



Preimplantation Genetic Diagnosis (PGD)

What is PGD?

Preimplantation genetic diagnosis (PGD) is a method of assessing embryos prior to pregnancy. This can only be performed in couples undergoing in vitro fertilization (IVF) to conceive. The embryos are tested prior to transfer to determine if they are chromosomally normal. Embryo testing can be used to detect a specific gene disorder that may be inherited from a patient or her partner.

Possible benefits

Diseases such as cystic fibrosis, sickle cell disease, hemophilia, Tay Sach's disease and Fragile X syndrome are among those that can be identified with PGD. Another indication for PGD includes a patient or partner who carry a balanced translocation. Lastly, aneuploidy screening can be achieved with PGD. Aneuploidy testing involves screening for the most common causes of miscarriage—abnormalities on chromosomes 13, 14, 16, 18, 21, 22 and the sex chromosomes. Aneuploidy screening with PGD may be recommended for women with recurrent miscarriage or repeated IVF failures.

PGD can be used to prevent diseases in which both the male and female partners are carriers (e.g., cystic fibrosis, sickle cell disease, beta thalassemia). PGD can be used to prevent other diseases as well (e.g., Duchenne's muscular dystrophy,). Lastly, PGD for aneuploidy involves screening embryos for the most common causes of recurrent miscarriage.

Healthy, chromosomally normal embryos can then be distinguished from nonviable and diseased ones, and only those are used for transfer.

Traditionally, embryos conceived by in vitro fertilization (IVF) were only assessed microscopically to predict their viability; as suggested by their overall appearance. Pre-implantation genetic diagnosis (PGD) goes a step further, by actually screening the genetic information contained within the embryo prior to deciding which embryos to transfer. In other words, embryos free from disease can be selected and preferentially transferred back to the patient.

A normal embryo must have 46 chromosomes in the right combination to enable normal viability - 23 from the mother and 23 from the father. If the early dividing cells do not divide equally and distribute these chromosomes equally and in the right way, then genetic imbalances result. This occurs more often in older women, and is the most significant reason why fertility declines with increasing age. This also explains why chromosomal and congenital anomalies also increase with increasing age of the female partner.

Method

The embryologist biopsies or removes cells from an embryo to determine if the chromosomes are normal. Typically, this procedure is performed on day 3 and results are available in time to proceed with an embryo transfer on day 5.

PGD is a form of genetic diagnosis performed prior to implantation. This implies that the patient's oocytes should be fertilized in vitro and the embryos kept in culture until the diagnosis is established. It is also necessary to perform a biopsy on these embryos in order to obtain material on which to perform the diagnosis. The diagnosis itself can be carried out using several techniques, depending on the nature of the studied condition. Generally, PCR-based methods are used for monogenic disorders and FISH for chromosomal abnormalities and for sexing those cases in which no PCR protocol is available for an X-linked disease. These techniques need to be adapted to be performed on blastomeres and need to be thoroughly tested on single-cell models prior to clinical use.

Finally, after embryo replacement, surplus good quality unaffected embryos can be cryopreserved, to be thawed and transferred back in a next cycle.