Nobelförsamlingen
The Nobel Assembly at Karolinska Institutet

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The Nobel Assembly at Karolinska Institutet has today decided to award

The Nobel Prize in Physiology or Medicine 2010

to

Robert G. Edwards

for the development of in vitro fertilization

SUMMARY

Robert Edwards is awarded the 2010 Nobel Prize for the development of human in vitro fertilization (IVF) therapy. His achievements have made it possible to treat infertility, a medical condition afflicting a large proportion of humanity including more than 10% of all couples worldwide.

As early as the 1950s, Edwards had the vision that IVF could be useful as a treatment for infertility. He worked systematically to realize his goal, discovered important principles for human fertilization, and succeeded in accomplishing fertilization of human egg cells in test tubes (or more precisely, cell culture dishes). His efforts were finally crowned by success on 25 July, 1978, when the world´s first "test tube baby" was born. During the following years, Edwards and his co-workers refined IVF technology and shared it with colleagues around the world.

Approximately four million individuals have so far been born following IVF. Many of them are now adult and some have already become parents. A new field of medicine has emerged, with Robert Edwards leading the process all the way from the fundamental discoveries to the current, successful IVF therapy. His contributions represent a milestone in the development of modern medicine.

The Nobel Assembly, consisting of 50 professors at Karolinska Institutet, awards the Nobel Prize in Physiology or Medicine. Its Nobel Committee evaluates the nominations. Since 1901 the Nobel Prize has been awarded to scientists who have made the most important discoveries for the benefit of mankind.

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Infertility – a medical and psychological problem

More than 10% of all couples worldwide are infertile. For many of them, this is a great disappointment and for some causes lifelong psychological trauma. Medicine has had limited opportunities to help these individuals in the past. Today, the situation is entirely different. In vitro fertilization (IVF) is an established therapy when sperm and egg cannot meet inside the body.

Basic research bears fruit

The British scientist Robert Edwards began his fundamental research on the biology of fertilization in the 1950s. He soon realized that fertilization outside the body could represent a possible treatment of infertility. Other scientists had shown that egg cells from rabbits could be fertilized in test tubes when sperm was added, giving rise to offspring. Edwards decided to investigate if similar methods could be used to fertilize human egg cells.

It turned out that human eggs have an entirely different life cycle than those of rabbits. In a series of experimental studies conducted together with several different co-workers, Edwards made a number of fundamental discoveries. He clarified how human eggs mature, how different hormones regulate their maturation, and at which time point the eggs are susceptible to the fertilizing sperm. He also determined the conditions under which sperm is activated and has the capacity to fertilize the egg. In 1969, his efforts met with success when, for the first time, a human egg was fertilized in a test tube.

In spite of this success, a major problem remained. The fertilized egg did not develop beyond a single cell division. Edwards suspected that eggs that had matured in the ovaries before they were removed for IVF would function better, and looked for possible ways to obtain such eggs in a safe way.

From experiment to clinical medicine

Edwards contacted the gynecologist Patrick Steptoe. He became the clinician who, together with Edwards, developed IVF from experiment to practical medicine. Steptoe was one of the pioneers in laparoscopy, a technique that was new and controversial at the time. It allows inspection of the ovaries through an optical instrument. Steptoe used the laparoscope to remove eggs from the ovaries and Edwards put the eggs in cell culture and added sperm. The fertilized egg cells now divided several times and formed early embryos, 8 cells in size (see figure).

These early studies were promising but the Medical Research Council decided not to fund a continuation of the project. However, a private donation allowed the work to continue. The research also became the topic of a lively ethical debate that was initiated by Edwards himself. Several religious leaders, ethicists, and scientists demanded that the project be stopped, while others gave it their support.

The birth of Louise Brown - an historic event

Edwards and Steptoe could continue their research thanks to the new donation. By analyzing the patients´ hormone levels, they could determine the best time point for fertilization and maximize the chances for success. In 1977, Lesley and John Brown came to the clinic after nine years of failed attempts to have a child. IVF treatment was carried out, and when the fertilized egg had developed into an embryo with 8 cells, it was returned to Mrs. Brown. A healthy baby, Louise Brown, was born through Caesarian section after a full-term pregnancy, on 25 July, 1978. IVF had moved from vision to reality and a new era in medicine had begun.

IVF is refined and spreads around the world

Edwards and Steptoe established the Bourn Hall Clinic in Cambridge, the world´s first centre for IVF therapy. Steptoe was its medical director until his death in 1988, and Edwards was its head of research until his retirement. Gynecologists and cell biologists from all around the world trained at Bourn Hall, where the methods of IVF were continuously refined. By 1986, 1,000 children had already been born following IVF at Bourn Hall, representing approximately half of all children born after IVF in the world at that time.

Today, IVF is an established therapy throughout the world. It has undergone several important improvements. For example, single sperm can be microinjected directly into the egg cell in the culture dish. This method has improved the treatment of male infertility by IVF. Furthermore, mature eggs suitable for IVF can be identified by ultrasound and removed with a fine syringe rather than through the laparoscope.

IVF is a safe and effective therapy. 20-30% of fertilized eggs lead to the birth of a child. Complications include premature births but are very rare, particularly when one egg only is inserted into the mother. Long-term follow-up studies have shown that IVF children are as healthy as other children.

Approximately four million individuals have been born thanks to IVF. Louise Brown and several other IVF children have given birth to children themselves; this is probably the best evidence for the safety and success of IVF therapy. Today, Robert Edwards´ vision is a reality and brings joy to infertile people all over the world.

Robert G. Edwards was born in 1925 in Manchester, England. After military service in the Second World War, he studied biology at the University of Wales in Bangor and at Edinburgh University in Scotland, where he received his PhD in 1955 with a Thesis on embryonal development in mice. He became a staff scientist at the National Institute for Medical Research in London in 1958 and initiated his research on the human fertilization process. From 1963, Edwards worked in Cambridge, first at its university and later at Bourn Hall Clinic, the world´s first IVF centre, which he founded together with Patrick Steptoe. Edwards was its research director for many years and he was also the editor of several leading scientific journals in the area of fertilization. Robert Edwards is currently professor emeritus at the University of Cambridge.

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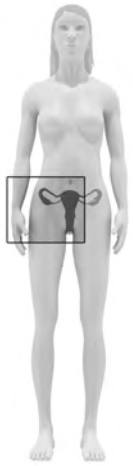
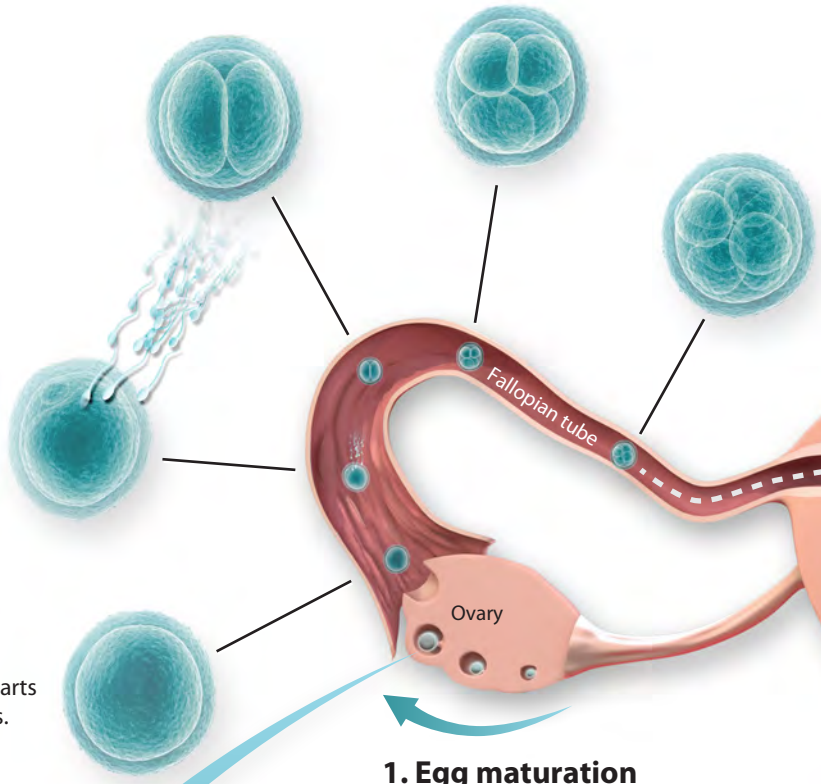
Natural fertilization



4. Cell division
The fertilized egg starts dividing and is now called an embryo.

5. Implantation
The embryo attaches to the mucosa in the uterus, where it continues to develop.

3. Fertilization
One sperm fertilizes the egg. A reaction in the egg blocks other sperm from entering.



2. Ovulation
The egg is released and starts its migration to the uterus.

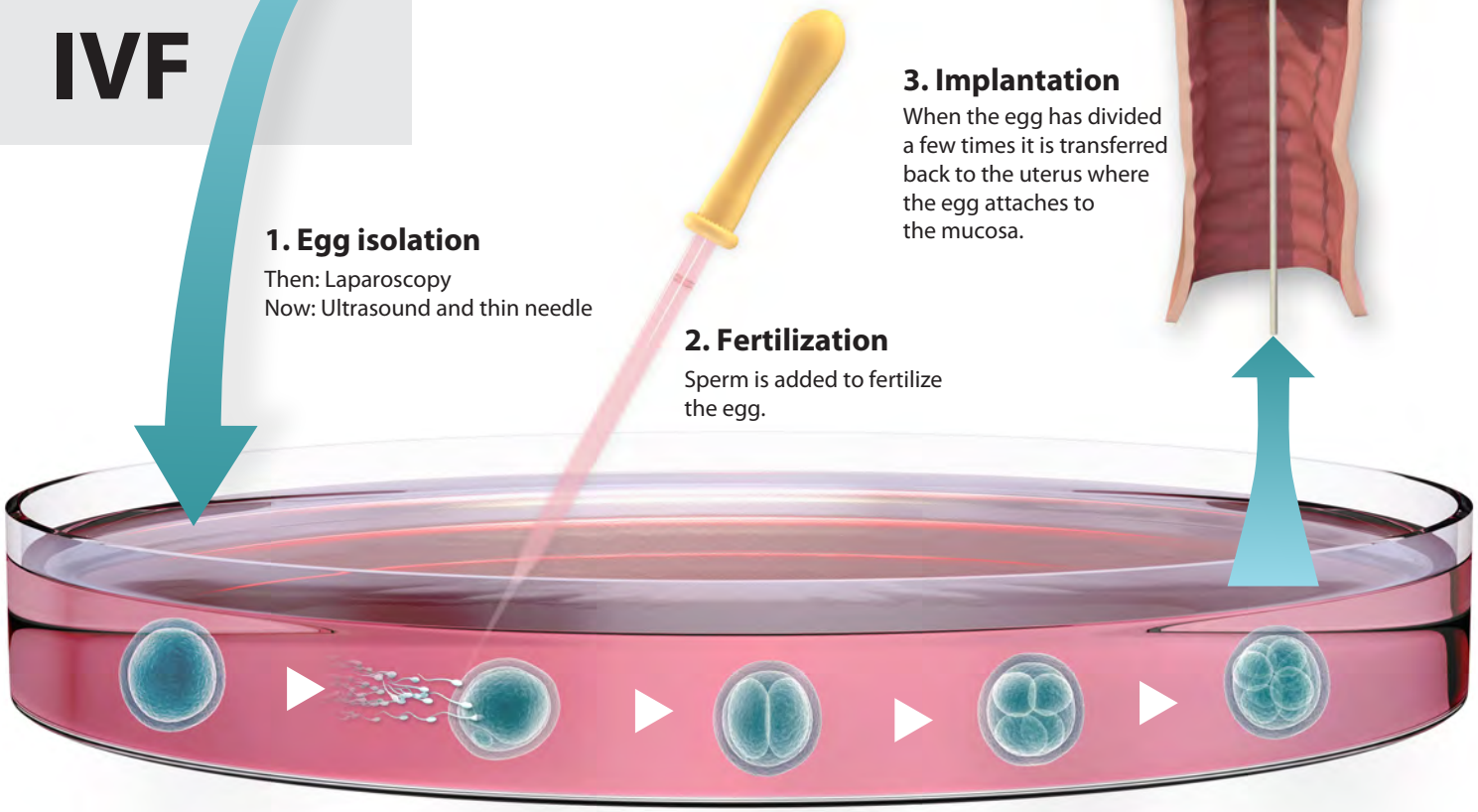
1. Egg maturation
An egg matures in the ovary.

IVF

3. Implantation
When the egg has divided a few times it is transferred back to the uterus where the egg attaches to the mucosa.

1. Egg isolation
Then: Laparoscopy
Now: Ultrasound and thin needle

2. Fertilization
Sperm is added to fertilize the egg.



IVF is used when sperm and egg can not meet under normal conditions. Common causes include obstructed fallopian tubes, too few eggs or impaired production of sperm.

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Illustration: Mattias Karlén