. Eighty of these were complete perforations. The rate of perforations per 1000 insertions was 1.4 (95 per cent CI: 1.1–1.8) for LNG-IUSs and 1.1 (95 per cent CI: 0.7–1.7) for copper IUDs. The crude relative risk for LNG-IUSs versus copper IUDs was 1.3 (95 per cent CI: 0.8–2.2). Only nine per cent of perforations were identified immediately, most were identified at follow-up. Breastfeeding at the time of insertion was associated with a significant increase in risk of perforation. The relative perforation risk for women breastfeeding versus not breastfeeding was 6.1 (95 per cent CI: 3.9–9.6); the respective relative risks for LNG-IUS and copper IUD users were 6.3 (95 per cent CI: 3.8–10.5) and 7.8 (95 per cent CI: 2.8–21.4). After perforation, the majority of IUDs were removed laparoscopically or vaginally via the strings, with few requiring laparotomy. There were no reported cases of bowel injury, septicaemia, peritonitis or other serious sequelae. The conclusion to be drawn from this study is that uterine perforation remains a risk with IUD insertion, especially in women who are breastfeeding. There is, however, no significant difference in perforation risk between LNG-IUS and copper IUDs and the risk of serious sequelae fortunately appears low.

1 Heinemann K, Reed S, Moehner S, et al. Risk of Uterine Perforation with Levonorgestrel-Releasing and Copper Intrauterine Devices in the European Active Surveillance Study on Intrauterine Devices, *Contraception*, 2015, doi:10.1016/j.contraception.2015.01.007.

Salpingectomy at hysterectomy

In recent years, there has been an increasing understanding that high-grade serous ovarian and peritoneal cancers may originate in the Fallopian tubes. Consequently, it has been suggested that removal of the Fallopian tubes at the time of hysterectomy for benign conditions may reduce the incidence of ovarian cancer. Initially performed in women with high-risk inherited cancer genes (for example, BRCA1, BRCA2) more recent suggestions have included prophylactic salpingectomy in all women having hysterectomy for benign conditions, and for salpingectomy rather than clip tubal ligation for sterilisation. A recent RANZCOG statement suggests that consideration be given to these procedures when booking women for benign surgery.[1] Schenberg and Mitchell provide an interesting discussion of this issue in women with a known high-risk of ovarian cancer.[2] As well as clearly elucidating the evidence behind the tubal hypothesis of ovarian cancer, they discuss questions of quality-adjusted life expectancy with different timing of prophylactic bilateral salpingectomy and/or oophorectomy. While early removal of ovaries together with Fallopian tubes will provide the greatest reduction in risk of ovarian cancer in these women, early oophorectomy is associated with an increase in all-cause mortality, primarily from cardiovascular disease. The authors discuss the obvious ethical problems in a randomised controlled trial on the timing of oophorectomy in these women, but cite a modelling study by Kwon et al, which concluded that the highest quality adjusted life expectancy was obtained by an early bilateral salpingectomy, followed by oophorectomy at a later date.[3]

1 RANZCOG. C-Gyn 25 Managing the adnexae at the time of hysterectomy for benign gynaecological disease. 2014. www.ranzcog.edu.au/editions/doc_view/2030-managing-the-adnexae-at-the-time-of-hysterectomy-for-benign-gynaecological-disease-c-gyn-25.html .
2 Schenberg T, Mitchell G. Prophylactic bilateral salpingectomy as a prevention strategy in women at high-risk of ovarian cancer: a mini-review. *Front Oncol.* 2014, 21. 1-4.
3 Kwon JS, Tinker A, Pansegrau G, McAlpine J, Housty M, McCullum M, et al. Prophylactic salpingectomy and delayed oophorectomy as an alternative for BRCA mutation carriers. *Obstet Gynecol.* 2013. 121(1):14-24.

Reversal of hysteroscopic sterilisation

Regardless of method, some women who undergo surgical sterilisation will later regret the decision and wish to fall pregnant. Options for these women include surgical reversal of the sterilisation or in vitro fertilisation (IVF). While reversal of tubal ligation has been reported for many years, in more recent times hysteroscopic sterilisation techniques have evolved that may be expected to be more difficult to reverse. Monteith et al report a retrospective study of 70 women who had surgical reversal of hysteroscopic sterilisation and completed follow up at least 12 months later.[1] The vast majority of these women had undergone the Essure procedure (97 per cent) with the remainder having the Adiana procedure. Reversal was performed via a 5–10cm suprapubic incision, followed by removal of the tubal micro-insert. After confirming patency of the distal tubal segments they were reinserted either into bilateral wedge incisions at the site of the previous isthmic sections of the Fallopian tubes, or into a single posterior transverse uterine incision. Surgery was performed on an outpatient basis, with patients returning the day after surgery for assessment. Patients were emailed 12 months later with a questionnaire regarding pregnancies and complications. Of the 70 women in the study followed up at more than 12 months, 25 (36 per cent) reported becoming pregnant, with five women becoming pregnant twice. Of the total 31 pregnancies, 20 resulted in live births, eight were miscarriages, two were ongoing at the time of publication and one was unknown. All were natural conceptions and there were no reported ectopic pregnancies, uterine ruptures or hysterectomies. A further 25 women had the re-implantation surgery, but had less than 12 months follow-up. In this group there were seven pregnancies, including one live birth, four ongoing intrauterine pregnancies, one miscarriage and one ectopic treated with methotrexate. This study opens the possibility of an alternative to IVF for women who desire pregnancy after hysteroscopic sterilisation.

1 Monteith CW, Berger GS, Zerden ML. Pregnancy success after hysteroscopic sterilization reversal. *Obstet Gynecol.* 2014 Dec;124(6):1183-9. doi: 10.1097/AOG.0000000000000543.

Letters to the editor

Mid-urethral slings

In a review article on mid-urethral slings (*O&G Magazine* Vol 16 No 4 Summer 2014 p.45), Dr Tucker states that credit for their introduction is often given to Ulmsten and Petros, which I believe to be correct; however, he then states that it could be argued the original innovators were Raz and Stamey. I believe Dr Tucker is incorrect in this statement: both Stamey and Raz, as I understand their original descriptions of their surgical procedures, were aiming at bladder neck elevation by the transvaginal approach and not mid-urethral elevation. It is the work of Petros and the late Ulmsten that transferred attention from the bladder neck area to the mid-urethra and which has led to such dramatic advances in the treatment of urinary stress incontinence, since that concept was described by them. They deserve the credit for the operation that has cured stress incontinence in nearly two million women worldwide.

In addition, Dr Tucker states that he has no conflict of interest to declare in writing a review article that assesses numerous urogynaecological prostheses, but as an appointee to the Urogenital Prosthesis Clinical Advisory Group of the Australian Federal Government Department of Health I believe this does indeed constitute a conflict of interest or of potential bias. Perhaps more importantly, Dr Tucker also states he is a Member of the International Advisory Board for Boston Scientific, a large manufacturer of gynaecological prostheses. This company is currently the subject of a large medico-legal claim not dissimilar to that which has just been settled by American Surgical for close to a billion dollars. It is incongruous to say that this does not constitute a conflict of interest when writing a review article.

Dr Peter Ashton
FRCOG, FRANZCOG

Author's response

Dr Ashton's comments are relevant and deserving of a response and I thank him for his interest in the article. Firstly, by the mid 1980s, many gynaecologists, including myself, were attaching the 'Stamey' suspension sutures to the paraurethral fascia in the region of the mid-urethra – not as high as the bladder neck, to facilitate passage of the needle and minimise the risk of bladder trauma.

Secondly, my appointment with the Urogenital Prosthesis Clinical Advisory Group is totally unbiased and devoid of conflict of interest. In no way has this appointment influenced the published article. Importantly, within such committees, very rigid guidelines are in place to enforce this situation and ensure that no conflict of interest can bias, potentially or directly, the decisions of the committee.

Thirdly, my involvement with Boston Scientific has been on the Advisory Board for development of their neuromodulation system for sacral nerve stimulation. It is not associated in any way with the Boston Scientific mesh/tape prostheses. I also work with Medtronic (unpaid) to improve and advance the Medtronic sacral nerve neuromodulation system.

Dr Ian Tucker
MBBS, FRANZCOG, FRCOG, CU

VBAC safety

I retired last December, having been a student and Trainee in the 1960s and early 1970s. After MRCOG training in the UK, I returned to Australia and, over the course of my working life, became increasingly concerned about the lack of understanding of the lower segment not only among students, but also many registrars and even a generation of consultants. Fortunately, there seems to be some improvement of this understanding, but my observation is that this is not well applied in practice and, I believe, contributes to the risk of uterine rupture at vaginal birth after caesarean (VBAC).

During my training we were taught a physiological difference – the lower segment being passive and the upper segment being active – was the key to the safety of the lower segment caesarean section (LSCS) operation compared to the upper segment or classical caesarean. This reasoning explained the potentially catastrophic effects of rupture of the upper segment and the safety of LSCS, which was said to dehisce in a quiet and safe manner, requiring repeat caesarean but not causing other dangers. For some time after, I corrected registrars when they referred to uterine rupture, a more dangerous event than dehiscence, as a risk of VBAC, but have since become aware that the term 'rupture' can indeed be justified in this context.

My own experience during my training years and the first part of my specialist career here, when the VBACs I conducted were on patients whose first caesarean had been done by me or an older colleague with similar operative technique, was that on the very few occasions that a scar came apart it had indeed only dehisced, usually partially, and no harm ensued other than the caesarean being repeated. This statement can be dismissed as anecdotal, but surely observations from more than four decades' busy experience in training and independent practice should count for something.

Thoughts I tried to convey to my Trainees included:

- I would have had my knuckles rapped very smartly if during my training I made the transverse uterine incision as high as is commonly seen today. The lowest part of this incision is usually done a bit on the high side so the lateral parts very definitely extend higher into the uterus than would have been acceptable when I trained. I have tried to find published literature comparing the results of the muscle splitting transverse incision I was taught with the upward curved incision, but was only able to find comparison of blood loss, the smiley incision usually having just a bit less, rather than studies comparing outcome of VBAC in subsequent pregnancies.
- An appreciation that the lower segment forms in the latter part of pregnancy as the uterus stretches. This has become more significant in recent years as neonatologists are getting ever better results with younger fetuses and an increasing number of caesareans are performed for premature infants. I was pleased that in the latter part of my career many (but by no means all) of my colleagues started to recognise that LSCS done early in pregnancy, last I heard it was before 34 weeks, were not suitable for attempts at VBAC as the lower segment is not properly formed before this time.
- In many places, in the laudable interest of offering choice, a woman who has had a previous caesarean when presenting for

antenatal care will often have VBAC discussed/offered by the midwife who is the person of first contact before any review by an obstetrician. Thus there will often be pressure for or offers of VBAC in a population not screened for suitability or otherwise of this option. I have had a few very angry patients who were not at all happy to be told that they were not suitable candidates for VBAC. We can give in to their unrealistic requests, but we accept the responsibility. Satisfaction, or lack of it, with obstetric outcomes depends on how the outcome compares to the expectation more than the outcome itself.

- Failure to obtain operative notes of the primary caesarean is alarmingly common. Without the operative notes one cannot even be sure that the initial operation was LSCS, as there are many who still think that the sign of a LSCS is a Pfannenstiel abdominal scar and that a classical caesarean is indicated by a sub-umbilical vertical midline scar. The operative notes will confirm an uneventful operation or otherwise, for example, the occasional inverted-T or J-shaped extension of an incision or other operative difficulties. This means going to the effort of requesting a copy of the actual operation record, not just a discharge summary. In some places, such as parts of China, classical caesareans are still the routine so one can never assume that the primary operation was an uneventful LSCS.

All this can be dismissed as the anecdotal ravings of a sad, old has-been and it could be suggested that the reason we didn't see ruptures, as opposed to dehiscences, was that the caesarean rate was much lower. Nevertheless, we saw enough to all have seen several dehiscences. It should also be borne in mind that the rupture rate of VBAC after true classical caesarean is only around 20 per cent. I am personally convinced that if the above precautions were to be generally observed true LSCS would regain significant safety. Prospective studies would be very hard to do with our mobile population, are there any studies looking at details of the previous caesarian in cases of uterine rupture at VBAC?

Peter Kraus
RFD, MB BS, FRCOG, FRANZCOG

Training opportunities and procedural numbers

The article by Dr Rupert Sherwood 'Controversies in training' (*O&G Magazine* Vol 16 No 4) gives a very nice exposition of how RANZCOG can do its best (within the bounds of training opportunities in Australia) to ensure that Trainees who are going to need surgical skills get them. The article begins with a section entitled 'Do we have a problem?'. I think a fair summary of the five paragraphs in this section is 'yes'.

In the President's message in the same issue, Prof Permezel states quite aptly: 'While competency-based training is catchy phraseology for the educationalist, all who practice recognise the imperative of numbers.' Prof Permezel also notes 'few [Trainees] now travel overseas to boost training procedural numbers'. Older Fellows will remember that it was not so long ago that a large proportion of Trainees travelled to the UK and Ireland for part of their training and between 1960 and 1985 a number of teaching hospitals in Australia had routine rotation to a Papua New Guinea hospital for 6–12 months for Trainees. With the UK and Ireland joining the EU it is quite difficult for Australian and New Zealand Trainees to get registrar posts there, and in the 1980s PNG went out of favour for all sorts of reasons.

At Port Moresby General Hospital (PMGH) last year we supervised more than 15 000 births, there were over 4000 gynaecology operations, of which 600 were caesarean sections (CS) and 400 were major gynae operations. The low CS rate (four-to-five per cent) also means there are many cases of operative and complex vaginal births (more than 1000 in 2014). So, I think it is fair to say we 'have the numbers'. Adequate supervision for Trainees is provided by a group of six consultants, two of whom are Fellows of this College.

We have one fourth-year trainee (female) coming on a ten-month contract at the end of February, and there is a clinical lecturer vacancy that could be filled by a fifth- or sixth-year Trainee or recently qualified Fellow.

If any Trainee or Fellow is interested in a ten-month appointment (the employing agency would be the University of PNG and the appointee would have clinical duties in the PMGH), please contact the undersigned at: glenmola@dg.com.pg or gmola4@gmail.com for more details. The salary is only about AU$40 000 but the benefits include teaching and clinical (particularly procedural) experience that you would not get in most Australian hospitals.

Prof Glen Mola
FRANZCOG, DPH(Syd), FRCOG

Notice of Deceased Fellows

The College was saddened to learn of the death of the following Fellows:

Dr Euan Howell, VIC, on 16 September 2014
Dr Helen Anderson, VIC, on 8 December 2014
Dr Conrad Primmer, QLD, on 10 December 2014
Dr Dulcie Rayment, VIC, on 24 December 2014
Dr Louis Butterfield, NSW, on 29 January 2015
Prof Norman Beischer, VIC, on 2 February 2015

Provincial Fellows

Dr Tony Geraghty
FRANZCOG

A brief history of the College's Provincial Fellows shows the value of coming together for mutual support and learning opportunities.

The development of specialist obstetrics and gynaecology practice is a relatively recent one. The parent body, the Royal College of Obstetricians and Gynaecologists (RCOG), the organisation from which the Australian and New Zealand Colleges (later amalgamated) budded, was founded in 1929. Previously, there had been societies formed by those who saw obstetrics and gynaecology as a specialist area in its own right. Specialist practice brought with it the establishment of standards of care, specifically targeted research, a training program and eventually a program for continuing education.

Like many advances in medicine, the benefits are felt firstly in the cities, only filtering into the countryside sometime later. So it was that in the 1970s and 80s, specialist obstetrics and gynaecology practice came to the provinces. Prior to this time, the workforce was almost exclusively GPs, many of whom held diplomas from the RCOG, as a considerable proportion would have had postgraduate experience in UK hospital maternity units. These doctors were often cradle-to-grave practitioners who were held in high esteem by their communities and were given credit for doing the best they could in the presence of unfavourable outcomes. Their isolation was often compounded by poor road access and lack of any emergency aerial transport.

The result of the specialisation of the workforce brought with it a decreased reliance on the general practitioner and the impact of an increased litigation threat and reduced remuneration caused a rapid fall off in the number of GPs doing obstetrics. The consequence of this, as well as other factors such as reduced midwife numbers and rural economic decline, was the subsequent closure of many small maternity units throughout Australia. Deliveries became concentrated into regional units in larger provincial towns, making the role of the Provincial Fellow essential. The initial cohort of Provincial Fellows was largely Australian trained from Australian medical schools, predominately Australian born and male.

This group recognised that they shared similar problems. They were relatively isolated, were less well-resourced and supported than metropolitan colleagues, and needed to be self-reliant and to be prepared for any eventuality. The difficulties of obtaining ongoing training and education were well recognised. As a result, the Provincial Fellows Committee was formed, in 1989, to address the concerns specific to rural practice. Initially, rurality was defined as being more than 100km from a capital city, but subsequently this was changed as the Australian Standard Geographical Classification Remoteness Areas (ASGC-RA) tool, created by the Australian Bureau of Statistics, was adopted. Positions were created on Regional Committees and, subsequently, on the College Council for Provincial Fellows.

Table 1. Numbers of Fellows, by state and ASGC classification.

	NSW	NT	QLD	SA	TAS	VIC	WA	Total
RA1	418	1	218	110	0	359	110	
RA2	52	0	38	1	27	43	8	
RA3	1	11	29	3	6	4	6	
RA4	0	3	4	0	0	0	3	
%	11%	93%	24%	3%	94%	11%	13%	15%

The priorities for this newly formed group were establishing a forum for exchanging of ideas and concerns, access to recognised CPD programs and obtaining affordable locum cover to attend meetings and have holidays.

The first Provincial Annual Scientific Meeting (ASM) was held in 1999, in Warrnambool, Victoria, and has been a regular fixture ever since. The meetings have been as much about developing camaraderie among Provincial Fellows and exchanging information as an educational event. The meeting has been structured to give Fellows an opportunity to present papers in areas of their own research or personal interest and, in later years, a forum for engaging with our GP obstetrician colleagues.

Table 2. Summary of characteristics of PFs in 2012.

235 PFs = 15 per cent of Fellowship
66 per cent male 34 per cent female
Average age 53 (34–74yrs)
Greatest No Qld 72 c.f. 4 in SA
One per cent male, five per cent female <40yrs
40 per cent plan to stop private obstetrics in five years
93 per cent practising obstetrics

The most recent meeting – in Port Lincoln, South Australia, in March 2014 – while well attended by GP obstetricians, Trainees and medical students, was not well supported by Provincial Fellows. To determine why this occurred and to get guidance for the organisation of future meetings, a survey was sent to all Provincial Fellows. A different covering letter accompanied the survey, depending on whether the recipient was a regular attendee or not. The response rate from regular attendees was 53 per cent whereas for the non-attenders it was 39 per cent, with an overall response of 39 per cent. The most significant response from the survey was that there is still strong support for an annual meeting, but that the venue, format and timing will need to be refined in order to attract more delegates.

One other possible conclusion from the survey is that the Provincial Fellowship has also changed remarkably from the time of its inception and that newer Provincial Fellows have a different perception of their position. It is clear that a greater proportion of

the workforce is Specialist International Medical Graduates (SIMGs): 33 per cent. Without this group, many of the rural sites would have ceased to function and would have had to close or employ a locum workforce. The result is a greater heterogeneity than the group who originally established the Provincial Fellows Committee.

Table 3. Proportion of SIMGs by RA.

	RA1	RA2	RA3	RA4
Non SIMG Fellows	1019	113	44	4
SIMG	227	56	16	6
Total	1246	169	60	10
% SIMG	18%	33%	27%	60%

As the older group of Provincial Fellows retires from practice, it may be more difficult to maintain the sense of identity that made them such an effective force for improving the conditions of their comrades in the past. Only by fostering and supporting our most recent colleagues and acknowledging their contribution to the welfare of the families of rural Australia, are we going to continue with the spirit that developed within the Provincial Fellowship in the past. To that end, it is vital that those remaining from the initial cohort of Provincial Fellows engage with the newer Fellows, act as advisors and mentors and give encouragement to them to get involved in College activities, including the ASM.

The organisers of the ASM have a responsibility to make the meeting of acceptable academic standard, relevant to rural practice, affordable and at a venue that ensures something for all attending, especially families. After all, for them it may be their only annual holiday.

Honours awards

The following RANZCOG Fellow recently received a New Zealand Honours award:

- Member of the New Zealand Order of Merit
  Rev Dr Vincent Jonathan Hartfield, of Whanganui. For services to health.

Obituary

Ian Alexander MacIsaac
(1932 – 2014)

Ian Alexander MacIsaac was born on 17 June 1932, in Mooroopna in country Victoria. His primary education was in Euroa and his secondary education was at Assumption College in Kilmore. His medical degree was from Melbourne University and he graduated in 1956. He was a resident of Newman College during his studies.

His early training was at St Vincent's Hospital in Melbourne. In 1960 Ian, accompanied his wife Ruth and his son, went to England, travelling as a ship's doctor to save money. In England he worked at Queen Charlotte's and the Chelsea Hospital for Women in London and later in Middlesbrough. He obtained Fellowships from both the Royal College of Obstetricians and Gynaecologists and the Royal College of Surgeons.

On returning to Australia, Ian was one of the original group of consultants to staff the new Mercy Maternity Hospital, as it was originally known, when it opened in 1971, in East Melbourne. He was later head of one of the obstetric and gynaecology units. He also established a very large and successful private practice in obstetrics and gynaecology and was much loved by his patients and respected by his colleagues.

Ian was a teacher, role model and mentor to all the who worked with him at the Mercy. He was the person who would be called, even by experienced clinicians, when they had a difficult obstetric or surgical problem and he would always be available for them. He was noted for his calm demeanour, endless patience and tolerance.

When he stepped down from his role as head of unit, he continued to work in antenatal clinic and assisting his junior colleagues. It was very reassuring to have Ian as a surgical assistant, knowing that if difficulties arose he had the experience to help and guide.

The love of Ian's life was his wife Ruth. When she became unwell, he immediately stopped work to nurse her through her final illness. Ian was immensely proud of his family of five sons, three of whom became physicians. The other passion in Ian's life was the Richmond football club and, typical of Ian, his support never wavered, no matter how their fortunes varied.

Ian died suddenly on 20 June 2014. He is survived by his five sons and 18 grandchildren.

Dr Bernadette White
FRANZCOG
Vic

Author Index

Volume 16 – 2014
Volume numbers will appear first in index entries, issue numbers in brackets afterwards and page numbers following: , eg 10(1): 18 = Vol 10, No 1, page 18
Articles A, In and The are ignored in filing entries

The following abbreviations have been used:
O and G = obstetrics and gynaecology

Series names and editorials have been placed in square brackets [ ]
Eg Cervical cancer, postcoital bleeding [Q&a] 11(3): 54
[Q&a] refers to an article from the Q&a series

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*Articles written about working in overseas countries, have been indexed under the place name
eg Ethiopia 12(2): 63–65