

IVF Treatment

IVF stands for **in-vitro fertilization**. In vitro literally means 'in glass'. In this procedure fertilization takes place outside the female's body. The eggs and sperm are collected and mixed together in a glass petri dish. Fertilization is taking place outside the body.

There are many reasons why a couple may have to undergo IVF treatment:

- Blocked or damaged fallopian tubes means the sperm may not be able to reach the egg.
- Ovulation disorders. The female may not produce any eggs or may produce them infrequently.
- **Endometriosis**. This is where uterus tissue starts implanting in areas outside the uterus. The tissue can block the fallopian tubes and prevent the ovary from functioning.
- Reversing sterilization. If a woman has been sterilized, her fallopian tubes are cut and tied. It is not always possible to re-open the tubes. IVF may be the only option if the woman wants to become pregnant again.
- Poor sperm production or function. This will make it difficult for sperm to meet the egg.
- Genetic disorders. Eggs can be collected and the embryos screened for genetic disorders.
- Fertility preservation. For women undergoing cancer treatment, eggs can be collected and frozen. Cancer treatments can make a person infertile. Many women pay to have their eggs frozen so they can delay having children.

Freezing Human Eggs

IVF treatment may or may not require eggs to be frozen. Freezing eggs is a way of keeping a supply of **viable** eggs for use at a later time in life. These eggs can be then used by the donor. They may be donated to a female who cannot produce eggs of her own. There are several stages to undertake:

Stage 1. Testing for Female Infertility

The first stage in the process is to check that the female is healthy and to find out if there are any problems with her ovaries and hormone levels. This would involve blood and urine tests to check hormone levels. A pelvic examination is done to check that the ovaries are healthy. An **ultra sound scan** can be used to examine the ovaries inside the abdomen.

Stage 2. Stimulating Egg Production

On average the ovaries produce one egg each month. To ensure that more than one egg can be **harvested** for freezing, a woman must have her ovaries stimulated so that several follicles develop. Hormones are used to stimulate the ovaries. The hormones are injected into the blood. These hormones are based on the naturally occurring FSH (follicle stimulating hormone) and LH (luteinizing hormone) that are produced by the **pituitary gland**.

Exam Hint: Students should know the sequence of hormone production and release in the menstrual cycle. They can link this knowledge with increased doses of FSH and LH to stimulate egg production.

Stage 3. Egg Collection

About two weeks after the ovary has been stimulated with hormones, the eggs can be collected. The eggs develop inside fluid filled follicles. The follicle shows up on an ultrasound scan. It is about 15 – 20 mm in diameter. Using the ultrasound as a guide a hollow needle is passed up through the vagina to the ovary. The fluid in the follicle, together with the ovum, is sucked out through the needle. The number of eggs collected will vary with the age of the woman.

Stage 4. Freezing

The eggs are identified, sorted, and then placed in a special solution.

There are two different ways of freezing eggs:

- Using a **cryoprotectant**.
- **Vitrification**.

A cryoprotectant is a type of antifreeze. It is used to replace the water in the egg cell. Water expands when it freezes and the large ice crystals damage the egg membrane. Unfortunately, the cryoprotectant is toxic and can damage the egg. Eggs treated by this method are more difficult to fertilize once they have thawed out.

Vitrification involves rapidly cooling the egg with a cryoprotectant. This is done so quickly that ice does not have time to form. The mixture of egg and cryoprotectant form into a glass like gel. The process does not involve large expensive freezers so is cheaper. Vitrification seems to improve the eggs ability to survive the freeze/thaw processes.

After freezing, the eggs are stored in liquid nitrogen. Liquid nitrogen keeps the eggs at a temperature of -196°C . The eggs can be kept for 10 years or longer.

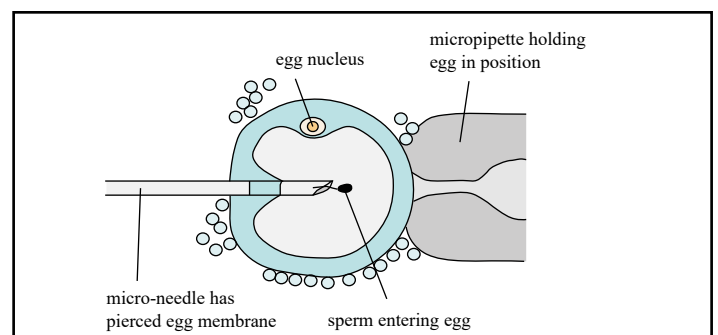
Cost of Freezing Eggs

All fertility treatments are expensive and there is no guarantee that they will work. Freezing eggs can cost as much as £14,000. This would include the hormone injections, collecting the eggs and storing them. If the egg is to be fertilized, it would then have to be thawed and mixed with sperm. Further IVF procedures would cost more money.

Using Frozen Eggs

Once the egg is thawed it would be mixed with sperm. If a frozen egg is successfully fertilized it will develop into an embryo. One technique that increases the chances of the sperm entering the egg is **intracytoplasmic sperm injection** or ICSI. Here, a selected sperm is injected through the egg membrane directly into the cytoplasm.

Fig 5 Showing the Technique of ICSI



The embryo would be inserted into the uterus of the mother at the correct stage of her cycle. Spare eggs may be donated to a woman who is unable to produce her own. The eggs are the property of the donor.

Advantages and Disadvantages of Freezing Eggs

Advantages

- It could enable a woman to have a baby in the future if she has medical problems that could lead to infertility. For example, if she is undertaking medical treatments for cancers.
- Women who are worried about their fertility declining may choose to freeze her eggs.

- A woman who could be injured because of a hazardous occupation may elect to freeze eggs. For example, a woman in the army.
- A person undergoing a sex change operation could harvest eggs and have them fertilized by a partner.
- A woman may wish to freeze eggs if she has a moral or religious objection to storing embryos.
- A woman who has had her eggs harvested may not need to continually undergo regular painful and unpleasant hormone injections.

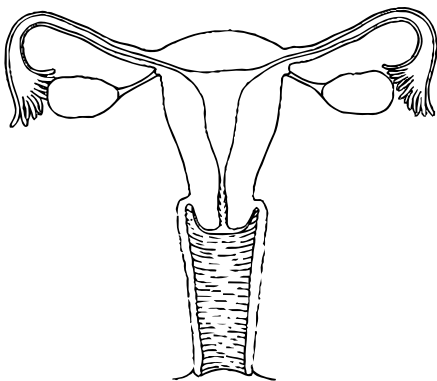
Disadvantages

- Freezing eggs is not as successful as freezing embryos. The egg can be damaged in the freeze/thaw process.
- To stimulate egg production, a woman needs to go through a series of unpleasant hormone injections. Hormones can cause side effects like nausea, bloating, and mood swings.
- Hormone injections can cause ovarian hyper-stimulation syndrome where the ovary overproduces eggs.
- Egg freezing is expensive with no guarantee of a successful outcome. Some couples take out large loans to pay for infertility treatments and they struggle to repay them.

If several frozen eggs are fertilized and develop into embryos, the chances of twins or multiple births is greater. Fewer babies have been born from frozen eggs than from frozen embryos. There is no evidence to show that there is any increase in birth defects, chromosomal abnormalities, or pregnancy complications with frozen eggs. Some companies are actually offering to pay for egg freezing in the UK so that women are able to develop their careers without taking a break to have a child.

Questions

- (a) What is a cryoprotectant?
(a) Suggest and explain what would happen to a human egg if it was placed in pure water after it had been collected?
(b) Why must eggs be frozen quickly in vitrification?
(c) Suggest why the success rate of fertilizing a previously frozen egg is low.
- Label the diagram to show where the following processes take place:



- Position where sperm are deposited at sexual intercourse.
- Formation of a follicle.
- Fertilization.
- Draw and label an arrow to show the movement of an ovum during ovulation.

- Fill in the gaps with the most appropriate word or words from the list below.

Adult females undergo a monthly _____ cycle.

The cycle is controlled by _____. FSH is produced by the _____.

This hormone targets the _____ and starts the development of cells which will develop into follicles.

A follicle is a _____ filled bubble in which the egg or _____ is formed.

To stimulate the ovary, _____ drugs containing high levels of FSH and LH can be given to a woman. This will make several _____ develop and more eggs will be released.

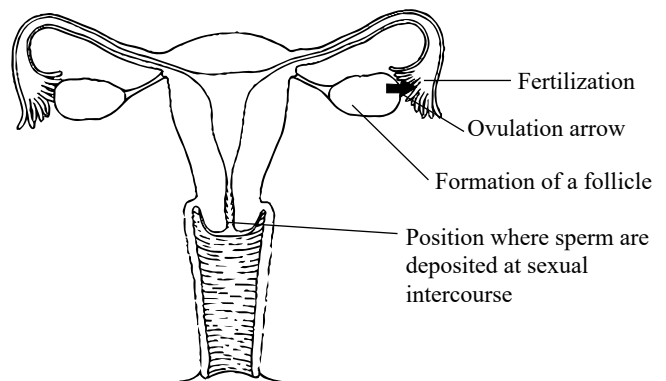
This _____ of the ovary is carried out so that the eggs can be _____. The eggs may be frozen and stored for use at a later time.

Alternatively, eggs can be fertilized _____. These may develop into _____.

ovary menstrual fluid fertility embryos
in-vitro harvested pituitary gland hyper-stimulation
hormones ovum follicles

Answers

- (a) Cryoprotectant is a type of antifreeze. It prevents large ice crystals from destroying the frozen egg.
- (b) A human egg placed in water would burst. This is because water would move into it by osmosis. The pressure inside the cell would increase. The membrane is too thin to withstand the increased pressure.
- (c) To prevent ice crystals from forming.
- (d) The process of freezing and thawing could change the cell membrane. If the cell membrane becomes impenetrable, a sperm will not be able to pass through and fuse with the female nucleus.



- Adult females undergo a monthly **menstrual** cycle. The cycle is controlled by **hormones**. FSH is produced by the **pituitary gland**. It targets the **ovary** and starts the development of cells which will start to develop into follicles. A follicle is a **fluid** filled bubble in which the egg or **ovum** is formed. To stimulate the ovary, **fertility** drugs containing high levels of FSH can be given to a woman. This will make several **follicles** develop and more eggs will be released. This **hyper-stimulation** of the ovary is carried out so that the eggs can be **harvested**. The eggs may be frozen for use at a later time. Alternatively, eggs can be fertilized **in vitro**. These may develop into **embryos**.