The Evolving Role of Genetics in Reproductive Medicine

Paul R. Brezina, MD, MBA[a,b,c,*], William G. Kearns, PhD[d,e]

KEYWORDS

• Genetics • Reproductive • Preimplantation genetic screening
• Preimplantation genetic diagnosis • Preimplantation • Chorionic villus sampling
• Amniocentesis • Cell-free DNA

KEY POINTS

- Genetics is increasingly being applied to reproductive medicine for both diagnosis and treatment.
- Preconception genetic testing, including testing for carrier states of conditions such as cystic fibrosis and hemoglobinopathies, will be increasingly used. There is an increasing trend to de-emphasize race to determine the appropriate testing.
- Antenatal genetic testing includes time-tested diagnostic evaluations such as chorionic villus sampling and amniocentesis. In addition, newer minimally invasive testing modalities are currently being developed and applied. The application of these tests is likely to increase in the future.
- Preimplantation genetic testing, including testing for specific genetic diseases and aneuploidy, is the practice of analyzing a biopsied sample of an egg or embryo obtained through in vitro fertilization. The ever improving accuracy and growing applications associated with this technology will likely lead to increased utilization.

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[a] Reproductive Endocrinology and Infertility, Fertility Associates of Memphis, 80 Humphreys Center, Suite 307, Memphis, TN 38120, USA; [b] Department of Obstetrics and Gynecology, Vanderbilt University Medical Center, B-1100 Medical Center North, Nashville, TN 37232, USA; [c] Department of Surgery, MS133, Room B3019, St. Jude Children's Research Hospital, 262 Danny Thomas Place, Memphis, TN 38105-3678, USA; [d] Department of Gynecology and Obstetrics, Johns Hopkins Medical Institutions, Phipps 264, 600 North Wolfe Street, Baltimore, MD 21287, USA; [e] Preimplantation Genetics, The Center for Preimplantation Genetics, LabCorp, 15001 Shady Grove Road, Suite 200, Rockville, MD 20850, USA
* Corresponding author. Reproductive Endocrinology and Infertility, Fertility Associates of Memphis, 80 Humphreys Center, Suite 307, Memphis, TN 38120, USA.
E-mail address: pbrezina@fertilitymemphis.com

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- Genetic analysis following fetal demise is now capable of evaluating the genetic karyotype of products of conception without growth in culture, through microarray technology. In addition, certain microarray evaluations are capable of ruling out maternal cell contamination. These advances may improve the diagnosis and future treatment of women suffering from failed pregnancy.
- It is incumbent on clinicians, however, to ensure that these interventions are used in a responsible, equitable, and ethical manner.

INTRODUCTION

At its core, reproductive medicine attempts to explain how human life is created and how it develops throughout pregnancy. Based on this understanding, therapies are developed and used to maximize outcomes. Specifically, increased pregnancy rates, decreased incidence of obstetric complications and miscarriage, and the avoidance of fetuses affected by birth defects or other deficiencies are the stated goal of much of the current research in reproductive medicine. The role of genetic testing to guide medical decision making in this regard is sizable and will likely continue to grow in the future.

Genetic evaluations within reproductive medicine may be subdivided into 4 main categories:

1. Preconception genetic testing: The genetic evaluation of prospective parents before pregnancy
2. Antenatal genetic testing: The genetic evaluation of women who are currently pregnant to determine the genetic makeup of the developing fetus
3. Preimplantation genetic testing: The genetic evaluation of an embryo, before uterine transfer, via an embryo biopsy during an in vitro fertilization (IVF) procedure
4. Genetic analysis following fetal demise: The genetic evaluation of the products of conception following a failed pregnancy

This article outlines each of these broad categories and describes the current appropriate applications of these technologies.

PRECONCEPTION GENETIC TESTING

Preconception genetic testing is the genetic evaluation of prospective parents before pregnancy (**Box 1**). Many individuals have a specific family history of certain genetic disorders, but many may also be at risk for unknown genetic diseases. Preconception genetic testing can be based on a couple's ethnicity or the medical history of a genetic

Box 1
Preconception genetic testing

- Many individuals may be unknown carriers of certain genetic diseases
- Preconception testing for a variety of genetic diseases is increasingly recommended in phenotypically normal individuals
- Technological advances have improved the accuracy and have decreased the cost of such testing
- Race is increasingly de-emphasized to determine appropriate testing panels