Reproductive Issues in the Workplace

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Practice Objectives

- Be able to cite some important court decisions regarding reproductive health issues in the workplace
- Be able to describe the difference between reproductive hazards and teratogens

Practice Objectives (cont'd)

- Be able to describe background rates of infertility and sub-fertility, miscarriage and stillbirths, birth defects, low birth weight and premature birth, developmental disorders, and childhood cancers

Practice Objectives (cont'd)

- Be able to list some suspected reproductive hazards and the suspected consequences of their exposures
- Be able to describe some prevention strategies to minimize exposure to workplace reproductive hazards

Introduction

- Question: "Doctor, if I work with substance X, will it hurt my baby?"
- Physician's response must incorporate;
  - scientific literature regarding substance X
  - quantification of the work exposure
  - sensitivity to the fears and concerns of the patient.

Populations of Concern

- Three groups of employees with concerns:
  - pregnant women
  - women of childbearing age
  - men
- Determining the exact cause of the concern is important.

Legal Opinion

- Supreme Court decision (International Union vs Johnson Controls - 1991)
  - does not allow employers to keep pregnant or fertile women from working in jobs that may injure a fetus and cause an adverse reproductive outcome.

Employer Approach

- Employers should:
  - develop educational programs for at risk employees
  - develop surveillance programs for adverse reproductive outcomes in its employees
  - create a policy to link employee removal from specific work activities based on specific work performance

Reproductive Hazards

- Definition: Substances or agents that affect the reproductive health of women or men or the ability of couples to have healthy children.

Suspected Reproductive Hazards

- Spontaneous abortion
  - anesthetic gases
  - arsenic
  - carbon disulfide
  - ethylene glycol ethers
  - inorganic mercury
  - lead
  - video display terminals

Suspected Reproductive Hazards (cont'd)

- neurologic dysfunction in children
  - lead
- childhood cancer
  - ionizing radiation
- CNS defects/malformations
  - organic mercury
  - ionizing radiation
  - vinyl chloride

Suspected Reproductive Hazards (cont'd)

- Low birth weight
  - arsenic
  - carbon monoxide
  - PCB's (polychlorinated biphenyls)
- Prematurity
  - lead
  - physical stress

Teratogens

- An agent or factor that results in birth defects or malformations in the developing embryo but does not result in any toxigenic effects to the mother.
- Example; Thalidomide

Children of thalidomide (CNN/file)

Thalidomide

Teratogenic Effects

- Are dose related:
  - High dose: embryolethal
  - Moderate dose: embryological defect
  - Low dose: may produce no effect

Teratology - General Principles

- Susceptibility to teratogens depends on the genotype of the conceptus.
- Susceptibility to teratogens varies with the developing stage of the fetus at the time of exposure.
- Teratogenic agents act through specific mechanisms on the developing cells and tissues

Teratology (cont'd)

- The final manifestations of abnormal development are;
  - malformation
  - growth retardation
  - functional disorders
  - death

Teratology (cont'd)

- Manifestations of abnormal development increase from no effect to the totally lethal as the dosage increases.

Reproductive Toxicology

- An understanding of normal reproduction is a necessary foundation for the recognition of adverse effects to the reproductive processes of both men and women.

Baseline (Normal) Rates

- 10-20% of pregnancies - spontaneous abortion
- 30-40% of spontaneous abortions have a chromosomal anomaly
- 3% of all newborn children will present with birth defects or congenital anomalies

Baseline (Normal) Rates

- 1% of men - azoospermia
- 2-4% of fetuses - stillborn
- 7% of births - low birth weight (<2500g)
- 0.4% of births - severe mental retardation

Baseline Rates (cont'd)

- 3% of anomalies in live births will manifest themselves during the postnatal period or later on in development
- 2/3 (67%) of all congenital anomalies or malformations have no known cause

Reproductive Toxicology

- Drugs (chemicals) and environmental agents are implicated in approximately 3% of congenital anomalies or malformations
- Other causes;
  - 1-2% - maternal metabolic imbalance
  - 2-3% - infection
  - 3-5% - chromosomal aberrations
  - 20% - known genetic transmission
  - 70% - unknown factors

Male Reproductive System Development

- Sexual differentiation begins at about 7 weeks after conception and is completed by the 4th month of gestation
- FSH acts on Sertoli cells in testes to release LH.
- LH stimulates the testicular Leydig cells to produce testosterone.

Sexual Differentiation

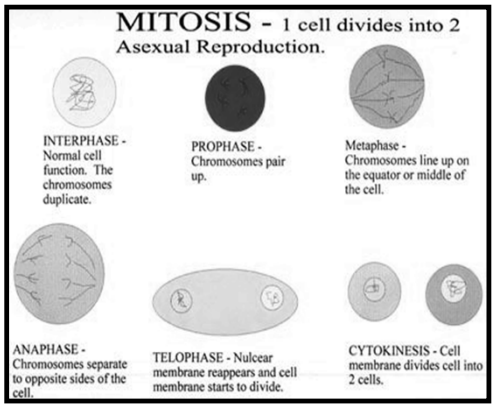
- Although males and females have identical FSH and LH, it is the hormonal effects on sex-specific target cells that produce sexual differentiation

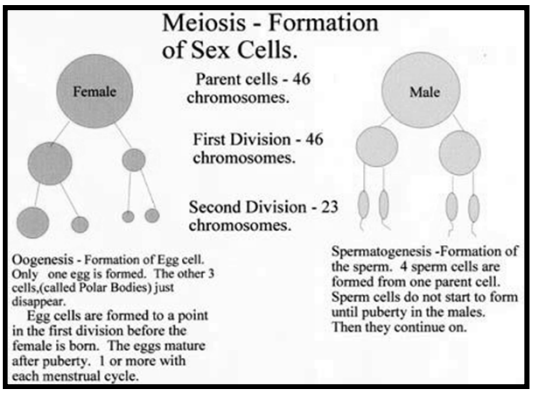
Male Reproduction

- Spermatogenesis - 70-80 day period of high rate cell division in adult men.
  - very susceptible to adverse influences

Male Reproduction (cont'd)

- spermatogonia (mitosis) -> spermatocytes
- spermatocytes (meiosis) -> spermatids
- spermatids mature into the characteristic head and tail shape of sperm





Male Reproduction (cont'd)

- Normal values:
- sperm production - 20-350 million/day
- human ejaculate - 50-150 million/ml
- Fertility criteria defined as:
  - > 40% motile sperm
  - > 20 million sperm per milliliter of semen
  - > 70% normal morphology

Affects on the Male Reproductive System

- Chromosomal or gene changes
  - can stop or slow the actual production of sperm
- Sexual performance
  - hormonal changes may affect sexual performance

Affects on the Male Reproductive System (cont'd)

- Hazardous chemicals, which may collect in the epididymis, seminal vesicles, or prostate may;
  - kill the sperm
  - affect sperm shape
  - affect sperm motility
  - be carried to the egg at the time of fertilization

Affect on Male Reproduction (cont'd)

- Pregnancy:
  - If a damaged sperm fertilizes an egg
    - miscarriage
    - fetal abnormality
    - congenital abnormality detected after delivery
  - If a reproductive hazard is carried in the semen
    - fetus may be exposed within the uterus

Female Reproduction

- Entire component of ova are present at birth, and number decreases with age.
- Approx. 400 mature ova are released during ovulation in a lifetime.
- Release of specific factors from the hypothalamus and hormones from the pituitary produce the development of the ovarian follicle.

Female Reproduction (cont'd)

- Follicle expels the mature ovum at the peak of the estrogen and luteinizing hormone levels, approx. 14 days after the beginning of menses.
- Fertilization and early development occur during the ensuing few days and are followed by implantation onto the uterine wall.

Fetal Development

- 3rd-8th wk - Embryonic stage (organogenesis)
- 9th-14th wk - Organ growth
- Adverse reproductive outcomes can occur at any of these points but organogenesis most susceptible.

Female Reproductive Problems from Workplace exposures

- Menstrual cycle effects
- Infertility and subfertility
- Miscarriage and stillbirths
- Birth defects
- Low birth weight and premature birth
- Developmental disorders
- Childhood cancer

Menstrual Cycle Effects

- Disruption of the hormonal balance between brain, pituitary, and ovaries may result in;
  - estrogen and progesterone imbalances
  - changes in menstrual cycle length
  - menstrual irregularity
  - failure to ovulate

Menstrual Cycle Effects (cont'd)

- Potential causative factors;
  - stress - e.g. physical and/or emotional
  - chemicals - e.g. carbon disulfide, xylene
  - metals - e.g. inorganic mercury
  - ionizing radiation

Infertility and subfertility

- 10%-15% of all couples are unable to conceive after 1 year of trying.
- Infertility evaluation includes assessment for;
  - Damage to the egg or sperm.
  - Hormonal abnormalities

Miscarriage and Stillbirths

- 1 in 6 pregnancies - miscarriage
- Occur for many reasons:
  - egg or sperm may be damaged so that the egg cannot be fertilized or cannot survive after fertilization.
  - Hormonal imbalance
  - Fetus may have not developed normally
  - physical problems with uterus or cervix.

Birth Defects

- 2-3% of births - major birth defect
- Most cases the cause is unknown
- First 3 months of pregnancy- most important
- Many women unaware that they are pregnant during much of this critical period.

Low Birth weight and Premature Birth

- 7% of U.S. births are born prematurely or are underweight.
- More likely to become ill and die during first year of life.
- Potential causes;
  - Poor maternal nutrition
  - smoking
  - alcohol use during pregnancy

Developmental Disorders

- Sometimes the brain of the fetus does not develop normally, which leads to developmental delays or learning disabilities later in life.
- 10% of children in the U.S. have some form of developmental disability.

Childhood Cancer

- Ionizing radiation has caused cancer in some children whose mothers were exposed during pregnancy.
- Preventive measures;
  - minimize use of X-ray on pregnant women
  - use of newer equipment that reduces the risk of exposure
  - use of protective shields

Routes of Worker Exposures

- Inhalation
- Skin absorption
- Ingestion
- Family members can be exposed by workers carrying the toxin home on skin, clothing, hair.

Exposures Prevention

- Employers are responsible for training and protecting their workers.
- Employees are responsible for learning about the hazards in their workplace, using PPE, and following proper work practices.

General Duty Clause

- Employer may be cited under section 5a(1) of the "general duty clause" of the Occupational Safety and Health Act of 1970;
  - for failing to provide working conditions free from recognized hazards likely to cause serious harm.

Exposure Prevention (cont'd)

- Store chemicals in sealed containers when not in use.
- Wash hands after contact with hazardous substances and before eating, drinking, or smoking.
- Avoid skin contact with chemicals
- Review all MSDS's to assess for workplace reproductive hazards

Prevent Home Contamination

- Leave contaminated clothing at work
- Store street clothes in separate area
- Wash work clothing separately
- Avoid bringing contaminated clothing or objects home.

Clinical Aspects

- Some physicians may respond to the women who asks, "Will compound X hurt my baby?" by writing "No chemical use allowed" on a slip.
- DO NOT DO THIS!!
- This may increase anxiety and liability

Clinical Algorithm

- Four categories:
  - woman may continue working
  - woman may continue working, job modification is desirable
  - woman may continue working only with job modification
  - woman may not work

Clinical Algorithm (cont'd)

- These categories are dependent to an extent on exposure limits.
- The published OSHA and ACGIH standard recommended thresholds can be used as starting points for exposure limit guidelines.

Clinical Resources

- NIOSH published *Guidelines on Pregnancy and Work* (publication no. 78-118) in 1978 which contained an algorithm for medical management of the pregnant worker. This can now only be ordered from the National Technical Information Service (NTIS) stock #PB83179952 @ (800)553-6847 or at www.NTIS.gov.
- NIOSH.gov

Guidelines for continuation of various jobs

- Secretarial/clerical — 40 weeks gestation
- Professional/Managm. — 40
- Sitting/light task
  - prolonged (>4 hrs) — 40
  - Intermittent — 40
- Standing
  - Prolonged (>4 hrs) — 24
  - Inter. (>30 min/hr) — 32
  - Inter. (<30 min/hr) — 40

Guidelines for continuation of work (cont'd)

- Stooping/Bending
  - repetitive(>10x/hr) — 20 weeks gestation
  - Intermittent(2-20x/hr) — 28
  - Intermittent(<2x/hr) — 40
- Climbing
  - Vertical ladders/poles
    - repetitive(>4x/8hrs) — 20
    - intermittent(<4x/8hr) — 28
  - Stairs
    - repetitive (>4x/8hr) — 28
    - intermittent(<4x/8hr) — 40

Guidelines for continuation of work (cont'd)

- Lifting
  - repetitive
    - <25lbs — 40 weeks gestation
    - 25-50lbs — 24
    - >50lbs — 20
  - Intermittent
    - <25lbs — 40
    - 25-50lbs — 40
    - >50lbs — 30

Clinical Determination

- Clinical determination of work-relatedness of adverse reproductive outcomes must be based on;
  - evaluation of the workplace
  - workplace surveillance data
  - knowledge of epidemiology (background)
  - patient's physical exam and lab findings
  - medical literature search

Questions?

THE END