Assisted reproductive technologies (ART) in Canada: 2007 results from the Canadian ART Register

Joanne Gunby, M.Sc.,[a] *François Bissonnette, M.D.,*[b] *Clifford Librach, M.D.,*[c] *and Lisa Cowan, M.Sc.,*[d] *on behalf of the IVF Directors Group of the Canadian Fertility and Andrology Society*

[a] Pegasus Technologies, Burlington, Ontario; [b] OVO Fertility Clinic, Saint-Luc Hospital, and University of Montreal, Montreal, Quebec; [c] CReATe IVF Program, Sunnybrook Health Sciences Center, Women's College Hospital, and University of Toronto, Toronto, Ontario; and [d] Victoria Fertility Center, Victoria, British Columbia, Canada

Objective: To present a report on assisted reproductive technologies (ART) cycles performed in 2007 in Canada and show trends in outcomes over time. This is the seventh annual report from the Canadian ART Register (CARTR).
Design: Prospective cohort study.
Setting: Twenty-six of 26 ART centers in Canada.
Patient(s): Couples undergoing ART treatment in Canada during 2007.
Intervention(s): ART treatments, including in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), and frozen embryo transfer (FET).
Main Outcome Measure(s): Clinical pregnancy, live-birth, and multiple-birth rates.
Result(s): A total of 13,482 ART cycles was reported to CARTR. In 8,972 IVF/ICSI cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 35.6% (41.0% per ET), and the live-birth rate was 28.6%; the multiple-birth rate per delivery was 30.2%, with a high-order multiple-birth rate of 1.1%. In 68% of cycles ICSI was performed. One or two embryos were transferred in 69% of cycles. In 404 IVF/ICSI cycles using donor oocytes, the clinical pregnancy rate was 44.6%, and the live-birth rate was 36.1%; the multiple-birth rate was 26.5%, with no triplet birth. In 3,224 FET cycles using the woman's own oocytes, the clinical pregnancy rate was 23.7%, and the live-birth rate was 17.8%; the multiple-birth rate was 24.1%, with a triplet birth rate of 0.2%. Birth outcomes were unknown for 2.0% of ongoing pregnancies.
Conclusion(s): For 2007, CARTR achieved 100% voluntary participation from Canadian ART centers for the fifth consecutive year. Clinical pregnancy and live-birth rates continued to increase in 2007 compared with previous years, with a decrease in high-order multiple births. (Fertil Steril® 2011;95:542–7. ©2011 by American Society for Reproductive Medicine.)

Key Words: Assisted reproductive technologies, frozen embryo transfer, in vitro fertilization, intracytoplasmic sperm injection, multiple births, oocyte donation, pregnancy rates

The Canadian Assisted Reproductive Technologies Register (CARTR) was first established in 1999 for the collection of treatment cycle data from Canadian fertility centers that were using assisted reproductive technologies (ART). The IVF Directors Group of the Canadian Fertility and Andrology Society (CFAS) directs the CARTR program, which is financially supported by participating ART centers. Participation in CARTR is voluntary.

Six previous reports from the Canadian ART Register, describing ART cycles performed in 2001 to 2006, have been published (1–6). Our purpose is to report on ART cycles performed in Canadian centers in 2007 and submitted to CARTR. Trends in outcomes over 3 years will also be examined.

Received March 9, 2010; revised May 13, 2010; accepted May 19, 2010; published online July 24, 2010.
J.G. has nothing to disclose. F.B. has nothing to disclose. C.L. has nothing to disclose. L.C. has nothing to disclose.
Supported by the IVF Directors Group of the Canadian Fertility and Andrology Society, Montreal, Quebec, Canada.
This is an abridged report. The full report is available online as Supplementary material.
Reprint requests: Joanne Gunby, M.Sc., 2534 Cavendish Drive, Burlington, ON, L7P 4E4, Canada (E-mail: gunbyj@mcmaster.ca).

MATERIALS AND METHODS

Data Collection

Staff at each center entered information for each ART treatment cycle initiated, using the new set of outcome variables that had been introduced in 2006 (6). The completed anonymous case records were sent to the CARTR coordinating center electronically, in yearly batch mode, where they were manually checked for accuracy and completeness. No on-site data validation from source documents was performed. The records from each center were then aggregated for data analysis using the computer program Statistical Package for the Social Sciences (SPSS), version 17 (SPSS Inc., Chicago, IL).

It was not necessary to obtain institutional review board approval for this study because data collection is one of the requirements for accreditation of centers providing ART services as organized by the CFAS in conjunction with Accreditation Canada. Centers are obliged to inform patients that such data will be collected in an anonymous manner.

Definitions of Outcomes

The definitions established by the International Committee for Monitoring Assisted Reproductive Technology (ICMART) are followed by CARTR (7). See the online version or our previous report (6) for detailed descriptions of outcomes.

Statistical Analysis

The statistics used in this report are mainly descriptive: rates, proportions, means, and medians. The chi-square test was used occasionally to compare

0015-0282/$36.00
doi:10.1016/j.fertnstert.2010.05.057

proportions. The chi-square test with trend was used to evaluate the change over time in pregnancy, live-birth, and multiple-birth rates.

RESULTS

Participating Centers

All 26 Canadian ART centers operating in 2007 voluntarily contributed to CARTR for that year (listed in the Appendix of the online version).

Overall Outcomes

In total, 13,482 treatment cycles involving ART were reported to CARTR for 2007. Overall, 4,334 ART cycles (32.1% of cycles started) resulted in a clinical pregnancy, at least 3,464 cycles resulted in a delivery (25.8% per cycle started), and at least 3,428 cycles resulted in a live birth (25.6% per cycle started). There were 71 cycles with ongoing pregnancies (2.0% of ongoing pregnancies) for which the birth outcome was not reported. Overall, there were at least 1,003 multiple births (29.0% of known births, including stillbirths): 974 twin births (28.1% per birth), 26 triplet births (0.8% per birth), and 3 quadruplet births (0.1% per birth).

The success and adverse outcome rates of the four most common ART procedures are described in the following sections and summarized in Table 1.

IVF/ICSI with Own Oocytes

The most common procedure performed was IVF, including intracytoplasmic sperm injection (ICSI), using the woman's own oocytes, with 8,972 cycles reported. Because cycles canceled before oocyte retrieval cannot be classified by type of insemination procedure, outcomes per cycle started can only be calculated for IVF and ICSI cycles grouped together.

Per IVF/ICSI cycle started, the clinical pregnancy rate was 35.6%, the live-birth rate was 28.6%, and the singleton live-birth rate was 20.0%. Donated sperm was used in 3.9% of cycles with oocytes retrieved. There were 59 ectopic pregnancies (0.7% per cycle started), including three heterotopic pregnancies, all of which resulted in a singleton live birth. The pregnancy loss rate was 15.8% of clinical intrauterine pregnancies (miscarriage 15.4%, therapeutic abortion 0.4%). Of the 2,584 known births (98% of ongoing pregnancies), 30.2% were multiple births (29.1% twins and 1.1% high-order multiples, including 25 sets of triplets and three sets of quadruplets).

Rates for IVF and ICSI separately can only be provided per successful retrieval (i.e., one or more oocytes retrieved). Of 8,173 IVF/ICSI cycles with a successful retrieval, 31.6% had insemination by standard IVF, 63.9% by ICSI, and 4.2% by IVF/ICSI split (some oocytes inseminated by each method). The clinical pregnancy rates per successful retrieval were 38.0% for standard IVF, 38.9% for ICSI, and 46.8% for IVF/ICSI split. Including the IVF/ICSI split cycles in the ICSI group, the clinical pregnancy rates per retrieval were 38.0% for IVF and 39.4% for ICSI, and the live-birth rates per retrieval were 30.5% and 31.8%, respectively. The ectopic pregnancy rate per retrieval was 0.7% with IVF and 0.7% with ICSI, and the pregnancy loss rates per intrauterine pregnancy were 15.4% (miscarriage 14.9%, therapeutic abortion 0.5%) and 16.0% (miscarriage 15.6%, therapeutic abortion 0.4%), respectively. Of 793 known births after IVF, 33.4% were multiple births (32.2% twins and 1.3% high-order multiples, including one set of quadruplets); of 1,779 known births after ICSI, 28.9% were multiple births (27.9% twins and 1.0% high-order multiples, including two sets of quadruplets).

IVF/ICSI with Oocyte Donation

In 2007, IVF/ICSI with oocyte donation (OD) was reported in 404 cycles. In OD cycles, per cycle started, the clinical pregnancy rate was 44.6%, the live-birth rate was 36.1%, and the singleton live-birth rate was 26.4%. Donated sperm was used in 8.9% of cycles with oocytes donated. There were four ectopic pregnancies (1.0% per cycle started). The pregnancy loss rate was 15.3% per intrauterine pregnancy (miscarriage 14.2%, therapeutic abortion 1.1%). Of 147 known births (99% of ongoing pregnancies), 26.5% were multiple births (all twins).

Information about the oocyte donor's age was available for all cycles. Donor age was <30 years in 53% of cycles, 30 to 34 years in 30%, 35 to 39 years in 16%, and ≥40 years in 1%. The clinical pregnancy rates per cycle started were 44.4%, 48.0%, 41.3%, and 0, respectively.

FET with Own Oocytes

In 2007, 3,224 frozen embryo transfer (FET) cycles using thawed embryos created in a previous IVF/ICSI cycle using the woman's own oocytes were reported. Per cycle started, the clinical pregnancy rate was 23.7%, the live-birth rate was 17.8%, and the singleton live-birth rate was 13.5%. There were eight ectopic pregnancies (0.2% per cycle started). The pregnancy loss rate was 22.3% per intrauterine pregnancy (miscarriage 22.1%, therapeutic abortion 0.3%). Of 576 known births (98% of ongoing pregnancies), 24.1% were multiple births (24.0% twins, 0.2% triplets).

FET with Oocyte or Embryo Donation

The category FET-OD includes transfer of cryopreserved embryos created from donor oocytes in a previous OD cycle (176 cycles) and cryopreserved donated embryos (23 cycles). Per cycle started, the clinical pregnancy rate was 24.6%, the live-birth rate was 19.6%, and the singleton live-birth rate was 14.6%. There was no ectopic pregnancy. The pregnancy loss rate per intrauterine pregnancy was 20.4% (miscarriage 18.4%, therapeutic abortion 2.0%). Of 39 known births (100% of ongoing pregnancies), 25.6% were multiple births (all twins).

Information about the oocyte donor's age was available for 98% of cycles. Donor age was <30 years in 54% of cycles, 30 to 34 years in 36%, and 35 to 39 years in 11%. The clinical pregnancy rates per cycle started were 26.7%, 22.9%, and 23.8%, respectively.

Birth Outcomes for All ART Procedures

At least 4,499 infants were born from all types of ART cycles started in 2007 in Canada: 2,461 infants from 2,461 singleton births (54.7% of infants), 1,948 infants from 974 twin births (43.3%), 78 infants from 26 triplet births (1.7%), and 12 infants from 3 quadruplet births (0.3%). Thus, 45% of infants were born from multiple gestations.

Of the 2,461 infants born as singletons, there were 24 stillbirths and 7 neonatal deaths, a total perinatal mortality rate of 1.3% per infant. The median gestational age at birth was 39 weeks (range: 24 to 44 weeks) for liveborn infants and 25 weeks (range: 20 to 41 weeks) for stillborn infants. Preterm delivery (<37 weeks) occurred in 14.3% of births and very preterm delivery (<32 weeks) in 2.3% of births. Birth weight was normal (>2,500 g) for 89.8% of liveborn singletons, low (1,500 to 2,500 g) for 8.7%, and very low (<1,500 g) for 1.6%. Some type of birth defect was reported for 52 infants (2.1% of infants).

Of the 1,948 infants born as twins, there were 38 stillbirths and 24 neonatal deaths, a total perinatal mortality rate of 3.2% per infant. The median gestational age at birth was 36 weeks (range: 17 to 43