High rates of embryo wastage with use of assisted reproductive technology: a look at the trends between 1995 and 2001 in the United States

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Objective: To determine what percentage of embryos achieved through assisted reproductive technology (ART) do not result in a live birth and to examine the relationships among the number of embryos transferred, infants delivered, and embryos wasted.
Design: Retrospective correlational study of the U.S. summary data of ART results for the years of 1995–2001.
Patients: Fertility clinics reporting data to the Society of Assisted Reproductive Technology (SART).
Intervention(s): None.
Main Outcome Measure(s): Statistics for ART cycles using fresh, nondonor eggs and embryos were derived, and the percentage of embryos wasted each year was calculated. Trends over time were evaluated for percent embryos wasted, the average number of embryos transferred, and the delivery per transfer rate. Correlations between these variables were analyzed.
Result(s): The percentage of embryos transferred that did not produce a live birth was 90.8 in 1995 and decreased to 84.9 in 2001. This trend significantly correlated with a reduction in the number of embryos transferred (from 3.9 to 3.1) and with an improvement in delivery rate per transfer (25% to 33.4%).
Conclusion(s): The vast majority of embryos produced in vitro and transferred fail to develop into an infant, supporting the concept that only a small fraction of embryos has the capacity to become a live birth. Clinicians should strive to reduce embryonic wastage without an adverse effect on delivery rates by perfecting methods of ovarian stimulation and embryo screening, and by transferring fewer embryos. (Fertil Steril® 2005;84: 325–30. ©2005 by American Society for Reproductive Medicine.)

Key Words: Assisted reproductive technology, in vitro fertilization, embryo selection, embryo transfer, delivery rate

Treatment of infertile couples using assisted reproductive technology (ART) continues to increase in frequency and acceptability. In 2001, the most recent year for which national summary statistics are available in the United States, 107,587 ART cycles were reported, which is an 82% increase from 1995 (1). Despite such widespread application and steadily improving success rates, many shortfalls of the treatment remain unresolved. An important limitation is the inability to accurately distinguish normal competent embryos, which have a high chance of resulting in a live birth, from chromosomally abnormal ones.

Preimplantation genetic diagnosis is a useful tool for genetic evaluation of embryos, but this technique remains of limited applicability due to cost, availability, inaccurate results, incomplete genetic evaluation, and other complicating factors. Morphologic embryo grading correlates to some extent with pregnancy rates (PRs), but cannot reliably select normal embryos (2, 3). Many chromosomally abnormal embryos progress to become blastocysts and thus cannot be detected before embryo transfer (ET) (4). Attempting to overcome this obstacle, clinicians routinely transfer more than one embryo into a woman's uterus, thereby hoping to increase the odds that one of them will be normal and will result in a live-born infant. To increase the number of embryos available for transfer aggressive ovarian stimulation is performed with the goal of maximizing the number of eggs retrieved.

Although this approach may seem logical, its benefits have never been evaluated with respect to its loss of biological materials, costs, and risks. Aggressive stimulation leads to increased risks of complications, such as ovarian hyperstimulation syndrome (OHSS), and increased costs due to the need for higher amounts of gonadotropins. Furthermore, the transfer of multiple embryos results in a higher rate of multiple gestations and the associated increase in perinatal morbidity and mortality. The assumption that it is better to transfer more embryos is contradicted by several observations, the most prominent of which is that most of the embryos generated in vitro and transferred, do not result in a birth and are thus wasted.

The object of this investigation was to assess the percentage of transferred embryos that did not result in a birth of an

Received February 10, 2005; revised and accepted April 20, 2005.
Presented at the 58th Annual Meeting of the American Society for Reproductive Medicine, Seattle, Washington, October 12–17, 2002.
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infant (embryonic losses or wastage). We wished to trace this percentage over time and to evaluate whether delivery rates or number of embryos transferred had any impact on embryo wastage. National summary data compiled by the Centers for Disease Control and Prevention, the Society for Assisted Reproductive Technology, and the American Society for Reproductive Medicine for the years of 1995–2001 were retrospectively analyzed.

MATERIALS AND METHODS

The Society for Assisted Reproductive Technology, the American Society for Reproductive Medicine, and the Centers for Disease Control and Prevention have been compiling data from programs offering ART in the United States since 1995. These summary statistics are published, with 2001 data being the most recent available (1, 5–10). These publications were reviewed and the following statistics were collected for each year: number of cycles progressing to egg retrieval, number of cycles progressing to ET, average number of embryos transferred, number of deliveries, and number of infants born.

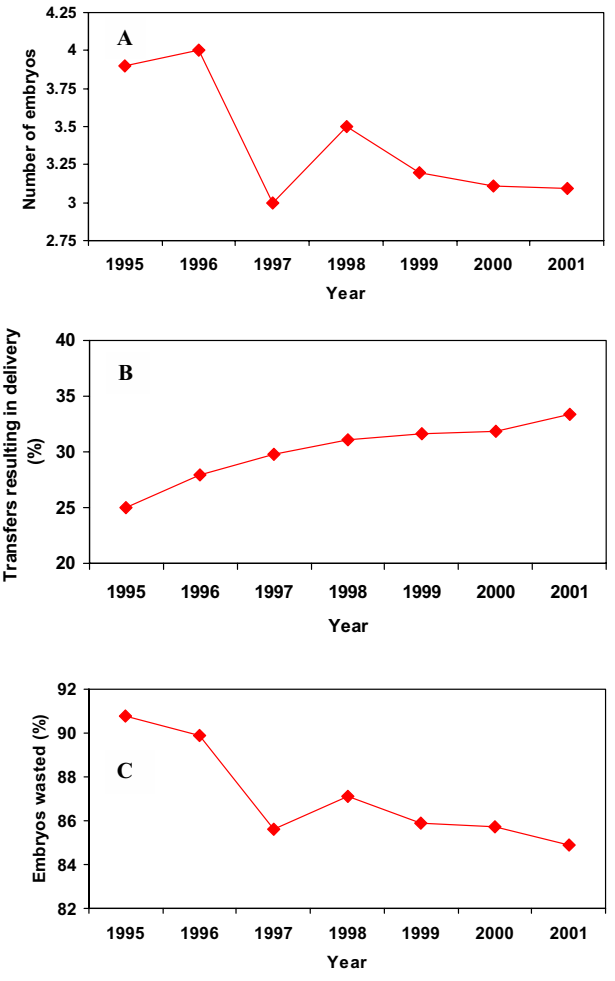
Some of these statistics could not be directly obtained and needed to be calculated from the available data. For 1999, 2000, and 2001 the number of infants was not provided in the report and had to be calculated from the number of deliveries and the percentage of singletons, twins, triplets, and higher order multiple deliveries. For 2001 the average number of embryos transferred was not provided and was calculated from the number of transfers and the percentage of transfers of 1 through 7 or more embryos. Only cycles using fresh nondonor eggs and embryos were included in the analysis. For 1995 through 2000 only IVF cycles, including intracytoplasmic sperm injection (ICSI), were analyzed. For 2001 a small number of gamete and zygote intrafallopian transfer (GIFT and ZIFT) cycles (only 1.2% of the ART cycles in 2001) could not be separated out and were also included.

The total number of embryos transferred for each year was calculated by multiplying the number of transfers by the average number of embryos transferred. For 2001 this number was calculated as described. The percentage of embryos wasted was calculated using 100 − (Number of infants/Number of embryos transferred × 100).

Data analyses were performed using Stata 7.0. Tests (College Station, TX) for trend were executed using linear regression to evaluate changes between years in the average number of embryos transferred, delivery rates, and the percentage of embryonic losses. Spearman rank-correlation coefficients were calculated between the percentage of embryos wasted and the average number of embryos transferred, and also between the percentage of embryos wasted and the deliveries per transfer. A linear regression model was then fitted using percentage of embryonic losses as the dependent variable.

FIGURE 1

Trends over time. (**A**) Trend in the average number of embryos transferred between 1995 and 2001 in the United States. (**B**) Trend in percentage of transfers resulting in delivery between 1995 and 2001 in the United States. (**C**) Trend in the percentage of embryos wasted between 1995 and 2001 in the United States.



Kovalevsky. Embryo wastage with ART: trends in USA. Fertil Steril 2005.

RESULTS

The number of oocyte retrievals and ET reported has increased every year since 1995. There were 35,269 retrievals in 1995 and 69,515 in 2001. Similarly, there were 31,794 transfers in 1995 and 65,363 in 2001. The average number of embryos transferred has decreased from 3.9 to 3.1, but the decline has not been consistent year to year (Fig. 1A); however, a trend toward transferring fewer embryos over time is apparent ($P=.048$).

During the years under investigation, both the number of deliveries and the number of infants born consistently increased (Table 1). The delivery rate (percentage of transfers