Effects of Embryo Transfer Catheters on the Endometrial Surface Noted at Hysteroscopy

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ABSTRACT

Study Objective: To assess the effects on the endometrial surface of embryo transfer catheters using hysteroscopy with ultrasound guidance.

Design: Prospective descriptive study (Canadian Task Force classification III).

Setting: University-based clinical practice.

Patients: Twenty patients with a documented difficult trial transfer (TT).

Intervention: All patients underwent an intraoperative TT using an Edwards-Wallace catheter (n = 10), a Soft-Pass catheter with obturator (n = 2), or an Echosight Patton catheter with a coaxial wire (n = 8), with placement assured using ultrasound. This was followed by hysteroscopy and cervical surgical correction.

Measurements and Main Results: A 5-mm hystroscope was used to visualize, assess, and document TT catheter placement and effects on the endometrial cavity. The Wallace catheter caused the least trauma (20%). The Soft-Pass catheter with obturator (100%) resulted in linear grooves in the endometrial surface. The most traumatic effects occurred with use of the coaxial catheter (38%), which caused shaving with petechial bleeding past the point of obstruction. In addition, 3 of the Wallace catheters were improperly placed (cannulation of tubal ostia, n = 2) and coiled back (n = 1).

Conclusion: Despite ultrasound guidance, endometrial disruption and catheter displacement occur with difficult embryo transfer catheter placement, which may suggest an explanation for lower pregnancy rates in these difficult cases. Greater attention to correction of cervical disease before an in vitro fertilization–embryo transfer cycle may improve clinical outcomes.

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DISCUSS

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Increased success rates with assisted reproductive technology have primarily been ascribed to improved stimulation protocols and laboratory techniques [1]. Outcome failures of human in vitro fertilization (IVF) are generally attributed to problems of embryo quality or uterine receptivity.

Most failures, however, occur after the transfer of apparently normal embryos and have been attributed to suboptimal embryo transfer (ET) technique. Until recently, ET has been considered an unimportant variable in the success of an assisted reproduction treatment cycle [2–6].

Recent studies have specifically addressed the technique of ET, potentially affecting the success of IVF, dispelling the historical notion that ET is an unimportant variable in the success of an assisted reproduction treatment cycle. Greater attention is given to the effects of blood or mucus on or in the catheter [7], ease of transfer [5,6], uterine contractility [8 transfundal placement [9], and catheter type [10,11].

To overcome some of these issues, the following have been...
suggested to improve clinical outcomes: a trial transfer (TT) [12], addressing cervical stenosis [12], administration of antibiotics [13], and use of abdominal or transvaginal ultrasound (US)-guided transfer [14–17].

The overall ease and the type of catheter used for ET generally go hand in hand and are strongly correlated with pregnancy outcome. Compared with easy ET, difficult ET results in significantly lower pregnancy rates and implantation rates [12]. To overcome difficult ET, there is a variety of commercially available ET catheters to facilitate placement. However, each is associated with bleeding, trauma, and stimulation of uterine contractions (affecting prostaglandin and oxytocin release), possibly affecting outcomes [8,18,19]. In general, soft catheters are preferred because firm catheters are more likely to induce cervical and endometrial irritation and trauma.

To further optimize pregnancy outcomes, the use of US-guidance in ET has been described in more than 150 clinical trials, with 20 randomized clinical trials and 3 meta-analyses, and a recent Cochrane review [20]. It is believed that US confirms the position of the ET catheter tip and site of embryo deposition within the uterine cavity, increases the frequency of easy ET, and averts endometrial indentation, potentially avoiding disruption of the endometrial cavity [21]. Nonetheless, US-guided ET does not eliminate the risk of tubal or cervical pregnancy [22,23] or disruption of the endometrium [24].

Inasmuch as we routinely perform hysteroscopy to correct cervical stenosis before ET, we present the effects of ET catheters noted at hysteroscopy after difficult TT and discuss the observed findings. In contrast to a previous blinded study in which the effects of TT were described [11], the present study examined the effects of US-guided placement of ET catheters on the endometrium during diagnostic hysteroscopy.

Materials and Methods

Institutional review board approval was obtained before data collection and analysis. Findings in 20 patients in a university-based clinical practice with documented difficult TT before an IVF cycle are reported.

Each patient underwent saline infusion sonography as previously described [25] and TT under transvaginal US guidance, as described by Kojima et al [26]. These occurred within 6 months before the IVF-ET cycle, either during the follicular phase of a spontaneous menstrual cycle or after a progesterin withdrawal bleed. The objectives were to identify any cervical or endometrial disease and to assess the depth and degree of angulation of the ET catheter before the IVF cycle.

For the purposes of this study, only those patients with a normal saline infusion sonogram and a difficult TT, as defined by the presence of substantial blood on the catheter, use of a tenaculum, and/or duration >90 seconds, underwent correction via hysteroscopy. Surgical procedures were performed within 2 to 4 weeks before initiating the IVF cycles.

Previous cervical manipulation (i.e., dilation and curettage, loop electrosurgical excision procedure, or insertion of an intrauterine device) had been performed in a total of 3 patients (Soft-Pass catheter with obturator [n=1] and the Echosight Patton catheter with coaxial wire [n=2]).

Preoperative intravaginal misoprostol (800 μg) was administered 12 hours before surgery. After administration of anesthesia, including mild intravenous sedation supplemented with a paracervical block, another TT was performed in all patients using a Wallace Embryo Replacement Catheter (Smiths Medical, Dublin, OH). If placement was unsuccessful using the Wallace catheter, placement using a Soft-Pass catheter with an obturator (Cook Medical, Inc., Bloomington, IN) was attempted, and if again unsuccessful, an Echosight Patton Catheter with a coaxial wire (Cook Medical) was used. The Echosight Patton Catheter system consists of 2 parts fitted coaxially: a 5.7F outer sheath and an inner 0.018-inch-diameter guidewire with coode tip. The inner wire is firm yet flexible, enabling maneuvering through difficult sites of entry. The outer sheath is passed over the guidewire and is echogenic to enable its imaging at abdominal or vaginal US. Intrauterine catheter placement was assured using transabdominal US (Siemens Medical Systems, Inc., Issaquah, WA) accompanied by a filled bladder after instilling 100 mL sterile saline solution through the Foley catheter. With the TT catheter in place, a 5-mm Gynecare VersaScope Hysteroscopy System (Ethicon, Inc., Somerville, NJ) with normal saline solution and pressure of 75 mm Hg was used to visualize, assess, and document the TT effects on the endometrial cavity. With a second operator holding the TT catheter, the hysteroscope was advanced using both a direct and a US-guided approach.

If cervical disease and/or stenosis were noted, one of two approaches was used. Either scissors were used to lyse or stretch the canal, enabling advancement of the hysteroscope, or a modification of a technique described by Noyes et al [27], referred to as cervical shaving, was performed. The Noyes technique involves hysteroscopically resecting protruding cervical ridges using a wire loop at 70 W of cutting current. A smooth cervical tract was created by shaving away an approximately 0.5-mm depth of cervical tissue, starting at the internal cervical os and extending caudad to the midportion of the cervical canal. In contrast to the Noyes cervical shaving technique, we used an intrauterine morcelation device (Smith & Nephew Endoscopy, Andover, MA), inserted through a working channel of an operative hysteroscope, in which a rotating blade powered by an electrical control unit was used to morcelate and create cruciate incisions at the 2-, 4-, 8-, and 10-o’clock positions [28]. Postoperatively, a Foley catheter was placed in the uterus, and antibiotic prophylaxis was administered.

Results

After adequate anesthesia was administered, a TT using the Wallace Embryo Replacement Catheter was successfully
advanced in 10 patients (50%); a Soft-Pass catheter with obturator was required in 2 patients (10%), and an Echosight Patton Catheter with a coaxial wire was necessary in 8 patients (40%) to navigate the internal os.

**Effects of Wallace Catheter**

The Wallace catheter was used in 10 patients and produced the least trauma. In 2 patients (20%), the catheter caused petechial irritation (appearing as superficial bleeding in the mucosa, in a dotted pattern), and 1 was placed subendothelially. Despite US guidance, the Wallace catheter passed directly into the tubal ostium in 2 patients (Fig. 1). In 1 patient, the catheter coiled touching the uterine fundus in a U shape, pointing the catheter tip toward the lower uterine segment (Figs. 2 and 3).

**Effects of Soft-Pass Catheter With Obturator**

In 2 patients, the outer sheath created a tunnel-shaped lesion through the subendometrium in the lower uterine segment, similar to a biopsy curette (Fig. 4). The defects were approximately 10 and 15 mm long and 2 and 4 mm deep, respectively. No bleeding was noted along the denuded endometrial edges.

**Effects of Echosight Patton Catheter With Coaxial Wire**

The Echosight Patton catheter produced the most trauma. In 3 of the 8 patients requiring this catheter (38%), the endometrium was sheared approximately 10 to 15 mm inferior to the tip of the external sheath of the catheter. One to 2 mm of shaved endometrium was observed along the posterior wall in 2 patients with a retroverted uterus, and along the anterior wall in 1 patient with an anteverted uterus. In 1 patient, blood was noted along the edges of the denuded endometrium.

**IVF Outcomes**

All patients underwent an IVF cycle. An easy ET was noted in nearly all patients (Wallace catheter, 100%; Soft-Pass catheter with obturator, 100%; and Echosight Patton Catheter with coaxial wire, 75%). In 2 patients in the Echosight Patton Catheter group, ET was moderately difficult. Clinical pregnancy rates were 60%, 100%, and 63% (including the 2 moderately difficult ET), respectively.

**Discussion**

There are multiple components in an IVF-ET cycle, each of which may influence the cycle's outcome. Embryo quality

**Fig. 3**

Second look ultrasound, transverse view, demonstrates the catheter (arrows) curling back toward the lower uterine segment.
is a critical factor, and is largely out of our control. At the culmination of these arduous cycles is the ET, a simple yet crucial step. A limited number of studies have addressed the technical aspects of an ET that may affect outcome [2].

US-guided ET clearly improves clinical outcomes and helps to identify events that may affect success, such as abutment of the catheter on the fundal wall or embedding beneath the endometrial surface [24]. US guidance provides confirmation of ET catheter placement, ultimately resulting in increased rates of both implantation and clinical pregnancy [16]. Others have described a higher pregnancy rate when embryos are placed at 5 cm from the external os [29] and, conversely, a higher incidence of ectopic pregnancy when the fundus was touched or embryos were placed <5 mm from the fundus [30]. Moreover, compared with catheters with softer tips, stiff catheters and those with a rigid outer sheath, although enabling easier placement, are more injurious to the endometrium by inducing bleeding and contractions [10].

Blood on the ET catheter tip, suggestive of trauma, is associated with lower implantation and pregnancy rates [31]. Mucous plugging has been associated with a higher incidence of retained embryos, possible embryo damage, and improper placement [6]. In addition, cervical mucus may be a source of contamination, and positive cultures have been associated with worsened outcome [7].

TTs are critical to map the direction of the cervix and uterus, minimizing the risk of unexpected difficulties during ET. A randomized controlled trial of TT vs no TT showed not only a reduced incidence of difficult transfers during ET but also improved implantation and pregnancy rates [12]. Moreover, identification of patients with cervical stenosis enables this problem to be addressed before an IVF cycle. Avoiding use of a trauma-producing catheter system at ET is highly desirable and more than likely improves clinical outcomes.

The present study included a group of patients with a difficult TT and examined the effects of ET catheters on the endometrial surface via direct hysteroscopic visualization. Despite the use of US guidance, all ET catheter types caused some damage to the endometrial surface. Although the significance of these lesions is not entirely known, concerns include placement of the embryos on damaged endometrium, subendometrial placement, plunging the end of the ET catheter with tissue or blood, and inducing uterine contractions. The Wallace catheter caused the least trauma, likely because of its soft tip; however, it caused petechial irritation. Although the exact clinical significance of this is not known, it may negatively affect the success of the ET by depositing the embryo(s) on a compromised surface. The Echoglas Patton catheter produced the most trauma.

Another concern is that improper catheter placement (<5 mm from the fundus) occurred despite the use of US guidance. Particular attention to the appropriate depth as measured at the TT is imperative. Although US-guided ET provides reassurance about the final placement of the embryos, specific attention to the position of the catheter tip is critical because the difference of even a few millimeters can mean tubal cannulation or redirection toward the cervical canal.

This study is the first of its kind to use the combination of US guidance and direct hysteroscopic visualization to examine the effects of ET catheters in a population of patients with known difficult TT. The number of cases studied was small, and findings may be generalizable only to those patients with a difficult TT and not to the greater IVF patient population. Other variables that cannot be accounted for include the second operator holding the ET catheter as the hysteroscope was advanced, during which slight movements of the catheter could have attributed to the findings. Future studies could be considered to examine a more heterogeneous group of patients and to determine the significance of these lesions.

In conclusion, ET is a critical component in the success of IVF-ET. These hysteroscopic views suggest that although US-guided ET is simple, reassuring, and may substantially improve pregnancy outcomes [16,24], the catheter tip in relation to the fundus, as well as the type of catheter used may be important elements in the transfer technique and may potentially cause endometrial damage. Correction of cervical disease before ET should not be overlooked and may minimize these effects.

References


