Synthetic Human Embryo

Why in news?

Recently, Israeli scientists have successfully grown a “human embryo” in the lab without using an egg or sperm.

What is an embryo?

- An embryo is an initial stage of development of a multicellular organism.
- **Sexual reproduction-** In organisms that reproduce sexually, embryonic development is the part of the life cycle that begins just after fertilization of the female egg cell and the male sperm cell.
- Embryo can be defined as an organism in the early stages of development. It undergoes multiple stages of development to develop into a new organism.
- Embryonic development is called *embryogenesis*.
- **Foetus**- It is the development of a single-cell (zygote) to a multicellular organism (foetus) characterised by the processes of cell division and cellular differentiation of the embryo that occurs during the early stages of development.

How was the embryo model created?

- **Stem cell mix-** They used a mix of stem cells (early cells that have the ability to differentiate into other type of cells).
- **Foetus formation-** They used a mix of stem cells and chemicals, a small portion which was able to spontaneously assemble to form different types of cells that form the foetus.
    - Cells that provide nutrient to the foetus.
    - Cells that lay out the plan for development of the body, and
    - Cells that create structures like placenta and umbilical cord to support the foetus.
- The naive-state stem cells were programmed to become certain types of body tissue, including
    - **Epiblast cells** - It become the foetus
    - **Trophoblast cells**- It become the placenta
    - **Hypoblast cells-** It supports the yolk sac
    - **Extraembryonic mesoderm**- It contributes to the overall embryo development
- **Early embryo**- This was able to spontaneously assemble into embryo like structure, mimicking molecular characteristics of an early embryo.
- **Complete model**- The scientists have called it one of the most complete models of a 14-day-old human embryo.
- None of them fully replicate the processes that happen during the early stages of

embryo development, but all of them add to their understanding.

- **Issue faced**- Only 1% of this mixture actually assembled spontaneously, making the process not very efficient.

Why are embryo models important?

- **Aim**- To provide an ethical way of understanding the earliest moments of our lives.
- **Diagnostic accuracy**- The research is crucial because the initial days of embryo development is when the majority of miscarriages and birth defects occur.
- Studying the initial stages may help understand genetic and inherited diseases better.
- **Improve IVF**- Study of normal embryo development, proper genetic code retainment, and the proper implantation in the womb may help in improving success rates of in vitro fertilisation (IVF).
- **Embryonic research-** It is important because currently developing alternative models in the lab is the only way to study the early embryo process.
- **Effect on embryo-** It allows scientists to understand the genetic, epigenetic and environmental effects on a developing embryo.
- **Genetic medicines**- It brings us closer to understand how futuristic genetic medicines can be implemented for the treatment of certain conditions.
- **Error in DNA duplication**- These models have helped scientists understand why error arise when the DNA is duplicated.
- The model has shown that errors occurred much earlier before the separation of daughter cells, when DNA duplication is ongoing.
- **Chromosomal disorder-** It also helps to study why one of the daughter cells receives too many or too few chromosomes.
- **Role of genes**- It allows to manipulate genes and to understand their developmental roles in a model system.
- **Functional specifications**- This model will let us test the function of specific factors, which is difficult to do in the natural embryo.
- **Synthetic embryology**- It made a significant milestone by developing the first ever synthetic human embryos.

Can lab-grown embryos be used to get pregnant?

These models are meant to just study the early stages of development of a foetus. They cannot be used to get pregnant.

- **Regulation-** It is legally supported in most countries that these embryo models will be destroyed after studying the first 14 days. Attempts to implant are not allowed.
- **Genetic modification**- Researchers would also ensure that any model embryo created for donor tissue purposes would be genetically modified to prevent the development of a brain or nervous system.
- **Mimics the properties-** Although they mimic several aspects of development, they are *not surrogates of actual embryos.*

Why is there a 14-day limit on embryo research?

- The limit was first proposed by a committee in the *UK in 1979* after the birth of the first test tube baby.
- The 14-day period is equivalent to when embryos naturally finish implantation.
- It is also when cells start becoming an "individual", and *breaking off into a twin is not possible.*
- The ethical considerations become different when it is a clump of cells and when it becomes an individual, often referred to as the *Primitive Streak.*
- While the models are not human embryos, they come very close to it.

Primitive Streak is a linear structure that appears in the embryo that marks its transition from having a radial symmetry (like an egg) to the bilateral symmetry of our bodies (marked by left and right hands and legs).

References

1. Indian Express- Whole model of human embryo without egg or sperm
2. Economic Times- Scientist develop human embryo