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Impact of Intracytoplasmic Sperm Injection in Human Assisted Reproduction

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Editorial

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ABSTRACT

The development of assisted reproductive technologies (ART) arises from the need to improve reproductive conditions, ensuring births in humans. Progress in this area of research has enabled the possibility of sperm selection with adequate morphological characteristics to ensure fertilization, embryo development, pregnancy and birth. However, further studies are required to increase reproductive efficiency.

EDITORIAL

New trends in assisted reproduction have increased technology development. Since the beginning of the *in vitro* conception as well as the introduction of advanced assisted reproductive technologies (ART), such as *in vitro* maturation (IVM), *in vitro* fertilization (IVF) and intracytoplasmic sperm injection (ICSI), one of the mayor tasks is the possibility to solve subfertility problems in humans.

The ICSI method is a technique where a spermatozoon is microinjected into the oocyte cytoplasm in order to produce an embryo capable to develop. ICSI was first reported in hamsters [1] but its application has also been used in mice, cattle, pigs [2] and mostly in humans. In terms of human reproduction, this method is one of the most important tools for the treatment of male infertility. Since the first human baby was born by ICSI [3], over 1 million children have been born by this procedure to date. However, this method does not result in high fertilization and embryo production rates because some of the checkpoints of natural fertilization are bypassed. These checkpoints are an inadequate zona pellucida (ZP) recognition, oocyte activation and acrosome reaction. Also, the sperm selection before injection is made only by a visual approach based on motility, which does not necessarily, reflects sperm quality [4]. Therefore, ICSI may increase the risk of injecting spermatozoa with genetic or functional abnormalities, reducing embryo development [5]. But also, oocyte degeneration can be produced after ICSI. During microinjection, the ZP and plasma membrane can be fractured leading to the influx of extracellular medium or efflux of cytoplasmic content. Another aspect to be considered is that the use of polyvinyl pyrrolidone (PVP) is necessary to slow the movement of the sperm so that immobilization, capture and injection can be performed. Therefore, PVP enters the oocyte during injection, and it has been reported to be toxic and detrimental to the cell [6].

Due to the unexpected low efficiency of ICSI, recent attempts including hyaluronic acid (HA) have increased implantation and pregnancy rates in humans. Clinical studies demonstrate that a higher pregnancy loss rate was observed in ICSI compared to the use of HA, 25% and 12%, respectively [7]. The HA is a polymer of disaccharides and is secreted in the reproductive system by the cumulus cells and oviduct. The use of HA is also known as physiological intracytoplasmic sperm injection (PICSI), which is based on the ability of sperm to bind to a HA hydrogel prior to fertilization, mimicking the natural binding of mature sperm to extracellular matrix of the cumulus oophorus surrounding the oocyte [8]. For PICSI, conventional plastic dishes containing 3 microdots of powdered HA are incubated within 15 min so that sperm can be attached by their head to the HA surface. Since one of main problems during ICSI is a reduced oocyte activation and acrosome reaction due to an inadequate sperm selection, contact with HA before injection allows acrosome activity for fertilization. Only sperm with adequate epididymis maturation, capacitation, and intact acrosome and hyaluronidase activity will attach to HA, increasing fertilization rates. Up to now, the need to increase reproduction efficiency has resulted in new technology development as PICSI and the latest intracytoplasmic morphologically selected sperm injection (IMSI). The higher magnification (>6,600X) by IMSI detects sperm structural abnormalities than ICSI (400X), improving implantation rates in patients with repeated failure to ICSI. Recent studies understanding the fertilization process have identified essential elements that are required to optimize ART as HA or sperm magnification. Currently these technologies allow many couples to conceive without risks [9]. In this way, technology represents a powerful application and benefit for reproduction. However, further studies are required to increase reproductive efficiency.

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