

Increasing Pregnancy by Improving Embryo Transfer Techniques

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1. Introduction

Embryo transfer (ET) is universally recognized as the final and most critical stage in an in vitro fertilization (IVF) outcome (Neithardt et al., 2005; Ghazzawi et al., 1999). The majority of couples (approximately 80%) who undergo IVF reach the embryo transfer stage, yet few pregnancies occur (Mansour & Aboulghar, 2002; Adamson et al., 2006). Although embryo genetic abnormalities (Munne et al., 1995) and imperfections in uterine receptivity are some important factors which influence implantation, embryo transfer technique may be directly responsible for a lot of unsuccessful embryo implantations. Embryo transfer necessitates the joint attempts of the reproductive biologist and the clinician. Without healthy embryos, embryo transfer will fail. On the other hand, a poor embryo transfer technique often results in embryo implantation failure (Schoolcraft et al., 2001). However, comparatively less attention has been paid to ET techniques than IVF technique (Mansour & Aboulghar, 2002; Schoolcraft et al., 2001). This might be due to misconception of some clinicians in which the type of transfer does not affect the outcome (Schoolcraft et al., 2001). The early researchers recommended that a careful embryo transfer technique is necessary for successful IVF (Meldrum et al., 1987). Recently, many investigators have identified the relationship between IVF outcome and different techniques and they have noted a pregnancy rate of 33.3% for “excellent” transfers, and 10.5% for “poor” transfers (Englert et al., 1986, as cited in Schoolcraft et al., 2001). In this chapter we attempt to review the variables and, techniques that may refine the embryo transfer technique and divide them to the following three stages: before, during, and after embryo transfer.

2. First stage: The preparation before embryo transfer

Variables affecting the pregnancy rate include: evaluation of the cervico-uterine axis, the performance of a dummy or mock transfer, and appropriate evaluation of the uterine cavity (Derks et al., 2009).

2.1 Evaluating the cervico-uterine axis

This evaluation is necessary to ensure suitable embryos placement. It can be undertaken by both dummy embryo transfer and ultrasonography. Both procedures are important for

evaluating the direction and length of the uterine cavity and cervical canal. To improve the outcome, it has been suggested that a dummy embryo transfer should be performed prior to the stimulation cycle (Mansour et al., 1990), or just before the actual embryo transfer (Sharif et al., 1995). If this technique is performed close to the time of embryo transfer for example at the time of oocyte retrieval, the pregnancy rate will decrease significantly due to late uterine contractions (Madani et al., 2009a). We previously assessed the appropriate time for evaluation of the cervical axis and uterine measurement. A total of 124 women who underwent IVF treatment were included in our study and divided equally into two groups. Measurement of the uterine cavity length from the external cervical os to the fundus, as well as determination of the cervico-uterine axis, was performed on days 2 or 3 of the menstrual cycle or at the time of oocyte retrieval. Our results indicated a statistically significant difference in clinical pregnancy rates between the two groups (64.2% vs. 35.8%, $P < 0.005$). Also, our results showed that the time of measurement affected clinical pregnancy rates in IVF cycles and the best time for uterine measurement is probably on days 2 or 3 of menstruation (Madani et al., 2009a).

2.2 Performing a dummy or mock transfer

Many unexpected agents make entering the uterine cavity difficult, such as cervical polyps or fibroids, a pin-point external os, and cervical deformation due to congenital anomalies or resulting from a previous surgery, all of which can be discovered by a 'dummy' or 'mock' transfer. In the case of cervical stenosis, cervical dilatation should be performed before ovarian stimulation (Mansour & Aboulghar, 2002).

2.3 Appropriate evaluation of the uterine cavity

Assessment of the uterine cavity by ultrasonography prior to the IVF cycle is essential for detecting uterine polyps as well as any fibroids that may be invading the uterine cavity or deformities to the cervical canal (Mansour & Aboulghar, 2002; Niknejadi et al., 2010). Polyps are the most common structural pathologies in the uterine cavity (Isikoglu et al., 2006) which it's incidental finding during ovarian stimulation, in either IVF or intracytoplasmic sperm injection (ICSI) cycles, is a challenge.

Polyp size (Lass et al., 1999; Isikoglu et al., 2006) and location (Yanaihara et al., 2008) may influence the success of embryo implantation during assisted reproductive treatment cycles. According to some research studies, endometrial polyps less than 1.5cm do not negatively influence the pregnancy outcome, whereas increased loss of pregnancy has been reported in others (Lass et al., 1999; Isikoglu et al., 2006). Endometrial damage by endometrial sampling (Barash et al., 2003) or hysteroscopic polypectomy (Varasteh et al., 1999; Spiewankiewicz et al., 2003; Stamatellos et al., 2008) may significantly improve the pregnancy rates. Recently, we reported the outcome of nine women with endometrial polyps less than 1.5 cm after hysteroscopic polypectomy (Madani et al., 2009b). Polypectomy was performed during ovarian stimulation (in eight patients with the standard long protocol) or during hormone replacement therapy (in one donor egg recipient). The interval between polyp resection and embryo transfer was 2-16 days. A relatively high pregnancy rate was noted in our study. One possible mechanism that has been proposed for the improvement of endometrial receptivity following endometrial damage by hysteroscopic polypectomy could be the events related to wound healing. During this process, there is a massive secretion of different cytokines and

growth factors, known to play important roles in implantation (Basak et al., 2002). Although several studies have reported good outcomes following hysteroscopic polypectomy during ovarian stimulation in IVF cycles (Batioglu & Kaymak, 2005; Madani et al., 2009b), due to debates over this topic, it is advisable to evaluate the uterine cavity prior to stimulation in order to determine the presence of an existing endometrial pathology.

3. Second stage: Measures during embryo transfer

A great attention has been paid to the embryo transfer technique during IVF. To ensure success, the crucial technique is to deposit embryos in the uterine cavity in the least traumatic manner possible (Mansour et al., 1990). Factors of influencing the pregnancy rate during this stage include (Derks et al., 2009; Schoolcraft et al., 2001) 1) cervical preparation, removal of mucus or blood on the catheter; 2) straightening the utero-cervical angle; 3) ultrasound use; 4) type of catheter; 5) Loading the embryo medium; 6) Embryo load method for transfer; 7) time of embryo transfer with regard to uterine contractions problem; 8) air injection before withdrawal of the embryo transfer catheter (Madani et al., 2010).

3.1 Cervical preparation, and removing the mucus or blood on the catheter

Cervical mucus seems to interfere with embryo entry into the uterus from the transfer catheter. This interference can be caused by excess cervical mucus that cover the transfer catheter and make the injection of the embryos effortless (Visschers et al., 2007). The presence of blood or mucus on the catheter, from tissues trauma, may also reduce implantation rates (Schoolcraft et al., 2001). It has been reported that, while drawing the catheter, cervical mucus may surround the embryos and dislodge them from their original place (Eskandar et al., 2007). Contamination of the catheter tip and uterus by cervical flora is another risk that has been reported to correlate with a lower pregnancy rate (Eskandar et al., 2007; Derks et al., 2009). The endometrial cavity may also be contaminated by cervical mucus. In a study performed by Egbase and colleagues (Egbase et al., 1996), positive cultures of the cervical mucus (70.9%) and catheter tip (49.1%) have been reported. The researchers noted improved clinical pregnancy rates for catheter tip-negative (57.1%) women compared with catheter-tip positive (29.6%) women. Similarly, another investigator has shown that the positive culture has a significant negative impact on transfer outcome (Fanchin et al., 1998a). Also better results may be obtained when vigorous cervical lavage was used prior to embryo transfer to remove all visible mucus (McNamee et al., 1998). Since bacterial contamination from the cervix and pelvic infections (such as pelvic abscesses) has been reported after embryo transfer (Sauer & Paulson, 1992), we cannot give prominence to the careful cleaning of the cervix prior to embryo transfer.

3.2 Straightening the utero-cervical angle

The smooth introduction of the transfer catheter into the uterine cavity can be compromised by the common anteverted uterus, which is found in most women (Sundstrom et al., 1984, as cited in Derks et al., 2009). By straightening the utero-cervical angle, uterine contractions and insertion trauma will be avoided, thus the embryo transfer success will be much higher. The utero-cervical angle can be straightened by means of following techniques (Derks et al., 2009) 1) distended bladder: a full bladder acts as a useful adjunct for transfer, particularly in cases of retroverted and ante flexus uterus

(Abou-Setta, 2007; Lewin et al., 1997); 2) gripping the cervix with a tenaculum 3) using an inner metal guide; 4) changing the patient position during embryo transfer.

3.3 Use of ultrasound guidance

Embryos are generally deposited in the uterine cavity by means of a transcervical transfer catheter. Traditionally, the "clinical touch" method has been used to guide catheter placement approximately 1 cm from the uterine fundus. This is a blind technique and clinicians must rely on their sense of touch to judge whether the transfer catheter has been introduced in its proper place (Brown et al., 2010). Therefore this method is often unreliable for evaluating the correct catheter location. Woolcott and Stanger (Woolcott & Stanger, 1997) used transvaginal ultrasound for embryo transfer so that catheter insertion to endometrial surface and uterine fundus was observed. They reported optimal catheter insertion in less than half of the cases because of the catheter either indenting or becoming embedded in the endometrium. It has been demonstrated that ultrasound-guided embryo transfer is helpful for women who have previously had difficult transfers (Kan et al., 1999), and that the rates of implantation and pregnancy have a significantly improvement (Coroleu et al., 2000). Other important benefits of ultrasound guided embryo transfer include providing an opportunity to observe the transfer catheter, the air bubble, the endometrial cavity and the endometrial feature (Strickler et al., 1985). The transferred air bubbles are often considered a marker for the embryo's position in the uterus. By performing the transfer under ultrasonographic guidance, the catheter and air bubble can be precisely located (Lambers et al., 2007). Based on some studies, catheter insertion at 1.5 or 2 cm from the fundus is better than insertion at 1 cm from the fundus (Coroleu et al., 2002). The air bubble position at embryo transfer is relevant to the pregnancy rate (Lambers et al., 2007).

3.4 Type of catheter

A Soft, flexible embryo transfer catheter is the best choice for minimizing the risk of trauma to the endocervix or endometrium, facilitating smooth insertion. Earlier studies have reported the benefit of using a soft catheter for embryo transfer. Many studies have evaluated various types of embryo transfer catheters and have confirmed a significantly better pregnancy rate with the use of soft catheters (Wood et al., 2000; Wisanto et al., 1989; Mansour et al., 1994; Ghazzawi et al., 1999; Mansour & Aboulghar, 2002). It is important to point out that in order to benefits from the catheter's softness; the outer rigid sheath should be stopped just at the internal cervical os, and not pushed beyond it. Stimulation due to passage of the embryo transfer catheter through the internal cervical os, can start contractions, which are caused by the release of prostaglandins (Fraser, 1992). Therefore, the idea of performing an embryo transfer without cervical manipulation seems wise (Dorn et al., 1999; Lesny et al., 1999b; Mansour & Aboulghar, 2002). In all, it is highly recommended to use agents that can facilitate a smooth embryo transfer and reduce unintended stimulation of the fundus, for example the application of soft-tipped catheters, which can improve pregnancy rate (Neithardt et al., 2005).

3.5 Loading the embryo medium

The composition of the medium that surrounds the embryo during embryo transfer is believed to be important at this critical stage. To enhance the chances of pregnancy by

increasing the probability of the embryo adhering to the uterus, adherence compounds have been developed which are added to the embryo transfer medium. One natural and most important adherent macromolecule recommended to be introduced into transfer media is hyaluronic acid which is known as an implantation enhancing-molecule (Bontekoe et al., 2010). Despite the lack of evidence, an exact mechanism by which hyaluronic acid improves implantation has led to the speculation that it increases cell-to-cell adhesion and cell-to-matrix adhesion (Turley & Moore, 1984 as cited in Bontekoe et al., 2010). Hyaluronic acid generates a viscous solution that might improve the embryo transfer process, preventing embryo expulsion (Simon et al., 2003).

Albumin is a macromolecule traditionally used as the main macromolecule in most culture media. Serum albumin, which is derived from blood, is an impure substance and there is a risk of contamination through the transmission of viruses. Studies have demonstrated that hyaluronic acid has a positive effect on pregnancy rates and can successfully replace albumin as a transfer medium (Simon et al., 2003; Mahani & Davar, 2007). The results of mouse studies have revealed significantly higher implantation and embryo development following addition of hyaluronic acid to the transfer medium when compared to transfer medium with no hyaluronic acid (Gardner 1999). EmbryoGlue® is a useful and available embryo transfer medium with a high concentration of hyaluronic acid which in some infertile patients it can improve clinical implantation and ongoing pregnancy rates. We have previously evaluated the efficacy of Embryo-Glue® as a human embryo transfer medium in IVF/ICSI cycles on 815 patients who were randomly divided into study (n=417) and control (n=398) groups. In both groups, the embryo culture medium was G-1TMver 3, supplemented with 10% recombinant human albumin. On the day of embryo transfer (day 3), excellent or good quality embryos were selected for transfer and then were placed in either Embryo-Glue® (study group) or fresh culture medium (control group) prior to transfer. According to our results, a significantly higher rates of clinical pregnancy and implantation in the tubal factors, a significantly better implantation rate in recurrent implantation failures were observed with Embryo-Glue® than G-1TMver3 (Valojerdi et al., 2006).

3.6 Embryo load method for transfer

The final aim of embryo transfer is to transport the embryo close to the fundal wall to create optimal conditions for implantation in the endometrium. Although there are different methods of catheter loading in IVF centers, similarities are observed in using the transfer of small volumes which are compositions of a sequence of air and liquid contents. It has been postulated that if the contents of the catheter load consist of liquid alone, the distribution of the embryos may occur throughout a larger area. On the other hand, since the uterine tissue can absorb air faster than liquid, the use of air in the transferred liquid can be beneficial (Eytan et al., 2004). The method of embryo transfer at our fertility center and in the majority of centers is the three-drop procedure (Friedman et al., 2011), with air bubbles separating the drop of medium that contains the embryo from two drops of Embryo-Glue® before and after the embryo drop (Figure. 1).

The advantage of using the air and liquid content for catheter loading is to prevent the embryo from adhering to the wall of the catheter at the time of injection (Eytan et al., 2004). The presence of two air bubbles on both sides of the medium that contains the embryo prevents the transfer of the embryo within the catheter (Eytan et al., 2004) and beside, in the

transfer under ultrasonographic guidance, the air bubbles are often considered a marker for the embryo's position in the uterus (Lambers et al., 2007). Finally by loading 1 μl of medium on the catheter tip, the probability of embryo expulsion will be stopped. It has been reported that larger volumes of fluid transferred (60 μl) correlate with retained embryos, yet it is advisable that a certain amount of media be loaded to assist with expelling the embryo (Hearns-Stokes et al., 2000). On the other hand, the transferred air volumes should be small enough to prevent the transport of the embryos into the cervix (Eytan et al., 2004). Based on the fact that a low speed of injection upon the catheter load into the uterus produces bubbles, which assist with transporting more transferred media into the fundus, it is advisable to transfer the embryo gently with minimal ejection speed. However, the speed of injection has not been studied clinically (L. Bungum & M. Bungum, 2009). It is proposed that to minimize the risk of retained embryos, the transfer catheter should be slowly withdrawn (Mansour & Aboulghar, 2002; Eytan et al., 2007).

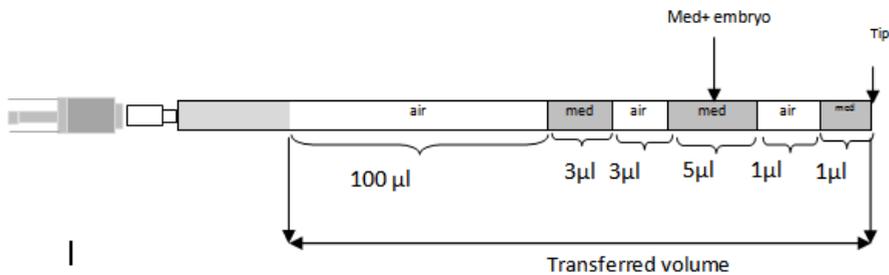


Fig. 1. The catheter load with a sequence of air and transfer medium

3.7 Time of embryo transfer with regard to uterine contraction problem

Studies in animals have demonstrated that uterine contractions have an effect on the implantation of embryos (Adams, 1980; Schoolcraft et al., 2001). In a study by Fanchin and colleagues (Fanchin et al., 1998b), the 5 minute ultrasound scans of the uterus were digitized for counting the occurrence of myometrial contractile activity. Their result showed an overall mean uterine contraction frequency of 4.3 per minute. They also noted that with increased frequency of the uterine contractions, the rates of implantation and pregnancy were reduced. The variables correlated with the frequency of uterine contractions are (Schoolcraft et al., 2001) 1) serum progesterone levels on the day of embryo transfer: By increasing progesterone levels, uterine contractions decrease; 2) difficulty of embryo transfer: the occurrence of uterine contractions depends on the difficulty of the embryo transfer. An investigation that used 30 μL of an opaque medium in 14 oocyte donors showed that, with easy mock embryo transfer, the frequency of uterine contractions were not altered and the opaque contrast medium remained for 45 minutes in the upper part of the uterine cavity. Conversely, forceful, random and fundocervical uterine contractions have been shown to occur following a difficult embryo transfer (Lesny et al., 1998); 3) applying a tenaculum: Uterine contractility increases when a tenaculum is used to grasp the cervix (Lesny et al., 1999b); 4) progression into the luteal phase: Uterine contractility lessens with progression into the luteal phase. This can be a causal factor for success of the embryo transfer in the blastocyst stage after five days of culture (Lesny et al., 1999a).

3.8 Injection of air before embryo transfer catheter withdrawal

A higher occurrence of immediate or delayed embryo expulsion is correlated with capillary action or the negative force created by moving the catheter back (Schoolcraft et al., 2001; Woolcott & Stanger, 1997). Some researchers have indicated that 15% of the transferred embryos are pushed out after embryo transfer and are found in the catheter tip, cervix and on the vaginal speculum (Mansour, 2005, Poindexter et al., 1986). This can be a reason for IVF failure (Ghazzawi et al., 1999; Mansour et al., 1994).

Pushing 0.2 mL of air into the catheter immediately following embryo transfer is an easy and low-cost addition to standard embryo transfer techniques (Madani et al., 2010). This appears to improve pregnancy rates. Recently we used this improved technique to perform 110 infertile women embryo transfers, and obtained a significant higher implantation and clinical pregnancy rates than controls. In this research, our purpose was to prevent embryo expulsion. By pushing air gently after driving out the embryos into the uterine cavity, we have tried to generate a positive air pressure in order to stop embryos from back-tracking with the catheter removal, or the creation of a force against the waves generated by uterine contractions, thus finally reducing the rate of embryo expulsion. However, we recommend further randomized clinical studies to confirm better treatment outcomes and clarify the exact mechanism of this simple, modified embryo transfer technique (Madani et al., 2010).

4. Third stage: Measures after embryo transfer

Recently, the use of evidence-based guidelines has been emphasized in order to optimize and standardize the embryo transfer protocol. However, there is debate on the post-transfer aspects of the embryo transfer. There are three main approaches for post embryo transfer intervention (Abou-Setta et al., 2009): 1) prevention of the expulsion of fluids and embryos from the cervix; 2) the use of a fibrin sealant (Bar-Hava et al., 1999, Feichtinger et al., 1992); 3) bed rest after embryo transfer (Sharif et al., 1998)

4.1 Prevention of the expulsion of fluids and embryos from the cervix

Closing the cervix following embryo transfer is one method proposed for preventing embryo expulsion. A recent prospective, randomized study has suggested mechanical closure of the cervix (Mansour, 2005) by loosening the screw of the vaginal speculum, following the introduction of the embryo transfer catheter. In this study, the cervical portio-vaginalis was closed by the two lips of the speculum. After gently withdrawing the embryo transfer catheter, the vaginal speculum was left for 5-7 minutes to put pressure on the cervix. Suprapubic heaviness and mild discomfort were the only complications reported in this study. To better confirm the usefulness of this intervention as a post-embryo transfer strategy, more well-designed and powered randomized controlled trials are needed (Abou-Setta et al., 2009).

4.2 Fibrin sealant

In the investigation by Ben-Rafael et al. (Ben-Rafael et al., 1995), "two step" technique (Feichtinger et al., 1992) has been applied for using a fibrin sealant. In this method, the application of multiple columns of air or medium cause splitting of the fibrin sealant and embryo sections. Initially, the sealant ingredients, followed by either an air or medium

column are loaded into the embryo transfer catheter. This method ends with the loading of a medium column containing the embryos into the transfer catheter. The proximity of the embryos to the uterine cavity and the creation of a layer between the embryos and the uterine cavity (by columns of media and fibrin sealant) are the basis of this technique. According to the theory which states that when embryos are next to the endometrium, the relationship between embryos and the mother tissue becomes easier, thus facilitating the adhesion process, and increasing the pregnancy rate (Abou-Setta et al., 2009). Movement of the fluid from the uterine cavity is an unwanted event after embryo transfer and usually observed in clinical practice (Schulman, 1986; Ghazzawi et al., 1999; Mansour, 2005). Of note, sometimes this fluid contains the transferred embryo (Ghazzawi et al., 1999) and this causes movement of the embryo away from its deposition place (Ghazzawi et al., 1999; Mansour, 2005; Schulman, 1986).

4.3 Bed rest

It has been speculated that embryo movement after transfer happens with instant mobilization following embryo transfer. A linear relationship between the success rates of embryo transfer and the time spent in a lying position has been seen. Since, limited numbers of embryos are transferred; embryo expulsion usually leads to transfer failure. Any interference that could stop this unintended exclusion would increase pregnancy rate (Abou-Setta et al., 2009). In the past, as a guarantee of success, complete bed rest was prescribed after embryo transfer for at least 24 hours with the aim of stopping the expulsion of fluids that contain the embryo due to gravity. With the intention of making the procedure easier and more patient-friendly, clinicians decided to reduce the time of resting (Sharif et al., 1998). Recent guidelines have considered 15 minutes as the time needed for bed rest (Abou-Setta et al., 2009). According to the research by Purcell and colleagues (Purcell et al., 2007), the bed rest period did not affect clinical pregnancy rate.

5. Single embryo transfer (SET)

Regardless of many advances in assisted reproductive technologies (ART), the live birth rate is still unsatisfactory; however, the success rate of ART has increased during the past 10-15 years (Gerris, 2009). In accordance with the report of the Society for Assisted Reproductive Technology, the live birth rate has increased by 4% in 6 years (28% in 1996 to 32% in 2002) (Neithardt et al., 2005). It is also important to note that in multiple embryo transfers, although the success rate of the pregnancy will increase, the live birth rate will not raise (Gerris, 2009). Over the past decade, the first study in 2003 indicated a similar pregnancy rate between single embryo transfer and double embryo transfer (Poikkeus & Tiitinen, 2008). Furthermore, on the base of several studies, pregnancy rates equaling double embryo transfer rates have been achieved by utilizing the combination of single embryo transfer and a later frozen embryo transfer (Thurin et al., 2004; Milliez & Dickens, 2009), decreasing the twin birth rate from 25 to 1%. The major benefit of single embryo transfer is the decrease in all known increased risks of obstetric and neonatal complications that are four times higher in twins than in singletons (Davis, 2004; Poikkeus & Tiitinen, 2008; Milliez & Dickens, 2009). Several investigators have proposed that careful patient selection and good quality embryos transfer (elective embryo transfer) reduces the risk of multiple pregnancies while maintaining a comparable live birth rate (Gerris, 2009).

Some others analyze single embryo transfer from an economic point of view (Bergh, 2005; Fiddellers et al., 2007). From a societal perspective, these studies show that savings in health costs related to twin pregnancies may equal the direct additional costs of the repeat SET cycles needed to achieve the same take-home baby rate. In many cases, the direct costs of treatment are the responsibility of the patients, whereas the costs related to multiple pregnancies are imposed on both patients and the government (Roberts et al., 2010). Finally, a more cost-effective and safer procedure may be offered by elective single embryo transfer for patients who undergo assisted reproductive technology.

6. Conclusion

Despite transferring one or two good quality embryos, there is still a question as to why the transfer is inefficient. The mechanisms underlying the implantation phenomenon are unknown and the clinical implications remain poorly understood. After embryo transfer, the control of the transferred embryos will be lost and we cannot distinguish which embryos reach the endometrial cavity and whether all of them have the same chance of implantation. There are numerous variables involved in embryo implantation and pregnancy, while embryo transfer technique is one of key factors which affect embryo transfer success. For this purpose, embryo transfer must be performed in a gentle and non-traumatic manner. Minimizing blood on the catheter tip (cervical trauma), the cervical mucus, the risk of embryo expulsion or retained embryos, the frequency and severity of uterine contractions, and performing a trial embryo transfer before the actual transfer all seems to be useful for embryo transfer. Additionally, the use of ultrasonographic guidance and soft catheters appears to enhance the chances of a successful outcome. Due to insufficient evidence from clinical trials, it is not clear which factors are crucial. Great attention should be paid to all these factors, which could optimize the embryo transfer. There are a number of questions to be answered by current and future research, in which a better outcome may be achieved. For example, enhanced knowledge about the conditions for implantation can be guidance for providing various types of media that are more compatible with normal embryo development. An improved catheter design perhaps by microcamera, may lead to the efficiency of embryo transfer by minimizing the damage to the uterine cavity, and finally determination of the exact mechanism of uterine contractions (mechanical, chemical or hormonal), may result in the use of materials and new techniques for decreasing the deleterious effects that occur during embryo transfer.

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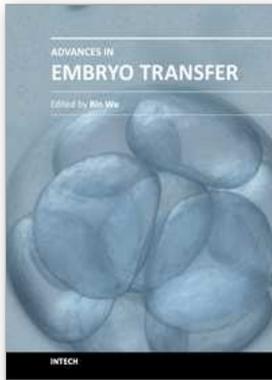
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Embryo transfer has become one of the prominent high businesses worldwide. This book updates and reviews some new developed theories and technologies in the human embryo transfer and mainly focus on discussing some encountered problems during embryo transfer, which gives some examples how to improve pregnancy rate by innovated techniques so that readers, especially embryologists and physicians for human IVF programs, may acquire some new and usable information as well as some key practice techniques. Major contents include the optimal stimulation scheme for ovaries, advance in insemination technology, improved embryo transfer technology and endometrial receptivity and embryo implantation mechanism. Thus, this book will greatly add new information for readers to improve human embryo transfer pregnancy rate.

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