

# In Vitro Fertilization <sup>[1]</sup>

By: Zhu, Tian Keywords: [Fertility](#) <sup>[2]</sup> [Fertilization](#) <sup>[3]</sup> [Reproduction](#) <sup>[4]</sup>

*In vitro* fertilization <sup>[5]</sup> (IVF) is an assisted reproductive technology <sup>[6]</sup> (ART) initially introduced by Patrick Steptoe <sup>[7]</sup> and Robert Edwards <sup>[8]</sup> in the 1970s to treat female infertility <sup>[9]</sup> caused by damaged or blocked fallopian tubes <sup>[10]</sup>. This major breakthrough in embryo research has provided large numbers of women the possibility of becoming pregnant, and subsequent advances have dramatically increased their chances. IVF is a laboratory procedure in which sperm <sup>[11]</sup> and egg <sup>[12]</sup> are fertilized outside the body; the term “in vitro” is Latin for “in glass.”

Although the procedure was not successfully established until the last quarter of the twentieth century, the history behind the development of IVF dates back much further. The first attempt at IVF on mammalian eggs was performed by Viennese embryologist Samuel Leopold Schenk <sup>[13]</sup> in 1878. Working with rabbit <sup>[14]</sup> and guinea pig <sup>[15]</sup> ova, Schenk noted that cell division occurred in cultures after sperm <sup>[11]</sup> were added to ova. In 1934 Gregory Pincus and Ernst Vinzenz Enzmann <sup>[16]</sup> also attempted *in vitro* <sup>[17]</sup> fertilization <sup>[5]</sup> with rabbits. They claimed to have produced the first successful pregnancy <sup>[18]</sup> using IVF, but later analysis of their study suggests that their fertilization <sup>[5]</sup> technically occurred *in vivo* <sup>[19]</sup>, or “in the body,” rather than *in vitro* <sup>[17]</sup>, “in glass.” They implanted the eggs into the rabbit’s uterus <sup>[20]</sup> after only twelve hours, before the eggs had fully matured, and fertilization <sup>[5]</sup> actually occurred inside the body.

The next milestone was in 1951, when two scientists working independently, Colin Russell Austin in Australia and Min Chueh Chang in the United States, demonstrated that spermatozoa <sup>[21]</sup> need to mature through certain stages before they develop the capacity to fertilize. By 1959 Chang was able to successfully use IVF to impregnate a rabbit <sup>[14]</sup>. Significant progress in developing a successful IVF technique with human embryos, however, would have to wait until the 1970s.

Patrick Steptoe <sup>[7]</sup>, a practicing gynecologist at Oldham General Hospital <sup>[22]</sup> who pioneered the use of laparoscopy in gynecology, teamed up with Edwards, a professor of human reproduction at Cambridge University <sup>[23]</sup>, to try to achieve a successful pregnancy <sup>[18]</sup> in humans <sup>[24]</sup> using IVF. Their collaboration started in 1968 when Edwards attended a lecture Steptoe gave on laparoscopy at the Royal Society of Medicine in London. They initially achieved successful fertilization <sup>[5]</sup> and cell division of eggs *in vitro* <sup>[17]</sup> (in a petri dish) with freshly extracted semen <sup>[25]</sup>, but were unable to successfully implant the fertilized egg <sup>[26]</sup> into the female uterus <sup>[20]</sup> until 1978. They manipulated hormone <sup>[27]</sup> levels in the female until the eggs were fully mature and then extracted several eggs from the ovaries through laparoscopy, an invasive technique requiring entry through the navel. The doctors fertilized the eggs *in vitro* <sup>[17]</sup>, and waited until the fertilized eggs divided into eight cells before implanting them into the female uterus <sup>[20]</sup> (up until the mid-1970s, they had waited until the fertilized egg <sup>[26]</sup> divided into 100 cells before implantation <sup>[28]</sup>).

In 1976 Edwards and Steptoe began working with an infertile couple, Lesley and John Brown. In the successful attempt, Edward and Steptoe transferred a fertilized egg <sup>[26]</sup> at midnight, the time at which the egg <sup>[12]</sup> was mature—accidental timing that they later discovered was critical when they realized that diurnal cycles of hormonal levels are crucial to the success of the egg <sup>[12]</sup> implanting in the wall of the uterus <sup>[20]</sup>. On 25 July 1978, Leslie gave birth to Louise Brown, the first “test tube baby.”

Since the birth of Louise Brown, over three million babies have been born as a result of IVF and other assisted reproductive technologies, and the technique has improved as well. Laparoscopy is no longer used to extract eggs from the ovaries. Instead, physicians use transvaginal oocyte retrieval <sup>[29]</sup>; that is, with a sonogram to visualize what they are doing, they guide a needle through the vaginal wall, and enter the ovaries to extract the eggs. By using this method, the risks associated with the anesthesia required for laparoscopy as well as the costs of the procedure are considerably reduced.

Physicians now begin giving women hormone therapy <sup>[30]</sup> two weeks prior to retrieving the eggs to increase the chance of recovering several healthy, mature eggs. Hormone therapies are usually administered through oral medications such as clomiphene citrate <sup>[31]</sup>, also known as Clomid <sup>[32]</sup>. Ultrasounds and blood tests are used to determine the optimal time for egg <sup>[12]</sup> retrieval (when the eggs are almost ready for fertilization <sup>[5]</sup>). Once physicians obtain the eggs, they then place them in a petri dish with sperm <sup>[11]</sup> for fertilization <sup>[5]</sup>. Usually about seven to nine eggs are fertilized. If a male fertility problem exists such as sperm <sup>[11]</sup> immotility or a low sperm <sup>[11]</sup> count, intracytoplasmic sperm injection <sup>[33]</sup> (ICSI) is commonly used to combat the problem. With ICSI, the physician manually injects a sperm <sup>[11]</sup> into an egg <sup>[12]</sup> with a needle to fertilize it.

The number of fertilized eggs physicians place in the uterus <sup>[20]</sup> in hopes that at least one will implant varies with the physician conducting the procedure. Physicians consider different factors with each couple, such as the number of trials the couple can afford to attempt. The remaining embryos are preserved through cryopreservation <sup>[34]</sup>, frozen for future use in case the first few embryos fail to implant in the uterus <sup>[20]</sup> wall on the initial attempt. Once the fertilized eggs each divide into eight cells, they are placed in a catheter and inserted through the cervix <sup>[35]</sup> into the uterus <sup>[20]</sup> (this usually occurs from two to three days after

retrieving the eggs and follows the same timeline as if the eggs were fertilized naturally).

When Edwards and Steptoe successfully helped the Browns give birth to Louise, the first “test tube baby,” many ethical debates arose. Many of these issues still surround embryo research today, and they include who essentially “owns” the embryos as well as whether scientists should be allowed to perform experiments for stem cell research with the extra cryopreserved embryos that are not implanted. Many religious groups, the [Roman Catholic Church](#)<sup>[36]</sup> being the most prominent, are strongly against IVF because it is not considered natural [conception](#)<sup>[37]</sup>.

IVF has greatly advanced embryo research as well as helped many infertile couples conceive when adoption was once their only option for children. Though there are other similar assisted reproductive technologies (ART) such as gamete intrafallopian transfer (GIFT) and [zygote intrafallopian transfer](#)<sup>[38]</sup> (ZIFT), IVF is currently the most popular. The development of [intracytoplasmic sperm injection](#)<sup>[33]</sup> (ICSI) has improved success rates.

## Sources

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