# TYPE OF STEM CELL (EMBRYONIC, ADULT AND CANCER STEM CELL)

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Stem cells can be divided into two categories: **Embryonic and Adult**.

Embryonic Stem Cells are totipotent cells capable of differentiation into virtually any cell type, as well as being propagated indefinitely in an undifferentiated state. The use of embryonic stem cells generates several ethical concerns regarding the consumption of blastocysts. This makes postnatal stem cells a more feasible approach for translation into clinical practice.

Adult Stem Cells are not totipotent, and they can be further classified depending on their origin and differentiation potential.

These are further classified as follows:

**Embryonic Stem Cells (ECS):** They are derived from the inner cell mass of the blastocyst. They can make all the cell types in the body and can self-renew (copy themselves) almost forever, so large supplies can be made. However, they have ethical issues associated with their use and their rate of differentiation is difficult to control and they might as well form tumors after injection.

**Embryonic Germ Cells:** Human embryonic germ (EG) cells share many of the characteristics of human ES cells, but differ in significant ways. Human EG cells are derived from the primordial germ cells, which occur in a specific part of the embryo/fetus called the gonadal ridge, and which normally develop into mature

gametes (eggs and sperm). Their isolation requires the generation of embryoid bodies from EG cells, which consists of an unpredictable mix of partially differentiated cell types. The embryoid body-derived cells resulting from this process have high proliferative capacity and gene expression patterns that are representative of multiple cell lineages. Advantages of these cells are that they are non-tumorigenic unlike embryonic stem cells but at the same time their isolation requires destruction of foetuses thus limiting their use till now on mice experiments. Also, they have less population doubling (70-80 cells doublings) as compared to Embryonic stem cells which cam make 200-300 cell doublings per sample.

**Amniotic Fluid / Fetal Stem Cells:** They are derived from aspirates of amniocentesis during genetic screening without any damage to embryo. They are used to make adipocytes, chondrocytes, osteoblasts, myocytes, endothelial cells, neuron-like and live cells. They are easier to obtain than other embryonic cells and have the same pluripotency as embryonic stem cells but are not tumorigenic. Their therapeutic value remains to be discovered and at times their retrieval can lead to loss of pregnancy and risk to unborn child (0.06% cases).

**Induced Pluripotent Stem Cells (iPS):** They refer to adult or somatic cells that have been coaxed to behave like embryonic cells. They can make all types of cells in the body. They could provide patient specific treatment but they can have a carcinogenic / tumorigenic potential. Also, it has not yet been established how reprogramming works in these cells and their need further comparison with embryonic stem cells.

**Umbilical Cord Blood Stem Cells:** They are taken from cord blood after the birth of the baby. They can differentiate into several cell types like liver cells, skeletal

muscle, neural tissue and immune cells and can be frozen and stored. Their limitations lies in fact that there is still a need to know how to them and a limited number of cells can be procured from umbilical cord. Also, graft reaction/rejection is a possibility. They are only proven of use in blood disorders.

**Adult Stem Cells/ Tissue Stem Cells / Mesenchymal Stem Cells (MSCs**): They are somatic /postnatal stem cells in several mesenchymal tissues. They are used to make only the types of cells that belong in their own tissue and they find application in transplantation therapy. Since, they are already partly specialised, it makes more straightforward to obtain the particular specialised cell type required. But, customising these stem cells is not possible and tissues must be 'matched' or come from the patient's own body for use in treatments. Scientists are still learning how to multiply; control and use different types of tissue stem cells.

**Bone Marrow Mesenchymal Stem Cells (BMMSC):** Their source is bone marrow of adult bones. They can make cells of the skeletal tissues: bone, cartilage, fat and support blood stem cells to make new blood cells. They are easily obtained from the bone marrow of patients used for efficient generation of skeletal tissues in the body. In vitro expansion capability appears to be lower. Donor age is important consideration for clinical efficacy of bone formation.

**Cancer Stem Cells (CSC):** The cancer stem cell (CSC) concept states that tumor growth, analogous to the renewal of healthy tissues, is fueled by small numbers of dedicated stem cells. It has gradually become clear that many tumors harbor CSCs in dedicated niches. hoped. Lineage-tracing and cell-ablation strategies have provided insights into CSC plasticity, quiescence, renewal, and therapeutic response. CSCs are actively recruited into tumor site, and contribute to tumor

microenvironment as either themselves or as the tumor-associated fibroblasts. They directly or indirectly regulate tumor cell proliferation, differentiation, immune tolerance, angiogenesis, metastasis and drug resistance through the interaction with numerous cytokines and growth factors as well as providing niche to the cancer cells in cooperated with ECM.