Chapter 16

REPRODUCTIVE TECHNOLOGY, GENE THERAPY, AND GENETIC COUNSELING

Chapter Summary

In previous chapters we have seen technological advances associated with modern genetics. Similar advances are helping infertile couples conceive, and hold the promise of altering defective genes.

Although many couples wish to prevent unwanted pregnancy, a large number of others are frustrated by infertility. Physical problems that prevent the sperm and oocyte from reaching each other are being overcome by in vitro fertilization or by injection of a single sperm into an oocyte. Surrogate parenting is another option. Reproductive technology is also extending the reproductive life of women, and helping cancer survivors who want to start families. Frozen sperm, oocytes, embryos, and even pieces of ovary are being used in these endeavors. These techniques are not free of risks or ethical dilemmas. Families needing a tissue donor for an older child can now select embryos carrying the right genetic makeup to be implanted.

When children are born with genetic disorders or develop symptoms later on in life, the ideal solution would be to transfer normal genes into those individuals. The problems involved in gene transfer include getting the genes to turn on in the correct tissue and avoiding reactions to the transporting vector. Stem cells capable of forming different kinds of adult tissue can also be modified by gene transfer. These cells are then transplanted into someone with an inherited disorder. Persons successfully treated with gene transfer can experience a more normal life but can still pass the abnormal allele to their children.
The highly experimental germ line therapy that modifies gametes rather than adult cells would solve this problem. Critics fear the logical extensions of gene therapy are “babies to order” and cloned humans.

Prenatal genetic counselors help individuals and couples assess their risk of having a child born with a genetic disorder based on pedigree analysis. If the couple already has an affected child, pediatric genetic counselors help determine if the cause is genetic. Genetic counselors who specialize in cancer counseling help people understand their risk of developing the disease. Genetic counselors are non-directive and do not urge clients to adopt one particular option.

**Learning Objectives**

After completing this chapter, you should be familiar with:

a. the ways in which technology enables people to prevent unwanted pregnancies and overcome infertility.

b. different types of gene therapy and the dangers involved in these experimental procedures.

c. ethical issues stemming from assisted reproductive technology and gene therapy.

d. the issues surrounding the use of gene therapy.

e. the functions of a genetic counselor.

**Key Terms**

- assisted reproductive technologies
- tubal ligation
- vasectomy
- *in vitro* fertilization
- gamete intrafallopian transfer
- intracytoplasmic sperm injection
- preimplantation genetic diagnosis
- gene therapy
- embryonic stem cells
- somatic cell nuclear transfer
- totipotent
- pluripotent
- multipotent
- somatic gene therapy
- germ-line gene therapy
- enhancement gene therapy
- genetic counseling
Multiple Choice

Circle the letter of the best answer.

1. The leading cause of infertility in women is
   a. the lack of a fertile partner
   b. the lack of follicles in the ovaries
   c. an inhospitable uterus
   d. blocked oviducts
   e. a weak cervix

2. *In vitro* fertilization
   a. occurs when sperm fertilize eggs outside of the body
   b. is only resorted to when women want large families
   c. guarantees twins or triplets
   d. involves the husband’s sperm being concentrated and placed in the uterus

3. According to the chapter introduction, Louise Brown was the “miracle baby” because she
   a. survived a difficult birth
   b. survived extensive birth defects
   c. was born to very elderly parents
   d. was the first human resulting from *in vitro* fertilization

4. Louise (question #3)
   a. cannot be distinguished by her appearance from children conceived in the usual way
   b. does not look like Mr. Brown; a donated sperm fertilized her egg
   c. was implanted in a surrogate mother
   d. is biologically related to all babies conceived the same way she was

5. According to Figure 16.1, the only method of birth control completely successful in preventing pregnancy is
   a. birth control pills
   b. an IUD
   c. condoms
   d. diaphragms
   e. none of the above

6. If Alex has a low sperm count, his wife, Alison, can still become pregnant through
   a. hormone shots for both individuals
   b. concentrating Alex’s sperm
   c. blocking Alison’s oviducts
   d. implants under the skin
7. Totipotent stem cells  
   a. are most common in adults  
   b. are able to form a few cell types  
   c. are created by gene transfer  
   d. are obtained from early embryos

9. Attempting to improve the future for children with severe combined immunodeficiency (SCID) would be classified as  
   a. somatic gene therapy  
   b. germ line therapy  
   c. enhancement gene therapy  
   d. unethical gene therapy

10. SCID (question #9) is an X-linked recessive disorder. If researchers are successful in altering bone marrow to prevent SCID, the patients with altered bone marrow  
   a. cannot pass a SCID allele to their children  
   b. will develop leukemia  
   c. could still have children with SCID  
   d. will still not live long enough to have children

11. Genetic counseling is usually not recommended for  
   a. couples who are first cousins  
   b. women with a history of miscarriage  
   c. all pregnant women  
   d. parents of children with birth defects who fail to thrive