

# **Biochemistry of biological fluids (BIOCH 472)**

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**Class 13:**

**Semen**

# Objectives for this lecture

- State the structures involved in sperm production and their function.
- Describe the normal appearance of semen and abnormalities in appearance.
- State the parameters considered when evaluating sperm specimen.

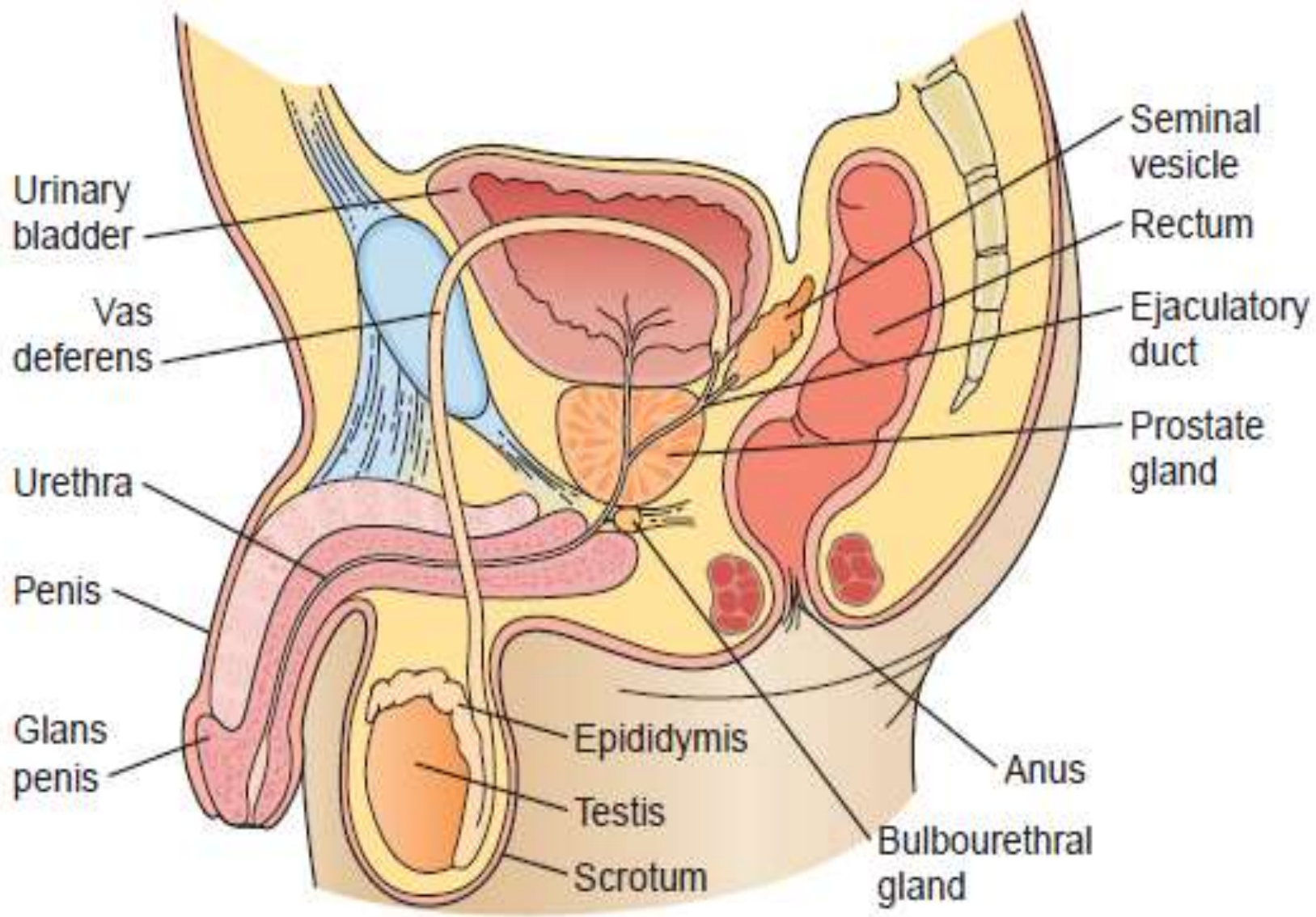
# Semen

- Semen analysis for:
  - ✓ Fertility to have children.
  - ✓ Patients with abnormal results need *in vitro fertilization (IVF)* at andrology labs.
  - ✓ Forensic analyses.

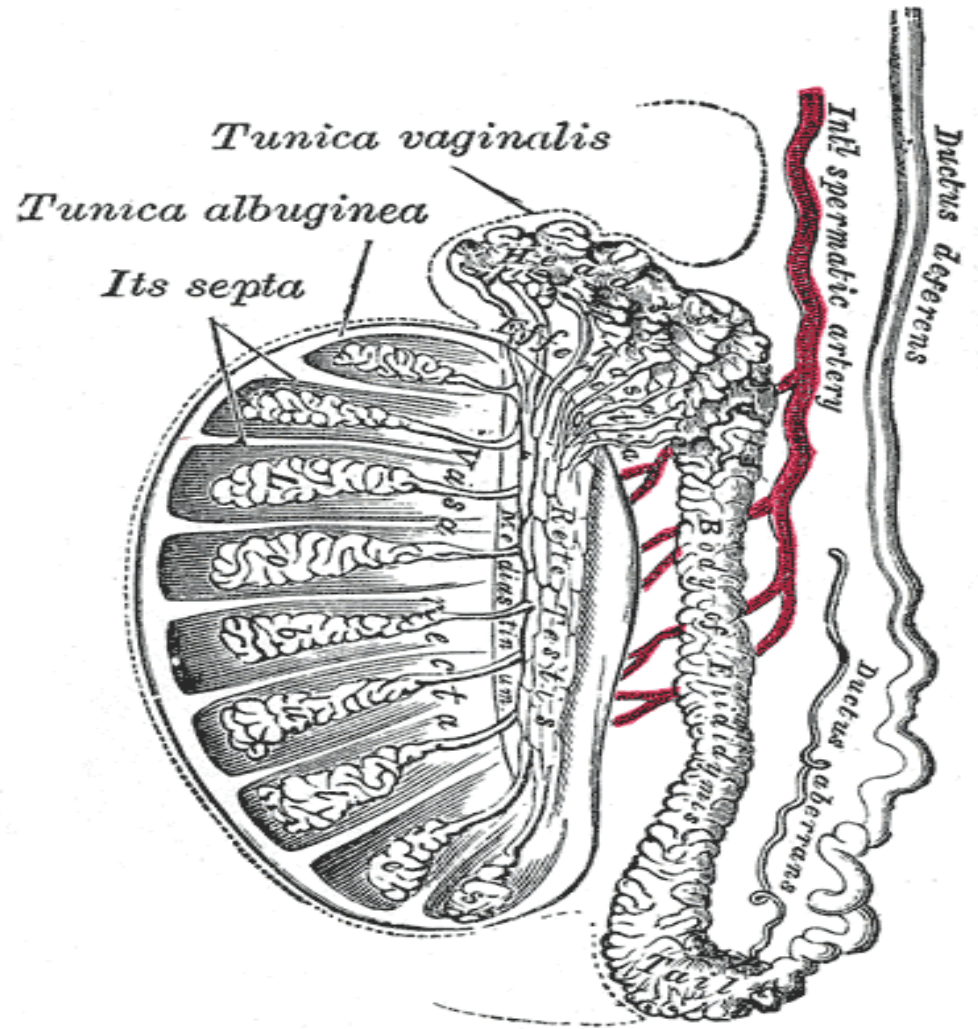
**Jobs**

# Physiology of Semen

- Parts contributed by the testes for Semen:
  1. Spermatozoa 5 %
  2. Seminal fluid 60 %
  3. Prostate fluid 20 %
  4. Bulbourethral glands 5 %



# ***In the Testis:***



## *In the Testis:*

- *Germ cells* located in the epithelial cells of the seminiferous tubules produce **spermatozoa**.
- *Sertoli cells* provide support and nutrients for the germ cells.
- In the *epididymis*, the sperm mature and develop flagella, and stored till ejaculation.



## ***Seminal vesicles :***

- produce the majority of the fluid present in semen (60% to 70%).
- Contains a high concentration of *fructose*.
- fructose is used for the energy needed for the flagella.
- Absence of fructose sperm do not display motility in the semen analysis.

## ***prostate gland:***

- Aids in **propelling** the sperm through the urethra by contractions during ejaculation.
- semen volume is **acidic** fluid produced by the prostate gland.
- acidic fluid contains ***acid phosphatase, citric acid, zinc, and proteolytic enzymes*** responsible for both the ***coagulation*** and ***liquefaction***.

## ***bulbourethral glands:***

- Below the prostate.
- Thick, **alkaline** mucus that helps to neutralize acidity.
- Semen fluid should be alkaline to:
  - ✓ Neutralize the vaginal acidity present from bacterial vaginal flora.
  - ✓ Without this neutralization, sperm motility will diminish.

# Specimen Collection



- After sexual abstinence of from 2 to 3 days to not longer than 5 days.
- prolonged abstinence give higher volumes and decreased motility.
- Use sterile glass or plastic containers.
- Collect in a room provided by the laboratory, by masturbation.
- Or collect in nonlubricant rubber or polyurethane condoms.

# Semen Analysis

- ***Appearance:***
  - gray-white color.
  - musty odor.
  - white turbidity due to WBCs (**infection**).
  - red coloration due to RBCs. (**prostate cancer**).
  - Yellow coloration caused by urine, or abstinence, or medications.
- ***Urine is toxic to sperm, affect motility.***

# Semen Analysis..... *Cont.*

- ***Liquefaction:***
  - fresh semen specimen is clotted.
  - liquefy within 30 to 60 min after collection.
  - Analysis begin after liquefaction occurred.
  - After 2 h, if specimen has not liquified, proteolytic enzymes such as alpha-chymotrypsin may be added.

# Semen Analysis..... *Cont.*

- ***Volume:***
  - Normal between 2 and 5 mL
  - Increased volume seen in abstinence.
  - Decreased is associated with ***infertility.***

# Semen Analysis..... *Cont.*

- **Viscosity :**
  - related to specimen liquefaction.
  - Normal specimen is easily drawn into a pipette and form droplets (**threads**) that do not appear clumped when discharged.
  - Increased viscosity impede sperm motility.



## Semen Analysis..... *Cont.*

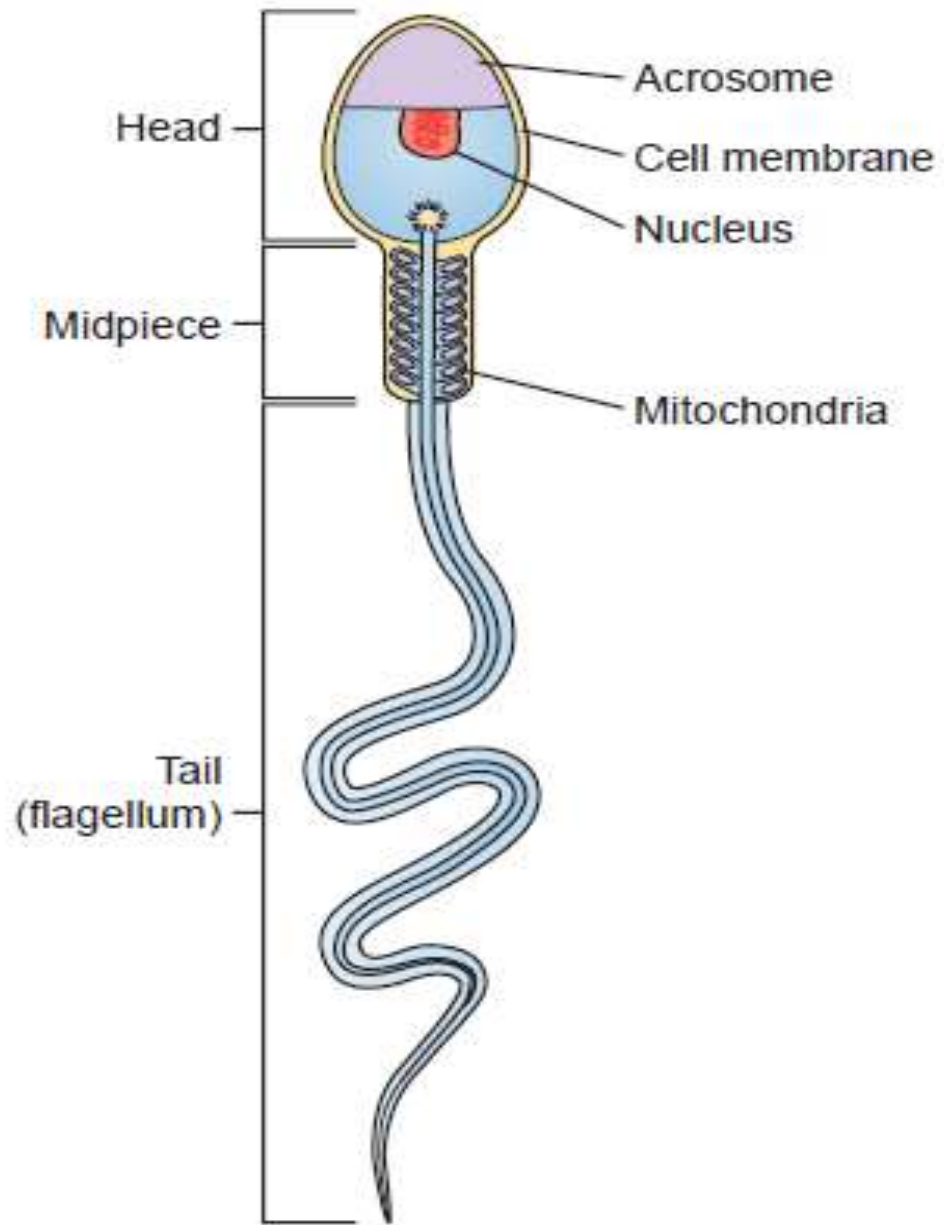
- ***pH :***
  - alkaline with a range of 7.2 to 8.0.
  - increased pH is indicative of infection.
  - decreased pH is due to increased prostatic fluid.

# Semen Analysis..... Cont.

- ***Sperm Concentration/Count :***
  - normal values 10 to 20 million sperm/ mL.
  - dilute semen to immobilizes the sperm.
  - diluting fluid contains sodium bicarbonate and formalin, or saline and water.
  - Only fully developed sperm counted.
  - ***immature sperm cells*** (spermatids) (>1million) caused by viral infections, exposure to toxic chemicals, and genetic disorders.

# Semen Analysis..... *Cont.*

- ***Sperm Morphology :***
  - nonmotile produces infertility.
  - evaluate the structure of head, neckpiece, midpiece, and tail.
  - abnormalities in head cause poor ovum penetration.
  - neckpiece, midpiece, and tail abnormalities affect motility.



**Figure 11-3** Normal spermatozoa structure.



Normal



Double head



Giant head



Amorphous head



Pinhead



Tapered head



Constricted head



Double tail



Coiled tail



Spermatid

# Semen Analysis..... Cont.

- ***Sperm Viability :***

- **abnormal viability:**

- ✓ normal sperm concentration.
- ✓ markedly decreased motility.

- carry eosin-nigrosin stain, and counting:

- ✓ ***Living cells*** remain a bluish white color
- ✓ ***dead cells*** stain red.

- normal viability requires 75% living cells.

# Semen Analysis..... Cont.

- ***Seminal Fluid Fructose :***
  - Low sperm concentration can cause a low to absent fructose level in the semen.
  - normal quantitative level is equal to or greater than 13 mol per ejaculate.
  - Specimens should be tested within 2 hours or frozen to prevent *fructolysis*.

# Semen Analysis..... *Cont.*

- ***Antisperm Antibodies :***
  - detected in semen, or serum (men / women).
  - possible cause of infertility.
  - blood-testes barrier separates sperm from the male immune system.
  - If barrier is disrupted by surgery, ***vasectomy***, trauma, and infection, the immune system damages the sperm.



# Semen Analysis..... Cont.

- ***Microbial Testing :***
  - presence of leukocytes indicates infection within the prostate.
  - Routine aerobic and anaerobic cultures and tests performed.
  - *Chlamydia trachomatis*, *Mycoplasma hominis*, and *Ureaplasma urealyticum*.

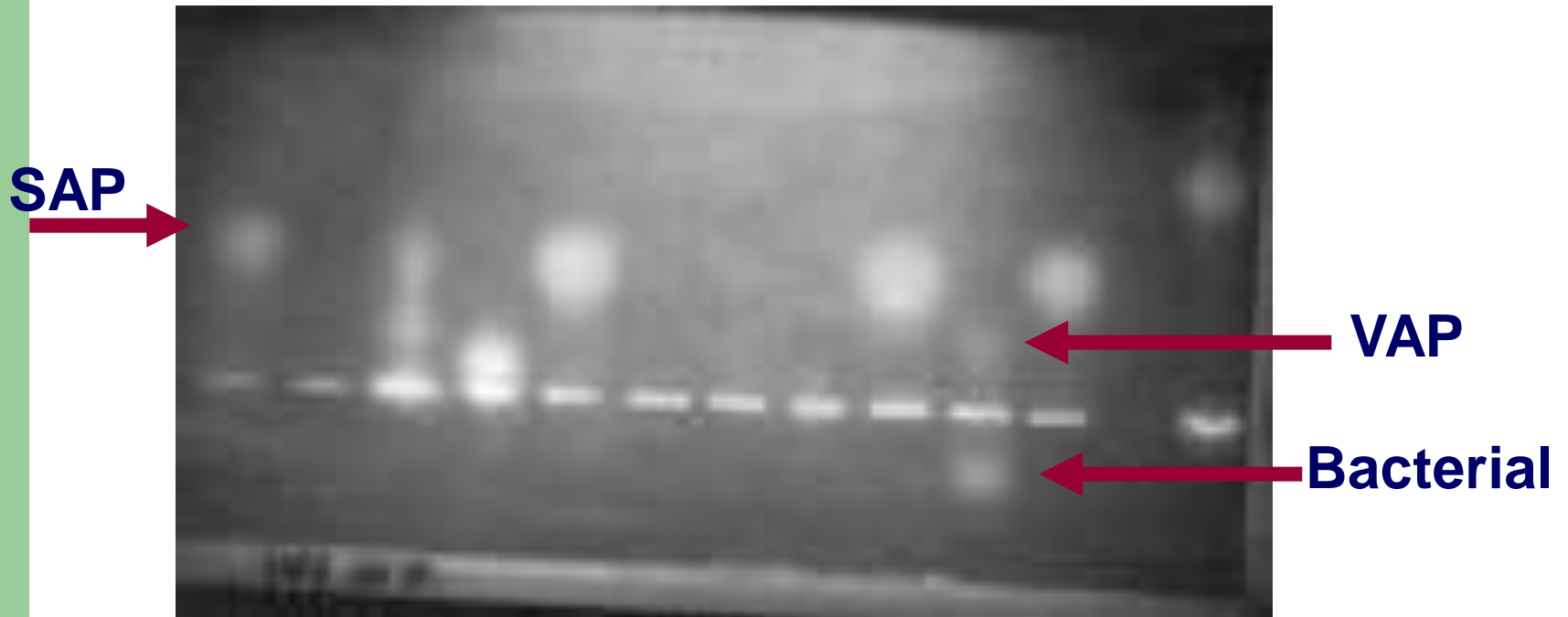
# Semen Analysis..... *Cont.*

- ***Chemical Testing :***
  - Determine the levels of:
    - ✓ neutral –glucosidase
    - ✓ Zn, citric acid, prostatic acid phosphatase.
  - Decrease indicate:
    - ✓ disorder of the epididymisa
    - ✓ Lack of prostatic fluid
  - **acid phosphatase** detection in sample for **rape**.

# Semen Analysis..... *Cont.*

- ***Sperm Function Tests :***
  - functional ability for reproduction and IVF.
  - specialized andrology laboratories:
    - ✓ hamster egg penetration assay.
    - ✓ cervical mucus penetration test.
    - ✓ hypo-osmotic swelling test.
    - ✓ in vitro acrosome reaction.

# SAP/VAP Electrophoresis



Laboratory Technique for Separating Seminal from Vaginal Acid Phosphatase