O&G MAGAZINE

TECHNOLOGY

Vol. 23 No. 3 | Spring 2021

a **RANZCOG** publication

O&G MAGAZINE

Vol. 23 No. 3 Spring 2021

Editorial Communications
O&G Magazine Advisory Group
RANZCOG
254–260 Albert Street
East Melbourne, VIC 3002 Australia
(t) +61 3 9417 1699
(e) OGmag@ranzcog.edu.au

Advertising Sales
Minnis Journals
(t) +61 3 9836 2808
(e) minnis@minnisjournals.com.au

Printer
SouthernImpact
(t) +61 3 8796 7000

O&G Magazine authorised by Ms Vase Jovanoska

For further information about contributing to *O&G Magazine* visit: ogmagazine.org.au.

ISSN 1442-5319

The College

Technology

RANZCOG acknowledges and pays respect to the Traditional Custodians of the lands, waters and communities across Australia, on which our members live and work, and to their Elders, past, present and future.

Women's health

The College

RANZCOG recognises the special status of Māori as tangata whenua in Aotearoa New Zealand and is committed to meeting its obligations as Te Tiriti o Waitangi partners.

From the President

Dr Vijay Roach
President

The theme for this issue of *O&G Magazine* is Technology. This topic brings to mind the many books and movies that have predicted technological advances in medicine which, at the time they were written, seemed fanciful or far-fetched. In 1932 Aldous Huxley described, in *Brave New World*, a future where babies were grown in bottles and then modified (through incremental doses of injected alcohol!) to create a stratified society. I remember watching the 1997 movie *Gattaca*, then as a final year RANZCOG trainee. It predicted preimplantation diagnosis, the ability to screen out 'defective' genes and, once again, a society demarcated into 'pure', IVF babies and those who had been conceived naturally, with the potential hereditary risks that entailed. Mary Shelley's *Frankenstein* foretold the possibility of organ transplant and in *Star Wars*, an autonomous humanoid 2-1B surgical robot successfully attaches a robotic arm to hero Luke Skywalker.

The authors of the Spring issue share their knowledge, experience and expertise with the application of technology to our speciality. Members of my age group will remember kneeling in a pool of fluid with your eye on the hysteroscope, or neck pain from using the laparoscope in the same way. Younger members couldn't imagine a time before the routine use of cameras, video monitors and robots. Endometrial resection and rollerball ablation were the default. The Mirena IUCD, arguably the biggest game-changer in gynaecological care after the pill, was only released in the USA in 2001! Technological changes have also paralleled significant social changes with fertility options for single women, same-sex couples, older women and even those who have had a hysterectomy. Stopping the biological clock is now possible with egg-freezing. We now have the ability to screen out multiple gene-defects, choosing the 'best' embryo, as *Gattaca* predicted. Ultrasound, using technology developed in World War II, was first used for medical purposes in 1956. I remember the ultrasound with our first child 30 years ago. It looked like a snowstorm! What can't we see now?

In *Sapiens*, Yuval Noah Harari suggests that perhaps medicine is just an algorithm and that human doctors could eventually be replaced by computers and robots. I think that this is a concept that we should embrace rather than feel defensive about. A computer can hold, and retrieve, much more data than an individual ever can. Eventually, a robot that is able to build a car will be able to safely remove an organ. But we're not there yet. Computers and robots are adjuncts and they supplement the qualities that only we possess. Risk assessment can only be objective to a degree. What matters to each of us is subjective and varies considerably. Critical thinking and ethical considerations are human processes that are constantly evolving and they can't be outsourced to a machine. Our patients seek kindness and compassion, the touch of a human hand, the warmth of a human smile. Technology will help us to deliver better health outcomes, but doctors, midwives, nurses and allied health practitioners are who a patient seeks. We're not redundant...yet!

This will be my last President's message for *O&G Magazine*. Books and movies may have predicted a pandemic but I certainly didn't see it coming! After a wonderful first year of meeting members across Australia, Aotearoa New Zealand and the world, I've had more screen time than my children! As the term draws to a close, I reflect with gratitude on RANZCOG's journey through the pandemic, our support of our members, our authority as a medical leader, the extraordinary volunteers, training supervisors and mentors who have strived to improve women's health and to train the next generation of women's health doctors. I'm proud of our advocacy. We will always have more to do but we should celebrate our progress in gender equity, inclusiveness, emotional wellbeing, abortion law reform, relationship building with our midwifery colleagues, consumers and multiple other stakeholders. RANZCOG is our College, your College, an organisation to which you belong, where you are valued and which makes a real and genuine difference.

Of course, it wasn't all beer and skittles. COVID has terribly impacted our work, lives and families. Engagement with the members revealed that not everyone agreed with the decisions that we made, or the direction that we took. That's the reality of leadership. Assuming no sinister intent, every good intention will have unanticipated, unintended and unrecognised consequences. The more that you try to do/achieve/change, and the bigger your audience, the more likely that one, or more people, will find an error, a point of disagreement, take offence or be negatively impacted. You can choose to do nothing (very tempting!), or you put your best foot forward, listen to the feedback, learn, and keep on trying. To my surprise, while I still struggle with 'constructive feedback', I am now able to absorb it with less personal affront. To those who found the College, or me, lacking, thank you for your

feedback. It has been heard and it helps to inform the way forward.

Saying thank you seems an inadequate way to express my feelings about the Chairs, Committee members, Councillors and members who have given so much of their time and good will. To Vase Jovanoska, RANZCOG's CEO, an extraordinary friend, tireless worker and consummate professional, thank you for working with me, for your support and stewardship of our College. Thank you to the most amazing staff. I felt that I was one of you and that we served the membership together. I wish we'd had more time to hang out. I can't mention names but Bec and Sabrina had to put up with me the most. I can hear them breathing a sigh of relief! Finally, to the RANZCOG Board: John and John, Gill, Judith, Julie, Ian, Ben and Yee. Quite simply, RANZCOG's success reflects your dedication, commitment, your collaborative and wise approach. Our members will never know quite how much you do but I will never forget. To John Tait, Yee and Ian, the College owes you a debt of gratitude for your long service. RANZCOG remains in very capable hands with incoming President Dr Ben Bopp and a wonderful Board. To Ben, Julie, Judith, Gill, John Regan, Boon, Jared, Nisha and Sue, I wish you every success, many Board dinners together and smooth waters ahead.

Finally (don't you love it when someone who writes such long essays says that?), I am conscious that the position of President is an honour and, for that honour, I want to thank the membership. I love my profession and I am genuinely connected to my College. I am also deeply connected to our purpose, excellence in women's health. There were many highlights during the last three years but one very proud moment was to open the RANZCOG Women's Health Summit in Canberra. I think that my message in the booklet best expresses the way that I feel.

"In 1975, colour television was broadcast for the first time in Australia and Aotearoa New Zealand. We emerged from a monochromatic view of the world and experienced the joy of diversity. Our senses were awoken to the opportunities that present themselves when the full spectrum of light is expressed, fully and uninhibited. Humanity, too, is that broad kaleidoscope of colour and movement, and we are so much richer when every voice is heard, and every person seen, and valued.

My desire is for our nations to be places where women can be who they can be, who they want to be. My aspiration is for our countries to be ones which respect the culture and traditions of First Australians and Māori, countries where women's safety is guaranteed, where physiological experiences of menstruation, sexual and reproductive health are discussed and normalised and where the health issues that women experience are validated, investigated and treated expertly.

I want Australia and Aotearoa New Zealand to be places where migrant and refugee women feel welcome and enabled to navigate the health system, where all forms of sexual expression are accepted and respected. We can develop, and promote, societies that supports education, healthier lifestyles and sensitive care for people as they grow older. Let's work together to achieve this. To learn we must listen to the voices of Aboriginal, Torres Strait Islander and Māori people, health professionals, and consumers from all backgrounds. Let's forsake our silos and work together, collaborating for a greater good. We must always place women at the centre.

We know what the issues are. We've talked about them for long enough. The health of women, their safety and their happiness has been neglected. It's time to redress that. It's time for women to have a seat at the table, to lead and to participate fully. Women's voices must be heard. Welcome to the RANZCOG 2021 Women's Health Summit. This is our opportunity. It's Time to Act."

So long, and thanks for all the fish (Douglas Adams, *The Hitchhiker's Guide to the Galaxy*).

From the CEO

Vase Jovanoska
Chief Executive Officer

Welcome to the latest issue of *O&G Magazine*. In my last article, I mentioned that we have had to adapt to new ways of working and that at any moment, given the ongoing situation of the pandemic, things could change in an instant. As I write this article, Melbourne has just commenced our 6th lockdown with a small resurgence of community cases that have the state on edge. Our thoughts and well wishes go to all states across Australia and New Zealand; we are all, in some way, dealing with the current uncertainty and unpredictability of life.

It has truly been amazing to witness the hard work and ongoing commitment of College members, trainees and staff as we continue to persevere through a very challenging and unprecedented time in our lives. We continue to work towards the improvement of health outcomes for women across Australia and New Zealand and I am pleased to report on our achievements since the last issue of *O&G Magazine*.

The College has officially relocated to 1 Bowen Crescent, Melbourne and in the short bursts of opportunity between lockdowns, when staff have been able to attend the office, we have had positive feedback and excitement in the air at the prospect of connecting and interacting with each other in person again. We look forward to welcoming all our members and trainees to College Place at Bowen Crescent.

The theme of this *O&G Magazine* is technology and in previous issues, have mentioned how much technology has become an even greater, more pervasive part of our lives as we have migrated to a working-from-home, hybrid model. Never has it been more important to have the right systems in place for service delivery, but we now also need to have the appropriate systems in place for interaction and engagement with each other. The world has changed, how we interact has changed and our reliance on fit-for-purpose technology is paramount.

Our new online portal, Integrate, is currently being developed with phase one set to launch end of August. Phase one will provide the foundation for RANZCOG's future training and CPD program delivery and will facilitate more accuracy of membership and training information. Following the phase one launch, CPD will be redeveloped for the new program starting July 2022, while the FRANZCOG training program is ported over from My.RANZCOG as well as bringing DRANZCOG online. The College is also working on revitalising our website, which is scheduled to go live at the end of the year. In addition to this, our new Learning Management System is being developed and analyses for potential exam question databank and new online solutions for written exams ae being investigated.

The areas that have experienced a massive shift to technology-based service delivery are the College's assessments, exams, workshops and events. Since the start of the pandemic and our increased reliance on technology, we have held more than 80 webinars including FRANZCOG and DRANZCOG revision courses and consumer and member information sessions: 14 large-scale events including our Annual Scientific Meeting (ASM), QLD Regional Scientific Meeting (RSM), South Australian/Northern Territory RSM and the RANZCOG Women's Health Summit (both hybrid events). In addition to this, approximately 250 candidates across FRANZCOG, DRANZCOG and Subspecialties sat online exams.

I would like to extend a formal congratulations to the newly announced RANZCOG Board whom, along with President-elect, Dr Benjamin Bopp, will continue the great work of our current College Board and President Dr Vijay Roach, over the next two years. I am also proud to announce that RANZCOG has exceeded our targets set for female representation on the incoming Board and we have a fantastic and broad representation of linguistic and cultural diversity as well as backgrounds and experience that reflects that of our membership. The new Board will take office after the Annual General Meeting in November.

I extend a warm welcome and congratulations to the College's newly elected 12th RANZCOG Council members. The RANZCOG Council have an important role in contributing to many of our College committees and shaping our strategic direction for the coming term. The Board and I look forward to working closely with you in championing the important work of the College.

In 2024, the College is due for full reaccreditation by Australian Medical Council (AMC) and Medical Council of New Zealand (MCNZ). The College has formed a working group that will prepare the reaccreditation by assessing all accreditation standards across the College, in consultation with appropriate stakeholders. Currently we are working on feedback from our last progress report to the AMC and how this can be incorporated in our training programs.

I am pleased to announce that RANZCOG recently launched a Bullying Discrimination and Harassment Survey. The survey will aim to capture an anonymous snapshot of the workplaces and training environments in which our members and trainees work. The information will then be reviewed by an independent Advisory Working Group who will provide recommendations to RANZCOG on how we as an organisation can support, advocate and cultivate respectful workplaces and aid in the prevention of bullying harassment and discrimination within the wider O&G specialty.

Finally, as always, I send my sincere gratitude and acknowledgment to the RANZCOG Board and President Dr Vijay Roach, who have had a very difficult and challenging 18 months but have continued to lead the College with grace and focus. I look forward to working closely with you during the transition to our new Board and Council.

LEADERS IN FOCUS

Dr Nisha Khot
MBBS, MD, FRCOG, AFRACMA, FRANZCOG

This feature sees Dr Nisha Khot in conversation with women's health leaders in a broad range of leadership positions. We hope you find this an interesting and inspiring read.

Join the conversation on Twitter
#CelebratingLeadership @RANZCOG @Nishaobgyn

Dr Hilary Joyce
FRANZCOG

In this issue of *O&G Magazine*, I interview Dr Hilary Joyce. Dr Joyce has had an impressive career as an O&G and fertility specialist, and in medical leadership. She was the first, and remains the only, woman President of the National Association of Specialist Obstetricians and Gynaecologists (NASOG)* between 2009–2011. Prior to this, Dr Joyce was the Executive Secretary at NASOG from 2006–2009. Dr Joyce has held leadership positions within AMA as the O&G representative on Federal AMA Council where she was on the Economics & Workforce Committee as well as the Ethics & Medicolegal Committee. She was also the NASOG Representative to RANZCOG Council during 2003–2007. Her stepping stone to medical politics was being elected to Council of the Australasian Menopause Society in 2001, an extension of her clinical interest in reproductive endocrinology. You can follow Dr Joyce on Twitter @drhilary_joyce.

What made you choose a career in O&G?

That is a very easy question to answer because O&G chose me! I thrived on academic success graduating first place in O&G at my medical school and second overall in the year. I had a hugely positive reception from female patients as a medical student and a young, professorial mentor who encouraged my career path. My inclination may have been towards physician training, but the unique appeal of obstetrics combined with medicine and surgery was difficult to resist. I find it intriguing that despite the leaning towards medicine, it is the procedural aspects of fertility treatment that now appeal to me the most.

If you had the opportunity, what would you change in your career?

There have been many sliding door moments in my life. Looking back, I would have returned to Melbourne when I finished my post-membership training in UK. With a newborn unquestionably commanding my attention, I accidentally became a trailing spouse. What started as a six-month stint in the Riverina, where my husband had been in the RAAF, turned into 10 years – a hidden decade!

I would have loved to complete CREI training had it existed at the time.

In medical politics, I would have accepted a requested nomination to Federal AMA Council Executive.

Many of my Yes and No responses were however okay.

What are some of the moments that have given you the most joy?

Again, academic success was a source of great satisfaction.

I enjoyed representing my colleagues and medical politics became central to my professional life.

Being a fertility specialist at Genea in Sydney, having a hand in creating babies who would otherwise never have been born and families that would otherwise not have existed has been a privilege. I enjoy receiving photos of my babies, and families who send me annual birthday updates hold a very special place in my heart.

Restoring vitality to women who had been destroyed by the most severe endometriosis.

Returning to my past life as an obstetrician, it gave me great pleasure to be a doctor's doctor – caring for colleagues, especially delivering their babies.

There was some beauty in a career where cumulative experience and building of skills over time were valued, and there was room for evolving interests.

Your career has spanned a time of significant advances in fertility treatment including laparoscopic surgery. Could you tell me more about your own journey?

The first IVF baby in Australia was born when I was doing a term in gynaecology at RMH before I started formal O&G training at RWH. Yes, I have witnessed some extraordinary advances – the development of the world's first vaginal US probe in Sydney, the transition from laparoscopic to US-guided

Dr Hilary Joyce

egg retrieval, major improvements in IVF success rates and the evolution of genetic diagnosis. The new Medicare rebate for Preimplantation Genetic diagnosis is long overdue and will be cost beneficial in prevention of serious genetic disorders such as Cystic Fibrosis. Now, late in my career, at least one child in every classroom has been conceived by IVF. Egg freezing has added an exciting dimension.

I had been on track to take up a position as Senior Registrar in the Reproductive Biology Unit at RWH but instead took the traditional path to UK with my husband for our fellowship training. I had remarkable mentors in ART including Ian Johnston, John McBain and Rob Jansen who created opportunities for me. I was a founding member of AGES and witnessed endoscopic surgery transform from a concept to mainstream reality, which suited me perfectly. We were fortunate to be able to offer both advanced laparoscopic surgery and IVF in our joint practice, sadly not a common experience for patients to be able to access both together. My own lived experience of infertility and endometriosis shaped my career in fertility treatment (just as well I'm not superstitious about my early academic fascination with endometriosis being a self-fulfilling prophecy)! It has been an immensely rewarding journey both intellectually and emotionally.

Who has been the greatest influence in your life?

My daughter. Many will consider this an inversion of the expected response to this question. Despite more obvious career successes, my daughter is undoubtedly my greatest achievement, and I remain in awe of her. Like my mother, I may have discouraged her from studying medicine!

My medical narrative has been shaped by all the people who have passed through my professional life, and to whom I owe a debt of gratitude.

Could you tell me more about NASOG?

NASOG was established in 1989, exactly a decade after the Australian College of O&G came into existence. NASOG is a not-for-profit organisation launched, at least in part, to enable specialist O&Gs to negotiate with government (and to advocate for us with other stakeholders). Its first action was to tackle the then low global obstetric fee rebate. Around 80% of College Fellows became NASOG members in the first two years after its inception. I see its support has waxed and waned depending upon what medico-political crisis is on the horizon. It serves the specific professional and political interests of all Australian O&Gs; more focused than global organisations like the AMA, with an emphasis on access and affordability of services. I stepped up and was elected to NASOG as NSW representative in 2003 during the Medical Indemnity crisis of 2001–2003. I became President of NASOG in 2009 at the height of the Safety Net dispute and found myself in Hansard records of Senate hearings only three weeks later, presenting on behalf of obstetricians, IVF doctors and our patients. In medical politics I found the purpose of my professional life with elevation to NASOG President completing the jigsaw.

What has been your experience of being a woman leader? What lessons have you learnt?

It is tricky trying to unravel the experience of being a leader versus being a woman leader.

I went into and held these positions by being myself.

Would it be different being a leader in a now female-dominant profession?

I see leadership as an exercise in citizenship, a social responsibility. I was at the time unaware of the existence of the impostor syndrome. I learned that relationships between executive members of an organisation and collaboration across organisations were powerful assets. The value of mentorship was brought to my attention by my own mentors and by my mentees who continue to open my mind to new worlds. To my absolute delight, I continue to have an influence on leaders of the next generation, mostly women, and I would be very happy if this were to be my lasting legacy.

I was preparing for this article during the (2020) Olympics and in this context note Natalie Cook, one of the gold medallist pair from Sydney 2000 in Beach Volleyball, saying (of this year's protégés ahead of their silver win) 'We laid a path that is full of belief and possibility for them.' I have an image in mind of a human gymnastic pyramid too. A repeating uplifting pattern.

What advice do you have for medical students/ interns who are interested in a career in O&G?

O&G is still the only field of medicine to offer so much diversity of opportunity – obstetrics, medicine, endocrinology, fertility services, imaging, surgery, academia and research – it has everything. There is a huge range of directions your career in O&G can take you. I would recommend exploring all opportunities including alternatives to and structures of private practice early on to get an idea of what a lifetime of O&G can look like. I would advise students to consider where they may want to settle because relocation, especially back to the city, can be difficult. I would like, however, the prospect of nonlinear training, being able to reassess and change direction. As a fertility specialist and mother, I recommend students/ trainees consider and prioritise their fertility goals. Finally, a plea to nurture your inner activist and become involved early in advocacy for yourself, your colleagues, your patients and the community.

What do you see as future challenges for O&G? Is there a role for generalist O&G in the future?

Equity is a standout; equity both in representation for O&Gs and in provision of services to women in all communities. Diversity and inclusivity go hand in hand. This challenge deserves much more emphasis than the scope of this interview allows, and there is great talent now contributing at RANZCOG to counter inequity in all forms. My pet concern is ageist sexism/ sexist ageism.

I believe we will welcome the emergence of the next female president of RANZCOG in the not-too-distant future.

The profession should be spearheading what journalist and author Gabrielle Jackson describes on the cover of her feminist volume *Pain and Prejudice* as 'a call to arms for women and their bodies' where systems have chronically underserved women, diminished and dismissed them. O&Gs are perfectly positioned to demand and craft change in a medical world where 'man is the default human being'.

I see credentialing for various aspects of O&G practice as a challenge for the future, so women may identify who has appropriate training and experience, beyond mere claims on a website!

In this age of social media, specialists will have to manage misinformation proactively to ensure that women and families are exposed to correct evidence-based material that can inform their care decisions.

I will also raise the importance of improving collaboration between specialties including colorectal surgeons, urologists, pain specialists etc so that women receive true multidisciplinary care that puts their needs at the centre. Integrated care will deliver the best outcomes for women, and it is up to O&Gs to ensure that we make this the norm.

While subspecialty training understandably gets more popular, we should acknowledge that the role of the generalist O&G is critical to delivering care, especially in rural and remote Australia.

We have a global responsibility towards improving women's healthcare

How do you balance your personal and professional life?

This was always an overriding problem for me and looms even larger in hindsight as I recognise how unreasonable much of what I endured was, undoubtedly compounded by having a partner in the same speciality with an equally demanding professional life – opposing two in five rosters, living at opposite ends of UK, a decade away from family supports while working in a rural practice, massive midcareer upheaval of relocation to Sydney and an unintended long-distance relationship. The 'on-call forever after' component of private practice was non-negotiable in trying to achieve a balance. Real-time expectations of email/phone responses took a cumulative toll before there was any allowance for telehealth.

So, 'Do what I say, not what I do'. We even ran a combined AGES-NASOG conference on Challenges in Practice 15 years ago and it is probably worth a revisit at intervals.

My book/travel group has been my escape. I have fond memories and many digital images of travel to beautiful places in pre-Covid times with a wonderful group of women and try to imagine a world in which this could happen again.

I considered alternative words for balance; perhaps integration? Poise appeals most.

What are your future plans – short and long term?

Having had a late-stage career interruption due to health matters, unexpected caring responsibilities and finally issues introduced by Covid, there sadly seems to be little prospect of my resuming clinical practice. My short-term plan is survival. Having had endometriosis for the better part of my life, I have learned that it offers no protection from additional serious medical conditions such as non-gynaecological cancer. I am now resurfacing and am ready for a 'career after a career'. I would welcome redirecting my skillset and harnessing my activism, preferably with some livelihood attached after my decade of voluntary roles in the 2000s! The position of Secretary of the Department of Health, however, is occupied! I am open to suggestions... Don't mention the R word!

I commend Dr Kirsten Connan for the initiative of *Leaders in Focus* and thank her and Dr Nisha Khot for the invitation to participate. I enjoyed the interview after a long virtual connection.

Dr Joyce has been invited to deliver the forthcoming Dan O'Connor Perpetual Lecture at AGES 2021, which will provide more insight into some of these areas.

* www.nasog.org.au

Twitter @drhilary_joyce

Editorial

Dr John Schibeci
DRANZCOG

Dr Sue Belgrave
FRANZCOG

Immediately prior to writing this précis, I was sitting in front of my open fireplace staring into the billowing, almost magical, flames in the same way as our ancestors had done over the millennia. Fire has been one of mankind's greatest discoveries – immutable, unable to be improved upon. This is in stark contrast to the rapidly changing medical landscape.

The 20th century brought us great advances in many areas of medicine, such as the discovery of X-rays, antibiotics, radiotherapy, chemotherapy, immunisation and heart surgery (to name just a few), as well as advances in surgery and anaesthesia.

John and I were interns in 1980. Simple things taken for granted today were not available to us. Blood tests were taken by students or junior doctors who had to write the patient details on forms and blood vials as there were no patient labels. There were no mobile phones or personal computers. There were pagers (bleeps) and hospital telephonists were key to the function of the hospital. Clinical diagnosis reigned supreme with only as much investigatory backup as was available in your workplace. My first year as a house surgeon was in small New Zealand city with no radiologists on site and X-ray reports arrived about three weeks after the clinical event, (eg. ?head or spinal fracture). There were no faxes, and ECGs had to be described in detail over the phone and reviewed by the senior doctor the following day. Information was from textbooks and the clinical knowledge of our seniors. In Sydney at that time there were only four CT scanners to cover the city, so their services were a premium and largely used for diagnosis of intracranial conditions with nuclear scans and air encephalograms the only other diagnostic modalities available. As a medical registrar the autopsy room was often a lunch time destination in an attempt to correlate pathology with clinical presentation, as there were no scans to back up your best diagnostic guesses.

Ultrasound, even though discovered in the 60s, was essentially only used for obstetrics, but we were actively discouraged from using it with our patients unless there was a very strong reason to do so. Fetal growth restriction for example was diagnosed using the tape measure and serial serum oestriol and human placental lactogen guided clinical decision making. Often women went through their pregnancy without a single ultrasound! At times a twin pregnancy was only diagnosed after delivery of the first baby. I delivered a second twin after the midwife had given the ecbolic on two occasions, illustrating the dangers of undiagnosed twin pregnancies.

Gynaecological diagnosis was largely via laparoscopy, which involved the surgeon looking down a telescope without magnification, using a gas machine that had difficulty maintaining an adequate pneumoperitoneum with no one else in the room seeing what was happening. Laparotomy was needed for diagnosis rather than just for treatment after appropriate imaging and blood work up.

How times have changed. Not only are mobile phones universal but ultrasound machines have contracted in size and are readily available.

We all appreciate these advances, especially to make diagnosis more accurate, but we have to remember the 'sting in the tail' that is overdiagnosis, as diagnostic modalities become more available and used for our protection, 'not missing something'. This unfortunately common situation can unnecessarily burden patients with a condition that would have left them unharmed long term.

There have been technological advances that have had major benefits for women in diagnosis and management. This is especially evident in fertility management, imaging and minimally invasive surgery with pre- and intra-operative optimisation.

Information is readily available, but it is important to understand levels of evidence and that along with good quality information there is 'fake news' with people pushing unsupported ideas. As health practitioners we have a responsibility to guide women to appropriate resources.

The information and technology explosion appears from our perspective to have negatively impacted on the importance of a thorough history from the woman and her family with examination to confirm or deny possible diagnoses and then to clarify with investigations. Effective communication remains our most valuable clinical tool.

This issue of *O&G Magazine* takes us out of an age where medicine was an art to where medicine has become more scientific, enhanced by technology in its exponential advance. Technology is not just machines, it's also chemistry, physics, computing and social expectations. Hence, we have articles on advances in surgical techniques such as laparoscopy and endometrial ablation (machines); articles on NIPT and PERT prediction (chemistry); an article on interventional radiology made possible by the ability to produce smaller and smaller tubes (physics and chemistry); articles on AI and technologies we take for granted (computing) and an article on educational apps (social expectations and computers). To protect our careers, there is also a great article on the ethics of innovation and the associated legal considerations .

We finally would like to thank the authors and the time and effort they put into educating us all.

Machine learning and clinical medicine

Dr Nathasha Wijesiriwardana
BSc, MBBS, DRANZCOG
Barwon Health

In 1950, Alan Turing suggested *The Imitation Game*, a test of whether a machine can exhibit intelligence indistinguishable from that of a human. Five years later, the term artificial intelligence (AI) was first used by John McCarthy in the description of a field dedicated to the creation of intelligent machines. Today, AI is a rapidly evolving field with many subsets, the majority of which apply machine learning (ML), a technique by which a computer can learn to perform a task without explicitly being taught how to. The numerous applications of ML include fields such as natural language processing, speech recognition and modern computer vision. These are already part of our daily lives: in your smartphone you will find examples in the way of predictive text, virtual assistants and face recognition. Many scientific disciplines have benefited from the rise of deep learning (DL), a subset of ML that focuses on the use of large artificial neural networks, allowing for processing of data on greater scales and at more complex levels [Figure 1].[1,2]

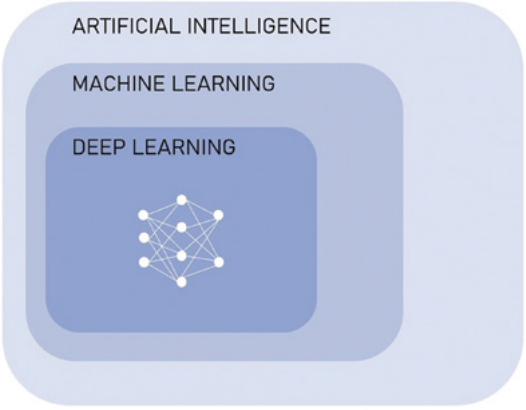


Figure 1. Relationship between AI, ML and DL.

Healthcare providers now appreciate that this technology can be utilised in clinical medicine to enhance the way we diagnose, make decisions and treatment plans, as well as monitor and predict outcomes. There has been an exponential increase in research related to medicine and AI over the past decade, with a significant contribution by radiology and ophthalmology.[1,3] Image interpretation relies greatly on pattern recognition and this, in combination with the availability of large databases of images, creates an ideal environment in which to apply DL in the field of computer vision.[1] A 2021 Australian survey highlighted that 15.7% of ophthalmologists and 6.1% of radiologists reported the use of AI in their daily clinical practice.[3]

Similar to image interpretation, CTG analysis is heavily based on pattern recognition and with high inter-clinician variability, is a task where AI could standardise and assist in decision making. ML for CTG interpretation has been examined as early as 1989, with many of the more recent algorithms demonstrating high accuracy comparable to clinician interpretation.[2] However, when applied, a significant difference in neonatal outcomes is yet to be demonstrated and it is likely to be some time before it is available in daily clinical practice.[2,4] It is important to note that, aside from the potential to enhance knowledge and improve outcomes, AI has a role to play in increasing efficiency and automating tasks.

In a global setting, where cervical cancer is a major public health problem, AI may be applied in diagnostics to assist the process of cervical screening, especially where access to laboratory resources is limited. DL analysis of digitalised cytology could be impactful in this situation, and there have been promising results in testing of algorithm accuracy, as well as practical application in a low-income setting.[5,6] Further to this, automated visual evaluation is also being examined in the analysis of cervical photography to detect pre-cancerous change.[7] Ongoing development of this could allow for efficient point-of-care testing with simple equipment and rapid availability of results.

ML can also be used to make predictions, which may assist in individualised risk assessment. An Australian group created a DL algorithm which was able to predict up to 45% of stillbirths in the test population, based on background characteristics and antenatal complications.[8] Another study included fetal biometry and umbilical artery doppler measurements in addition to demographics, which enabled prediction of 75% of stillbirths secondary to impaired placentation.[9] There are many models utilising DL for stillbirth prediction, which will require ongoing collaborative research and consideration as to how they might influence antenatal monitoring and intervention.

The above examples highlight that there are, of course, many barriers to the practical application of AI in medicine, including economic and ethical implications. One main reason why medicine may be

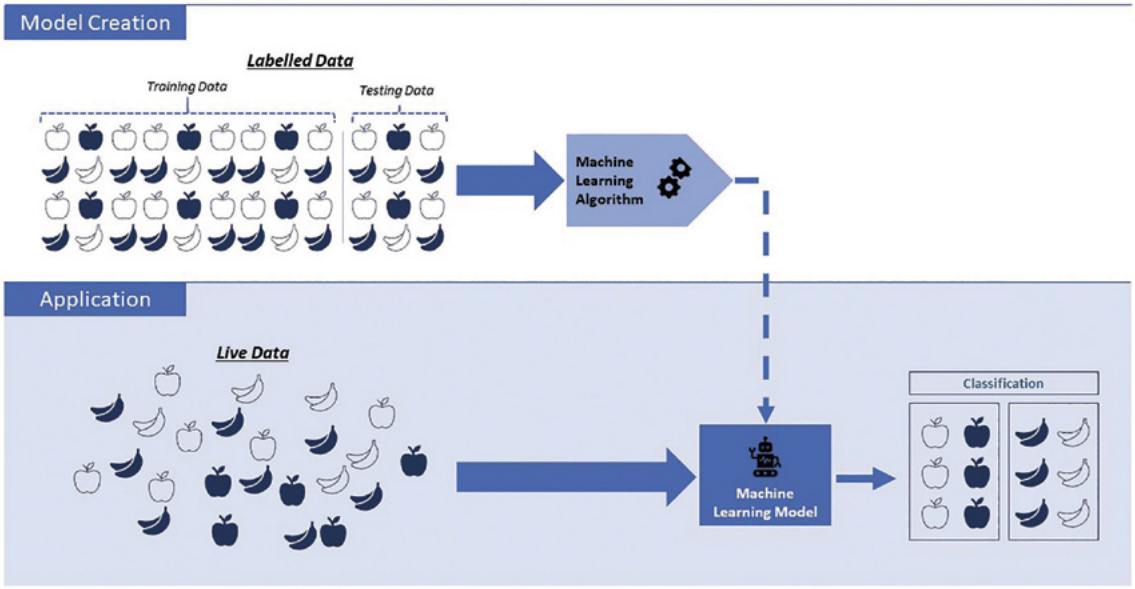


Figure 2. Representation of supervised ML.

hesitant to accept this technology in clinical practice is the lack of explainability, or the 'black box' nature of DL models.[1] These algorithms are often extraordinarily complex, to the extent that the process of obtaining a result or outcome cannot be interpreted, and the model cannot explain itself. Without this understanding, to what extent can we comprehend and apply this information, or explain it? 'Dr Roboto says so' is not an ideal answer and highlights why this technology can be considered more of an adjunct than a replacement.

This links into another major concern, which is the potential for bias. Most ML models in medicine utilise supervised learning, meaning that the system uses training data that has been labelled by humans, and is therefore both limited and subject to human influence [Figure 2].[1,2] Further, ML systems in numerous fields have been found to exhibit sex, race, social and other biases, which often stem from underrepresentation or misrepresentation in the underlying data.[10] An example is of Amazon's ML hiring system, which, largely due to existing male dominance in the technology industry, was actively penalising female and preferentially selecting male applicants.[11] It is known that sex-based bias is an ongoing issue in medical research but with regards to AI, a model presented with an imbalanced dataset can make skewed decisions that become lost in the 'black box', which are especially difficult to identify and can result in potentially unrecognised underperformance in relation to that group. Bias needs to be carefully anticipated and addressed in AI research so that in application, it does not further perpetuate or widen existing disparities.

There are a great number of potential applications of AI to O&G – further examples of current research areas include algorithms for prediction of preterm labour, gestational diabetes and IVF outcomes, ovarian cancer screening and prognostication, visual evaluation to aid embryo selection, and many more.[12] ML algorithms will continue to improve with more time and data, and, when it comes time for incorporation into practice, it will ultimately be up to clinicians to ensure safety and applicability. It will be our responsibility to understand the principles which will enable us to assess, enhance and then one day welcome this technology.

Special thank you to Danny for verifying the technicalities, and to Marilla for her enthusiasm!

References

1. Drukker L, Noble JA, Papageorghiou AT. Introduction to artificial intelligence in ultrasound imaging in obstetrics and gynecology. Ultrasound Obstet Gynecol. 2020;56:498-505.
2. Garcia-Canadilla P, Sanchez-Martinez S, Crispi F, et al. Machine Learning in Fetal Cardiology: What to Expect. Fetal Diagn Ther. 2020;47:363-372.
3. Scheetz J, Rothschild P, McGuinness M, et al. A survey of clinicians on the use of artificial intelligence in ophthalmology, dermatology, radiology and radiation oncology. Sci Rep. 2021;11(1):5193.
4. Balayla J, Shrem G. Use of artificial intelligence (AI) in the interpretation of intrapartum fetal heart rate (FHR) tracings: a systematic review and meta analysis. Arch Gynecol Obstet. 2019;300(1):7-14
5. Bao H, Sun X, Zhang Y, et al. The artificial intelligence-assisted cytology diagnostic system in large-scale cervical cancer screening: A population-based cohort study of 0.7 million women. Cancer Med. 2020;9(18):6896-6906.
6. Holmström O, Linder N, Kaingu H. Point-of-Care Digital Cytology With Artificial Intelligence for Cervical Cancer Screening in a Resource-Limited Setting. JAMA Netw Open. 2021;4(3):e211740.
7. Hu L, Bell D, Antani S, et al. An Observational Study of Deep Learning and Automated Evaluation of Cervical Images for Cancer Screening. J Natl Cancer Inst. 2019;111(9):923-932.
8. Malacova E, Tippaya S, Bailey HD, et al. Stillbirth risk prediction using machine learning for a large cohort of births from Western Australia, 1980–2015. Sci Rep. 2020:10(1);5354.
9. Akolekar R, Tokunaka M, Ortega N, et al. Prediction of stillbirth from maternal factors, fetal biometry and uterine artery Doppler at 19-24 weeks. Ultrasound Obstet Gynecol. 2016:48(5);624-630.
10. Cirillo D, Catuara-Solarz S, Morey C, et al. Sex and gender differences and biases in artificial intelligence for biomedicine and healthcare. NPJ Digit Med. 2020;3:81.
11. Goodman, R. Why Amazon's Automated Hiring Tool Discriminated Against Women. American Civil Liberties Union. October 12, 2018. Available from: www.aclu.org/blog/womens-rights/womens-rights-workplace/why-amazons-automated-hiring-tool-discriminated-against.vano
12. Iftikhar P, Kuijpers MV, Khayyat A, et al. Artificial Intelligence: A New Paradigm in Obstetrics and Gynecology Research and Clinical Practice. Cureus. 2020;12(2):e7124.

Technology we take for granted

Dr Wendy Burgess
FRANZCOG
Ngāti Kahungunu, Ngāti Hawea
Obstetrics and Gynaecology Specialist
Waitematā DHB

Dr Maneesh Deva
General Paediatrician
Clinical Lead Innovation i3
Waitematā DHB

From the original technological invention of the forceps by the Chamberlen brothers in the 17th century,[1] there has been continual development in obstetrics and gynaecology technology.

Technology we take for granted can allow more to be done for less cost, more to be done with less harm and more to be done than can be imagined. Technology is big business, in 2019, the global medical devices market reached a value of nearly $457 billion US dollars.[2]

This year marks 50 years of email. Although many of us curse our inboxes at times, email allows collaboration and real-time discussion, resulting in swift developments while saving trees.

Telehealth is clearly improving access and equity for rurally isolated families, to be able to access tertiary level advice in their own homes, but also reducing the cost from a half-day loss of productivity for a single medical appointment.

But with only 88% of Australia with mobile phone or internet access,[2,3] we need to be mindful of this equity gap, and that those already disadvantaged, are not made more so.

Patient benefits

Women now have immediate access to up-to-date information about their health via the internet. They are able to connect with support groups and peer counselling via social media. There are apps for self-management and apps for new interventions, there is even an app to connect to a pelvic floor trainer, thefemfit.com.

Wearable devices are everywhere, telling you, and your provider, your physiology state every minute of the day. The ubiquity of wearables (and their data) are expected to aid the likes of Apple, Google et al in further enhancing their digital profile of you, your kids and probably your household cat. The ongoing land grab for peoples 'big data' has been in full swing for several years and only recently have governments sought some regulation and controls with debatable results. The rabbit hole we all may be heading into with this is less clear with the emergence of artificial intelligence (AI).

Dr Michael Wynn-Williams operating in 2015.

Master John Banister delivering an anatomical lecture.

AI is currently seen in medicine with visual recognition in reading pathology and radiology films, performing advanced triage tasks and data prediction models. Where AI may lead us down from here asks several questions of how we manage healthcare and what we value: equity over efficiency? Safety over innovation? Disparities over invention? None of these answers are clear at this stage, but there is significant thought currently taking place around the world and how best to step into this new brave world. As obstetricians, there is a high degree of scrutiny of our work given the high stakes environment. Who should be accountable (or liable) when an AI system is involved in patient care? It is a question that is currently in its fetal stage of development.

Continued education benefits

No longer do we need to subscribe and wait for our quarterly journals to arrive. We can now set up a program like *Read by QxMD*, which will identify and notify you of articles, from a variety of journals, personalised to you. We can soon expect that AI will be an important tool in scouring medical journals to assist busy clinicians with acquiring new knowledge, new information and new opinions. Twitter is currently a wonderful tool where the convergence of humans and technology algorithms meet in both enlightening and disastrous ways, #Medtwitter. And for all of us time-poor, we can utilise commuting time by listening to medical podcasts that may keep us up to date, and review the latest published work while we sit back and take it in.

Training benefits

Where once we would gather around an operating table to catch a glimpse of the professor operating, we can now access repositories of surgical video sites from favourite local surgeons or international sites like *WebSurg*, entirely for free. These videos mean you can see exactly what they see with real-time commentary, pause and replay as necessary. Accompanied by laparoscopic trainers, both low and high fidelity, trainees and up-skilling consultants can learn within the safety of simulation.

Surgery made easier

We cannot forget that it was gynaecology that first developed laparoscopy, which has now progressed to single-port operative systems and the use of self-contained extraction systems meaning that 20cm specimens can be removed through a 3cm hole with knife morcellation or even a 12mm hole with a power morcellator.

Continuing improvements to equipment are producing better ergonomic devices. Surgical aides that we once dreamed of are available. For example, IGC fluorescence enhancement is improving lymph node dissection, and illuminating urethral catheters are a pelvic surgeon's godsend.

I am always reminded whenever I watch our general surgery colleagues, that we don't always utilise even the simple technologies at hand. Like the anti-fatigue mats to stand on, or putting on a headlamp. The surgeons also make better use of the external retractor systems when we struggle through our self-retainer.

Care made easier

Europe has licenced the use of continuous glucose monitoring and insulin pumps for gestational diabetes. These devices are so popular and convenient now, individuals are building and programming their own insulin regimens.

Once bulky $20k machines are reduced to an ultrasound probe that fits in your pocket and connects to your phone.

Platforms like Surgical Performance makes surgical logging and auditing effortless. It tracks your complications and benchmarks you against your fellow surgical community.

The artificial placenta,[5] 60 years in the making but currently limited to lambs, is headed towards eventual human participants. Also currently limited to the lamb intensive care unit are the locally developed monitoring devices assessing novel biomarkers of fetal distress that may one day obviate the need for current CTG and fetal scalp lactate monitoring.[6]

Community benefits

Some technology is translating from other industries, such as the pasteurisation of breast milk, which has led to the establishment of non-profit breast milk banks benefiting preterm babies across Australasia.

- Canterbury, NZ: www.cdhb.health.nz/health-services/human-milkbank
- Victoria: Mercy Health Breastmilk Bank
- Queensland: Royal Brisbane and Women's Hospital Milk Bank
- Queensland and northern New South Wales: Mothers Milk Bank Charity
- NSW: Royal Prince Alfred Hospital
- Western Australia: PREM Milk Bank
- South Australia and New South Wales: The Australian Red Cross Lifeblood's Milk Bank

The future

This leaves us to think, what else is possible? I imagine a 4D ultrasound scan that wraps around the pregnant pelvis in labour. It is able to precisely determine the anatomical landmarks of the fetal skull and maternal pelvis. It can tell cervical dilation, head position, and station. And when predetermined criteria are met, a robotic arm with a vast array of responsive sensors, made of a material yet to be discovered, attaches itself exactly on the vertex, distributing force to eliminate any trauma. With AI receptive learning, the arm then pulls with the perfect amount of traction in the necessary directions to allow optimal delivery. No longer the need for the Chambelens secret, and thereby the role of delivery room obstetrician becomes obsolete.

References

1. Dunn PM. The Chamberlen family (1560–1728) and obstetric forceps. *Archives of Disease in Childhood - Fetal and Neonatal Edition*. 1999;81:F232-F234.
2. Burke H. Who are the top 10 medical device companies in the world? Proclinical Blogs, 2020. Available from: www.proclinical.com/blogs/2020-9/who-are-the-top-10-medical-device-companies-in-the-world
3. Deloitte. Mobile Consumer Survey: The Australian Cut. 2017. Available from: www2.deloitte.com/au/mobile-consumer-survey
4. Kemp S. Data Reportal. https://datareportal.com/reports/digital-2020-australia
5. De Bie FR, Davey MG, Larson AC, et al. Artificial placenta and womb technology: Past, current, and future challenges towards clinical translation. *Prenatal Diagnosis*. 2021;41:145–58.
6. RANZCOG Virtual ASM 2021 – Fiona Brownfoot, Fetal Monitoring in Complex Pregnancies.

Predicting preeclampsia

Dr Gabriel Jones
BSc (Hons), MD
DPhil (Oxon) Candidate
University of Oxford
Nuffield Department of Obstetrics & Gynecology
John Radcliffe Hospital, Headington,
Oxfordshire, UK

Prof Shaun Brennecke AO
BA, BMedSci (Hons), MB BS, DPhil (Oxon),
FRANZCOG
Director, Department of Maternal-Fetal Medicine
Royal Women Hospital, Parkville, Victoria,
and University of Melbourne,
Department of Obstetrics & Gynaecology

Preeclampsia is the most common serious medical disorder of human pregnancy.

It remains a common cause of maternal and perinatal morbidity and mortality both nationally and internationally.

In the absence of a clear and specific molecular or genetic aetiology, the definition of preeclampsia remains a syndromal one, involving an agreed upon collection of clinical features. These are pregnancy-induced hypertension (BP ≥140/90) accompanied by at least one of the following new-onset conditions at or after 20 weeks of pregnancy:

- proteinuria
- maternal organ dysfunction (eg. renal, hepatic, neurological and hematological complications)
- and/or uteroplacental dysfunction (eg. fetal growth restriction)[1]

A major historical justification for undertaking antenatal care (and one which remains relevant today) has been screening for preeclampsia by measuring blood pressure at routine clinical visits. This approach facilitates the eventual diagnosis of preeclampsia but does not lend itself to predicting or preventing the condition.

Recent advances in early pregnancy multiparametric screening technology and the discovery of circulating placental factors involved in the pathogenesis of preeclampsia now offer opportunities to correct this shortcoming and allow a major pregnancy care recalibration in favour of preeclampsia prediction (and thus prevention) rather than diagnosis.

The placental circulating factors are:

- soluble fms-like tyrosine kinase 1 [sFlt-1] (which increases in the maternal blood stream in advance of the clinical appearance of preeclampsia), and
- placental growth factor [PlGF] (which decreases in the maternal blood stream in advance of the clinical appearance of preeclampsia)[2,3]

These molecules can be measured in plasma and serum on automated laboratory platforms and are usually reported as a ratio of sFlt-1/PlGF (herein called the **P**re**E**clampsia **Ra**a**T**io or PERT test).

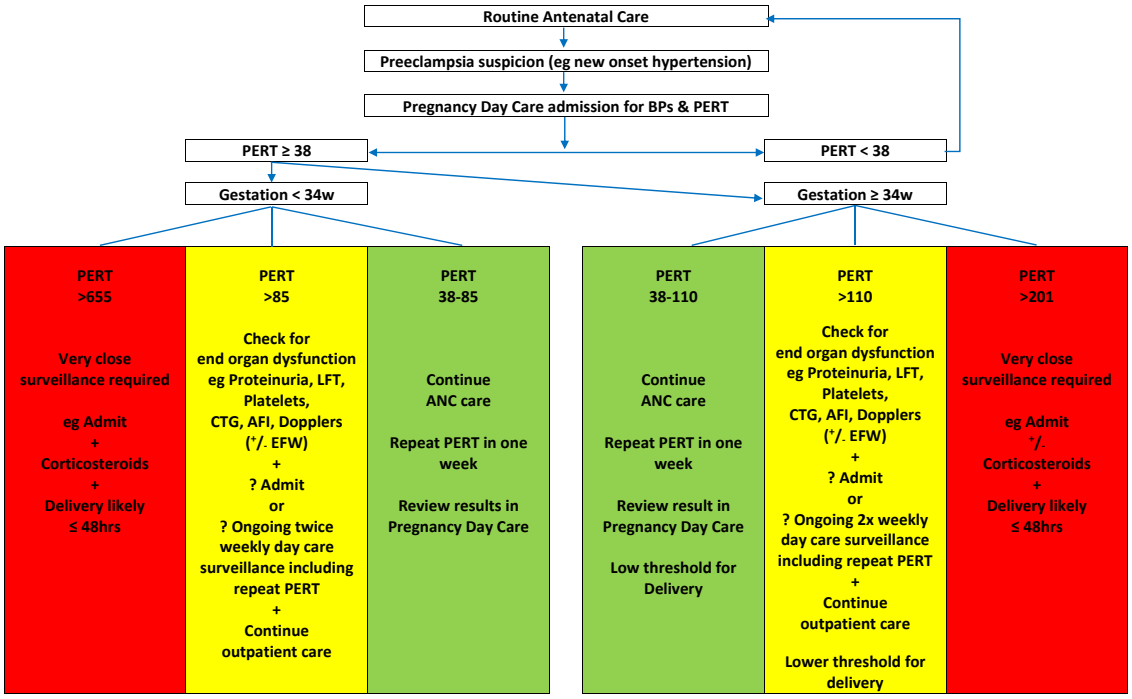
While acknowledging that these new preeclampsia prediction technologies are not yet widely available in Australia and New Zealand, their description in this article is aimed at providing some helpful background information in anticipation of their increased availability in the near future.

Table 1. Risk factors for preeclampsia.

A past history of placental-dysfunction-related disease, including preeclampsia, fetal growth restriction and placental abruption
Chronic hypertension
Chronic kidney disease
Multiple pregnancy
Type I or II diabetes mellitus
Systemic lupus erythematosus/other autoimmune disease
Advanced maternal age (over 40 years)
Pregnancy interval of more than 10 years
First pregnancy
History of thrombophilia
Family history of preeclampsia
New paternity
Obesity

Figure 1.

CLINICAL PRACTICE GUIDELINE FOR USE OF THE PREECLAMPSIA RATIO TEST (PERT) FOR MANAGEMENT OF SUSPECTED PREECLAMPSIA IN A PREGNANCY DAY CARE SETTING



Early pregnancy prediction

Late first trimester screening from 11–14 weeks' gestation using the Fetal Medicine Foundation (FMF) algorithm (derived from maternal history, mean arterial pressure [MAP], uterine artery pulsatility index [UTPI] and serum PlGF [or PAPP-A when PlGF is not available]) allows for significantly better early detection of pregnant women at increased risk of later pregnancy preeclampsia than relying on maternal risk factor assessment alone (see Table 1), though such clinical assessment is helpful in selection of cases for early screening.[4,5]

Importantly, this early identification of women considered to be at high risk of developing preeclampsia allows them to receive prophylaxis with low dose aspirin (eg. 150 mg daily, taken at night) in a sufficiently timely fashion to significantly reduce their risk of disease, particularly early onset and preterm preeclampsia.[6,7]

Mid-pregnancy prediction

Second trimester (19–24 weeks) screening using the FMF algorithm has also been demonstrated in an Australian population to be effective in identification of women at risk of preterm preeclampsia.[8] While detection of this group may be too late for full prophylactic efficacy of low dose aspirin, increased pregnancy care surveillance and use of the PERT test (see below) allows for appropriate clinical vigilance as their pregnancies progress.

Later pregnancy prediction

In the latter half of pregnancy, increasing evidence is demonstrating the clinical utility of the PERT test in the prediction, diagnosis, differential diagnosis and management of preeclampsia.

In the PROGNOSIS trial, which studied 1050 women with suspected preeclampsia, a PERT result of ≤38 ruled out preeclampsia within one week with a negative predictive value of 99.3% and within four weeks with a negative predictive value of 94.3%. A PERT result >38 ruled in preeclampsia within four weeks with a positive predictive value of 36.7%.[9]

Similar results have been reported in other studies involving different populations, and the PERT test has also been shown to assist triage towards appropriate hospitalisation in women with suspected preeclampsia (references available on request).

These studies support the use of the PERT test for stratifying pregnant women with suspected preeclampsia into a low-risk group who can safely continue with routine outpatient antenatal care and a high-risk group who require increased maternal and fetal welfare surveillance, possibly as inpatients. Such stratification optimises patient satisfaction and cost-effective use of hospital resources.

An example of a clinical practice guideline for use in a pregnancy day care setting when performing the PERT test is provided in Figure 1, and Table 2 provides some illustrative case scenarios.

Local and international experience with the PERT test (references available on request) also supports its value:

1. in the surveillance of **asymptomatic women** at high risk of preeclampsia. For example, women who have a predicted high risk for preeclampsia on history or using the FMF late first trimester algorithm may be followed with monthly PERT tests from 20 weeks, even if they are asymptomatic. Under these circumstances, a PERT test result of <38 is very reassuring for

both the patient and her clinician.

2. in assessing the **severity** of preeclampsia. The higher the PERT result, the higher the risk of maternal complications such as acute lung oedema, HELLP syndrome, placental abruption, renal failure or refractory hypertension. The PERT test can also be useful in predicting fetal outcomes related to growth and prematurity of the baby.
3. in assessing the **rate of progression** of preeclampsia. The rate of change of PERT levels is an important marker for the progression of disease. A rapid increase in PERT results points to a worsening of the clinical situation, including earlier onset disease, placental dysfunction associated with fetal growth restriction, a shorter interval to delivery and more adverse outcomes, although this does not necessarily mean that immediate delivery is always necessary.
4. in the **differential diagnosis** of conditions which mimic preeclampsia, including non-HELLP thrombocytopenia, chronic hypertension, chronic kidney disease (eg. lupus nephritis, diabetic nephropathy, renal transplant), migraine headache or other types of chronic headache, obese patients with fatty liver of pregnancy who may have transaminitis.
5. in predicting the risk of adverse outcomes in high-risk pregnancies with **comorbidities** such as autoimmune diseases (systemic lupus erythematosus, the anti-phospholipid syndrome) and diabetes. The PERT test can discriminate between placental dysfunction and other complications related to comorbid disease (eg. lupus-flare, lupus nephritis).
6. as a **superior predictor** of preeclampsia compared to other biochemical (eg. uric acid, liver enzymes, urinary protein) and haematological (eg. haemoglobin, platelets) tests.
7. in **twin pregnancies**, which carry twice the risk of developing preeclampsia compared to singleton pregnancies. While the PERT test provides prognostic and diagnostic information in such pregnancies, variations in the PERT normal ranges between singleton and twin pregnancies mean the use of the ratio test beyond 30–32 weeks is less discriminatory for preeclampsia in twin pregnancies than when used in singletons.
8. in stratifying **small for gestational age** fetuses into healthy small babies and those with fetal growth restriction secondary to chronic placental insufficiency.
9. for management planning and decision making relating to **delivery timing**.
10. as a **cost-effective adjunct** for the clinical management of preeclampsia in a range of healthcare settings.
11. as a possible point-of-care test in **low- to middle-income health care settings** to identify those pregnant women who can safely remain in their local environments and those who need transfer to higher levels of maternity care.
12. in the selection of participants for **clinical trials** of preeclampsia management by identifying patients at higher risk of developing preeclampsia and thereby facilitating more cost-effective study recruitments of sufficient sample sizes.

Table 2. Illustrative case scenarios.

Case 1: 26 yo, G1P1, BMI 25 Pregnancy -> uneventful until 33/40; c/o increased oedema; BP 135/85, urinalysis = nad; PERT 145; increased antenatal surveillance (twice weekly short stay pregnancy day care reviews); PE diagnosed at 35/40; delivery at 36/40 for worsening PE.
Case 2: 33 yo, G2P2, BMI 27 First pregnancy -> delivery at 30/40 with severe PE and FGR. Second pregnancy -> much anxiety; LDA from 10/40; monthly PERT testing from 22/40; All PERTs < 38; anxiety much relieved; outpatient antenatal care only; -> delivery at term.
Case 3: 35 yo, GIP1, BMI 38 Pregnancy -> GDM at 28/40; borderline HT 140/85 at 31+1/40; PERT = 902!; urgent scan -> previously unsuspected severe FGR (<3rd percentile); immediate admission, corticosteroid therapy; delivery at 31+3; BW = 1130 g; baby discharged home after five weeks of neonatal care weighing 2274 g.
Case 4: 40 yo, G1P1, BMI 30; IgA nephropathy; LDA from 12/40 Pregnancy -> persistently borderline HT and urinalysis ++/+++ throughout pregnancy; monthly PERT testing from 20/40; All PERTs < 38; no superimposed PE; delivery at term.

Conclusion

New technologies for identifying women at risk of developing preeclampsia promise to facilitate improved maternal and perinatal outcomes in this high-risk group. Just as importantly, these technologies will also allow women identified as low risk to safely minimise unnecessary interventions during their pregnancies.

References

1. Brown MA, Magee LA, Kenny LC, et al. Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. *Hypertension*. 2018;72(1):24–43.
2. Maynard SE, Min JY, Merchan J, et al. Excess placental soluble fms-like tyrosine kinase 1 (sFlt1) may contribute to endothelial dysfunction, hypertension, and proteinuria in preeclampsia. *J Clin Invest*. 2003;111(5):649-658.
3. Levine RJ, Maynard SE, Qian C, et al. Circulating angiogenic factors and the risk of preeclampsia. *N Engl J Med*. 2004;350(7):672–683.
4. Fetal Medicine Foundation. Risk for preeclampsia. 2021. Available from: https://fetalmedicine.org/research/assess/preeclampsia/first-trimester. Accessed 05 February 2021.
5. Park FJ, Leung CH, Poon LC, et al. Clinical evaluation of a first trimester algorithm predicting the risk of hypertensive disease of pregnancy. *ANZJZOG*. 2013;53(6):532-9
6. Rolnik DL, Wright D, Poon LC, et al. Aspirin versus placebo in pregnancies at high risk for preterm preeclampsia. *N Engl J Med*. 2017;377(7):613–22.
7. Park F, Russo K, Williams P, et al. Prediction and prevention of early-onset pre-eclampsia: impact of aspirin after first-trimester screening. *Ultrasound Obstet Gynecol*. 2015;46(4):419-23
8. Black C, Rolnik DL, Al-Amin A, et al. Prediction of preterm pre-eclampsia at midpregnancy using a multivariable screening algorithm. *ANZJZOG*. 2020;60(5):675-82.
9. Zeisler H, Llurba E, Chantraine F, et al. Predictive value of the sFlt-1:PlGF ratio in women with suspected preeclampsia. *N Engl J Med*. 2016;374(1):13–22.

Laparoscopic surgery and technology

Dr Katie Christensen
BSc, MBBS, MHM, FRANZCOG

Dr Tal Jacobson
MA, MBBS, FRCOG, FRANZCOG

Driving a 20-year-old ago car is still a similar experience to driving a modern car, but the incremental addition of technologies such as ABS brakes, traction control, air bags, satellite navigation, adaptive cruise control, lane keeping and parking assist (to name just a few) has led to a safer and more refined driving experience. Similarly, modern laparoscopic surgery has benefited from multiple incremental developments, but the benefits and limitations remain the same today as they did 20 years ago.

Laparoscopic surgery has been used in gynaecology for over 50 years.[1] As technologies have advanced, it has become the standard of care for many benign and malignant gynaecological conditions, allowing increasingly complex procedures to be performed with less morbidity than traditional open approaches. It is difficult to isolate a single aspect of laparoscopic surgery whose technological progress has dramatically changed outcomes for patients or surgeons; rather, there has been incremental progress across a myriad of components that together have expanded the horizons of what is achievable through a minimally invasive approach.

Some of the important areas of recent progress in laparoscopic surgery have been in the fields of camera technologies, robotics, laparo-endoscopic single site (LESS) surgery and electrosurgical instruments. The range of complementary technological advances that have allowed surgeons to optimise these things, however, is vast, and includes advances in technologies such as simulation, virtual reality, entry methods, anti-adhesion products, anti-slip and patient positioning products, sutures, gas humidification and warming, and tissue extraction methods. In many cases, the benefits of a particular new technology can only be realised when other complementary technologies have advanced sufficiently to support it, and a lack of suitable supporting products can be one of the reasons new technologies fail or that implementing them can become prohibitively expensive.

There are other challenges, too, for new technologies to be successfully adopted and implemented. Many gynaecologists may have been made wary in recent times through experiences with technologies where issues emerged over time, such as meshes, hysteroscopic ablative and sterilisation procedures, or morcellation technologies, and this can discourage clinicians and health services from trialling new products. Additionally, cost is one of the most important factors that drives decision making at an organisational level, and being able to demonstrate improvements in patient outcomes is critical in making a case for innovation, yet it is difficult to study the incremental benefit of any one technology in a landscape of constant innovation and change.

Camera systems

There are a range of advances in camera technologies that have progressed the capabilities of laparoscopic surgery, such as 4K and 3D video imaging systems, integrated operating theatres, integration with virtual reality and artificial intelligence applications, and the ability to utilise enhanced imaging techniques such as near-infrared (NIR) fluorescence imaging with indocyanine green (ICG) during laparoscopic procedures.

One of the fundamental challenges of performing laparoscopic surgery is adapting to a two-dimensional representation of a three-dimensional space, and depth perception becomes especially important with increasingly complex procedures. Most 3D systems for laparoscopic and robotic surgery utilise dual-channel laparoscopes to provide two vertically separated images that, when viewed through specialised lightweight glasses, simulates the binocular imaging provided by two laterally separated eyes. The resultant visual effect, called stereopsis, is the perception of depth due to the

disparities in the two images, and it is used by most surgeons during open surgery, but is lost when using a standard 2D laparoscope.[2] In a simulation environment, 3D laparoscopic systems have been shown to shorten the learning curve for junior trainees performing standardised tasks on a box trainer, with fewer errors and faster operating times.[3] Outside of the simulation environment the evidence is less robust, but pooled data across all surgical specialties suggests a shortened operative time and fewer complications with 3D systems. Specifically in gynaecology, there is evidence that 3D systems produce shorter operative times for more complex procedures such as those requiring suturing. 3D systems do have some pitfalls, however. Up to 30% of the general population and nearly 10% of surgeons are stereo blind, and therefore would not benefit from this technology.[3] Additionally, 3D systems can increase visual fatigue, headaches and discomfort, and there are no prospective studies or RCTs directly regarding their cost.[2]

In contrast, 4K (or 'ultra-high definition') systems produce a 2D image but one with four times the number of pixels of standard high-definition systems. While these images lack the ability to provide binocular cues for depth perception in the same way that the images from 3D systems can, the improvements in picture quality allow for an enhancement of monocular depth cues that improves performance to a similar degree as 3D laparoscopic systems.[2,4] They do not require the user to wear any special glasses, simplifying their introduction and use in a surgical environment. Currently there are several head-to-head studies underway comparing the benefits of 3D and 4K imaging systems in laparoscopic surgery.

There are a range of other enhanced imaging techniques that can be used in gynaecologic laparoscopy for both benign and malignant conditions. In endometriosis surgery, various techniques have been used to map the borders of deep infiltrating endometriosis nodules including 5-aminolevulinic acid-induced fluorescence, autofluorescence imaging, methylene-blue, narrow-band imaging and NIR imaging using ICG.[5] NIR-ICG has been shown to be useful in defining the border between endometriotic nodules and healthy tissue, but data regarding its diagnostic value for less severe endometriosis has been mixed.[6,7] NIR-ICG has a range of other applications in laparoscopic surgery, and in particular has been used for sentinel lymph node mapping in gynaecologic cancers.[8]

Robotics

Robotic assisted surgery (RAS) has become increasingly popular in gynaecology, especially in the US, where nearly half of all laparoscopic hysterectomies are performed using some robotic assistance.[9] Robotic systems incorporate a mechanical robot which operates the camera and surgical instruments, and a separate console from which the surgeon operates. In addition to the technology involved in the mechanics of the robot itself, they integrate other technological advances used in conventional laparoscopy such as 3D cameras, articulated instruments and advanced electrosurgical devices, and are capable of single-incision surgery. They require a significant outlay for the acquisition of the robotic system, as well as additional training for the surgeon and theatre staff. Purported benefits over conventional laparoscopy include 3D vision, articulated instruments with greater freedom of motion, more precise dissection, tremor filtration and a shorter learning curve.[10] These advantages may allow surgeons to complete more difficult cases with robotic assistance than would have been possible laparoscopically, but when compared directly with conventional laparoscopy, the evidence supporting a benefit for patients is limited. Regarding hysterectomy, a 2019 Cochrane review found that there was a lack of high-quality evidence to support any difference between conventional laparoscopy and RAS, but that there was no demonstrable difference in intraoperative or postoperative complications, with a longer operating time in the robot-assisted group (mean difference 41 minutes) and a shorter mean length of hospital stay for RAS patients by 0.3 days.[10]

Electrosurgery

Electrosurgical and other energy systems
A number of developments in electrosurgery have led to improved safety and efficacy. Isolated electrosurgical units without reference to ground are much safer than the original ground referenced generators. Active electrode monitoring minimises the risk of burns from stray currents and damaged instruments. Tissue sealing technologies assess the impedance of tissue as the diathermy is activated to provide the optimal amount of power for vessel sealing with minimal thermal spread. The use of ultrasonic energy systems such as the harmonic scalpel provides a reliable and safe alternative to electrosurgery, and in some instruments such as the Thunderbeat (Olympus) both electrosurgical and ultrasonic modalities have been combined

LESS surgery

Laparo-endoscopic single site (LESS) surgery is not new to gynaecology, being used for tubal sterilisation for around 50 years.[11] The premise is to utilise multiple ports or instruments through a single incision, avoiding the additional morbidity of each subsequent port. It can hardly be described as a new technology, but rather is finding new applications as other technologies advance in the field of minimally invasive surgery, allowing increasingly complex procedures to be performed using a single incision. The range of gynaecologic procedures able to be performed using LESS includes hysterectomy, adnexal procedures, pelvic lymphadenectomy and resection of endometriosis.[12] The use of bariatric length and angled laparoscopes and articulated instruments can help to overcome the challenges of instrument crowding and lack of triangulation that can limit the functionality of LESS.[13] More recent progress in the space of LESS has been in combining it with robotic surgery (R-LESS) or natural orifice transluminal endoscopic surgery (NOTES), which when performed vaginally is known as vNOTES. There is growing experience with vNOTES to perform a range of gynaecological conditions including myomectomy, adnexectomy, sacrocolpopexy, tubal re-anastomosis, pelvic lymph node dissection and hysterectomy.[14] Data supporting the benefit of vNOTES over conventional laparoscopy is lacking, however, with research so far focusing on reporting the feasibility and safety of this approach. In terms of robotics, the da Vinci SP™ utilises a single port rather than a conventional multi-port platform. Data thus far supports that R-LESS surgery is safe and feasible, and has equivalent outcomes to multiport robotic surgery with less scarring, but high-quality comparative studies are needed before its superiority over other approaches can be assumed.[15]

The future

The next revolutionary step for cars will be fully autonomous self-driving. This has taken longer than expected but is likely to be available in several countries within the next decade. The next big development step for laparoscopic surgery will be robotic surgery with artificial intelligence assisting the surgeon to minimise complications. Perhaps the robot will be able to advise the surgeon that there is an 87% chance that the structure they are about to cut is the ureter and ask them to confirm that they wish to proceed before allowing it! Subsequent development of a fully autonomous surgical robot is currently science fiction, but may not be as far away as we think.

Conclusion

Surgery has developed in an evolutionary, rather than revolutionary way. The implementation of new technologies has allowed surgeons to develop new techniques and procedures with increased safety and reliability.

References

1. Wheeless CR. Anesthesia for diagnostic and operative laparoscopy. *Fertility and Sterility*. 1971;22(10):690–4.
2. Yim C, Lo CH, Lau MH, et al. Three-dimensional laparoscopy: is it as good as it looks?—a review of the literature. Annals of *Laparoscopic and Endoscopic Surgery*. 2017;2(8).
3. Arezzo A, Vettoretto N, Francis NK, et al. The use of 3D laparoscopic imaging systems in surgery: EAES consensus development conference 2018. Surgical Endoscopy. 2019;33(10):3251–74
4. Harada H, Kanaji S, Hasegawa H, et al. The effect on surgical skills of expert surgeons using 3D/HD and 2D/4K resolution monitors in laparoscopic phantom tasks. Surgical Endoscopy. 2018;32(10):4228–34.
5. Al-Taher M, Hsien S, Schols RM, et al. Intraoperative enhanced imaging for detection of endometriosis: A systematic review of the literature. European Journal of Obstetrics and Gynecology and Reproductive Biology. 2018;224:108–16.
6. Siegenthaler F, Knabben L, Mohr S, et al. Visualization of endometriosis with laparoscopy and near-infrared optics with indocyanine green. Acta Obstetricia et Gynecologica Scandinavica. 2020;99(5):591–7.
7. Cosentino F, Vizzielli G, Turco LC, et al. Near-Infrared Imaging with Indocyanine Green for Detection of Endometriosis Lesions (Gre-Endo Trial): A Pilot Study. Journal of Minimally Invasive Gynecology. 2018;25(7):1249–54.
8. Papadia A, Imboden S, Siegenthaler F, et al. Laparoscopic Indocyanine Green Sentinel Lymph Node Mapping in Endometrial Cancer. Annals of Surgical Oncology. 2016;23(7):2206–11.
9. Desai VB, Guo XM, Fan L, et al. Inpatient Laparoscopic Hysterectomy in the United States: Trends and Factors Associated with Approach Selection. Journal of Minimally Invasive Gynecology. 2017:151-158.e1.
10. Lawrie TA, Liu H, Lu DH, et al. Robot-assisted surgery in gynaecology. Cochrane Database of Systematic Reviews. 2019.
11. Wheeless CR. Elimination of second incision in laparoscopic sterilization. Obstetrics and Gynaecology. 1972;39(1):134–6.
12. Escobar PF, Starks D, Fader AN, et al. Laparoendoscopic single-site and natural orifice surgery in gynecology. Fertility and Sterility. 2010;94(7):2497–502.
13. Chern BSM, Lakhotia S, Khoo CK, Siow AYM. Single incision laparoscopic surgery in gynecology: Evolution, current trends, and future perspectives. Gynecology and Minimally Invasive Therapy. 2012;1:9–18.
14. Li C-B, Hua K-Q. Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) in gynecologic surgeries: A systematic review. 2019. doi.org/10.1016/j.asjsur.2019.07.014
15. Matanes E, Lauterbach R, Boulus S, et al. Robotic laparoendoscopic single-site surgery in gynecology: A systematic review. European Journal of Obstetrics and Gynecology and Reproductive Biology. 2018;231:1–7.

A review of apps used by our patients

Dr Philippa Costley
MBBS (Hons), FRANZCOG

How did we ever manage without apps? Well, somehow, we did before 2008, when the app stores first opened their virtual doors and changed the way we live. The 'health and fitness' category of app has become particularly popular and, within that genre globally, there are more apps relating to pregnancy than to any other medical topic. Indeed, a 2019 Chinese study found that almost half of the participating patients recruited from two maternity hospitals in Shanghai used pregnancy-themed apps.[1] This suggests that, while previous generations consulted friends, family, medical professionals and books, in just over a decade apps have become a leading source of pregnancy-related information. This is not surprising, given that apps offer readily accessible information at any time and at little or no cost. We may have reached the point where the mobile phone has replaced *What to Expect When You're Expecting* on every pregnant woman's bedside table.

And it's not only pregnant health consumers who are enthusiastic users. Health care professionals use them too to provide up-to-date medical resources or document medical care. A study of O&G residents in 2017 showed that 93% used apps in a clinical setting although, interestingly, only 53% recommended apps to patients, with many simply unaware of appropriate apps to suggest.[2]

The enthusiastic adoption of pregnancy apps is a positive development for women, empowering them to make more informed decisions about their health and maternity care.[3] However, it's wise to approach all apps with a discerning eye. Some are poorly designed or, more worryingly, contain incorrect information. Others have the potential to compromise confidentiality if personal data is transmitted without encryption or sold for marketing purposes. There may be monthly subscription

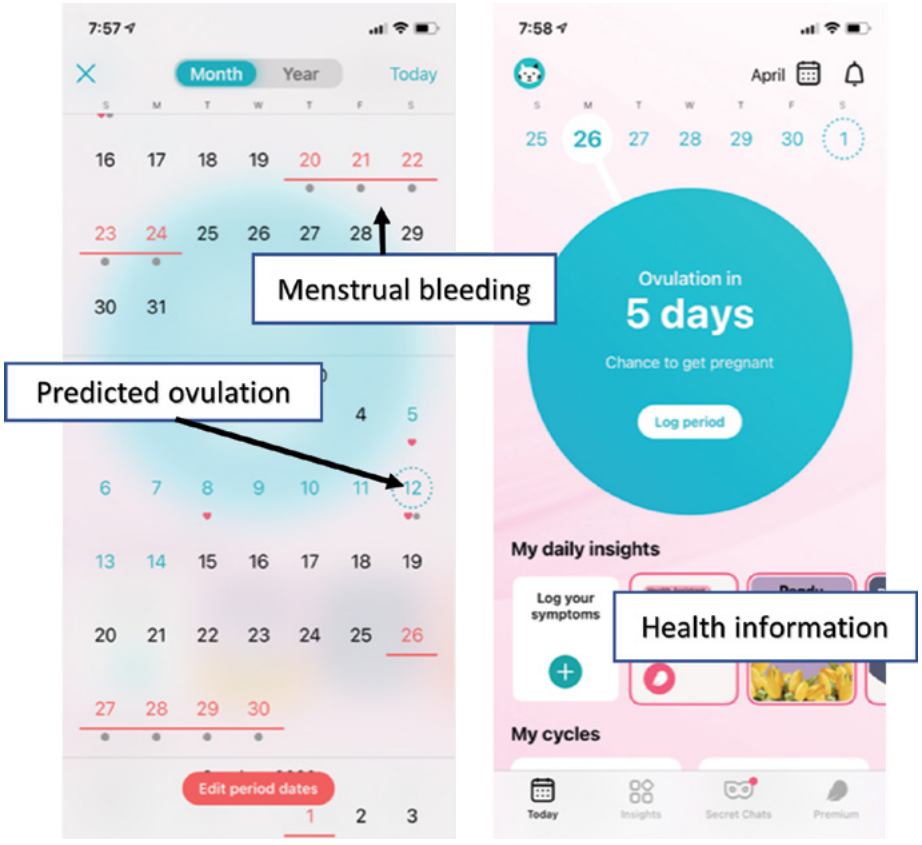


Figure 1. Screenshots from *Flo*.

costs that do not become evident until an app is downloaded and opened. Many of the apps are from America or Europe and may contain information that does not relate to the Australian healthcare system.

Here are some of the types of apps and some examples that may be helpful to patients – they were generally selected on the basis of having the highest number of reviews in the App Store, and therefore probably the highest usage.

Cycle management

In our ever-busy lives, cycle tracking apps developed for fertility awareness and family planning can be extremely useful. Many of them use cycle timing to predict the fertile window by averaging the cycle length and predicting the timing of ovulation. As useful as this obviously is for women who are trying to conceive, its effectiveness depends on the accuracy of the data that users input. Other uses for cycle tracking apps include menstrual symptom recording such as pelvic pain or heavy bleeding, mood tracking and medication monitoring. They also promote patient engagement in their own care.[4]

Flo is the '#1 most downloaded health app in the App Store' as its website says. Its content is produced by a medical board of 60 doctors, psychologists and nutritionists from Europe and North America, and has research partners that include The University of Adelaide's Robinson Research Institute. Key features include its period tracker and ovulation calendar, which, harnessing AI, uses cycle length to predict ovulation and the fertile window (it can also analyse cycle length averages). Users can also document menstrual symptoms and access expert information about different women's health topics.

Pregnancy tracking

Pregnancy tracking apps tell users what's going on with their baby (and themselves) throughout their pregnancy. They usually feature a description of each developmental stage and explain what women can expect when they reach them. They can also be very useful sources of information, especially for first time mums-to-be. Another common feature is that they invite the user to conceptualise the size of their baby at any given point via a comparison with various fruits, all the way from a poppy seed to a watermelon. Most offer calendars to help users remember medical appointments, and some also feature blogs for expectant parents to connect with others who are at a similar gestation. The social media elements of pregnancy tracking apps often showcase photos of women at different gestations, although too much comparison with others can be dangerous. Pregnancy tracking apps that are popular among our patients are *What to Expect* and *BabyCenter*. These are two hugely popular and trusted apps, though one important note of caution is that neither of these apps states their source(s) of information.

Fitness

Given the advantages of doing exercise throughout pregnancy, the many apps in the 'fitness tech market' that are designed for pregnant women is welcome. Many provide flexible fitness regimes, especially ones that can be done from home, and the possibility of modifying workouts (usually pre-prepared) according to the stage of pregnancy that the user has reached. It's worth remembering that online programs require

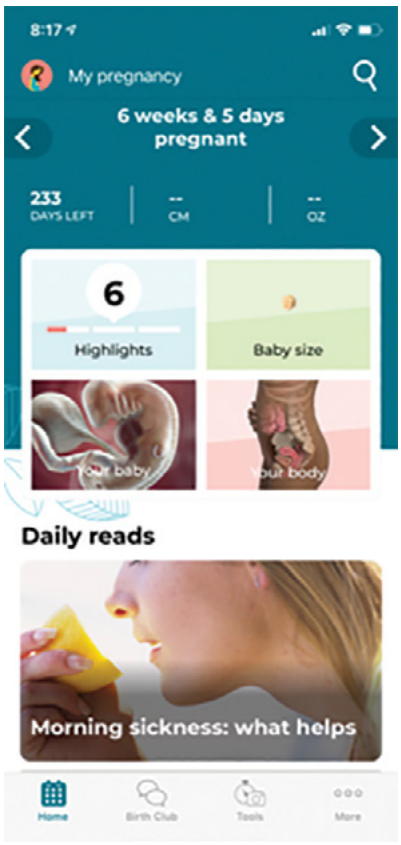


Figure 2. Screenshot from *BabyCenter*.

a significant amount of commitment to stick to and benefit from. A disadvantage is that there's no one present to ensure that the exercises are being performed safely and correctly.

Baby2Body is an app that covers fitness and 'wellness' in both pregnancy and the postnatal period. It offers a wide range of workouts for various stages of pregnancy, and these workouts can be done without equipment. The fact that *Baby2Body* is partnered with the Royal College of Obstetricians and Gynaecologists should inspire confidence in its content, and it links to an impressive amount of health-related articles. Its content categories include 'Keep fit', 'Stay calm', 'Enjoy food' and 'Be informed'; the fifth – 'Feel sexy' – may contain information that doesn't arise in a standard consultation with an obstetrician, and may therefore constitute added value.

Specific conditions

The pregnancy app market has evolved to include offerings developed for women who have specific medical conditions, including mental illness, hypertension and diabetes. These apps aim to deliver accessible, clinically important antenatal health information that can play a part in the delivery of positive pregnancy outcomes.

Pregnant with Diabetes is a free app for pregnant women with types 1 or 2 diabetes, women who develop gestational diabetes during their pregnancy and diabetic women who want to become pregnant. Its content, which is produced by two professors in Copenhagen (one a consultant endocrinologist, the other a consultant obstetrician), provides users with information on diet, exercise and weight gain. There are two content-related caveats: first, it is very

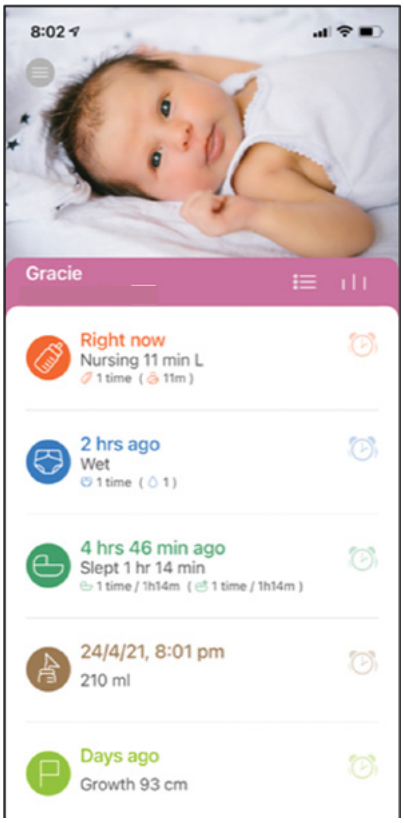


Figure 3. Screenshot from *Baby Tracker*, documenting feeding, sleeping, nappies and growth.

technical and would be difficult for women with low health literacy to follow; also, it contains slight variations on Australian recommendations.

There are glucose and blood pressure monitoring apps which provide the useful function of logging (and making easily accessible) BSLs, insulin dosing and BP data. A good example is *MyFetalLife*, which has features including a blood pressure tracker and gestational diabetes log.

Naming

Scott? Delta? Dennis? For some parents-to-be, deciding what to call their baby is a joy – two minds joined in seamless agreement on the perfect name. For others, the process degenerates into a war, where names of exes are played against famous football players. That's when a naming app comes to the rescue. *Kinder* uses a similar selection process to a dating app. Each parent downloads it and swipes left for names they do not like and right for ones they do. Then *Kinder* highlights the matches. Cute!

Apps for postnatal use

While every parent's experience of the postnatal phase is unique, it's fair to say that adjusting to the 'new normal' can be extremely hard at times. Apps that help parents adjust and feel more knowledgeable can help them better enjoy their new baby.

Based on the baby development book of the same name, *The Wonder Weeks* is based on the work of two Dutch doctors of educational psychology who claim that the mental development of babies takes place in leaps and bounds and that their behaviour is influenced by age-linked regression periods. The app provides a timeline to inform caregivers about upcoming leaps so that they can prepare to manage the more difficult behaviour (yet another sleep regression) that's coming their way.

There are many apps that help new parents document aspects of babies' behavioural patterns such as sleeping, feeding regime and the production of wet/dirty nappies – a handy tool for exhausted parents. Many track important medical information such as weight gain, as well as recording important milestones. One of the most popular is *Baby Tracker*, which has the brilliant feature of only requiring one-handed data input. There is a concern with these apps, though, namely that some parents become obsessive over this documentation.

The *Maternal and Child Health* app was developed by the Victorian Government's Maternal and Child Health (MCH) Service. It tracks children's development and discusses the milestones that are expected at each age. Recently updated, it has vital information on Victoria's child immunisation schedule and allows users to access their child's Australian Immunisation Record online. The app has links to health-related articles produced by The Royal Children's Hospital and the Better Health Channel, as well as lots of useful contacts. The Royal Children's Hospital produces its own app, called *Kids Health Info.* It has more than 300 multi-language fact sheets that give accurate and reliable health information, including advice on when to present for medical care.

Conclusion

There are apps for just about everything. As a health professional, apps can help us care for patients by accurately logging healthcare information such as menstrual cycles, symptoms or BSLs in gestational diabetes. It is useful for us to know the best apps to be able to improve healthcare for our patients.

Health consumer apps can be useful for providing health information at our patients' fingertips. There are also apps to make life easier for patients by logging health data, developing home fitness regimes or switching baby monitor while baby is sleeping in another room. However, we must be aware of the limitations of these. It is still important to review the sources of the information to ensure our patients are receiving high quality information.

References

1. Wang N, Deng Z, Wen LM, et al. Understanding the Use of Smartphone Apps for Health Information Among Pregnant Chinese Women: Mixed Methods Study. *JMIR Mhealth Uhealth*. 2019;7(6):e12631. doi:10.2196/12631
2. Perry R, Burns RM, Simon R, Youm J. Mobile Application Use Among Obstetrics and Gynecology Residents. *J Grad Med Educ*. 2017;9(5):611-15. doi: 10.4300/JGME-D-17-00163.1
3. Tripp N, Hainey K, Liu A, et al. An emerging model of maternity care: smartphone, midwife, doctor? *Women Birth*. 2014;27(1):64-7. doi: 10.1016/j.wombi.2013.11.001.
4. Karasneh RA, Al-Azzam SI, Alzoubi KH, et al. Smartphone Applications for Period Tracking: Rating and Behavioral Change among Women Users. *Obstetrics and Gynecology International*. 2020. https://doi.org/10.1155/2020/2192387

In vitro maturation: a clinical approach

Dr Doreen Yeap
MBBS, FRANZCOG
Fertility Specialists of Western Australia,
Bethesda Hospital

Assisted reproductive technology is an important component of clinical care for couples presenting for fertility treatment, with in vitro fertilisation (IVF) contributing to 14,000 births in Australia in 2018.[1] However, risks of IVF include the occurrence of ovarian hyperstimulation syndrome (OHSS) especially in women with polycystic ovarian morphology (PCOM) or polycystic ovarian syndrome (PCOS). An alternative, incorporating the technique of oocyte in vitro maturation (IVM), provides results comparable to conventional IVF, while avoiding the risk of OHSS.[3]

IVM describes the maturation in vitro of immature cumulus oocyte complexes (COCs) retrieved from antral follicles as opposed to in vivo maturation as occurs in conventional IVF where mature oocytes are retrieved.[4] Edwards first observed in vitro maturation occurring spontaneously in 1965, and early attempts at IVM used oocytes from unstimulated ovaries. The first IVM baby was born in 1991 using donor oocytes from unstimulated ovaries.[5] Subsequently, in 1994, Trounson et al reported a pregnancy following IVM in an unstimulated cycle in a woman with PCOS.[6] However, pregnancy rates at that time were very low, hence there was little uptake of this technique. Subsequently, work was done on specific culture conditions as well as patient selection and variations in stimulation and priming protocols. FSH priming was eventually adopted by some groups, resulting in better outcomes; however; the pregnancy rates were still low.[7]

Attempts to improve outcomes using hCG trigger improved maturation rates and fertilisation with pregnancy rates around 30%.[8] However, the collected COCs had to be assessed at multiple time points to identify the extrusion of polar bodies resulting in multiple rounds of intracytoplasmic sperm injection (ICSI) for a single egg collection, an impractical methodology. In the last 20 years, significant progress has been made. We first published our work on IVM in 2012 reporting a pregnancy rate per embryo transfer from IVM with FSH priming but no hCG trigger, comparable to that of conventional IVF.[3] Recently, pre-maturation protocols and the discovery of new culture media additives have demonstrated potential to further maximise maturation and oocyte developmental competence. There are now more than 5,000 babies estimated to have been born via IVM.[9]

Indications for IVM

Women with high antral follicle counts requiring IVF have a significant risk of OHSS. This can be a serious iatrogenic, potentially life-threatening condition that results from excessive ovarian follicular response to gonadotrophins during the course of IVF. The reported incidence of OHSS ranges from mild, which is seen in almost 20%–33% of cycles, whereas a moderate to severe form is found in approximately 3%–6% of cycles, and a severe form in approximately 1% of cycles.[2] Women with PCOM or PCOS are a higher risk for OHSS. A diagnosis of PCOS characterises 37–63% of all women who experience severe OHSS.[10,11] IVM is an alternative approach as it avoids the risk of OHSS while achieving comparable pregnancy and live birth rates to conventional IVF. In our clinic, we recorded live birth rate of 45% per embryo transfer with no episodes of OHSS in women with PCOM or PCOS.[3] We use IVM in the first treatment cycle for patients who are considered to have a high risk of developing OHSS, often women with PCOS. We also use IVM in women who had conventional IVF cancelled due to over-response to gonadotrophins, and in patients who previously experienced OHSS. There may be a possible role for IVM in women at risk of OHSS living in rural or remote areas, who might otherwise require intensive monitoring following transvaginal oocyte aspiration in conventional IVF.

IVM has a role in fertility preservation for women with hormone-sensitive cancer (eg. breast/oestrogen-sensitive tumours) who need to minimise their exposure to high oestradiol concentrations during the treatment cycle. Additionally, it is possible to retrieve immature oocytes at any time in the menstrual cycle, including luteal phase, thus offering flexible options for urgent fertility preservation. Grynberg et al found there was no major difference in the number of COCs recovered or their in vitro maturation rates, irrespective of the phase of the cycle at which egg retrieval is performed, suggesting that IVM is a promising tool for breast cancer patients seeking urgent oocyte cryopreservation.[12] Creux et al also found no significant difference in the number of oocytes retrieved, maturation rates after 48 hours of culture, or the number of oocytes cryopreserved for COCs retrieved for IVM at different stages of the menstrual cycle in women with cancer requiring gonadotoxic therapy.[13] However, there is a paucity of data regarding the outcome of oocytes cryopreserved in cancer patients regardless of technique, with very few live births having been reported in this group, thus caution is recommended.

The IVM procedure

Our treatment protocol involves a short duration of stimulation, usually five to seven days of gonadotrophins, without hCG trigger, scheduling the retrieval once the lead follicle measures 1.2 cm. The average number of oocytes retrieved following an IVM cycle at our unit is 13.[14] We use a 16-gauge double lumen needle, and the yield is approximately 55% of follicles aspirated. The oocytes are cultured in the laboratory for 24 hours using a combination of culture media supplemented with maternal serum, recombinant FSH and hCG. In our experience, the maturation rate is approximately 73%. Fertilisation of IVM oocytes has traditionally been done using ICSI, but our group reported similar outcomes using IVF with 68% fertilisation.[15] Blastocyst development is comparable, but the total number of blastocysts available is less than in a conventional IVF cycle, a factor of the number of eggs retrieved and lower fertilisation rates. Our earlier experience found a lower pregnancy rate with fresh embryo transfer, so we adopted a 'freeze all' approach, transferring a blastocyst in a subsequent frozen embryo cycle, an approach which has resulted in a live birth rate that approximates those of a standard IVF cycle.[14]

Clinical pregnancy rates have been reported to range from 0–14.8% for cycles with no hormonal priming and between 9%–21% for cycles with hormonal priming.[16–18] In a retrospective case-control study of 121 women with polycystic ovaries who underwent 178 treatment cycles from our clinic, we found an overall cumulative live birth rate of 41% with IVM and 55% with conventional IVF.[14] This is likely due to the lower number of mature oocytes obtained in the IVM group (9.6 vs 12) leading to a lower number of resultant blastocysts compared to IVF/ICSI in PCOS women. Similar results have been described elsewhere.[19] In women with PCOM or PCOS, IVM has a significantly lower rate of OHSS than conventional IVF, with no cases of OHSS occurring in IVM and moderate to severe OHSS occurring in approximately 7–11% of IVF-treated women.[14,20,21]

Long-term safety

There have been concerns about the longer-term safety of this technique, but to date no difference in congenital malformations has been reported with IVM compared to conventional IVF. Roesner et al in 2017 reported on a two-year developmental follow-up of children conceived by IVM, finding no difference in cognitive development and biometric parameters compared with children conceived by conventional IVF.[22] Concerns were raised that IVM oocytes might harbour epigenetic disorders such as those associated with Beckwith-Wiedemann Syndrome or Angelmans syndrome.[23] However, Kuhtz et al did not detect major epigenetic alterations in IVM oocytes.[24] They concluded that optimised human IVM procedures had no significant effects on the establishment of DNA methylation patterns at three maternally and one paternally imprinted genes. Additionally, Pliushch et al in 2015 did not detect any impact of IVM on methylation levels of six imprinted, five tumour-suppressor, two pluripotency and two metabolic genes in umbilical cord samples and placental tissues of children conceived by IVM compared to those conceived by conventional assisted reproduction.[25]

In a retrospective study, Fadini et al examined obstetric and perinatal outcomes of children born from IVM oocytes comparing them to children conceived from mature oocytes, reporting comparable obstetric and perinatal outcomes.[26] Buckett et al found no difference in birthweight nor congenital abnormalities in babies born from IVM compared with conventional IVF.[27] Soderstrom-Anttila also reported normal birth weights in children born following IVM.[28] A separate analysis by Buckett et al found that clinical miscarriage rates were slightly higher in women undergoing IVM compared to conventional IVF.[29] However, this difference was attributable to underlying PCOS, as rates were similar for IVM and conventional IVF in women with PCOS.[29] Similarly, in our clinic we noticed no significant difference in miscarriage rates in PCOS women following IVM treatment compared to PCOS women who underwent conventional IVF. We did notice higher birthweights (3.34 kg vs 3.20 kg) with IVM compared with conventional IVF in women with polycystic ovaries.[14]

Conclusion

There are now effective ways of reducing the risk of OHSS within an IVF, cycle but the risk is still present. With IVM the risk of OHSS is avoided, with current protocols achieving comparable pregnancy rates to conventional IVF. Thus IVM is an effective and safer alternative to conventional IVF in patients at high risk of OHSS. IVM may also be offered to women in circumstances where conventional IVF poses other risks, or urgent fertility preservation is required.

References

1. Newman JE, Paul RC, Chambers GM. Assisted reproductive technology in Australia and New Zealand 2018. National Perinatal Epidemiology and Statistics Unit, the University of New South Wales, Sydney, Australia, 2020.
2. Mourad S, Brown J, Farquhar C. Interventions for prevention of ovarian hyperstimulation syndrome in in vitro fertilisation cycles: an overview of Cochrane reviews. *Cochrane Database Syst Rev.* 2017;1:CD012103.
3. Junk SM, Yeap D. Improved implantation and ongoing pregnancy rates after single embryo transfer with an optimised protocol for in vitro oocyte maturation in women with polycystic ovaries and polycystic ovary syndrome. *Fertil Steril.* 2012;98:888-92.
4. De Vos M, Smitz J, Thopmson JG, Gilchrist RB. The definition of IVM is clear – variations need defining. *Hum Reprod.* 2016;11:2411-5.
5. Cha KY, Koo JJ, Choi DH, et al. Pregnancy after in-vitro of human follicular oocytes collected from non stimulated cycles, their culture in-vitro and their transfer in a donor oocyte program. *Fertil Steril.* 1991;55:109-13.
6. Trounson A, Wood C, Kausche A. In vitro maturation and fertilisation and developmental competence of oocytes recovered from untreated polycyctic ovarian patients. *Fertil Steril.* 1994;72:353-62.
7. Chian RC, Buckett WM, Too LL, Tan SL. Pregnancies resulting from in vitro matured oocytes retrieved from patients with

Summary

- In vitro maturation (IVM) involves retrieval of immature cumulus oocyte complexes from antral follicles, which undergo culture in the laboratory prior to fertilisation and embryo transfer.
- IVM can be undertaken at any stage of the menstrual cycle, including luteal phase.
- Results of IVM are comparable to conventional in vitro fertilisation (IVF) per embryo transfer, while avoiding the risk of ovarian hyperstimulation syndrome (OHSS).
- IVM should be considered for women at increased risk of OHSS, especially women with PCOS, and could be considered for women with hormone-sensitive malignancies where exposure to high oestradiol concentrations is contraindicated.

polycystic ovary syndrome after priming with human chorionic gonadotropin. Fertil Steril. 1999;72:639-42.

8. Sauerbrun-Cutler MT, Vega M, Keltz M, McGovern PG. In vitro maturation and its role in clinical assisted reproductive technology. Obstet Gynecol Surv. 2015;70:45-57.
9. Delvigne A, Demoulin A, Smitz J, et al. The ovarian hyperstimulation syndrome in in-vitro fertilization: a Belgian multicentre study. I. Clinical and biological features. Hum Reprod. 1993;8:1353-60.
10. MacDougall MJ, Tan SL, Jacobs HS. In-vitro fertilization and the ovarian hyperstimulation syndrome. Hum Reprod. 1992;7:597-600.
11. Grynberg M, Poulain M, le Parco S, et al. Similar invitro maturation rates of oocytes retrieved during the follicular or luteal phase offer flexible options for urgent fertility preservation in breast cancer patients. Hum Reprod. 2016;31:623-29.
12. Creux H, Monnier P , Son W, et al. Immature oocyte retrieval and in vitro oocyte maturation at different phases of the menstrual cycle in women with cancer who require urgent gonadotoxic treatment. Fertil Steril. 2017;107:198-204.
13. Walls ML, Hunter T, Ryan JP, et al. In vitro maturation as an alternative to standard in vitro fertilization for patients diagnosed with polycystic ovaries: a comparative analysis of fresh, frozen and cumulative cycle outcomes. Hum Reprod, 2015;30:88-96.
14. Walls ML, Junk SM, Ryan JP, Hart RJ. IVF versus ICSI for the fertilization of in-vitro matured human oocytes. Repro Biomed Online. 2012;25:603-7.
15. Mikkelsen AL, Lindenberg S. Benefit of FSH priming of women with PCOS to in vitro oocyte maturation procedure and the outcome: a randomized prospective study. Reprod. 2001;122:587-92.
16. Chian RC, BuckettWM, Tulandi T, Tan SL. Prospective randomized study of human chorionic gonadotrophin priming before immature oocyte retrieval from unstimulated women with polycystic ovarian syndrome. Hum Reprod. 2000;15:165-70.
17. Lin YH, Hwang JL, Huang LW, et al. Combination of FSH priming and hCG priming for in-vitro maturation of human oocytes. Hum Reprod. 2003;18:1632-6.
18. Fadini R, Renzeni MM, Dal Canto M, et al. Oocyte in vitro maturation in normo-ovulatory women. Fertil Steril. 2013;99:1162-9.
19. Child T. A comparison of in vitro maturation and in vitro fertilization for women with polycystic ovaries. Obstet Gynecol. 2002;100:665-70.
20. Gremeau AS, Andreadis N, Fatum M, et al. In vitro maturation or in vitro fertilization for women with polycystic ovaries? A case–control study of 194 treatment cycles. Fertil Steril. 2012;98:355-60.
21. Roesner S, von Wolff M, Elsaesser M, et al. Two year development of children conceived by IVM: a prospective controlled single-blinded study. Hum Reprod. 2017;32:1341-50.
22. Chen Z, Robbins KM, Wells KD, Rivera RM. Large offspring syndrome: A bovine model for the human loss of imprinting overgrowth syndrome Beckwith-Widemann. Epigenetics. 2013;8:591-601.
23. Kuhtz J, Romero S, De Vos M, et al. Human in vitro oocyte maturation is not associated with increased imprinting error rates at LIT1, SNRPN, PEG3, GTL2. Hum Reprod. 2014;29:1995-2005.
24. Pliushch G, Schneider E, Schneider T, et al. Invitro maturation of oocytes not associated with altered deoxyribonucleic acid methylation patterns in children from IVF or ICSI Fertil Steril. 2015;103:720-7.e1.
25. Fadini R, Renzini MM, Guarnieri T, et al. Comparison of the obstetric and perinatal outcomes of children conceived from in vitro or in vivo matured oocytes in in vitro maturation treatments with births from conventional ICSI cycle. Hum Reprod. 2012;27:3601-8.
26. Buckett WM, Chian R-C, Holzer H, et al. Obstetric outcomes and congenital abnormalities after in vitro maturation, in vitro fertilization, and intracytoplasmic sperm injection. Obstet Gynecol. 2007;110:885-91.
27. Soderstrom-Anttila V, Salokorpi T, Pihlaja M, et al. Obstetric and perinatal outcome and preliminary results of development of children born after in vitro maturation of oocytes. Hum Reprod. 2006;24:1508-13.
28. Buckett WM, Chian R-C, Dean NL, et al. Pregnancy loss in pregnancies conceived after in vitro oocyte maturation, conventional in vitro fertilization, and intracytoplasmic sperm injection. Fertil Steril. 2008;90:546-50.

Developments in NIPT: is bigger better?

Dr Lynn Townsend
MBBS, BSc(Hons), FRANZCOG, DDU
Ultrasound Care Australia, Sydney Australia
UNSW, Sydney Australia

Mia Liepins
B App Sc, MRS M.Gen.Couns, MHGSA
Ultrasound Care Australia, Sydney Australia

Gabrielle Fleming
BSc, M.Gen.Couns
Ultrasound Care Australia, Sydney Australia

Non-invasive prenatal testing (NIPT) is the process of examining cell-free fetal DNA in the maternal circulation. Since the first NIPT was performed in Australia during late 2012, there have been rapid developments in test uptake and utility. Increasing popularity and technological advances have brought further understanding of the strengths and limitations of NIPT.

Understanding NIPT relies on an understanding of basic biology. Genetic information (genes) are arranged on larger structures called chromosomes, which are numbered based on size. Humans typically have 22 pairs of autosomes, and a single pair of sex chromosomes, resulting in a total of 46 chromosomes. Aneuploidy is the term used to describe an imbalance in chromosomal material, and accounts for the majority of early miscarriage.[1]

First described by Bianchi and colleagues,[2] the NIPT has expanded from a simple screening test for Trisomy 21 (Down syndrome), to the option of assessing genome-wide aneuploidy, including the sex chromosomes, segmental changes and microdeletions.

The most common aneuploidy in the community is Trisomy 21. It is also the least lethal and most subtle of the autosomal aneuploidies, largely due to the 21st chromosome containing relatively limited genetic information, compared to its counterparts within the chromosomal library. On the other hand, Trisomy 1, which involves the largest chromosome is invariably associated with miscarriage when aneuploid, given the amount of genetic material that it stores.

Initial methods for detecting fetal aneuploidy using maternal blood attempted to detect whole fetal cells. However, the methodology presented challenges as the maternal innate immune system mopped up free fetal whole cells, rendering the test with low sensitivity and specificity.[3] Fragments of trophoblastically derived DNA proved more fruitful, with the limitation there may be a discrepancy between the placental and fetal chromosomal complements due to mosaicism.

Counting DNA fragments is the basis of most NIPTs, to assess whether there is an overall difference in expected fragments, an example being over-representation of chromosome 21 in Trisomy 21. This methodology is seemingly simple; however, it relies on several key factors. Firstly, a major assumption is made that the maternal free DNA is non-contributive and the mother is assumed to be euploid. Secondly, a correction factor using complex mathematics is required to account for the relative size of the varying chromosomes. For example, as the 1st chromosome contains at least 10 times genetic information compared to the 21st chromosome, a correction for the number of increased fragments of the chromosomes is required. Lastly, an awareness is required that aneuploid placentae apoptose at different rates to euploid placentae. For example, a Trisomy 21 placenta sheds a vast amount of DNA into the maternal circulation, thus increasing the fetal fraction compared to the maternal complement which increases sensitivity of the test for chromosome 21.[4]

Fundamentally, NIPT is a screening tool. Diagnostic testing using Chorionic Villus Sampling (CVS) or amniocentesis is recommended to provide certainty in the context of a high risk result. Additionally,

formal first trimester ultrasonographic assessment is crucial, as not all congenital issues are chromosomal in origin. Without ultrasound, major anomalies such as anencephaly could be missed at this critical first trimester opportunity; as would assessment of multiple gestations, missed miscarriage and opportunities for other first trimester testing such as early pre-eclampsia screening.

Different test platforms have key differences. The Illumina platform (Generation, Percept, Nest, Genesyte) uses a counting methodology, that examines the whole genome by massively parallel sequencing. Fragments are assessed with respect to each other and are plotted with the X-axis being the chromosome in question, and the Y-axis reflecting the relative number of fragments. Mathematical modelling is required so the Y-axis is corrected to reflect euploidy and to correct for the different amount of genetic material on each chromosome. An imbalance in chromosomal material will result in an increased or reduced signal, provided there is no balanced aneuploidy, such as triploidy.

The Roche platform (Harmony) also uses a counting methodology which relies on comparing the key chromosomes (21, 18, 13, X and Y), to key reference chromosomes that are assumed to be euploid, such as chromosome 1. The Natera platform (Panorama) counts smaller fragments called SNPs (single nucleotide polymorphisms) to generate targeted genome assessment.

Although there are differences in methodology, all NIPT brands perform extremely well for chromosome 21, with sensitivities and specificities of more than 99%. This means, in general, that a low risk result is very reassuring. A high risk result for Trisomy 21 has a high positive predictive value of greater than 90%. These findings are also partly attributed by the community incidence of Trisomy 21 and the increased apoptosis of the Trisomy 21 placenta as described above.

Performance metrics for Trisomies 18, 13 and the sex chromosomes are more variable, but given the relatively high incidence in the community, are used in conjunction with ultrasonographic screening to guide appropriate invasive testing when high risk.

Recently, the Illumina platform in particular has been used in Australia to assess all 46 chromosomes as well as large segmental changes. Screening for rare autosomal trisomies and segmental aneuploidy has been found to be far less impressive with a lower positive predictive value.[5] There is a greater risk of a false positive result with this test option, which may contribute to heightened parental anxiety and unnecessary invasive testing, which has the small but real risk of iatrogenic pregnancy loss. In our practice, almost all rare autosomal trisomies detected on NIPT have proven to be false positives. The few true positive cases in our cohort were detected independently by careful sonographic assessment, which revealed an abnormal appearing fetus.

Genetic counselling is defined as a communication process, which aims to help individuals, couples and families navigate the complex genetic contribution to specific health conditions.[6] In this context, the purpose is to facilitate informed decision making, with respect to the preferences of the patient and family. Challenges arise when communicating complex information to the general population, in a way that is understandable. There is a current perception that the bigger and wider tests must be 'better', given the cost of NIPT in Australia. We hope to have illustrated the importance of weighing the clinical utility of additional information detected using expanded NIPT, against the limitations of reduced sensitivities and specificities in the context of screening conditions with very low community incidence.

In conclusion, NIPT has revolutionised the detection of Trisomy 21, and, to a lesser degree, the other aneuploidies. With the expansion of NIPT to include genome-wide, segmental and microdeletion screening, there are implications of increased invasive testing with the iatrogenic risk to the pregnancy. Whilst we welcome ongoing development of the test, careful sonographic assessment of the fetus continues to be critical and weighed against the use of indiscriminate technology and the 'bigger is better' approach.

References

1. Maxwell SM, Colls P, Hodes-Wertz B, et al. Why do euploid embryos miscarry? A case-control study comparing the rate of aneuploidy within presumed euploid embryos that resulted in miscarriage or live birth using next-generation sequencing. *Fertil Steril*. 2016;106(6):1414-9.
2. Pertl B, Bianchi DW. Fetal DNA in maternal plasma: emerging clinical applications. *Obstetrics & Gynecology*. 2001;98(3):483-90.
3. Bianchi DW, Simpson JL, Jackson LG, et al. Fetal gender and aneuploidy detection using fetal cells in maternal blood: analysis of NIFTY I data. *Prenatal Diagnosis*: Published in Affiliation with the International Society for Prenatal Diagnosis. 2002;22(7):609-15.
4. Lo YD, Lau TK, Zhang J, et al. Increased fetal DNA concentrations in the plasma of pregnant women carrying fetuses with trisomy 21. *Clinical Chemistry*. 1999;45(10):1747-51.
5. Benn P, Malvestiti F, Grimi B, et al. Rare autosomal trisomies: comparison of detection through cell-free DNA analysis and direct chromosome preparation of chorionic villus samples. *Ultrasound in Obstetrics & Gynecology*. 2019;54(4):458-67.
6. Patch C, Middleton A. Genetic counselling in the era of genomic medicine. *British Medical Bulletin*. 2018;126(1):27-36.

Interventional radiology

Dr Rahul Bera
BMedSci, BMBS, MRCS (Edin), FRCR (UK)
Clinical Lead, Interventional Radiology
Waitemata DHB, North Shore Hospital and Auckland City Hospital

Dr Rukshan Fernando
BSc, MBBS, MRes, FRCR, EBIR
Consultant Interventional Radiologist
North Shore Hospital and Auckland City Hospital

Interventional radiology (IR) is a rapidly growing subspecialty that allows minimally invasive treatment of a multitude of conditions in a number of body systems under image guidance.

Rather than a referral service like diagnostic radiology, IR is gaining recognition worldwide as a clinical specialty in its own right. This involves giving opinions on patient care at multidisciplinary meetings, seeing patients in clinic pre and post procedure and managing in-patient care.

Interventional Radiology is reshaping current practice in many clinical specialties and obstetrics and gynaecology is no exception.

In this article we will outline IR options for the management of fibroids and pelvic vein congestion.

Fibroid embolisation

After being first reported in 1995,[1] uterine artery embolisation (UAE) has since established itself as a safe and efficacious treatment for uterine fibroids, with comparable quality of life outcomes (QOL) to surgery. It is now included in multiple guidelines for uterine fibroid treatment by bodies around the world including the American College of Obstetrics and Gynaecology and the Royal College of Obstetrics and Gynaecology. These guidelines recognise the comparable QOL outcomes to surgery, but with the

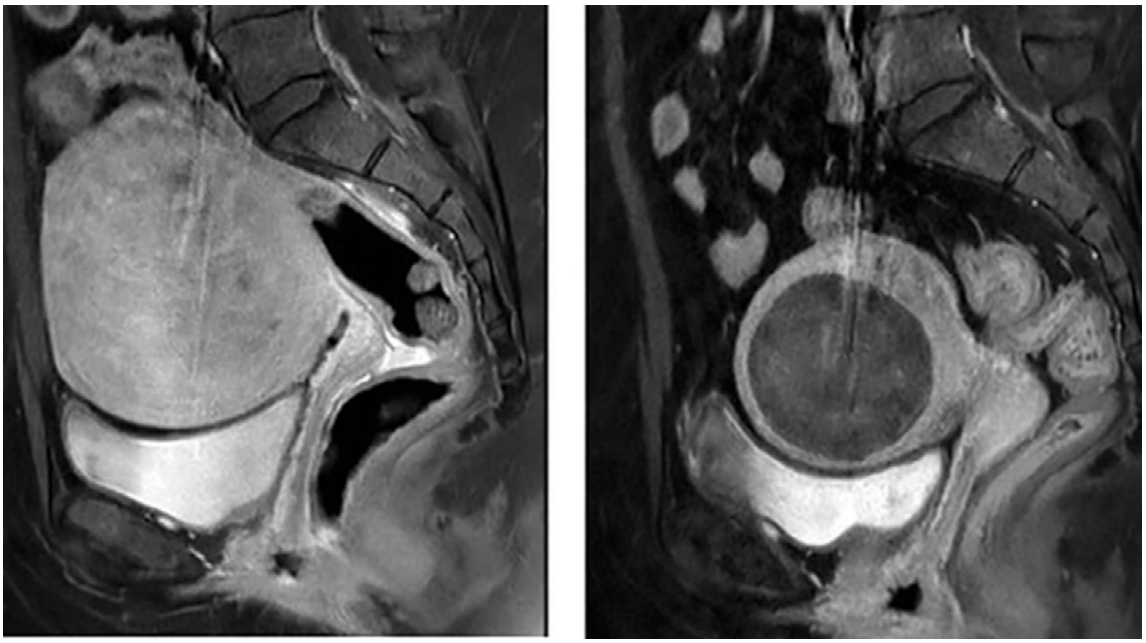


Figure 1. Sagittal MRI T1 post-contrast. **a)** Pre-embolisation, demonstrating large enhancing fibroid **b)** Post-embolisation, showing volume reduction and non-enhancement of the fibroid.

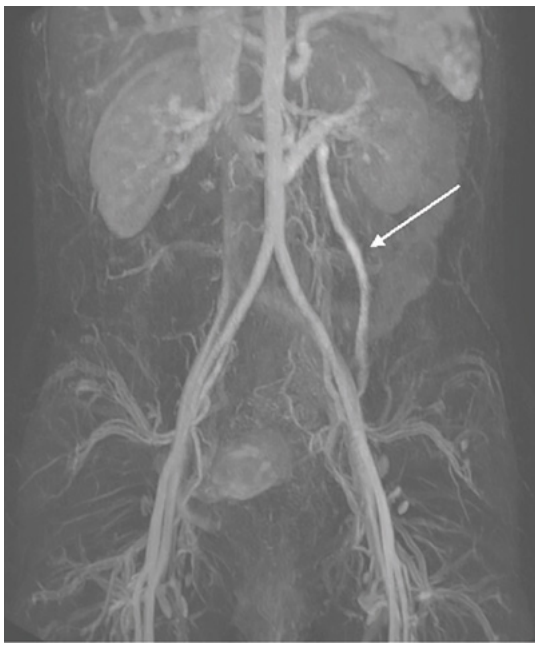


Figure 2. MR venogram demonstrating incompetent left ovarian vein.

caveat of an increased re-intervention rate. Despite this, it has been globally underutilised, particularly in Australia and New Zealand. One study found UAE represented approximately 2.7% of the number of surgical procedures performed for uterine fibroids under the Medicare system.[2]

It is vital to have our gynaecology colleagues on board with the current data on UAE and recognise the potential benefits to patients. A study in the Netherlands[3] found that several misconceptions prevailed about UAE with regards to its efficacy (40% of gynaecologists responding felt UAE was ineffective, despite extensive data and guidelines confirming otherwise) and rate of eventual hysterectomy (half of respondents felt that there was a 50% risk of eventual hysterectomy, EMMY trial showed this is in the order of 31% at 10 years,[4] sparing almost 70% from significant surgery).

Patient experience with UAE is also undergoing refinement with the increasing adoption of trans-radial access and the use of either the superior hypogastric nerve block (SHGNB),[5] intra-arterial lidocaine or combination thereof. Both the access and analgesic adjuncts allow for faster mobilisation, reduced peri-procedural discomfort and earlier discharge. In our experience, the vast majority of women prefer to be at home for the night following the procedure. It has been demonstrated that a same day discharge protocol is feasible with a low rate of early return (0.5% re-admission rate).[6]

In a recent randomised controlled trial (FEMME trial)[7] myomectomy was compared to UAE, and a marginal difference in QOL outcome was determined in favour of myomectomy. Final QOL score 84 (myomectomy) vs 80 (UAE), the very modest difference being of dubious clinical significance, also of note the symptom score component showed no difference between the two interventions at one or two years. This study further confirms the high efficacy of UAE.

Technique

In our institution, patients for UAE are seen in IR clinic after having an MRI, which helps identify location, size and vascularity of fibroids as well as variant arterial anatomy or collateral ovarian arterial supply.

Pre-procedural analgesia, anti-emetic and antibiotics are given, and the procedure is performed under conscious sedation. A 5Fr sheath is inserted into the left radial artery. Each uterine artery is selectively catheterised in turn and small PVA particles (500–700 micron) are delivered to achieve stasis of flow. A superior hypogastric nerve block with 20ml of 0.25% Ropivacaine is performed, which lasts approximately 8–12 hours. Overall procedural duration is 30–60 minutes. The patient has an inflatable wristband placed at the access site to achieve haemostasis and this is deflated over the course of 45 minutes. Discharge occurs four hours after the procedure, provided she has adequate control of her pain.

Pelvic congestion syndrome

Pelvic congestion syndrome (PCS) is one of the most underdiagnosed causes of chronic pelvic pain in women. It is defined as the presence of ovarian and pelvic varicose veins associated with chronic pelvic pain persisting longer than six months, exacerbated by prolonged standing, coitus and menstruation.[8]

It typically affects young multiparous women in their 20s to 30s and is usually diagnosed after excluding other causes such as adenomyosis, endometriosis, urological and gastrointestinal problems.

PCS caused by incompetent or absent venous valves is known as pelvic venous insufficiency (PVI) and is analogous to the varicocele in men. Valves are absent from the ovarian veins in 15% of women and incompetent on the left and right in 40% and 35% respectively.[9] Other causes can be external compression of pelvic venous drainage at the left common iliac vein, May-Thurner Syndrome, or the left renal vein, Nutcracker Syndrome.

Diagnosis

Catheter venography is the gold standard for diagnosis, but this is invasive and requires ionising radiation. It is best reserved for cases that are inconclusive on non-invasive imaging or for treatment.

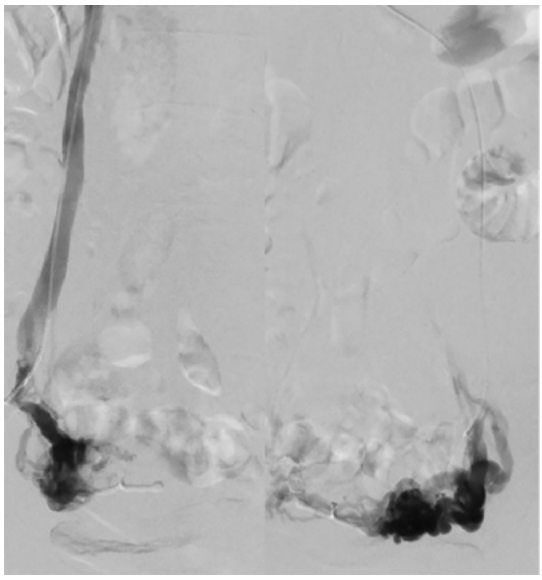


Figure 2a. Incompetent Right ovarian vein. Parauterine varices fed by Incompetent left ovarian vein.

Figure 2b. Post-embolisation with coils in both ovarian veins.

Transabdominal and transvaginal doppler ultrasound is usually the go to modality allowing non-invasive dynamic assessment. Criteria for diagnosis include dilated tortuous ovarian and parauterine veins (>4mm) with slow or retrograde flow. Valsalva can be used to accentuate reflux.[10]

Time resolved MR angiography (Figure 1) has been shown to be an accurate method of diagnosing ovarian vein reflux and multiplanar MRI is excellent for diagnosing alternate causes of pelvic pain.[11]

Endovascular treatment

This is performed as a day case procedure under local anaesthetic and light sedation from either a jugular or femoral venous approach. It is safe, effective and durable.[12]

The aim is to occlude the incompetent veins as close to the origin of reflux as possible (Figure 2). There are two approaches to treatment. The first is to stage the treatment with ovarian vein embolisation and if there are ongoing symptoms to then embolise the internal iliac veins. The second is to do a complete embolisation of all four territories in one sitting.

Embolisation can be performed with coils and plugs with or without liquid embolics such as sclerosant (3% sodium tetradecyl sulfate) and glue (Figure 2b).

Technical and clinical success is high with complications rare. Immediate complications include haematoma at the puncture site or in the target vein, non-target embolisation and stroke. Delayed complications include coil migration.

Summary

The literature shows that transcatheter embolisation is a safe, effective and durable option for the treatment of fibroids and PCS. IR working together with gynaecologists would allow better patient selection and education, ultimately enabling women to make an informed choice regarding their treatment.

References

1. Ravina JH, Herbreteau D, Ciraru-Vigneron N, et al. Arterial embolization to treat uterine myomata. *Lancet*. 1995;346(8976):671-2.
2. Makris GC, Butt S, Sabharwal T. Unnecessary hysterectomies and our role as interventional radiology community. *CVIR Endovasc*. 2020;3:46.
3. de Bruijn AM, Huisman J, Hehenkamp WJK, et al. Implementation of uterine artery embolization for symptomatic fibroids in the Netherlands: an inventory and preference study. *CVIR Endovasc*. 2019;2(1):18.
4. de Bruijn AM, Ankum WM, Reekers JA, et al. Uterine artery embolization vs hysterectomy in the treatment of symptomatic uterine fibroids: 10-year outcomes from the randomized EMMY trial. *Am J Obstet Gynecol*. 2016;215(6):745.e1-745.e12.
5. Pereira K, Morel-Ovalle LM, Taghipour M, et al. Superior hypogastric nerve block (SHNB) for pain control after uterine fibroid embolization (UFE): technique and troubleshooting. *CVIR Endovasc*. 2020;3:50.
6. Sher A, Garvey A, Kamat S, et al. Single-System Experience With Outpatient Transradial Uterine Artery Embolization: Safety, Feasibility, Outcomes, and Early Rates of Return. *American Journal of Roentgenology*. 2021;216:975-80.
7. Manyonda I, Belli AM, Lumsden MA, et al. Uterine-Artery Embolization or Myomectomy for Uterine Fibroids. *N Engl J Med*. 2020;383:440-51.
8. Harris RD, Holtzman SR, Poppe AM. Clinical outcome in female patients with pelvic pain and normal pelvic US findings. *Radiology*. 2000;216:440-3.
9. Freedman J, Ganeshan A, Crowe PM. Pelvic congestion syndrome. The role of interventional radiology in the treatment of chronic pelvic pain. *Postgrad Med* J. 2010;86: 704-10.
10. Bookwalter CA, VanBuren WM, Neilen MJ, et al. Imaging appearance and non surgical management of pelvic venous congestion syndrome. *Radiographics*. 2019;39:596-608.
11. Yang DM, Kim HD, Nam DH, et al. Time-resolved MR angiography for detecting and grading ovarian venous reflux: comparison with conventional venography. *Br J Radiol*. 2012;85: e117-e122.
12. Hansrani V. Abbas A, Bhandari S, et al. Trans-venom occlusion of incompetent pelvic veins for chronic pelvic pain in women: A systematic review. *Eur J Obstet Gynecol Reprod Biol*. 2015;185:156-163.

Methods of endometrial ablation

Dr Dimity Archer
MBBS, Level 4 RANZCOG trainee,
Launceston General Hospital

Endometrial ablation, defined as the surgical removal or destruction of the endometrial lining of the uterus, is a commonly performed procedure for the treatment of heavy menstrual bleeding, with an estimated 25% of women in their child-bearing years experiencing abnormal uterine bleeding.[1]

Background

Endometrial ablation, in some form, has been practiced for many years. The first ablation procedure documented was with chemical astringents to control a postpartum haemorrhage.[2] In 1898, Dührsen introduced steam into the uterus in an attempt to control heavy menstrual bleeding.[3] This was noted to result in total atrophy of the uterus. The 19th century also saw electrosurgical techniques such as the use of a unipolar ball and fulguration being used, followed by radium in the early 1900s for treating both benign and malignant disorders.[3]

Cryoablation, the use of extreme cold to destroy tissues, was first documented in the 1960s.[3] It was noted to persistently spare the cornual endometrium which limited its use. A neodymium yttrium-aluminium-garnet laser was introduced in the 1980s, and while this showed excellent depth penetration through the tissues, it was costly and preceded the modern fluid managing techniques, making this both inaccessible and unsafe at the time.[3]

The latter decades of the 1900s showed the use of continuous-flow resectoscopes, which gained increasing popularity.[3] With this method came reports of morbidity and mortality related to fluid overload, prompting the development of non-resectoscopic methods of endometrial ablation. The year 1997 showed the first of these devices being introduced into the market, and currently there are at least six different types of second-generation (non-resectoscopic) endometrial ablation devices available globally.[3]

Indications and contraindications

The indications for endometrial ablation include the treatment of heavy menstrual bleeding in premenopausal women, which is usually ovulatory in nature.[4]

Prior to proceeding with endometrial ablation, it is important that the woman has an assessment of her endometrial cavity, review of the myometrial thickness (particularly if she has had previous uterine surgery such as a septum resection or caesarean section), and that endometrial sampling has been performed to exclude malignancy as a cause for her bleeding.[4] She should also be counselled regarding alternative options for managing her abnormal uterine bleeding, risks of the procedure, expected outcomes and the need for reliable contraception ongoing.[4]

Table 1. Contraindications of endometrial ablation.[4]

Absolute contraindications	Relative contraindications
Pregnancy	Congenital uterine anomalies
Future fertility desires	Postmenopausal status
Active pelvic infection	Myometrial thinning
Previous transmyometrial surgery	Uterine cavity length greater than or equal to 10–12cm
Intrauterine contraceptive device in situ	
Known/suspected endometrial hyperplasia	

Table 2. Comparison between first-generation and second-generation endometrial ablation techniques for the treatment of heavy menstrual bleeding.

	Resectoscopic ablation	Non-resectoscopic ablation
Rates of reduction in menstrual blood loss and amenorrhoea	Similar	Similar
Patient satisfaction	Similar	Similar
Need for repeat surgical intervention	Similar	Similar
Anaesthesia	More likely to require GA/regional anaesthesia	More likely to be tolerated under local anaesthesia
Operating time	Longer	Shorter
Risk of surgical complications	Higher risk of: • Fluid overload (0.3% vs 0%) • Hematometra (2.4% vs 0.9%) • Cervical laceration (2.2% vs 0.2%)	Higher rates of: • Failure of the equipment (9.1% vs 1.6%) • Nausea and vomiting (19% vs 7.7%) • Uterine cramping (38% vs 33%)
Surgical training required	Longer training time	Less training time
Cost	Higher	Lower
Need for further operation including hysterectomy	Higher	Lower

Summary of methods of endometrial ablation

First generation endometrial ablation (resectoscopic endometrial ablation)

These methods are performed by resection or ablation of the endometrial lining under hysteroscopic guidance, and use resectoscopic electrosurgical instruments or laser. Techniques include electrosurgical desiccation with a rollerball, resection of the endometrium with a monopolar or bipolar electrode, radiofrequency vaporisation or laser vaporisation.[5]

These methods require specific operative hysteroscopic training and are not usually tolerated under local anaesthesia. They have the additional risks of longer surgical operating time, fluid overload risks and often require pre-operative hormonal suppression or treatment.[5]

Second generation endometrial ablation (non-resectoscopic endometrial ablation)

These methods are performed using a disposable device, which is introduced into the uterine cavity and delivers energy in a uniform manner to destroy the endometrial lining. There are multiple methods and devices available commercially worldwide, including:[5]

- Bipolar radiofrequency, eg. NovaSure®
- Thermal Balloon ablation/Hot liquid filled balloon, eg. ThermaChoice®, Cavaterm™ and Thermablate EAS™
- Cryotherapy, eg. Her Option®
- Circulating hot water, eg. Hydro ThermAblator®
- Microwave, eg. Microwave Endometrial Ablation
- Combined thermal and bipolar radiofrequency, eg. Minerva®
- Vapor ablation, eg. Mara™

The most common non-resectoscopic methods used in Australia include bipolar radiofrequency and thermal balloon ablation.

Bipolar radiofrequency (Novasure®)

The bipolar radiofrequency device uses a mesh-covered disposable probe which is attached to a generator to deliver a radiofrequent current to the endometrium. This vaporises and coagulates the endometrium, as well as desiccating and coagulating the underlying superficial myometrium for up to 120 seconds.[6] In addition, the device monitors carbon dioxide levels to assess for evidence of uterine perforation, and uses suction to remove debris and vapour throughout the procedure. The advantages of using bipolar radiofrequency for endometrial ablation includes the high rates of success with a reduction in bleeding at five or more years of 97-98% and amenorrhoea in 75–97%.[7] Only 3–8% of women post ablation required a hysterectomy in this study. This method does not require preoperative treatment with medications such as Gonadotrophin receptor agonists or progestogens.[5] The disadvantages include that this device has had limited research performed to assess the effectiveness of the device in the setting of submucosal or intramural fibroids extending into the endometrial cavity. Small studies suggest intracavity lesions less than 3mm are not associated with a reduction in efficacy or patient satisfaction.[8]

Thermal balloon ablation (Cavaterm™)

This method is performed by placing a silicone balloon via an introducer into the endometrial cavity. The balloon is expanded to a pressure of 160–220mmHg with a fluid medium such as glycine and the fluid is then heated to 68–87 degrees Celsius for 8–10 minutes.[5]

Success rates for thermal balloon ablation are variable, with rates of reduced uterine bleeding of 22–81% and amenorrhoea in 23–58% of women at four years. These studies were performed on older devices, with current data demonstrating improved rates of bleeding or amenorrhoea of 74–83% and a 15% rate of hysterectomy with the most current model available in Australia.[9] Disadvantages of this

Table 3. Complication rates for resectoscopic and non-resectoscopic methods of endometrial ablation.[5]

Complication	Resectoscopic ablation	Non-resectoscopic ablation
Uterine perforation	1.3%	0.3%
Haemorrhage	3%	1.2%
Haematometra	2.4%	0.9%

technique include increased postoperative pain when compared with other non-resectoscopic techniques, and discrepancies in the literature regarding the efficacy of this method in women with submucosal fibroids. This is related to the device requiring contact with the endometrium for ablation to occur. However, other studies have shown this method can be used in submucosal fibroids up to 3cm in size,[10] highlighting the need for further research in this area.

Outcomes and efficacy

Both resectoscopic and non-resectoscopic methods of endometrial ablation have comparable outcomes in terms of amenorrhoea or reduction in menstrual blood loss at both one year and at 2–5 years. Studies performed are heterogenous in their assessment of how menstrual loss was measured and assessed. A Cochrane review in 2009 demonstrated rates of amenorrhoea of 37% vs 38% and 53% vs 48% in non resectoscopic and resectoscopic groups at one and two–five years respectively.[11]

This meta-analysis also demonstrated equivalent patient satisfaction between the two types of endometrial ablation (91% in the resectoscopic group compared with 88% in the non-resectoscopic group) which persisted from one year to two–seven years, with similar rates of repeat surgical intervention for abnormal uterine bleeding found. Repeat surgical intervention rates following endometrial ablation is up to 25%, with the need for any type of surgery (hysterectomy included) at 21% for non-resectoscopic methods and 25% for resectoscopic methods. Rates of hysterectomy following ablation were demonstrated at 14% in the non-resectoscopic group and 19% in the resectoscopic group.[11]

Complications of endometrial ablation

Pelvic infection is uncommon and can take the form of endometritis (1.4–2%), myometritis (0–1%), pelvic inflammatory disease (1.1%) and pelvic abscess (1–1.1%).[5]

Post ablation tubal sterilisation syndrome occurs in up to 10% of women following an endometrial ablation with a tubal ligation performed previously and is characterised by intermittent or cyclical pelvic pain.[5] Suggested causes include contractures of the uterus with intrauterine scarring and/or trapped blood from active endometrium in the cornua. Diagnosis is guided by history, with MRI being useful for visualising blood in the cornua. Management is similar as for haematometra; dilation of the cervix, hysteroscopic guided adhesiolysis, laparoscopic excision of remaining portions of the fallopian tubes, or hysterectomy as definitive management.[11]

Conclusion

Endometrial ablation is an effective method for managing abnormal uterine bleeding. There are a variety of different approaches to performing an endometrial ablation, including both resectoscopic and non-resectoscopic methods. Non-resectoscopic methods involve less dedicated training in their use, shorter operating time and less serious complications, with no increased rates in the need for a hysterectomy or repeat procedure. Practitioners must have an awareness about the availability, benefits and limitations of each method when counselling patients with abnormal uterine bleeding.

References

1. Royal College of Obstetricians and Gynaecologists. National heavy menstrual bleeding audit. London: RCOG, 2014.
2. Wortman M. Endometrial Ablation: Past, Present, and Future Part I. *Surg Technol Int.* 2018;32:129-38.
3. Wortman, M. Late Onset Endometrial ablation failure. *Case Reports in Women's Health.* 2017;15:11-28.
4. Royal College of Obstetricians and Gynaecologists elearning: Indications and Contraindications of Endometrial ablation. Available from: https://elearning.rcog.org.uk//uterine-cavity-surgery/endometrial-ablation/indications-and-contraindications
5. Laberge P, Leyland N, Murji A, et al. SOGC Clinical Practice Guideline: Endometrial ablation in the management of Abnormal Uterine bleeding. 2015;37(4):362-76.
6. Instructions for use: NovaSure Advanced Device. Available from: https://gynsurgicalsolutions.com/resource/
7. Fultop T, et al Novasure impedance controlled endometrial ablation: long term follow up results. *Journal of Minimally Invasive Gynaecology*. 2007;(14)1:85.
8. Sabbah R, Desauliers G. Use of the NovaSure Impedance Controlled Ablation System in patients with intracavity disease: 12 month follow up results of a prospective single arm clinical study. *Journal of Minimally Invasive Gynaecological Surgery*. 2006;13(5):467
9. Amso N, et al. Uterine endometrial thermal balloon therapy for the treatment of menorrhagia: long term multicentre follow up study. *Human Reproduction.* 2003;18(5):1082.
10. ACOG Practice Bulletin. Clinical management guidelines for Obstetricians and Gynaecologists- Endometrial Ablation. *Obstetrics and Gynaecology*. 2007;109(5):1233.
11. Lethaby A, Hickey M, Garry R, et al. Endometrial Resection/ablation techniques for heavy menstrual bleeding. *Cochrane Database Systematic Review*. 2009.

Ethical considerations for surgical innovation

Dr Naomi Holbeach
FRANZCOG Advanced Trainee
Senior Registrar, Mercy Hospital for Women, Vic
PhD Candidate, Melbourne Law School
BSc, LLB (Hons), MBBS (Hons), MRMed

Surgical specialties, including gynaecology, have a long history of innovation. The introduction of novel technology into clinical practice is an important issue for the speciality as it continues to move forward and provide better surgical care to patients.[1] Doctors have legal and ethical obligations in the delivery of patient care, whether the care is innovative or not. In *Childs v Walton*, for example, Samuels JA said that '[novelty] itself is neutral…But a new departure in professional practice or technique must conform to the accepted ethical standard of the profession'.[2]

Surgical innovation is also precious, and in the interests of improving surgical treatment we should introduce innovative technologies with care at every step. Failure to do so may undermine public trust in the profession as well as the innovation ultimately leading to a lost opportunity.

This is a brief summary of some of the issues that arise in relation to departures from standard care in the form of surgical innovation. For brevity, the issues considered here will include consent, surgical experience and training, preoperative planning, the role of clinical trials, documentation and postoperative follow up. The definition of surgical innovation has been debated elsewhere at length,[3–7] but for the purposes of this piece it is the introduction of a novel surgical practice, which may include technology or devices.

Informing the patient that the procedure is novel

There is a duty to warn of material risks during preoperative discussions that was established by *Rogers v Whitaker*.[8] The case famously involved a woman with unilateral blindness who underwent a procedure on the affected eye. She was informed of the risks of the procedure but not of the rare risk of sympathetic ophthalmoplegia. She was affected and left blind in both eyes. The High Court found that the risk of sympathetic ophthalmoplegia was significant to her and for this reason ought to have been discussed. Material risks that should be discussed in preoperative counselling include risks that a person in the position of the patient would attach significance to, and risks that the doctor knew or ought to have known this particular patient would attach significance to.

The innovative or novel nature of a new procedure is likely to be considered material and should be disclosed to a patient for a procedure that involves surgical innovation. The following three cases demonstrate this point and a number of others relevant to the discussion. In *Health Care Complaints Commission v Reid ('Reid')*, the NSW Civil and Administrative Tribunal noted at the outset that the procedure, which was the implantation of the Tissue Fixation System, a type of vaginal mesh, was not mainstream and so the patient should be told that it was novel.[9] In New Zealand, a robotic-assisted laparoscopic radical prostatectomy resulted in harm to a patient caused by the extended operating time due to the surgeon's learning curve with the new procedure.[10] As in *Reid*, the Commissioner concluded that the surgeon ought to have informed the patient that the procedure was new.[10] In *Mills v Oxford University Hospitals NHS Trust ('Mills')* the patient suffered a major stroke following a neurosurgical debulking of a glioma using a minimally invasive endoscopically-assisted open craniotomy, which was not the standard approach at the time.[11] The Court found that neither the approach nor surgical conduct was negligent, but the surgeon breached the duty to warn by not making it clear that the procedure was novel.[11]

There is evidence that, more than merely stating that the innovative surgery is new, it should be made clear to the patient that it is not first-line treatment and exists as an alternative to standard treatment options. In *Mills*, the Court found that novel surgical approach should have been offered as an alternative to the standard technique alongside a discussion about the comparative risks and benefits.[11] The Court clarified that however the surgeon chose to describe the novelty of the procedure, it should have included an explanation that it was 'not well established' and that other surgeons employed an alternative approach.[11] Likewise in *Reid*, there should have been a discussion about alternative treatments, and a particular discussion about the complications relating to the novel treatment.[9]

The surgeon's experience with novel technology

There is a learning curve for any new procedure and there is some evidence to suggest that this is relevant to include in preoperative discussions with the patient. The Commissioner in the New Zealand case above found that the urologist should have informed the patient of his limited experience performing the robotically-assisted laparoscopic prostatectomy.[10] The conclusion of the Commissioner highlighted the surgeon's awareness of how long he took to perform the surgery (six hours) compared to more experienced surgeons (two to three hours). It was accepted that the risk of complications increased with increased operating time, and this should have been discussed with the patient. Disclosing surgical competence was also addressed in *Reid,* where the Tribunal found that the failure to disclose that it was the surgeon's first time as lead surgeon and that he required supervision was unprofessional conduct.[9] The distinctions between surgeon, researcher, financier and innovator may lead to a conflict of interest as was the case in *Health Complaints Commission v Petros*.[12] These cases do not directly comment on the steps that surgeons should take to train in a new procedure, but it would be advisable to comply with College, hospital or health department policies on supervision, ethics

oversight, and credentialling with respect to novel surgical techniques.

Preoperative planning for new surgical techniques

Preoperative preparation and the experience of the surgical team as a whole is also relevant to the performance and success of a new procedure. The surgical team includes the surgical assistant, anaesthetist, and nursing and theatre staff. The Macquarie Surgical Innovation Identification Tool (MSIIT) can be a useful way to prospectively identify surgical innovation to trigger preoperative safety mechanisms and allow the surgical team to plan ahead. This short point of care questionnaire acknowledges the role that the entire surgical team play in optimising the surgical outcome.[13] Preoperative planning could include training, discussions about anaesthesia and predicted anaesthetic time, equipment availability, contingency planning should there be intraoperative problems, whether a medical device representative should be present, and whether a surgeon experienced with the technique should be present. It may be important to inform some patients of these preparatory steps and precautions as well as the presence or participation of additional personnel in the procedure including surgical colleagues and medical device representatives.

The role of research and clinical trials

Considering the potential risks that surgical innovation poses, some would argue that all surgical innovation should occur in the context of research. Less is known about the safety and efficacy of surgical innovation, so how can it be confidently recommended and performed? Innovation in surgery is sometimes introduced through research and clinical trials, but in some cases it is introduced through innovative practice. The distinction between innovation and research is not always clear and there is overlap. Research is a systematic investigation that aims to create generalisable results.[3] This differs from innovative practice where the innovation is primarily to benefit the individual patient.[14]

The NHMRC National Statement acknowledges that the distinction may not be clear and when advice on the appropriate course can be sought from a Human Research Ethics Committee or institutional review board.[15] Some of the ethical considerations that will be relevant to deciding whether an innovation should be introduced through a clinical trial will include:

- The nature and severity of the risks (eg. permanent, functional impact)
- The nature of the technology (eg. permanent, implantable, energy-bearing or tissue-destructive)
- The vulnerability of the population (eg. children, incompetent patients)
- The nature of the condition (eg. if the condition is non-life-threatening or if the impact on quality of life is relatively minor)
- The chance of success is low, or the predicted benefit is limited or not patient-centred

Follow up, documentation and communication

Postoperative care of the patient who has been treated with a novel surgical device or technology is another important element to consider. The Senate Committee report on vaginal mesh formed the view that women affected by complications of transvaginal mesh experienced great difficulty accessing medical assistance.[16] Their recommendation was that women should be provided with a patient card and information booklet with advice on where to seek assistance in the event of an adverse event.[16] The report also recognised the importance of establishing a national register of medical devices for which work is underway.[16] The availability of information to patients, primary care providers and others is one way that we can ensure patients have access to care should adverse events occur, especially if they occur in the long term. The information provided could include a clear pathway for seeking assistance, especially if the primary surgeon is unable to provide care. In the absence of a national register for medical devices, clear and detailed documentation where a novel procedure has occurred will be valuable. Given that adverse events with respect to new medical technology may be unpredictable, delayed in onset and diagnosis, keeping medical records for an extended period of time could aid patients and colleagues to provide care for complications.

Conclusion

The introduction of novel technology in gynaecology offers potential benefits to patients, the healthcare system and gynaecologists. The nature of innovation and novel technology in healthcare is that there are risks and some risks cannot be known at the outset. As a result, particular care is needed to ensure that patients are informed, that the surgeon and surgical team are prepared and trained for the surgery, that preoperative planning is meticulously done, and that documentation and communication are clear. Future work in this area will hopefully bring clarity around doctors' ethical and legal obligations when engaging in innovative surgical practice, offering greater confidence to innovate safely and responsibly.

References

1. Riskin DJ, Longaker MT, Gertner M, Krummel TM. Innovation in Surgery. *Ann Surg*. 2006;244(5):686–93.
2. Childs v Walton. Vol. [1990], NSWCA. p. 41.
3. Biffl WL, Spain DA, Reitsma AM, et al. Responsible Development and Application of Surgical Innovations: A Position Statement of the Society of University Surgeons. *Journal of the American College of Surgeons*. 2008;206(6):1204–9.
4. Birchley G, Ives J, Huxtable R, Blazeby J. Conceptualising Surgical Innovation: An Eliminativist Proposal. *Health Care Anal*. 2020;28(1):73–97.
5. Earl J. Innovative Practice, Clinical Research, and the Ethical Advancement of Medicine. *The American Journal of Bioethics*. 2019;19(6):7–18.
6. Rogers WA, Lotz M, Hutchison K, et al. Identifying Surgical Innovation: A Qualitative Study of Surgeons' Views. *Annals of Surgery*. 2014;259(2):273–8.
7. The National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research. The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research. Department of Health, Education, and Welfare; 1979.
8. Rogers v Whitaker. Vol. 175, CLR. 1992. p. 479.
9. Health Care Complaints Commission v Reid. Vol. 2018, NSWCATOD. p. 162.
10. Health and Disability Commissioner. Informed Consent to Innovative Treatment. New Zealand; 2009. Report No.: 08HDC20258. Available from: www.hdc.org.nz/decisions/search-decisions/2009/08hdc20258/
11. Mills v Oxford NHS Trust. Vol. [2019], EWHC. p. 936.
12. Health Care Complaints Commission v Petros. Vol. [2019], NSWCATOD. p. 83.
13. Hutchison K, Rogers W, Eyers A, Lotz M. Getting Clearer About Surgical Innovation: A New Definition and a New Tool to Support Responsible Practice. *Annals of Surgery*. 2015;262(6):949–54.
14. Margo CE. When Is Surgery Research? Towards an Operational Definition of Human Research. *Journal of Medical Ethics*. 2001;27(1):40–3.
15. National Health and Medical Research Council. National Statement on Ethical Conduct in Human Research. 2007. Available from: www.nhmrc.gov.au/about-us/publications/national-statement-ethical-conduct-human-research-2007-updated-2018#
16. Senate Community Affairs Committee. Number of Women in Australia who have Transvaginal Mesh Tapes and Related Matters. 2018. Available from: www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/MeshImplants/Report

Q&A

For the broader *O&G Magazine* readership, balanced answers to those curly-yet-common questions in obstetrics and gynaecology.

Dr Tracey J Zakazakaarcher
MBBS(Hons), BaBioMedSc. CSO RAN
DRANZCOG adv, FRANZCOG trainee

Q How would you assess and manage the patient who presents with abdominal trauma in the third trimester?

A

Trauma is the leading non-obstetric cause of maternal mortality and morbidity, occurring in 8% of all pregnancies. Motor vehicle accidents (MVA) are the most commonly reported abdominal trauma. Fetal injury resulting from trauma can be classified as direct or indirect (Table 1). Direct trauma can attribute to fractures of the spine and skull, haemorrhage from injury to extremities or intracranial haemorrhage and organ ruptures. Direct trauma can compromise maternal physiology. Indirect trauma in this table is defined as trauma that has occurred secondary to the direct trauma. Fetal compromise can be present without obvious maternal injury

Abdominal trauma needs immediate evaluation to determine the severity of the trauma. Minor trauma accounts for 90% of the trauma presentations and 25% of the fetal deaths from abdominal trauma in third trimester. 10% are considered major with only 2% requiring surgical intervention.

Primary obstetric survey should be conducted on presentation with escalation to consultants as required. All hospitals should have effective triage systems allowing rapid detection of irregular observations with escalation protocols. All staff should understand the physiological changes of pregnancy – cardiovascular, haematologic, respiratory and gastrointestinal – in order to provide a systematic evaluation, as the severity of maternal injury directly relates to fetal compromise.

Always remember there are two patients: maternal and fetal. Remember that maternal resuscitation is paramount and needs to be first priority. A multidisciplinary team approach for primary survey has shown better maternal and fetal outcomes. Rapid maternal resuscitation ultimately reduces risk to the fetus. As pregnancy progresses, the associated physiological changes become more significant and the abdominal anatomy becomes distorted. A patient could lose up to 30% of total volume prior to any signs of shock. Serious maternal injury may indicate the need for perimortem caesarean; if needed this must be acted upon quickly.

Management at the primary survey

Management is determined on the mechanism of injury and clinical findings. Primary survey allows immediate management of life-threatening abdominal trauma via resuscitation and surgical intervention as needed.

Once patient stable, secondary survey is mandatory to determine obstetric and non-obstetric injuries, the level of assessment, and investigations needed for further management.

Secondary survey

Firstly, determine the mechanism of Injury and obtain a full antenatal history followed by a full evaluation of maternal and fetal condition, keeping in mind the differential diagnosis of third trimester abdominal trauma.

Table 1. Causes of third trimester abdominal trauma.

Direct	Indirect (resulting from direct trauma)
• Motor vehicle accidents • Domestic violence • Penetrating trauma • Mild blunt trauma • Falls • Suicide • Self harm • Burns • Toxic exposure • Maternal physiological change • Aneurysm • Ruptured liver or spleen • Intercranial or limb injury causing fetal compromise	• Placenta abruption, mainly from MVA • (Rapid deceleration and incorrect seatbelt use) • Preterm labour • Uterine rupture (rare: 0.6%)

Primary obstetric survey	Perimortem caesarean
DRS ABC E TILT **D**anger **R**esponse **A**irway **B**reathing **C**irculation **E**nvironment **TILT**- left lateral tilt Uterine displacement as alternative to TILT when cardiac compressions, intubation are required. ?? Perimortem caesarean	**Indicated** – maternal cardiac arrest. Gravid uterus above umbilicus or >20 weeks Up to 30 mins after cardiac arrest commenced. Lie patient supine – increases effective cardiac compressions. Removes pressure for IVC/aorta Decrease preload Improves lung volume compliance Reduces maternal oxygen demand Increased chance of maternal and fetal survival

Vitals

Blood pressure, pulse, temperature, pain, oxygen saturations, ECG.

Remember to consider the physiological changes of third trimester.

Bloods

FBC, Group and hold, LFT. Coags, kleihauer-Betke,Lipase Coags + ROTEM (Rapid assessment of clotting) urine.
Positive Keilhauer-Betke indicates fetal-maternal haemorrhage. Remember that anti-D should be given to all Rh-negative mothers in third trimester. Continue regular monitoring.

CTG

It is recommended that a minimum of four hours of CGT monitoring be conducted for all presentations with third trimester abdominal trauma. Placenta abruption can occur over time; therefore, CTG may be indicated up to 24 hours post injury. If CTG is abnormal, consider immediate delivery. If labour has commenced, do not treat with tocolytics. If preterm, treat with Betamethasone, magnesium sulphate. If necessary, transfer to a secondary or tertiary centre

Examination should be done with consent and chaperone if possible.

Abdominal palpation

Look for tenderness, contractions, rigidity, injury. Bruising. Seat belt marks. Always look for evidence of domestic violence.

Speculum

Check for vaginal bleeding, evidence of trauma or sexual assault, determine cervical dilatation and perform high vaginal and low vaginal swabs, wound swabs, amnisure and fetal fibronectin, depending on the clinical scenario.

Vaginal examination

Conduct only when necessary and rarely for preterm presentations. Do not perform unless you have checked ultrasound scans for vasa praevia, placenta praevia.
Vaginal bleeding and/or uterine tenderness can indicate abruption, especially in trauma cases.

Imaging

Ultrasounds, CT scans and MRI should be done as indicated. Informed consent should be sought In acute cases. Imaging should be priority while awaiting lab results. A follow-up ultrasound should be done within two weeks on all trauma obstetric patients needing admission.

Management

Management is determined upon history and examination findings as well as clinical expertise and available resources. If delivery is needed and is not urgent, consider the gestational age. If <34 weeks, give Betamethasone 11.4 IU, 12–24 hours apart, with escalation to consultant, theatre, anaesthetics, paediatrics, ICU, as required. Consider delivery vaginal or LUSCS, consider need for transfer, consider stability of the patient. If delivery is not urgent, determine outpatient verses inpatient management and the timing of future monitoring such as antenatal visits, ultrasounds, repeat bloods and delivery. Remember to escalate as situations change and always document everything.

Further reading

- Murphy NJ, Quinlan JD. Trauma in pregnancy: Assessment, management, and prevention. *Am Fam Physician.* 2014;90(10):717–22.
- Gumm K, Kennedy M, Oats J, et al. TRM 05.01 Pregnancy and Trauma Guideline. *Trauma Service Guidelines.* 2006;1–14.
- Vaynshtein J, Guetta O, Replyansky I. Abdominal Pain in Pregnancy. *JAMA Surg*. 2019;154(2):176–7.
- Guideline QC. Quennsland Clinical Guideline: Trauma in pregnancy. Queensland Health. 2019. Available from: www.health.qld.gov.au/qcg
- Greco PS, Day LJ, Pearlman MD. Guidance for Evaluation and Management of Blunt Abdominal Trauma in Pregnancy. *Obstet Gynecol*. 2019;134(6):1343–57.
- Barraco RD, Chiu WC, Clancy TV, et al. Practice management guidelines for the diagnosis and management of injury in the pregnant patient. *J Trauma - Inj Infect Crit Care*. 2010;69(1):211–4.
- Jain V, Chari R, Maslovitz S, et al. Guidelines for the Management of a Pregnant Trauma Patient. *J Obstet Gynaecol Canada.* 2015;37(6):553–71.
- Berlingieri P, Grudzinskas JG. Assessment of abdominal pain in pregnancy. *BMJ Best Pract*. 2018; Available from: http://bestpractice.bmj.com/best-practice/monograph/664/diagnosis/differential-diagnosis/by-category.html
- Woodhead N, Nkwam O, Caddick V, et al. Surgical causes of acute abdominal pain in pregnancy. *Obstet Gynaecol.* 2019;21(1):27–35.
- Samberkar PN, Chow TK, Samberkar SP. Fatal spontaneous rupture of splenic artery aneurysm in third trimester pregnancy. *Malays J Pathol.* 2018;40(3):337–41.
- Chavan NN, Rohidas V, Waikule H. Accidental haemorrhage in third trimester: maternal and fetal outcome. Int J Reprod Contraception. *Obstet Gynecol*. 2019;8(4):1633.
- Bouyou J, Gaujoux S, Marcellin L, et al. Abdominal emergencies during pregnancy. *J Visc Surg*. 2015;152(6):S105–15.
- Lien C, Ali A, Culhane J. Blunt abdominal trauma with uterine rupture and fetal demise. *Journal of Trauma.* 2017;19(3):219-221.
- Brookfield K G-QV, Davis J, Schulman C. Maternal death in the emergency department from trauma. *Archives of Gynecology and Obstetrics*. 2013;288:507-512.
- ANZCOR. Management of Cardiac Arrest due to Trauma; ANZCOR Guideline 11.10.1: Australian and New Zealand Council of Resusitaiton April 2016.
- Judson R, Liersch K. TRM 08.07 Xray imaging during pregnancy 4 ed. Melbounre: The Royal Melbourne Hospital Trauma Service; 2017.

Full list available online

RANZCOG Consumer Network

Ms Julie Hamblin
RANZCOG Board Member
Chair, Consumer Network Working Group

Dr Gillian Gibson
RANZCOG Board Member
Deputy Chair, Consumer Network Working Group

During 2020, RANZCOG established a Consumer Network to provide opportunity for consumers to contribute more substantively to RANZCOG work, and to the pursuit of excellence in women's health more broadly. This College initiative was based on the successful Royal College of Obstetricians and Gynaecologists (RCOG) Women's Network and Women's Involvement Panel, a College Facebook group in the UK.

The RANZCOG Consumer Network comprises three elements: the Consumer Network Working Group, a private Consumer Network Facebook Group and the existing consumer representation across various RANZCOG Committees.

The Consumer Network will enable RANZCOG to share, engage and partner with a broad and diverse range of health consumers in Australia and New Zealand. It will provide a forum where consumers can exchange views about what matters to them in relation to the issues on which RANZCOG is working. It will be a touchstone to ensure the College is alive to the perspective of the users of health services and not just that of health practitioners.

As the independent member of the RANZCOG Board and a consumer of women's health services herself, Julie Hamblin had no hesitation in accepting the invitation to Chair the Consumer Network; 'I believe deeply that an openness to women's perspectives will be of huge benefit to RANZCOG in ensuring that we remain focused, relevant and in tune with the issues that are most important to the women whose interests we serve.'

The RANZCOG Consumer Network has eleven members, including the College's three Committee consumer representatives, five recruited consumer members, RANZCOG trainee representative, Board member Dr Gillian Gibson, an O&G specialist in New Zealand, and Ms Julie Hamblin as the Chair.

Ms Hamblin explains 'my previous work as a health lawyer taught me that lack of mutual understanding between doctors and their patients is at the heart of many unsatisfactory health outcomes. Integrating medical knowledge and expertise with a real understanding of what the patient wants and needs is the key to good healthcare. It requires humility on the part of health practitioners and an ability to listen to points of view that may be different from their own. It is our ambition that the Consumer Network will bring RANZCOG closer to achieving this goal.'

All interested consumers are encouraged to participate in the Facebook Group, and input is welcomed from family, carers, friends and other support people in addition to patients themselves. It will be a forum in which people can raise concerns as well as provide feedback on RANZCOG's policy and advocacy work.

RANZCOG is excited about this initiative which has enormous potential to enhance the quality and relevance of RANZCOG's work. We are looking forward to a new level of engagement with our consumer stakeholders and some challenging and thought-provoking debates around issues of concern.

Ms Tessa Kowaliw
RANZCOG Council Consumer Representative
Member, Consumer Network Woking Group

Every good care provider knows the value of actively listening to consumers and genuinely partnering with them as part of healthcare delivery. Asking a consumer, 'How do you feel about that?' is a very simple way to both engage them in their care and to make space for their input. Similarly, we have learned over time that consumer representation in focus groups, committees and other formal settings is important. Inviting a consumer to attend meetings and respond to draft documents, for example, opens the door to community perspective. These familiar strategies for consumer engagement are essential stepping stones for building trust between clinical and patient communities; these approaches both allow clinicians to test the value and relevance of consumer input, and give consumers a chance to assess how well this input is received and 'actioned'.

Once established, this foundation allows for more ambitious consumer engagement goals – a bigger database of consumer representatives with a broader variety of roles to play, the inclusion of the consumer voice at earlier stages of service design, a greater, less formal ease of dialogue between clinicians and consumers. With the advent of social media platforms and our more recent shift towards hybrid meeting formats, there has been no better time to further iterate how consumer engagement both looks and happens. Technology allows us to bridge the gap between clinical decision makers and consumers in new ways, including those consumers in the community who might previously have been harder to equitably engage.

In this context, RANZCOG has been quick to recognise and seize this opportunity to employ our 'new ways of working' to take consumer engagement to the next level. Our new Consumer Network Working Group (CNWG) is an exciting example of an investment in consumer leadership. It will act as a mechanism by which matters of concern to the women's healthcare community can be heard. The CNWG is additionally a knowledge base and a link to broader networks upon which the College can call. As a group containing members from across Australia and New Zealand, the transition to Zoom meetings could not have come at a better time for the CNWG. Furthermore, the associated RANZCOG Consumer Network Facebook group now offers an additional opportunity to members of the consumer community beyond the CNWG to join in, learn more about RANZCOG, and build positive working relationships.

I am delighted that RANZCOG has chosen to take these next steps towards a mature and robust model of consumer and community engagement, and I look forward to seeing how these groups continue to evolve and develop with the input of our fantastic consumer members.

Election of Board Directors for the 12th RANZCOG Council

The members below have been elected to the RANZCOG Board for the Twelfth RANZCOG Council, November 2021–2023, joining President-Elect Dr Benjamin Bopp.

RANZCOG is pleased to report that that we have exceeded our targets set for female representation on the incoming Board. There is also a broad representation of linguistic and cultural diversity, reflective of the diverse cultural breadth within our membership.

Along with Dr Bopp, the elected Board Directors will take office at the conclusion of the 2021 Annual General Meeting in November.

Congratulations to all the members on their election.

Dr Benjamin Bopp
MBBS FRANZCOG
President-Elect

Ben has been a specialist O&G for more than 20 years. He is currently the Director of Obstetrics at Gold Coast University Hospital, a position he has held for the last three years. Previously, he worked as a generalist (obstetrics, gynaecology and IVF) in private practice.

In addition to previous involvement with the College Women's Health Committee, Continuing Professional Development and Revalidation Committee, and Education Strategy Committee, Ben has been actively involved with the SIMG Assessment Committee, which he currently Chairs, and is also Chair of the College's Australian Workforce Working Group.

Ben has been a RANZCOG Councillor since 2010 and Board Director since 2016.

Dr Gillian Gibson
BSc(Hons) MBChB Dip Obstet MRCOG FRANZCOG
Vice-President

Gill has been a RANZCOG Fellow since 1997. She was a New Zealand representative on the 9th and 10th RANZCOG Councils 2014–2018 and member of the O&G Magazine Advisory Group 2011–2018. She is ex-officio member of Te Kāhui Oranga ō Nuku, an elected member 2005–2011 and Chair of the New Zealand committee 2008–2010.

She is a Generalist O&G at Auckland District Health Board (ADHB) with a special interest in outpatient gynaecology including hysteroscopy, colposcopy and sexual & reproductive healthcare. She is Clinical Director of the Auckland regional first trimester abortion service. She has a private gynaecology practice and was a member of a private obstetric group practice in Auckland for 18 years (1997–2016).

This will be Gill's second term as a Board Director.

Dr John Regan
MBBS FRANZCOG
Vice-President

John is a practising O&G in Melbourne with his principal public appointment being Head of Obstetrics at Monash Medical Centre in Clayton.

He has been involved with RANZCOG for many years, and has been a RANZCOG Councillor since 2012.

He is currently the Chair of the Subspecialties Committee, having previously been involved with the Women's Health Committee, the Continuing Professional Development Committee, the Finance and Risk Management Committee and the SIMG Committee.

John has also been instrumental in RANZCOG's recent move to College Place.

First elected to the Board in 2018, this will be John's second term as a Board Director.

A/Prof Boon Lim
MBBS FRCOG FRANZCOG
Vice-President

Boon trained in O&G in Scotland, and upon completion, he held consultant positions in New Zealand, Scotland, England and Tasmania before moving to Canberra. He has held senior clinical academic positions with the Universities of Auckland, Aberdeen, Cambridge, Tasmania and currently with the Australian National University.

Elected to Council in 2012, Boon has been on several committees of the College and is currently Chair of the RANZCOG Continuing Professional Committee. He has a keen interest in training and education and is on the Board of Examiners as joint Co-ordinator of the Short Answer Questions for the FRANZCOG Examination.

Boon is Clinical Director of the Division of Women, Youth and Children at Canberra Health Services. He is a member of the ACT Board of the Medical Board of Australia, Specialist Adviser to the Therapeutic Goods Administration (TGA), the Executive Committee of the Australian Preterm Birth Alliance and the Steering Committee of the Stillbirth Baby Bundle.

This will be Boon's first term as a Board Director.

Dr Nisha Khot
MBBS MD FRCOG FRANZCOG AFRACMA
Board Director

Nisha is a Victorian obstetrician working at The Royal Women's Hospital, Joan Kirner Women's and Children's Hospital and Bacchus Marsh Hospital. She also holds clinical educator positions at University of Melbourne Medical School and Notre Dame University. She trained in India and the UK before moving to Australia.

Nisha has a special interest in simulation-based education, especially in rural and low-resource settings. As an educator with ONE-Sim program, she provides inter-professional training for maternity care providers in India.

Elected to Council in 2018, she is a member of the Women's Health and SIMG committees. She is the deputy chair of the Gender Equity and Diversity working group for RANZCOG. She has been an examiner for both advanced diploma and Fellowship examinations.

Nisha is a passionate advocate for equitable and diverse representation in healthcare leadership, sexual and reproductive rights of women and equitable access to healthcare and health literacy for migrant and refugee women.

This will be Nisha's first term as a Board Director.

Dr Susan Fleming
MBChB FRANZCOG EMBA
Board Director

Susan is a New Zealand medical graduate. She undertook her O&G training and early years of clinical practice at Sydney's Royal Prince Alfred Hospital. In 2002, after a period in North America, she returned to New Zealand where her latter professional life has been focused on leadership within O&G.

From 2013 to 2017 she was Director of Women's Health at Auckland DHB. One of her many interests has been the use of information technology to support care delivery. Although no longer clinically active, she remains professionally engaged and is a New Zealand Councillor on Te Kāhui Oranga ō Nuku and the RANZCOG New Zealand representative for the Asian Oceania Federation of Obstetricians and Gynaecologists (AOFOG).

This will be Susan's first term as a Board Director.

Dr Jared Watts
MBBS(Hons) MPHTM MHM MIPH FRANZCOG
Board Director

Jared is currently the Head of Obstetrics and Gynaecology in the Kimberley of Western Australia, and the Co-Director of Obstetrics and Gynaecology for the WA Country Health Service. He also works as a medical coordinator for the WA Rural Clinical School. Jared is a WA Clinical Senator and previously been a Regional RANZCOG Councillor, and the Chair of the CCDOG and Regional Fellows Committees.

He has completed further studies in medical administration, public health and tropical medicine and has worked internationally in several low-resource settings including Nigeria, Cambodia, Laos and Syria.

Jared is passionate about Indigenous and rural medicine and the role of generalists and the essential part they play in ensuring all women have access to high-quality clinical care close to their home, family and support networks.

This will be Jared's first term as a Board Director.

Obituary

Dr William Alexander Fraser
1924–2020

William Alexander Fraser (known as Bill) was born in Hamilton on 15 July 1924, the son of Dr TC (Tam) and Madge Alexander Fraser. He was educated at Southwell School and at King's College, where he was a prefect and member of the First XV. He went to Otago medical school. Despite his later lean build, he played as a prop in the university rugby team, gained his blue, and represented South Island Universities XV. He graduated MB ChB in 1947, taking the Stanley Batchelor Memorial Prize for Clinical Surgery.

His junior doctor years were spent in Auckland. Initially planning to specialise in Medicine, he was called back to Hamilton to help out with his father's practice because of the latter's illness. Initially in general practice with a high obstetric caseload, he took his Diploma on Obstetrics in Auckland. He was encouraged to specialise in O&G with the return of his old friend Bob Gudex to Hamilton. He went first to National Women's Hospital and obtained his MRCOG in 1961. After some time in England, he returned to his family and joined practice in association with Bob Gudex. A part-time position in O&G at Waikato Hospital followed. The Gudex & Fraser team ('Bill & Bob') was a powerful unit. Both were highly energetic and productive, and innovative surgeons, as well as attracting a large patient load. Both were popular practitioners, and keen to teach and encourage their juniors.

In addition to clinical work, Bill was involved with the local O&G Society, a member of the Waikato Area Health Board service development committee, and a member of a Medical Advisory Committee formed to assist and advise the Medical Superintendent of Waikato Hospital. He was a member of the Maternity Benefits Tribunal.

He became FRCOG in 1977 and was a Foundation Fellow of the New Zealand College of Obstetrics and Gynaecology (later Royal) when it was formed in 1982. He was head of the O&G service at Waikato Hospital from 1980 until 1988. A particular expertise was developed in the surgery of urinary incontinence.

He had wide interests apart from medicine, in particular horticulture, being prominent in camellia and rhododendron organisations, and later cattle breeding. He was knowledgeable in many subjects, from bees to electronics to cars. He had a series of exotic cars long before they became readily available in New Zealand. He was a hero and role model to a generation of young doctors.

In 1953, he and Judith Allan were married in Ashburton. They had four children: Alastair (a Taupo GP), Jane, Kate (both nurses), and David (chemical engineer, later finance). There are eleven grandchildren, and two great grandchildren. A private ceremony was held to commemorate his long life after he died on 24 November 2020, aged 96.

Remembering Our Fellows

Our College acknowledges the life and career of Fellows that have passed away:

- **Dr Lois Wald** , NSW, March 2021