Embryo disposition: choices made by patients and donor oocyte recipients

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Objective: To compare final embryo disposition between patients and donor oocyte recipients.

Design: Retrospective study.

Setting: Private infertility practice.

Patient(s): Patients undergoing IVF with embryo cryopreservation.

Intervention(s): None.

Main Outcome Measure(s): Final cryopreserved embryo disposition.

Result(s): A total of 1,262 patients using autologous oocytes had 5,417 embryos cryopreserved. A majority either used their embryos (39%) or continued storage (35%). Of 364 patients, who did not use their remaining 1,406 embryos, 77 (21%) donated 290 embryos to other infertile couples, 41 (11%) donated 160 embryos for research, and 246 (68%) discarded 956 embryos. Concurrently, 272 donor oocyte recipients had 1,233 embryos cryopreserved. A majority either used their embryos (40%) or continued storage (23%). Of 110 recipients that did not use their remaining 455 embryos, 62 (56%) donated 280 embryos to other infertile couples, 6 (6%) donated 31 embryos for research, and 42 (38%) discarded 144 embryos.

Conclusion(s): In our patient population, a higher proportion of patients with infertility ultimately used or stored their cryopreserved embryos for future reproduction compared with donor oocyte recipients. However, recipients were much more likely to donate to other infertile couples and less likely to discard their remaining embryos compared with patients. (Fertil Steril 2011;95:940–3. ©2011 by American Society for Reproductive Medicine.)

Key Words: Embryo donation, embryo disposition, embryo cryopreservation

Cryopreservation of embryos represents a major advance in assisted reproduction. With progress in ovarian hyperstimulation protocols and laboratory techniques for embryo culture along with a desire to transfer fewer embryos and avoid high order multiple gestations, more embryos are currently available for cryopreservation. The availability of cryopreserved embryos allows patients the opportunities for pregnancy without having to undergo an additional ovarian hyperstimulation cycle and oocyte retrieval with their attendant risks. However, this advance is associated with ethical dilemmas regarding disposition of the remaining embryos if the couple decides not to use them. Our program counsels patients before the IVF cycle regarding the options available for disposition of their cryopreserved embryos. Although all patients make these decisions before their IVF cycle with informed consent, they are required to complete a secondary consent before final disposition. This article examines our experience at Nashville Fertility Center with embryo donation. We chose to look at the decisions that couples made for final disposition of their remaining embryos and the outcome of the subsequent donation cycles.

MATERIALS AND METHODS

This was a retrospective study to examine all patients who participated in our embryo cryopreservation program between January 1, 1998 and December 31, 2008. A small number of patients who had their initial IVF cycle at another program and who shipped their embryos to our program were also included. During this time frame, patients signed a consent form and made decisions regarding disposition of their embryos for various circumstances that might occur in the future. These include:

1. Death, disability, or legal incapacity of the patient, the partner, or both.
2. Legal separation or divorce.
3. Decide not to use the stored embryos in an attempt to initiate pregnancy.
4. The patient reaches the upper age limit for participation in embryo transfer at Nashville Fertility Center (her 50th birthday).

The patients had four options that they could choose from for disposition of the cryopreserved embryos. The chosen option could be different for each of these situations.

1. Made available to the other spouse for control as to their use or disposition.
2. Made available to other couples for donation on an anonymous basis.
3. Discarded without further development or examination in a manner consistent with the disposal of other human tissue.
4. Made available for research in the interest of contributing to advances in science and medicine.

At the time of final disposition, the couples were required to complete, sign, and notarize a secondary consent. Patients who desired to donate their embryos in an open donation arrangement instead of anonymously were referred to an agency that arranges open donations. We examined the decisions made by patients for final disposition and compared any differences in these decisions made by patients using autologous oocytes and donor oocyte recipients. We did not examine this based on the use of donor sperm.

In our program, 45% of embryos in culture progress to the blastocyst stage and are either transferred or cryopreserved. Embryos are cryopreserved almost exclusively at the blastocyst stage on day 5 or 6 of culture for several reasons: [1] this enables us to select the best embryo(s) for transfer and cryopreserve other blastocysts; [2] fewer embryos are ultimately cryopreserved and stored compared with freezing at earlier stages such as pronuclear or cleavage stages; and [3] blastocysts have a high survival rate with more than 80% surviving cryopreservation and thawing.

All statistical comparisons were performed using either $\chi^2$ analysis or Fisher’s exact test where appropriate. $P<.05$ was considered statistically significant.
RESULTS

Autologous IVF Cycles

Between January 1, 1998 and December 31, 2008, 2,778 patients undergoing IVF with autologous oocytes had 17,623 untransferred embryos. Of this total, 1,242 patients (45%) had 5,350 blastocysts cryopreserved. An additional 20 patients had 67 cryopreserved embryos shipped to our program for their future use.

Seventy-four percent of these patients either used their cryopreserved embryos (39%) or kept them in storage for their own future use (35%). At the end of 2008, there were 1,856 embryos stored, 47 embryos had been shipped to other centers, and 2,108 embryos had been thawed for frozen embryo transfer (ET) cycle(s). There were 364 patients who did not use their remaining 1,406 embryos. Table 1 shows the disposition of these embryos. Seventy-seven patients (21%) donated 290 embryos to other infertile couples, 41 (11%) donated 160 embryos for research, and 246 (68%) discarded 956 embryos.

By the end of 2008, 93 of the 290 donated embryos remained in storage for anonymous donation. Forty-seven embryos (16%) were determined to be ineligible for donation due to either the donating couple’s refusal to complete Food and Drug Administration-mandated tissue donation screening and blood work, incomplete personal profile, or disease in the sibling offspring of the donated embryos; these embryos were discarded. The remaining 150 embryos were thawed for frozen ET into donor embryo recipients.

The outcomes of patient and donor embryo recipient frozen ET cycles are shown in Table 2. Patients using autologous embryos underwent 735 frozen ET cycles. Eighty-two percent of the embryos survived the thaw and were transferred resulting in the delivery of 327 infants and a delivery rate per transfer of 34%. Donor embryo recipients underwent 52 frozen ET cycles. Eighty-three percent of the embryos survived the thaw and were transferred resulting in the delivery of 34 infants and a delivery rate per transfer of 50%.

Donor Oocyte Recipient Cycles

During the same time period of January 1, 1998 and December 31, 2008, 404 recipients undergoing IVF with donor oocytes had 3,453 untransferred embryos. Of this total, 268 recipients (65%) had 1,209 blastocysts cryopreserved. Three additional recipients had 24 embryos shipped to our program for their own use.

Sixty-three percent of the available embryos were either used by the recipients (40%) or kept in storage for their own future use (23%). At the end of 2008, there were 318 embryos in storage for recipients’ own use, 11 embryos had been shipped to other centers, and 449 embryos had been thawed for recipients’ frozen ET cycles. There were 110 recipients who did not use their remaining 455 cryopreserved embryos. Table 3 shows the disposition of these embryos. Sixty-two recipients (56%) elected to donate their remaining 280 embryos to other infertile couples, 6 recipients (6%) elected to donate their remaining 31 embryos for stem cell research, and 42 recipients (38%) elected to discard their remaining 144 embryos.

By the end of 2008, 68 of the 280 donated embryos remained in storage for anonymous donation. Forty-seven embryos (16%) were determined to be ineligible for donation due to either the recipient’s partner’s refusal to complete Food and Drug Administration-mandated tissue donation screening and blood work, incomplete male profile, or disease in the sibling offspring of the donated embryos; these

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**TABLE 1**

Utilization of cryopreserved embryos originating from autologous oocytes.

<table>
<thead>
<tr>
<th>Patient’s own use</th>
<th>Not used by patient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Currently in storage</td>
</tr>
<tr>
<td>No. of patients&lt;sup&gt;a&lt;/sup&gt;</td>
<td>483 (34%)</td>
</tr>
<tr>
<td>No. of embryos</td>
<td>1,856</td>
</tr>
</tbody>
</table>

<sup>a</sup>Patients may appear in more than one group as some either used or stored their embryos and donated or discarded the remaining.


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**TABLE 2**

Results of frozen ET cycles using embryos originating from autologous oocytes.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Donor embryo recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>548</td>
</tr>
<tr>
<td>No. of frozen ET cycles</td>
<td>735</td>
</tr>
<tr>
<td>No. thawed</td>
<td>2,108 (Ave. 2.9/patient)</td>
</tr>
<tr>
<td>No. transferred</td>
<td>1,736 (Ave. 2.4/patient)</td>
</tr>
<tr>
<td>No. delivered</td>
<td>251 (34%)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>No. of infants</td>
<td>327</td>
</tr>
</tbody>
</table>

<sup>a</sup>P<.05, <sup>c</sup>x<sup>2</sup> analysis.

DISCUSSION

The transfer of donated embryos into other infertile couples has proven to be a very successful alternative for couples who have been unable to conceive with their own gametes, and has been shown in a multicenter study to be more cost-effective than oocyte donation (1). Keenan et al. (2) reported on 702 donated frozen ETs from four infertility clinics and three embryo donation agencies. These transfers resulted in 249 deliveries (35.5%) and an implantation rate of 19.9% and compare favorably with rates they reported for patients undergoing IVF with their own gametes (2). Our results are similar and support the concept that embryo donation is an excellent alternative for patients who have been unsuccessful in conceiving with their own gametes.

Although embryo donation eliminates the genetic contribution of both parents, the woman is still able to experience the pregnancy and delivery. The success rates in our embryo donation program vary from 42%–50% delivery rate per transfer depending on whether the source of the oocyte was an oocyte donor or a patient with infertility. The delivery rate is significantly higher than the rate seen when these embryos are transferred back into the infertile patient (34%, P<.05; χ² analysis), but not the original recipient of the donor oocytes (33%). It is possible that this difference is due in part to embryo selection. A larger proportion of donated embryos originate from successful IVF cycles in patients with infertility (86% of donated embryos) and donor oocyte recipients (83% of donated embryos). However, when donor embryo frozen ET cycle outcomes were compared using sibling embryos from successful IVF cycles versus sibling embryos from unsuccessful IVF cycles, there were no significant differences in delivery rates for either patient embryos (52% vs. 43%, P>.05; Fisher’s exact test) or donor oocyte recipient embryos (36% vs. 64%, P>.05; Fisher’s exact test). This suggests that another factor unrelated to the quality of the embryos is playing a part in the original patient’s infertility diagnosis.

In our patient population, a higher proportion of patients with infertility ultimately either use their cryopreserved embryos or keep them in storage for future reproduction compared with donor oocyte recipients (74% vs. 63%, P<.05; χ² analysis). The higher percentage of use by patients with infertility may be due to the higher delivery rate in donor oocyte recipients than patients with infertility. When comparing donor oocyte recipients and patients with infertility who had embryo cryopreservation in their fresh IVF cycle, we found that the delivery rate per transfer for donor oocyte recipients was slightly higher than for patients with infertility (63% vs. 56%, P>.05; χ² analysis), but this difference did not reach statistical significance. As would be expected, the average age of the patients with infertility who had embryo cryopreservation was significantly lower than the donor oocyte recipients average age in the study (32.3 vs. 39.7 years, P<.05; χ² analysis). Therefore, the older recipients

### TABLE 3

<table>
<thead>
<tr>
<th>Recipient’s own use</th>
<th>Not used by recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently in storage</td>
<td>Shipped to other facility</td>
</tr>
<tr>
<td>No. of recipientsᵃ</td>
<td>67 (22%)</td>
</tr>
<tr>
<td>No. of embryos</td>
<td>318</td>
</tr>
</tbody>
</table>

ᵃ Some recipients used some of their embryos and donated or discarded others.

### TABLE 4

<table>
<thead>
<tr>
<th>Donor oocyte recipients</th>
<th>Donor embryo recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>122</td>
</tr>
<tr>
<td>No. of frozen ET cycles</td>
<td>162</td>
</tr>
<tr>
<td>No. thawed</td>
<td>449 (Ave. 2.7/patient)</td>
</tr>
<tr>
<td>No. transferred</td>
<td>370 (Ave. 2.3/patient)</td>
</tr>
<tr>
<td>No. delivered</td>
<td>54 (33%)ᵃ</td>
</tr>
<tr>
<td>No. of infants</td>
<td>66</td>
</tr>
</tbody>
</table>

ᵃ Not statistically significant, χ² analysis.

may be less likely to keep their embryos in storage for their own use and return for additional frozen ET cycles than the younger patients with infertility, especially if they conceived during their fresh IVF cycle. In fact, only 46% of recipients of donor oocytes who delivered after their fresh cycle continued storage of their cryopreserved embryos and returned for one or more frozen ET cycles compared with 62% of patients with infertility ($P<.05$; $\chi^2$ analysis). However, there was no significant difference between the number of recipients and patients with infertility who continued embryo storage and returned for one or more frozen ET cycles in the group who did not deliver after their fresh IVF cycles (80% vs. 76%, $P>.05$; $\chi^2$ analysis).

Despite the fact that embryo donation remains successful, the major impediment seems to be the number of embryos that are made available for donation. Although the use of the cryopreserved embryos by the original couple is the desired outcome, reproductive donation of the couple’s remaining embryos would be the preferable option. McMahon and Saunders (3) examined attitudes of couples with stored frozen embryos toward conditional embryo donation. They found that only 22% of respondents were willing to consider the option and that only 4% of men and women surveyed would likely donate their embryos to another couple. Furthermore, they had no cases where both partners stated that donation was the likely outcome. A limitation of this study is that it was performed in Australia where couples are made aware that identifying information could be provided to the offspring on request at the age of 18 years. This certainly could limit couples willingness to consider embryo donation based on their view of this disclosure. These investigators concluded that policies giving donors more control over the fate of donated embryos might improve the acceptability of embryo donation.

In a study of patients who had completed disposition decisions for their frozen embryos, deLacey (4) discovered that the final decision for disposition was greatly influenced by the patients’ conceptualization of their embryos. She found that three major metaphorical foundations came to light through discussions with the participants about their decision to discard or donate frozen embryos. These were adoption, tissue donation, and pregnancy termination metaphors. She found that patients who became embryo donors were influenced in their decision to donate by their perception of embryo discard as a form of pregnancy termination and embryo donation as tissue donation. Conversely, patients who discarded embryos were influenced by their perception of embryo donation as a form of adoption, or giving their potential children away. She concluded that the patients’ final embryo disposition decision is shaped more by what

is abhorrent to them than by what is desirable in the options that are available to them, and their final decision is an avoidance of that least desirable option.

In a large multi-institutional survey of patients with embryos currently in storage, Lyerly et al. (5) sought to establish whether patients’ preferences for embryo disposition correlated with several defined factors. These were demographic characteristics, attitudinal factors, and views on the moral status of human embryos. They found that patients with no children or fewer children and those attributing a high moral status to embryos were more likely to use the embryos or store them for future reproduction. Those patients with embryos in storage for >5 years, those attributing low moral status to embryos, and those giving high importance to concerns about the embryo, future fetus, or child were more likely to discard the embryos or keep in storage indefinitely. Those patients more likely to donate for reproduction attributed a high moral status to embryos, or high importance to altruism.

Lanzendorf et al. (6) reviewed embryo disposition preferences of 149 couples discontinuing storage of their cryopreserved embryos. In contrast to our findings, they found that the majority (59%) elected to donate to scientific research, 38% had their embryos discarded, and only 3% elected to donate to others for attempting pregnancy. They suggest that the low rate of reproductive donation in their center may have been negatively impacted by the absence of an on-site anonymous embryo donation program. Likewise, the high rate of embryo donation to research may have been influenced by their university hospital setting and ongoing Institutional Review Board-approved research protocols.

In conclusion, our study shows that couples willing to donate their remaining embryos are clearly in the minority regardless of whether the embryos resulted from their own oocytes or donor oocytes. At present, several questions remain unanswered. How do we encourage patients to donate their remaining embryos without coercion? Should options for patients be limited? Should the options be different for patients using their own oocytes versus those using donor oocytes? And finally, will oocyte cryopreservation alleviate this problem?

We are currently participating in a multicenter study to evaluate the process that patients go through when deciding the disposition of their remaining cryopreserved embryos so that we may develop methods to help patients with these difficult decisions. As the technology of oocyte freezing evolves from an experimental to a standard procedure, the problem of remaining embryos may diminish, but it is unlikely to be completely resolved.

**REFERENCES**