What is new in IVF?

Assisted reproductive technology has come a long way in 40 years

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It was just over 40 years ago that the first ever human pregnancy conceived through in-vitro fertilisation (IVF) was reported by the team from Melbourne.[1] Unfortunately, the pregnancy only lasted for a few days and was what we would now call a biochemical pregnancy. It took another 5 years before Louise Brown, the world's first IVF child, was born in the United Kingdom on 25 July 1978, through the efforts of Patrick Steptoe and Bob Edwards,[2] from their 102nd human embryo transfer. The British team had another birth, a less well known Alastair MacDonald, in January 1979, but the next 11 births occurred in Melbourne.[3,4]

Melbourne then became the international centre for IVF, not only converting the process to clinical treatment with a near 10% success rate by using stimulated cycles,[5] but also pioneering world-firsts such as embryo freezing,[6] egg donation,[7] in-vitro maturation,[8] blastocyst transfer[9] and microinjection techniques — although the first human birth using microinjection was in Singapore. IVF was initially developed to overcome tubal disease before being adapted for use in women with unexplained subfertility.[10] It also became the first effective treatment of male subfertility.[11]

Now, in 2014, IVF is practised in virtually every developed country. Well over five million babies have been born using the technology, from fresh and frozen embryo transfers.

There have been several changes to the practice of IVF in recent years.

For controlled ovarian hyperstimulation (COH), the ability to predict response by measuring the anti-Müllerian hormone level[12] has introduced greater precision. The application of gonadotropin-releasing hormone (GnRH) antagonist regimens has enabled shorter treatment cycles, and the availability of a long-acting follicle-stimulating hormone injection (corifollitropin alfa) has reduced the number of injections women have to administer. The risk of ovarian hyperstimulation syndrome, a potentially serious complication of COH, has been almost eliminated by the ability to induce ovarian maturation by using a GnRH agonist in GnRH antagonist cycles.

The technique of oocyte collection has changed little since the introduction of the transvaginal ultrasound-guided technique in 1985,[13] although there has been movement from the operating theatre to procedure rooms in some centres.

There have also been major changes in the IVF laboratory. Although first reported in 1998,[9] blastocyst transfer is now becoming the preferred method in leading IVF units around the world. This not only more closely matches the normal physiological process of conception, in which the embryo reaches the uterine cavity at the blastocyst stage (Day 5 after fertilisation) rather than the cleavage stage (Day 2 or 3), but it also allows a more scientific selection of the "best" embryo. Another major advance in the laboratory is the use of time-lapse photography of embryo development, which is being used to predict the embryo most likely to result in a successful pregnancy. The other change is the use of vitrification rather than slow freezing to preserve embryos, a technique that is better suited to blastocyst freezing, with survival rates exceeding 95%.[14]

There has been a move towards single embryo transfer (SET), in which Australia is again leading the world. While twins may be "cute" and seem like a good solution for childless couples, the perinatal morbidity and possible long-term medical and social problems of a multiple pregnancy[15] mean that moving towards SET is the only responsible way to go. We have recently reported that the chance of taking home a healthy, full-term baby is higher if SET rather than double embryo transfer is performed.[16]

IVF has also been used in the area of pre-implantation genetic diagnosis for fertile couples who do not want to resort to antenatal diagnosis and possible termination of pregnancy when they are at risk of transmitting serious genetic conditions.

More recently, IVF technology has been applied to fertility preservation. This can be undertaken by freezing embryos, oocytes or ovarian tissue, with subsequent IVF treatment. The first successful Australian pregnancy after frozen ovarian tissue autotransplantation, which resulted in the birth of a healthy female baby, was reported in the Journal in 2013.[17] This was followed by a set of IVF twins born after implanting ovarian tissue into the anterior abdominal wall.[18]

Another exciting development is the possibility of therapeutically improving the mitochondria within oocytes in the IVF laboratory. In the UK, the Human Fertilisation and Embryology Authority is in the process of approving the use of mitochondrial transfer from a third-party donor in the case of mitochondrial disease. A modification of this technique is the use of autologous germline mitochondrial energy transfer (AUGMENT; OvaScience), which acts a bit like putting a new battery in an old car, and may make older eggs more fertile.

We have come a long way in reproductive medicine during the past 40 years, and I cannot even imagine where the next 40 years will take us.

Competing interests: I am a shareholder in Monash IVF.

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