Intracytoplasmic Sperm Injection [1]

By: Zhu, Tian Keywords: Reproductive assistance [2] Fertilization [3]

Intracytoplasmic Sperm Injection (ICSI) is an assisted reproductive technique (ART) initially developed by Dr. Gianpiero D. Palermo [5] in 1993 to treat male infertility [6]. It is most commonly used in conjunction with in vitro (IVF) fertilization [7] or a less commonly used technique called zygote intrafallopian transfer (ZIFT). In natural fertilization [8], the sperm [10] must penetrate the surface of the female egg [11], or oocyte [12]. When the male has a fertility problem such as low sperm [10] count, malformed sperm [10] shape, or sperm [10] immobility, there is a significant decrease in the chance a healthy sperm [10] will penetrate the outer surface of the oocyte [12]. Other fertility problems ICSI can be used to overcome include the sperm [10] having trouble attaching to the egg [11] or the male having a blockage in his reproductive tract preventing normal ejaculation. In this procedure, the physician first obtains the sperm [10] and oocytes from the male and female and then manually injects the sperm [10] through a needle into the oocyte [12] to fertilize it in an injection plate. The physician then places the fertilized egg [13] into the female’s uterus [14] for implantation [15], following IVF or ZIFT procedures.

Physicians obtain sperm [10] by the same methods as with IVF: either through masturbation, by using a collection condom, or by surgically removing sperm [10] from a testicle through a small incision. The females are treated with fertility medications for approximately two weeks prior to oocyte [12] retrieval to stimulate superovulation [16], where the ovaries produce multiple oocytes rather than the normal one oocyte [12]. The oocytes are retrieved by either laparoscopy, or more commonly, transvaginal oocyte retrieval [17]. In the latter procedure, the physician inserts a thin needle through the cervix [18], guided by a sonogram and pierces the vaginal wall and then the ovaries to extract several mature ova.

Before the physician can inject the sperm [10] into the oocyte [12], the physician must prepare the sperm [10] by washing and exposing it to various chemicals to slow the sperm [10] movement and prevent it from sticking to the injection plate. Physicians treat the oocytes with hyaluronidase to single out the oocyte [12] ready for fertilization [8] by the presence of the first polar body. The physician then injects one prepared sperm [10] into an oocyte [12] with a thin needle. Often, physicians will fertilize several eggs so they can implant more than one into the uterus [14] and increase the chance of at least one successful pregnancy [19]. This also allows them to save extra embryos, using cryopreservation [20], in case later IVF rounds are needed. After the physician manually fertilizes the oocytes, they incubate for sixteen to eighteen hours and develop into a pronucleate egg [13] (a successfully fertilized egg [13] about to divide into an embryo). The egg [11] then grows for one to five days in the laboratory before the physician places it in the female’s uterus [14] for implantation [15].

Some problems may occur after injecting the oocyte [12] with a sperm [10]. The needle can possibly damage the oocyte [12] upon penetration; the oocyte [12] may stop dividing into an embryo at some point; or once the fertilized oocyte [12] has reached the embryo stage, the embryo may stop growing. Despite these possible problems, the chance of fertilization [8] increases dramatically with ICSI compared to simply mixing the oocytes and sperm [10] in a Petri dish and waiting for fertilization [8] to occur unaided. Studies have shown that successful fertilizations occur 50% to 80% of the time.

Since the introduction of ICSI, Intrauterine Insemination (IUI) has decreased in popularity by 80%. IUI is another technique used to combat male infertility [6]. One approach is to concentrate the amount of sperm [10] in the semen [21] by removing some of the seminal plasma, the liquid portion of the semen [21]. Another strategy in IUI is to treat the sperm [10] with drugs to improve motility. With ICSI, it is possible to be more selective and choose specific sperm [10] according to their sex chromosomes and possibly other genetic factors, allowing the opportunity to choose the healthiest sperm [10] and thereby eliminate significant genetic disorders. ICSI has greatly advanced male infertility [6] treatment and increased successful fertilizations and pregnancies when IVF alone was previously ineffective. Because ICSI adds very few risks of any possible birth defects [22], it has become a widely used technique to help many become pregnant when all other options have failed.

Sources

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