C33 - RADIATION EFFECTS ON REPRODUCTIVE ORGANS & FERTILITY RATES

Objectives

01

ILLUSTRATE THE REPRODUCTIVE ORGANS

02

EXPLAIN FERTILITY RATES

03

DISCUSS RADIATION EFFECTS ON FEMALE REPRODUCTIVE ORGANS

04

DISCUSS RADIATION EFFECTS ON MALE REPRODUCTIVE ORGANS

05

PORTRAY THE VULNERABILITY OF REPRODUCTIVE ORGANS

06

ILLUSTRATE THE DAMAGING QUANTITY OF RADIATION

07

EXPLAIN PREVENTATIVE MEASURES

08

EXPLAIN THE ADVANTAGE OF RADIATION

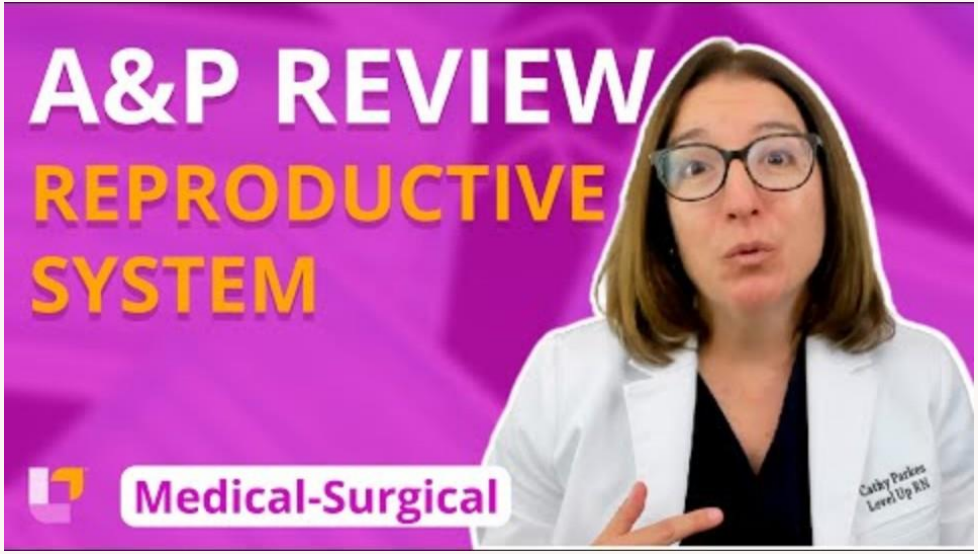
09

DISPLAYED CONCLUSION

01

OVERVIEW OF REPRODUCTIVE ORGANS

QUICK REVIEW



(Level Up RN, 2022)

02

FERTILITY RATES

DECLINING NUMBERS

BIRTH RATES IN AMERICA (Croxton, 2025)

- Birth rates in America have significantly declined in the last couple years Believed to be caused by a shift in values
- Ideas like marriage and children are being pushed back
- Teenage pregnancies have also decreased
- However, record low fertility rates have also been brought to the forefront

LOW FERTILITY RATE CAUSES (Cleveland Clinic, 2023)

- Age
- Eating disorders
- Substance abuse
- Obesity or being underweight
- Abnormalities in the hypothalamus or pituitary
- Chronic conditions
- Radiation exposure

03

RADIATION EFFECTS ON FEMALE REPRODUCTIVE ORGANS

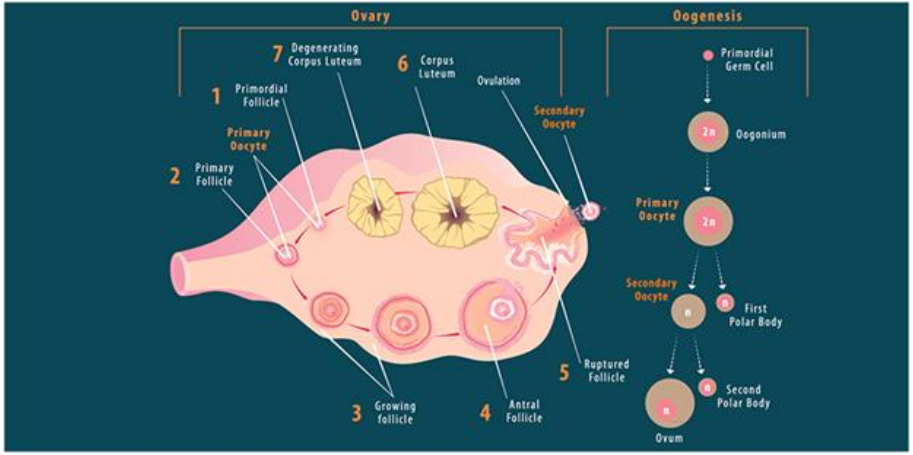
FEMALE ANATOMICAL EFFECTS OF RADIATION

OVARIES

- Extremely sensitive to radiation
- House the oocyte reserves

OOGENESIS

- Process of female germ cell development
- Very vulnerable to radiation



Note: From *Byju's*, 2017.
https://cdn1.byjus.com/wp-content/uploads/2017/02/130.png

COMPLICATIONS

PREMATURE OVARIAN FAILURE

- Ovaries lose their normal function prematurely
- Can result from 2-3 Gy
- 0.1 Gy may impair ovarian failure
- Over 2 Gy can cause permanent infertility

IMPACT ON FERTILITY

- These complications lead to the body having a lower chance of producing viable eggs

OTHER COMPLICATIONS

- Radiation exposure can also have a negative impact on the uterus

IMPACT ON FERTILITY

- Complications in pregnancy
- Reduced fertility
- Miscarriages
- Long-term health effects of the uterus

(Marci et al., 2018)

04

RADIATION EFFECTS ON MALE REPRODUCTIVE ORGANS

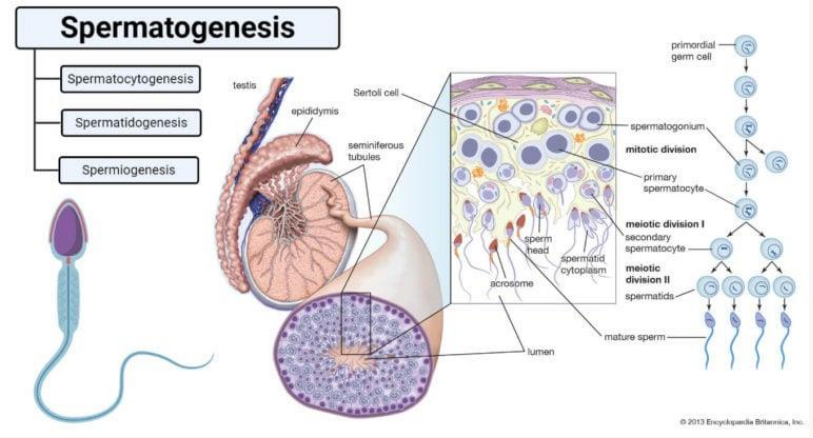
MALE ANATOMICAL EFFECTS OF RADIATION

TESTES

- Extremely sensitive ionizing radiation due to their high proportion of proliferating germ cells

SPERMATOGENESIS

- Process of sperm cell development
- Typically has a negative reaction to exposure of ionizing radiation
- Can potentially lead to varying degrees of infertility
- .1-1 Gy can impair spermatogenesis either temporarily or permanently



Note: From *Encyclopædia Britannica*, 2013.
https://microbenotes.com/wp-content/uploads/2020/11/Spermatogenesis-768x415.jpeg

COMPLICATIONS

REDUCED SPERM COUNT

- Doses that are more than 1 Gy considerably reduce sperm count
- May lead to temporary or permanent infertility

OTHER COMPLICATIONS

- Hormonal changes
- Damage to Leydig cells
  - Located on the testes and produce testosterone
  - Crucial to male reproductive function
  - Damage to these cells may compromise testosterone production

EFFECTS BASED ON DOSAGE

- Low Dose: May cause temporary disruptions in sperm production
- Low to Moderate Dose: Typically causes reversible infertility, but recovery time varies and could take up to several years
- High Dose: May cause prolonged or irreversible damage

05

VULNERABILITY OF REPRODUCTIVE ORGANS

MOST VULNERABLE AGE FOR COMPLICATIONS

PREPUBERTAL AGE

- The gonads are immensely sensitive to radiation
- Reproductive organs are most vulnerable to radiation in this stage

SCARY REALITY

- A study of ovarian function after chemotherapy showed that:

  70% of patients who received radiation to the abdomen during childhood failed to undergo or complete pubertal development and multiple patients developed premature menopause

ADDITIONAL THINGS TO KEEP IN MIND

- Radiation still can be very damaging to adult reproductive organs
- The threshold dose of radiation to damage germinal epithelium or damage that would be inversible is unknown
- An estimation states that 2 or less Gy would destroy half of immature oocytes
- 25-50 Gy would produce infertility in one third of young women and infertility all women 40 and older

06

DAMAGING QUANTITY OF RADIATION

QUALITATIVE DATA

- Dose
- Duration
- Tissue Type

EXAMPLE

Irradiating the Central Nervous System → Increased Timing of Puberty → Potential for Benign Tumor on the Pituitary Gland

QUANTITATIVE DATA

>2 Gy to the testes

Irreversible
aspermia may occur

>15 Gy to the testes

Function of Leydig cells
can be interrupted or
completely diminished

4 Gy in women <40

30% chance of
sterility

4 Gy in women >40

100% chances of
sterility

(Ogilvy-Stuart & Shalet, 1993)

07

PREVENTATIVE MEASUSRES

SHIELDING STUDY

METHODS

- Routine abdominopelvic CT exam
- 34 male subjects **with** gonadal lead shielding
- 32 male subjects **without** gonadal lead shielding
- In no part of the study were the testes in the primary beam of radiation

RESULTS

- Testicular dose was recorded using thermoluminescent dosimetry
- Factors such as weight and body mass index were considered

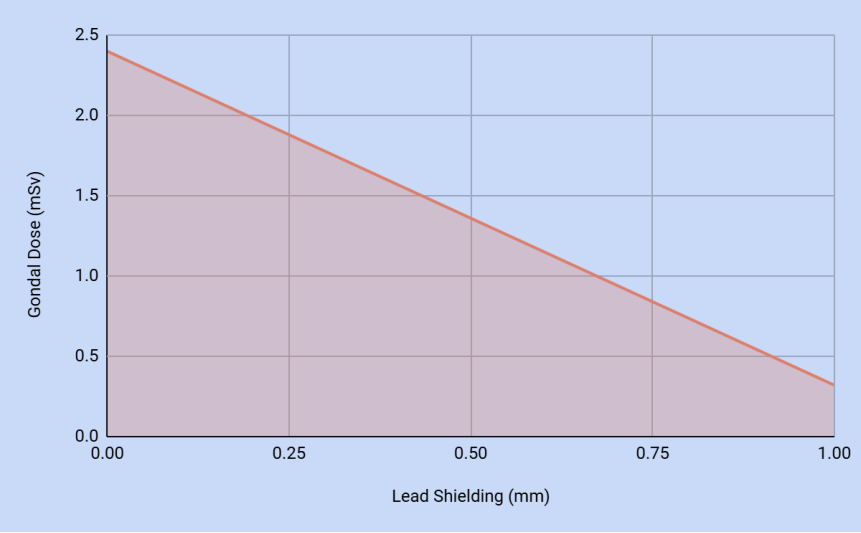
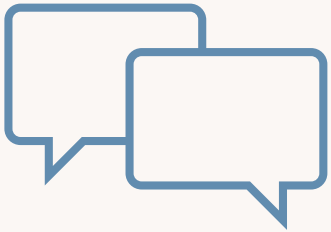


Figure 1. The results are illustrated above. An average decrease of 87% in gonadal dose was documented in the male subjects who were properly shielded with gonadal lead shielding.

(Hohl et al., 2005)

WE NO LONGER SHIELD, WHAT ELSE CAN WE DO?



- COLLIMATE
- PROPER POSITIONING
- GOOD COMMUNICATION WITH PATIENTS
- BE KNOWLEDGEABLE OF POSITIONING ALTERNATIVES
  - Performing any exam PA rather than AP can decrease gonadal dose by 50%

08

ADVANTAGE OF RADIATION

THREE IDEAS

HYSTEROSALPINGOGRAM (HSG)

- Ensures fallopian tubes are open
- Checks for any blockages
- In some cases, can clear a blocked tube

(myUpchar English, 2021)

DIAGNOSTIC CT SCANS

- Used to detect tumors or other abnormalities in the reproductive system
- Faster and better diagnosis for patient

MAMMOGRAMS

- Looks for abnormalities in the breast tissue
- Routine exams can detect breast cancer early
- Less dosage than a typical x-ray

09

CONCLUSION

OUR FINDINGS

VULNERABILITY

- From a medical standpoint, radiation is known to be a reproductive hazard
- The reproductive organs are most vulnerable at the prepubertal age
- Radiation is still very damaging to adult reproductive organs

IMPACTS OF RADIATION - POSITIVE & NEGATIVE

- Negative:
  - Temporary or permanent infertility
  - Miscarriages
  - Altered puberty timeline
- Positive:
  - HSG
  - CT Scans
  - Mammograms

PREVENTATIVE MEASURES

- Shielding
- Collimation
- Proper positioning
- Communication
- Positioning Alternatives

RESOURCES

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RESOURCES CONT'D

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