Refinements in the methodology of injection for transvaginal gamete intra-Fallopian transfer

Robert Woolcott1,2,3, James Stanger1, Robert Cohen2 and Sherman Silber3

1Lingard Fertility Centre, Newcastle, NSW 2291, Australia and
2St Lukes Hospital, St Louis, Missouri, USA
3To whom correspondence should be addressed

Eighty-seven volunteer patients with non-tubal infertility initially intending to undergo gamete intra-Fallopian tube transfer (GIFT) via a transabdominal route were re-scheduled for ultrasound-guided transvaginal GIFT which was performed using a Jansen-Anderson tubal transfer set. Emphasis was placed on (i) definite ultrasound confirmation of the transfer catheter within the Fallopian tube, (ii) low transfer volumes (50 µl), (iii) high sperm transfer densities and (iv) slow injection of gametes. Transvaginal Fallopian tube catheterization was possible in 83 patients (95.4%). Twenty-three of 83 (27.7%) patients conceived (clinical pregnancy). The viable ongoing pregnancy rate was 20.5%. These results compare favourably to those previously reported for both transvaginal and transabdominal GIFT. This study suggested that the fluid dynamics of gamete injection following transvaginal Fallopian tube catheterization are different to those following transabdominal methods. Further study is necessary to define the optimal methodology for transvaginal GIFT and to enhance the ability of the procedure to produce pregnancy rates comparable to transabdominal GIFT.

Key words: injection methodology/transvaginal GIFT

Introduction

Since the initial reports of pregnancy as a result of ultrasound-guided transcervical Fallopian tube catheterization for embryo transfer and gamete intra-Fallopian transfer (GIFT) by Jansen and Anderson (1987) (see also Jansen et al., 1988), there has not been wide acceptance of this technique as a method of treating non-tubal infertility. The potential benefits to patients undergoing GIFT via a non-surgical approach to the Fallopian tube, including the ability to avoid the potential morbidity of general anaesthesia and the absence of post-incisional pain, are substantial (Bustillo et al., 1988; Bustillo and Schulman, 1989; Strowizki et al., 1993). However, the technical difficulties of transvaginal tubal catheterization and lower than expected pregnancy rates (Hurst et al., 1993; Lucena et al., 1990; Jansen and Anderson, 1993) have limited the acceptance of transvaginal gamete intra-Fallopian transfer (TV-GIFT). In addition debate continues around the relative merits of all forms of GIFT compared to in-vitro fertilization–embryo transfer (IVF–ET). Despite the absence of large prospective randomized controlled studies demonstrating differences in pregnancy rates between GIFT and IVF–ET, GIFT remains a commonly used technique. Indeed the 1991 World Collaborative Report on In Vitro Fertilization and Alternative Assisted Reproduction (Cohen et al., 1993) reported 11 793 GIFT transfer cycles with a pregnancy rate of 29.3% compared to 99 314 IVF–ET transfer cycles with a pregnancy rate of 17.9%. Thus refinements in TV-GIFT to provide consistent attainment of pregnancy rates similar to transabdominal GIFT provide a strong argument to use this treatment preferentially for patients with non-tubal infertility. In this study we report that attention to the differing fluid dynamics of injection of gametes at TV-GIFT may improve pregnancy rates to a level which equates to those of transabdominal GIFT.

Materials and methods

Patients

Eighty-seven volunteer women, intending to undergo GIFT via an abdominal approach, were instead scheduled for TV-GIFT. TV-GIFT was performed in 83 patients. Their ages ranged from 25 to 45 with a mean of 35.8 years. The duration of infertility varied between 2 and 10 years with a mean of 4.6 years. Most had undergone a variety of treatments for infertility in the past, utilizing both IVF–ET and GIFT, 34 were undergoing GIFT for the first time. As a dominant cause of their infertility, 29 had endometriosis, 25 had a male factor with semen parameters below World Health Organization standards (>20 million sperm/ml, >50% motility, >40% normal morphology), five had premature ovarian failure and the remainder had unexplained infertility.

Methods

Each patient underwent controlled ovarian stimulation with the gonadotrophin releasing hormone analogue, leuproyelin (short regimen) and human menopausal gonadotrophin (HMG). Human chorionic gonadotrophin (HCG) was given 36 h prior to oocyte collection. Luteal phase support was provided by either i.m. or oral micronized progesterone. Ultrasound-guided transvaginal follicle aspiration was performed with a mean of 14.3 oocytes being retrieved.

A concentrated sperm preparation was obtained utilizing Percoll gradients and a swim-up technique. The transfer catheter was loaded with a mean of 3.75 oocytes and 1.4 million sperm, the sperm/oocyte ratio being intentionally higher than that used for abdominal GIFT. Sperm solution (15–20 µl), followed by oocytes, and a further 10–20 µl of sperm were drawn into the
transferring a catheter to a maximum of 50 µl. 5 µl of air was situated at either end of the gamete mixture.

Following follicle aspiration a speculum was passed and the vagina and external cervical os were carefully cleaned of blood and mucus. A Jansen—Anderson tubal transfer cannula (Model K-JITS 2000, William Cook Australia, Brisbane, Australia or Model K-JITS 59797 William Cook OB/GYN, Spencer, IN, USA) was then passed through the cervix and rotated laterally to approach the uterine aspect of a Fallopian tube. The K-JITS 2000 model was used as first choice due to particular physical properties indicated in our discussion below. The position of the cannula tip was confirmed by ultrasound. If an inaccurate placement was noted the procedure was repeated to approach the contralateral tube. If the K-JITS 2000 model could not be accurately placed after a single attempt at either tubal ostium then the K-JITS 59797 model was used with a single attempt at each tubal ostium. The K-JITS 59797 model was used on three occasions. Correct positioning of the cannula was essential and if not obtained the procedure was abandoned at that point and an abdominal GIFT performed. A 3/2 French unloaded transfer catheter was then passed into the Fallopian tube under direct ultrasound visualization. If this trial catheter was seen to pass freely into the tube it was withdrawn and immediately a loaded transfer catheter was then passed under ultrasound visualization into the tube.

The gametes were then injected under direct ultrasound visualization at an extremely slow rate. Fifty to 60 s were taken for the injection. It was possible in every case to see turbulence associated with the initial and/or terminal 5 µl of air passing into the Fallopian tube by ultrasound observation. This observation served as confirmation of tubal placement of gametes. It is our contention that a very slow injection of gametes is critical to the success of TV-GIFT.

Results

It was possible to catheterize a Fallopian tube in 83 out of 87 (95.4%) patients. Twenty-three patients achieved clinical pregnancies (27.7%) and an additional two patients had evidence of a biochemical pregnancy. Five patients had multiple pregnancies. Six patients (26.1%) had a spontaneous miscarriage. Seventeen patients (20.5%) had a viable ongoing pregnancy with 19 viable fetuses. There were no ectopic pregnancies. One of the three patients in whom TV-GIFT was attempted but was not technically possible also conceived utilizing transabdominal GIFT immediately following the aborted tubal catheterization.

Pregnancy rates for subgroups determined by the dominant cause of infertility were: endometriosis, 27.6% (8/29), male factor, 20.0% (5/25), premature ovarian failure, 40.0% (2/5), idiopathic, 33.3% (8/24).

The only identifiable complication was that of a urinary tract infection in one patient, presumably related to urinary catheterization prior to oocyte collection. In particular there was no suggestion of pelvic infection nor inflammation.

Discussion

It is our view that the most important aspect of obtaining pregnancy rates comparable to transabdominal GIFT when utilizing TV-GIFT relates to the differing physics of depositing gametes into the Fallopian tube. We contend that intrinsically TV-GIFT is no less likely to achieve pregnancy provided that the operators understand the different technical features necessary to transfer gametes in appropriate concentrations to a localized area within the tube.

Essential to the understanding of retrograde tubal gamete or embryo deposition is the physics of fluid flow within a cylinder. Provided that a constant force is applied the flow rate is inversely proportionate to the fourth power of the radius. The necessity to utilize small diameter 2 French (0.54 mm inner diameter) transfer catheters in order toatraumatically catheterize the Fallopian tube increases the velocity of ejection when compared to transabdominal GIFT catheters. Consideration of this information is necessary to avoid wide dispersion of gametes along the tube and a risk of transperitoneal gamete injection with consequent reduction in the prospects for pregnancy.

Anderson and Jansen have suggested that both low transfer volumes and catheter placement may be of importance when performing TV-GIFT. Previous radiological studies carried out by them (Jansen and Anderson, 1990) have indicated that peritoneal spill of radio-opaque dye injected after transcervical Fallopian tube catheterization can occur rapidly when as little as 60 µl is injected. Our observations suggest that rate of injection is of greater importance. There is likely to be an interaction between volume and rate of injection in determining the likelihood of transperitoneal migration. During clinical observation we have identified very rapid transit of turbulence along the Fallopian tube towards the fimbrial end when injection rates of 15 s have been utilized to inject 50 µl of gametes. The results of the present study suggest that slowing the rate of injection may have a beneficial effect by minimizing gamete dispersion and avoiding extratubal (intraperitoneal) spill of gametes. We have therefore initiated further study of the fluid dynamics of injection into the Fallopian tube from the vagina (Woolcott and Stanger, 1994) which indicates that a much slower injection rate of 12.5 µl per min is appropriate.

The number of spermatozoa transferred during this series of TV-GIFT procedures was substantially greater than that usually reported in association with transabdominal GIFT. Patients categorized as having male factor infertility in this study suffered from mild to moderate oligozoosperma or asthenozoosperma as more severe abnormalities precluded the transfer of a minimum of at least 100,000 spermatozoa and were not treated with GIFT. The aim of increasing the sperm transfer number was simply to counteract the potential wide dispersion of gametes along the tube during TV-GIFT and thus allow appropriate concentrations of sperm to be maintained in proximity to oocytes. There may be a relationship between sperm transfer densities and injection rate whereby faster injection rates may be acceptable when sperm transfer densities are increased. Further study is needed to clarify this relationship.

Reports relating to TV-GIFT have generally concentrated on issues relating to the technical aspects of tubal catheterization (Jansen and Anderson, 1990; Strowitzki et al., 1993; Hurst et al., 1993). With appropriate ultrasound expertise and a practised approach to placement of the outer guiding cannula adjacent to the uterine Fallopian tube orifice, we have found it relatively easy.
to consistently catheterize at least one Fallopian tube. Some difficulties do arise which relate to the physical properties of the outer guiding cannula. The K-JITS 2000 model of the Jansen—Anderson tubal transfer set has an outer cannula made of Teflon. It has the advantage of being soft, pliable and when subjected to the heat of the intra-uterine environment moulds rapidly to the normal angle of approach to the Fallopian tube making tubal catheterization relatively simple. However, this model does have the disadvantage of the operator not being able to apply sufficient torque to enable easy fine adjustment of position of the cannula tip should this be necessary to allow tubal catheterization. The K-JITS 57987 model is made of polyethylene and is slightly firmer than the K-JITS 2000, which allows the operator to adjust its position within the uterine cavity. The K-JITS 57987 model does not readily mould to the normal anatomical approach to the tubal ostia, which can on occasions lead to the course of the transfer catheter not being perfectly parallel to the tubal lumen. This may lead to the transfer catheter abutting the lateral edge of the intramural portion of the Fallopian tube and thus not allowing its free passage to the isthmus.

There is a need to establish the optimal physics of the retrograde injection into the Fallopian tube in order to maximize concentration and minimize the risk of peritoneal passage of gametes. It is inappropriate to assume that the methods of gamete injection used during transabdominal GIFT procedures can be simply applied to the transvaginal route. Little attention has been given to the physics of injection of gametes during GIFT procedures or of intra-uterine embryo transfer. Given that all aspects of assisted reproduction have the fluid dynamics of flow within cylindrical tubes as one of the common variables, it is important that we turn out attention to this potentially significant component of our management.

Conclusions

Pregnancy rates from TV-GIFT comparable to transabdominal GIFT can be obtained provided that appropriate emphasis is placed on four factors: definite ultrasound confirmation of transfer catheter within the Fallopian tube; low transfer volume (50 μl); high sperm transfer densities; and, most importantly, extremely slow injection of gametes. Studies of the fluid dynamics of retrograde injection into the Fallopian tube are necessary in order to accurately define the optimal methodology for this technique, and thereafter TV-GIFT should be re-evaluated.

References


Received on January 13, 1994; accepted on April 19, 1994.