

Fertility Preservation in the Age of Assisted Reproductive Technologies



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KEYWORDS

- Fertility preservation • Cryopreservation • Freezing • Egg • Sperm • Oocyte
- Cancer • Oncology

KEY POINTS

- Strategies used to accomplish fertility preservation are many.
- Over the past several decades, new technologies, especially related to assisted reproductive technologies and in vitro fertilization, have greatly expanded ways to accomplish fertility preservation. These advances have also grown the indications for pursuing fertility potential in general.
- Surely, advances in technology will continue to be optimized in the future.
- By all indicators, the role for fertility preservation in society and medicine is likely to only increase over the next several decades.

The authors have no pertinent disclosures and conflicts of interest.

Sources of Funding: None.

Contributors: P.R. Brezina, A.P. Bailey, R.W. Ke, J.L. Klosky, and W.H. Kutteh primarily searched the literature and wrote the first draft of the article; P.R. Brezina is guarantor.

Competing Interests: All authors have completed the Unified Competing Interest form and declare no support from any organization for the submitted work, no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years, and no other relationships or activities that could appear to have influenced the submitted work.

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Obstet Gynecol Clin N Am 42 (2015) 39–54

<http://dx.doi.org/10.1016/j.ogc.2014.09.004>

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INTRODUCTION

Reproduction has been and will always be central to the human experience. Many individuals experience situations that may compromise their future fertility. The reasons for this are many, ranging from social pressure to defer childbearing, to exposure to gonadotoxic agents (eg, chemotherapy) that damage reproductive organs. Both men and women may be placed in environments that could compromise their future fertility.

Historically, the options for preserving fertility were quite limited. Women could choose to have children earlier in life than they would have ideally chosen at the possible expense of their careers. Men known to have a malignancy could undergo cryopreservation (freezing) of their sperm before being exposed to caustic chemotherapy. Barring these 2 approaches, the options for fertility preservation, particularly for women, have been quite limited.

The past several decades, however, have seen technologies that have changed the historical limitations regarding fertility preservation. Assisted reproductive technologies (ART) associated specifically with in vitro fertilization (IVF) have ushered in new tools that are now routinely used to preserve fertility. Cryopreservation of unfertilized eggs and embryos gives a new set of options for women desiring fertility preservation for a variety of indications. An outline of available technologies currently used for fertility preservation is shown in **Box 1**. In addition, the use of surgical, medical, pharmacologic, and psychological interventions offer mechanisms to facilitate fertility preservation, particularly in the setting of oncology. This review attempts to offer an overview of the state of the art within fertility preservation.

CRYOPRESERVATION TECHNOLOGIES AVAILABLE

Sperm Cryopreservation

The ability to cryopreserve human sperm was first established in 1953 in a report by Bunge and Sherman.¹ Since this time, the use of sperm cryopreservation has become the dominant method of fertility preservation for men faced with fertility challenges.²

The process of performing sperm cryopreservation is relatively straightforward. Sperm is classically obtained through masturbation.³ In some cases in which sperm is not possible to be obtained through ejaculation, surgical techniques also exist that may retrieve sperm for cryopreservation.³ The semen obtained is then allowed to liquefy at room temperature and analyzed for motility, concentration, and morphology.³ Following this, many centers will use a selection process such as a swim-up or density gradient centrifugation to identify the most viable sperm within the sample, which is then cryopreserved.³ Cryopreserved sperm are considered relatively stable and may be used even decades later to result in pregnancy.⁴

Some studies have noted DNA damage to some but not all sperm following cryopreservation.⁵ However, the safety of using cryopreserved sperm to achieve pregnancy is generally accepted, as decades of healthy pregnancies have resulted from cryopreserved sperm.^{3,6} Once thawed, sperm may be used to achieve pregnancy either through intrauterine insemination techniques or through IVF.

A common indication for sperm cryopreservation is fertility preservation in the setting of cancer. Current recommendations from multiple professional societies recommend that men diagnosed with cancer should universally be offered sperm cryopreservation before initiation of treatment with chemotherapy or radiation that could reasonably impact sperm production.^{6,7} However, using sperm cryopreservation in

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