

THE CREATION OF GAMETES FROM STEM CELLS

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One of the most promising areas in current scientific research involves the use of stem cells. These are unspecialized cells that have the ability to self-replicate and give rise to specialized cells in developmental processes and to replace cells lost from normal turnover or disease in the specific organs and tissues in which they are found.

Stem cells can be obtained from the blastocyst (embryonic stem cells, ESC), but in a wide range of adult tissues (somatic stem cells, SSC).

The ESCs are isolated from a group of cells called the inner cell mass (ICM) of the blastocyst in the pre-implantation stage embryo. These ESCs differed from the adult stem cells in their capability to differentiate in culture, under appropriate and specific conditions, into most of the cell types of all three embryonic germ layers (endoderm, ectoderm and mesoderm) and also into germ cells, a property that is termed pluripotency. From the ICM cells in culture have been derived pluripotent ESC lines in several species to date, including the human. The adult stem cells are multipotent because their potential to differentiate into different cell types is more limited.

The first successful derivation of hESCs was reported by Thomson et al. (1998) and afterwards by Reubinoff et al. (2000), who also demonstrated the differentiation potential of hESC cells under *in vitro* conditions. Since those initial experiments, important advances have been achieved and numerous studies have reported the derivation of new hESC lines and methods to differentiate them into many cell types, including germ cells.

Many biochemical differences and culture requirements between mouse and human ESCs have been demonstrated, but despite them, studies in murine ESCs have provided a better understanding of human ESCs biology.

The development and improvement of the research on ESC-derived gametes has gained attention from our field in the last years. It has been proved by different authors that murine ESCs can develop into primordial germ cells (PGCs) *in vitro*. Using different strategies may occasionally form early spermatid and oogonia, and although less consistently, differentiation into mature gametes (Hübner et al., 2003; Toyooka et al., 2003; Geijsen et al., 2004; Lacham-Kaplan et al., 2006; Novak et al., 2006; Nayernia et al., 2006). In humans, ES cells (hESCs) also show spontaneous or induced differentiation into cells with markers related to PGCs (Clark et al., 2004; Kee et al., 2006; Chen et al., 2007). In this presentation we will comprehensively review the scientific advances performed on ESC-derived gametes, the new avenues to avoid clinical and social rejection and the potential benefits for the reproductive field.