Gestational carrier pregnancy

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Objective: To evaluate the results of a gestational carrier program in terms of pregnancy rates in fresh and cryopreserved cycles.

Design: Retrospective analysis.

Setting: Private IVF program.

Patient(s): Women with uterine or medical reasons for unsuccessful gestation.

Intervention(s): In vitro fertilization of oocytes with fresh or cryopreserved ET to gestational carriers.

Main Outcome Measure(s): Pregnancy rates and deliveries.

Result(s): A PR of 56.3% and a cycle rate of 30.8% was achieved in each patient <40 years of age in 117 cycles of fresh or cryopreserved ET. There were no pregnancies for nine patients >40 years of age in 27 cycles.

Conclusion(s): Carrier gestation offers a satisfactory solution to childlessness caused by uterine or major medical factors.


Key Words: Carrier gestation, gestational surrogate pregnancy

Gestational carrier pregnancy, to be distinguished from surrogate pregnancy (1), allows women without a functioning uterus or those whose pregnancy would greatly worsen a preexisting medical problem to raise their genetic child. Described first by Utian’s group (2, 3), the procedure engendered moral, ethical, and legal controversy and has not received as wide an acceptance as egg donor-recipient pregnancy. Administration of this type of program demands considerable input and communication between psychologist, reproductive endocrinologist, obstetrician, and lawyer.

The relationship between the genetic mother and carrier is rarely anonymous, as is usually the case with egg donation; the carrier’s children, if old enough, must be given explanations; the carrier’s husband must be supportive, and the birth certificate issue among others must be solved. Not surprisingly, few programs offer this service. In this report we detail clinical results and describe the psychologic and medical screening used.

MATERIALS AND METHODS

Between March 1, 1988, and March 1, 1997, 75 couples were accepted into an Institutional Review Board-approved gestational carrier program. Eleven of the enrolled couples had already obtained cryopreserved embryos in other IVF programs that did not offer gestational carrier service. Some couples had already identified a known gestational carrier candidate; others relied on candidates who answered advertisements or who volunteered by direct referral from other carriers. After a telephone informational session and/or receiving a program packet, prospective carriers were invited to attend a bimonthly support group during which procedures and issues were discussed. Those who continued to manifest interest were interviewed by a clinical nurse coordinator, a psychologist, and a physician.

Candidates underwent standardized psychologic testing with use of an objective measure for major psychopathology (the Minnesota Multiphasic Personality Inventory-2 or the Personality Assessment Inventory), the Dyadic Adjustment Scale, Sentence Completion, Life
Events Checklist, and the Pennsylvania Reproductive Associates Infertility Survey (PRAIS) (4). Each candidate was discussed at the IVF team meeting at which a decision was made for inclusion or exclusion, with close attention paid to family history as well as medical history and obstetric performance.

Gestational carrier volunteers had to meet the following inclusion criteria: [1] be over age 21 and under age 41; [2] be a free and willing paid volunteer with complete informed consent; [3] have no active sexually transmitted diseases, cancer, substance abuse, significant medication use, and/or prior chemotherapy or radiation therapy; [4] demonstrate normal fertility in the past; [5] have no repetitive medical or psychiatric complication related to their obstetric history; [6] have a lifestyle that would not compromise the potential for normal growth and development of the fetus; [7] be fully capable of handling the emotional and time stresses involved in the pregnancy, the relationship with the genetic parents, and those added stresses of being a gestational carrier (e.g., separating and surrendering the baby at birth); and [8] be capable of fully understanding and complying with the contractual agreement between herself and the infertile couple.

After acceptance, carriers were asked to select a genetic parent couple with whom they thought they could work and explore building a collaborative relationship. The program psychologist presented couples based on the length of time on the waiting list and gave demographic attributes and choices on basic issues, such as desire to have prenatal testing or willingness to terminate a pregnancy. If a suitable match were made and the parties assessed themselves to be compatible, continued evaluation and counseling by the psychologist was performed throughout and after the pregnancy. Genetic parents and gestational carriers each chose an attorney interested in this area of reproductive law, and the contract between the parties was completed before treatment could begin.

Laboratory screening of both women included serum testing for syphilis; gonorrhea; Chlamydia trachomatis; cytomegalic inclusion virus; human immunodeficiency virus; as well as hepatitis A, B, and later C. In addition, screening for toxoplasmosis was performed where applicable. Genetic fathers were screened also. The carrier underwent additional obstetric screening for rubella, rubeola, varicella, and ABO-Rh type. The parents had specific ethnic screens (e.g., for Tay-Sachs disease, thalassemia, and sickle cell presence) where applicable. Most carriers agreed to chorionic villus biopsy or amniocentesis if the mother was >35 years old.

In a few cases both carrier and parents agreed not to interrupt the pregnancy if chromosomal findings were abnormal, but in all the other cases both agreed to interrupt the pregnancy under those circumstances. Other issues that were discussed included possible embryo reduction for pregnancy in excess of twins, the need for cesarean section, and the need for special testing throughout the pregnancy.

Most of the mothers had no menses; therefore, endocrine screening directed toward ovarian function was performed on a weekly basis with estradiol and progesterone serum sampling, augmented with basal body temperature (BBT) charts, urinary LH testing at home, pelvic ultrasonography, and clomiphene citrate (CC) challenge testing according to the BBT pattern or after medroxyprogesterone acetate administration. A “test” cycle in the recipient was not performed routinely with respect to endocrine testing or endometrial biopsy.

The most common causes of infertility that led to a carrier gestation attempt were diethylstilbestrol (DES) (n = 11), the Rokitansky syndrome of vaginal-uterine agenesis (n = 10), and prior hysterectomy (n = 29); infertility was due to postpartum hemorrhage or accreta in 12 cases and uterine-cervical cancer in 10 cases. The other patients had various indications, including systemic lupus erythematosus (SLE), severe diabetes, congenital heart disease, recurrent pregnancy loss and recurrent hemolysis, elevated liver enzymes, and low platelets during pregnancy (HELLP) syndrome.

Stimulation and Synchronization

Early experience with attempts to have the mother and carrier synchronized with the former stimulated for oocyte retrieval and the latter in a natural menstrual cycle produced four cancellations of ET in 14 cycles; therefore, all other cycles were performed within the context of the carrier down-regulated with nafarelin acetate or leuprolide acetate and then given exogenous estrogen and progesterone in modulated doses according to the progress of the mother’s stimulation cycle. Carriers who had not been sterilized or whose husband had not been sterilized were required to abstain from coitus in natural cycles.

Genetic mothers had a long protocol of down-regulation and stimulation with urinary gonadotropins and/or urinary FSH in a standard fashion with doses decided initially by age, and later in the cycle, by estradiol levels and ultrasonography. Ovulation was induced with 10,000 U of hCG when follicular size, number, and estradiol levels were satisfactory, with a usual minimum of three follicles in excess of 17 mm in diameter and an estradiol level of >1,000 pg/mL.

Carriers received estradiol by transdermal patch or as oral micronized estrogen tablets (2 mg each). Progesterone was given as oral micronized progesterone, progesterone suppositories, or progesterone in oil intramuscular injection. An attempt was made to keep estradiol luteal levels in the range of that of a normal pregnant cycle. Progesterone levels were monitored at 5- to 7-day intervals, and a pregnancy test was first performed at 12 days after oocyte retrieval.

Oocyte Pick-up

Oocyte retrieval was performed by transvaginal, transvesical, and transabdominal ultrasonic guided methods, as well as laparoscopic approaches, according to the patient’s anatomy. Generally speaking, the transvaginal approach was...
suitable for patients with a surgical correction of vaginal agenesis but was not suitable for those who had created a vaginal pouch with dilatation-pressure techniques. Oocytes of patients whose ovaries had been surgically elevated and laterally displaced after hysterectomy or central pelvic irradiation were best retrieved via laparoscopy.

### Embryo Replacement

Embryos were inserted into the carrier uterus at 48 hours after retrieval early in the program and at 72 hours later on an idealized cycle day of 17 ± 1 (SD) if the endometrium was at least 9-mm thick on ultrasound measurement at the time of hCG administration. Estrogen supplements were decreased as rising serum values suggested placental function, but progesterone supplements usually extended to about the 70th day of pregnancy after retrieval.

Obstetric care was given by physicians who had been interviewed by the gestational carrier and genetic parents and whom they assessed to be sympathetic to this process.

### RESULTS

The population of genetic mothers included 75 women, 11 of whom came from other programs with cryopreserved embryos. All embryos of two patients were cryopreserved without a fresh transfer in consideration of their age while awaiting a suitable carrier. Genetic mothers ranged from 27 through 44 years, with a mean age (± SD) of 34.6 ± 5.9 years.

There were 37 established pregnancies for 36 genetic mothers over 120 cycles of fresh and 24 frozen cycles of embryo replacement to a carrier, for a 49.3% success rate per couple. None of the nine patients >40 were successful in 26 cycles of fresh and 1 cycle of frozen ET. For the 64 patients <40 years of age who underwent egg retrieval and replacement, a pregnancy rate (PR) of 56.3% was achieved with a cycle rate of 30.8%. The implantation rate for fresh transfer cycles was 0.13 with a mean of 2.5 embryos transferred compared with 0.26 and 2.7, respectively, for thawed transfers.

There were 24 term deliveries, three premature births, one immature delivery, one spontaneous abortion, and one therapeutic abortion because of abnormal chromosomal complement. Seven pregnancies are currently ongoing, and one of these has been diagnosed as XO/XX mosaic. There were six sets of twins, with two accounting for two of the three premature deliveries. One of these twin gestations represented selective reduction of triplets to twins.

Table 1 shows conception by cycle. Small sample size precluded analysis of rate by cycle. Six of the 11 patients who came to us with previously cryopreserved embryos conceived. Table 2 documents the conception rate according to the number of embryos replaced. Generally speaking, the number was decided by availability, genetic mother’s age, and the degree to which the carrier was willing to carry a multiple pregnancy. Table 3 details some of the clinical data from the three main groups of genetic mothers—women whose mothers took DES, women with Rokitansky syndrome, and women who had undergone hysterectomy. No significant differences were noted.

Thirty-seven genetic mothers previously had become pregnant, and 19 were delivered of an infant. All but two of the carriers had delivery at least once. Exceptions were made in these two cases because the carriers were relatives.

There were two complications of oocyte retrieval in this group. One was an inadvertent enterostomy made during a laparoscopic trocar insertion in a patient with prior abdominal surgeries, including a hysterectomy. This was instantly recognized and repaired without further sequelae. The other problem occurred in a patient who was receiving chronic warfarin for congenital heart disease requiring artificial heart valves. She was switched to heparin, the heparin reversed, and oocyte retrieval was performed without incident. Because the heparin-coumadin switch was made in the reverse

### Table 1

**Conception by cycle.**

<table>
<thead>
<tr>
<th>Cycle no.</th>
<th>Embryo transfer</th>
<th>Patient no.</th>
<th>No. of conceptions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fresh</td>
<td>58</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Cryopreserved</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Fresh</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Cryopreserved</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Fresh</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cryopreserved</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Fresh</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Fresh</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

* Thirty-six women conceived (1 conceived twice).

### Table 2

**Conception rate by embryos replaced.**

<table>
<thead>
<tr>
<th>No. of embryos replaced</th>
<th>No. of cycles</th>
<th>No. of pregnancies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fresh ET</td>
<td>Frozen ET</td>
</tr>
<tr>
<td>1</td>
<td>33</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>39</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>4*</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>24</td>
</tr>
</tbody>
</table>

* Twin gestation.
† Triplet gestation selectively reduced to twins.
direction, she became overanticoagulated with resultant bleeding from a corpus luteum cyst resulting in a hemoglobin drop to 8 g. Coagulation parameters were corrected carefully, and no operative intervention or transfusion was necessary.

**DISCUSSION**

Utian et al. (3) described seven pregnancies achieved after 31 transfers of oocytes from genetic mothers to gestational carriers. They also made some recommendations designed to standardize and facilitate the entire process. In general we have followed these recommendations, except that we provide the fertility services as well as recruit and screen the prospective carriers. One reason for this difference is confidence in our screening process compared with an external agency. Financial arrangements, if any, were determined by the parties and their legal consultants.

Recruitment developed in direct response to the increasing demand by prospective genetic parents who had no available volunteer gestational carrier. Psychologic screening was designed to detect the presence of any current major psychopathology, and psychologic counseling was introduced to educate all parties about the stresses and demands of the program. Specific attention is given to the intense dynamics of the relationship among all these parties, i.e., genetic parents, gestational carrier, carrier’s partner, and carrier’s children. Anticipating and negotiating these relationship issues mitigates future problems. This psychologic screening and continued contact with mother and carrier is a major factor in ensuring a successful outcome on a global basis.

Marrs et al. (5) described 45 couples who had 81 cycles of ET to a carrier. A clinical pregnancy was obtained in 19, with 15 deliveries. Thus, one-third of the couples was successful. The mean age of the mothers was 38.8 years, and both zygote, tubal transfer, and uterine ET were used without a difference in PRs being noted. An average of 3.4 embryos were transferred, compared with our average of 2.5 per transfer.

Meniru and Croft (6) reported results of carrier gestation in 16 cases in which hysterectomy had been performed. A total of 11 patients completed 16 cycles of embryo replacement with six pregnancies occurring, but two miscarried. In our study, carrier conceptions occurred for 5 of 11 patients with Rokitansky syndrome, 4 of 10 patients who took DES, and 12 of 29 patients who underwent hysterectomy (1 twice).

The series of carrier gestations reported by Serafini et al. (7) covered 91 prospective genetic parenting mothers <39 years of age and 35 mothers >40 years of age. The younger women had greater numbers of oocytes retrieved, but the average numbers of fresh embryos transferred were similar, with 3.7 for the younger group versus 3.4 for the older. Our mean number of transferred embryos was significantly lower at 2.5 for fresh cycles and 2.7 for frozen-thawed cycles, reflecting our concern with high-order multiple pregnancies, especially in a carrier population. Serafini’s group reported 55 ongoing pregnancies, 14 spontaneous abortions, and 67 nonpregnant women in the 136 retrieval cycles for women <40, in which there were 121 fresh and 46 thawed cycles of embryo transfer. This compares with 34 delivered or ongoing pregnancies, one immature delivery, and two abortions in 94 fresh and 23 thawed embryo replacement cycles in women <40 years of age in our study.

Failure to achieve pregnancy in 26 fresh cycles and 1 frozen thawed cycle replacement of embryos generated by women ≥40 years of age was disappointing but not surprising, given the importance of oocyte quality versus the seemingly wider latitude of endometrial environment.

The increased implantation rate of thawed embryos compared with freshly transferred embryos was surprising. In most cases, no fresh transfer had been performed; therefore, the usual selection process of transferring the best appearing or most rapidly dividing embryos was not operative.

We could not discern any difference in stimulation pattern, number of oocytes retrieved, number of oocytes fertilized, or number of embryos replaced according to diagnosis. These data are presented in Table 3. Specifically, our fear that hysterectomy, sometimes performed for malignant disease, might have compromised ovarian blood flow and follicular development seems to be unfounded. Egg retrieval was sometimes difficult because of anatomical changes brought about by surgery, radiation, or by congenital factors, especially with vaginal agenesis (8). Retrievals were performed according to perusal of previous operative notes and

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**TABLE 3**

Clinical parameters of genetic mothers’ gestational carrier cycles.

<table>
<thead>
<tr>
<th>Patient diagnosis</th>
<th>Mean age (±1 SD)</th>
<th>Mean (±1 SD)</th>
<th>Mean (±1 SD)</th>
<th>Mean (±1 SD)</th>
<th>Implantation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>of genetic mother</td>
<td>no. of eggs</td>
<td>no. of eggs fertilized</td>
<td>no. of embryos transferred</td>
<td></td>
</tr>
<tr>
<td>DES</td>
<td>37.4 ± 3.0</td>
<td>7.2 ± 4.4</td>
<td>2.2 ± 1.5</td>
<td>2.2 ± 1.2</td>
<td>0.17</td>
</tr>
<tr>
<td>Rokitansky syndrome</td>
<td>33.2 ± 7.2</td>
<td>8.2 ± 5.7</td>
<td>4.2 ± 2.7</td>
<td>3.3 ± 1.1</td>
<td>0.07</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>36.2 ± 3.9</td>
<td>10.1 ± 21.0</td>
<td>5.8 ± 14.7</td>
<td>3.7 ± 1.4</td>
<td>0.15</td>
</tr>
</tbody>
</table>

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a measurement by ultrasound of the distance from the top of
the vagina to the ovary. Attention also was paid to interven-
ing structures that were not motile on ultrasound.

Running a carrier program places a great deal of stress on
the medical team because of the menstrual cycle synchroni-
zation factor and the need to keep the two parties in emo-
tional cadence as well. We have found that having one nurse
and one or two physicians on the team who are involved with
this complex process on a day-to-day basis greatly facilitates
the administration of the program.

Six of 11 patients with cryopreserved embryos from other
programs conceived (all in the first cycle) on thaw and
transfer. We have encouraged couples who desire carrier
gestation and who have no available carrier program in their
immediate geographic area to have egg collection, fertiliza-
tion, and retrieval locally and to have embryos cryopreserved
that will be shipped subsequently to our laboratory. If this
continues to be a satisfactory protocol with respect to PRs,
regional centers willing to provide and monitor carrier ges-
tations would become a valid concept. At the same time it
should be noted that one of our successful cases occurred
with embryos that were frozen and transferred from Austra-
lia, where carrier gestation is not permitted.

The issue of gestational carrier laying claim to the child has
been addressed already, successfully, in favor of the genetic
parents (9), although in some states the genetic parents have no
legal rights. Even with stringent screening and attention to
detail, these medicolegal catastrophes may occur; however, the
emotional reward to parents, carriers, their respective families,
and the IVF team makes gestational carrier pregnancy worth the
effort.

References

1. English ME, Mechanick-Braverman A, Corson SL. Semantics and
science: the distinction between gestational carrier and traditional sur-
2. Utian WH, Sheean L, Goldfarb JM, Kiwi R. Successful pregnancy after
in vitro fertilization and embryo transfer from an infertile woman to a
Preliminary experience with in vitro fertilization-surrogate gestational
4. Braverman AM, Corson SL. Characteristics of participants in a gesta-
5. Marrs RP, Ringler GE, Vargyas JM, Stone BA. The use of surrogate
gestational carriers for assisted reproductive technologies. Am J Obstet
Gynecol 1993;168:1858–63.
6. Meniru GI, Craft IL. Experience with gestational surrogacy as a treat-
ment for sterility resulting from hysterectomy. Hum Reprod 1997;12:
51–4.
7. Serafini P, Tran C, Richardson A, Norbryhn G, Nelson J, Tan T,
Batzofin J. In vitro fertilization surrogacy. Assist Reprod Rev 1994;4:
155–61.
8. Batzer FR, Corson SL, Gocial B, Daly DC, Go K, English ME. Genetic
offspring in patient with vaginal agenesis: specific medical and legal