

FEMALE PELVIS:

**Gross, Cross-Sectional &
Sonographic Anatomy of the
Female Pelvis;
its Physiological & Anatomical
Changes with ag, cycle & early
Gestation**

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At the end of the classroom activities, the student should be able to:

1. Describe the bony components of the female pelvis.
2. Enumerate the constituents of the pelvic brim and the pelvic outlet.
3. Vividly describe the different shapes of pelvis and their clinical implications.
4. Itemize the ligaments and muscles of the pelvis, and describe the functions of these.
5. Give a brief description of importance of radiographic and sectional anatomy in ultrasonography , with particular reference to pelvic anatomy.
6. Briefly describe the development of the zygote up to implantation, and appreciate the simultaneous changes in the endometrium, zygote and ovary.
7. Account for the anatomical & physiological changes in menstrual cycle.
8. Describe the anatomical and physiological changes in pregnancy, especially relating to the pelvic anatomy.

Outline of Classroom Activities

1. Broad Division of Pelvic Anatomy
2. Ossification of the hip bone
3. Pelvic Brim, Pelvic Outlet, Pelvic Canal
4. Pelvic Shapes
5. Pelvic Ligaments
6. Pelvic Diaphragm
7. Pelvic Walls
8. Sectional & Sonographic Anatomy
9. Endometrium & Menstrual Cycle
10. The Developing Human
11. Changes in Female Anatomy in Gestation
12. Changes in Female Physiology in Gestation

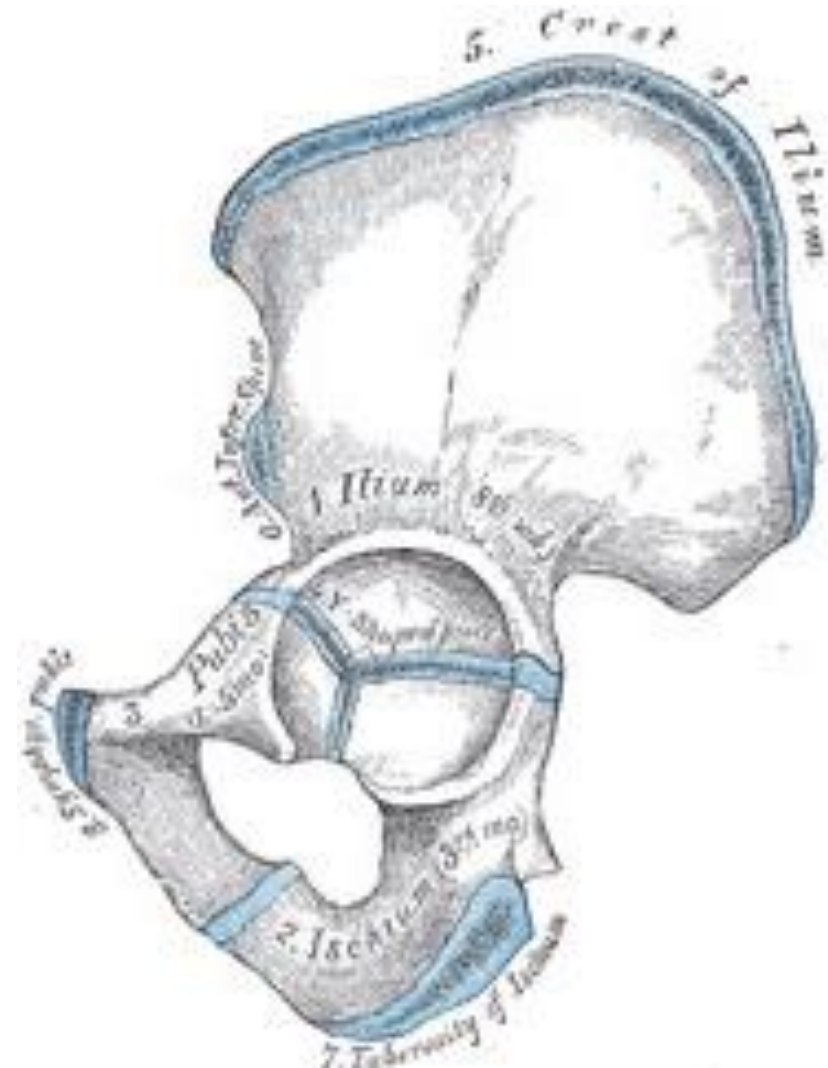
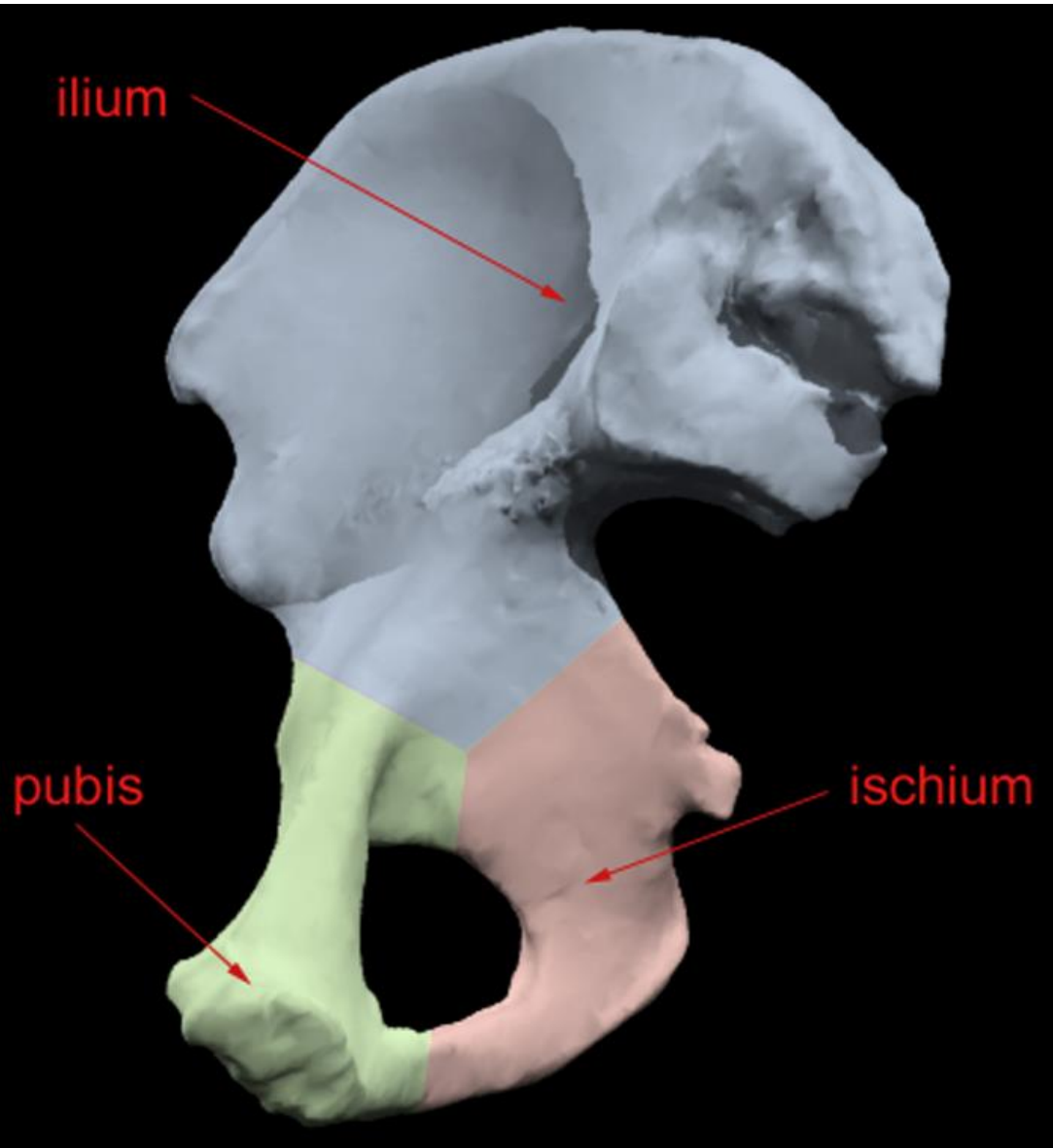
Pelvic Anatomy

- A. Solid part : Pelvic bone**
- B. Soft part : Pelvic ligaments & muscles**

Pelvic Bone

- **2 Innominate bone :**
 - **Ilium**
 - **Ischium**
 - **Pubic**
- **Sacrum**
- **Coccyx**

- The hip bone is originally made up of 3 bones

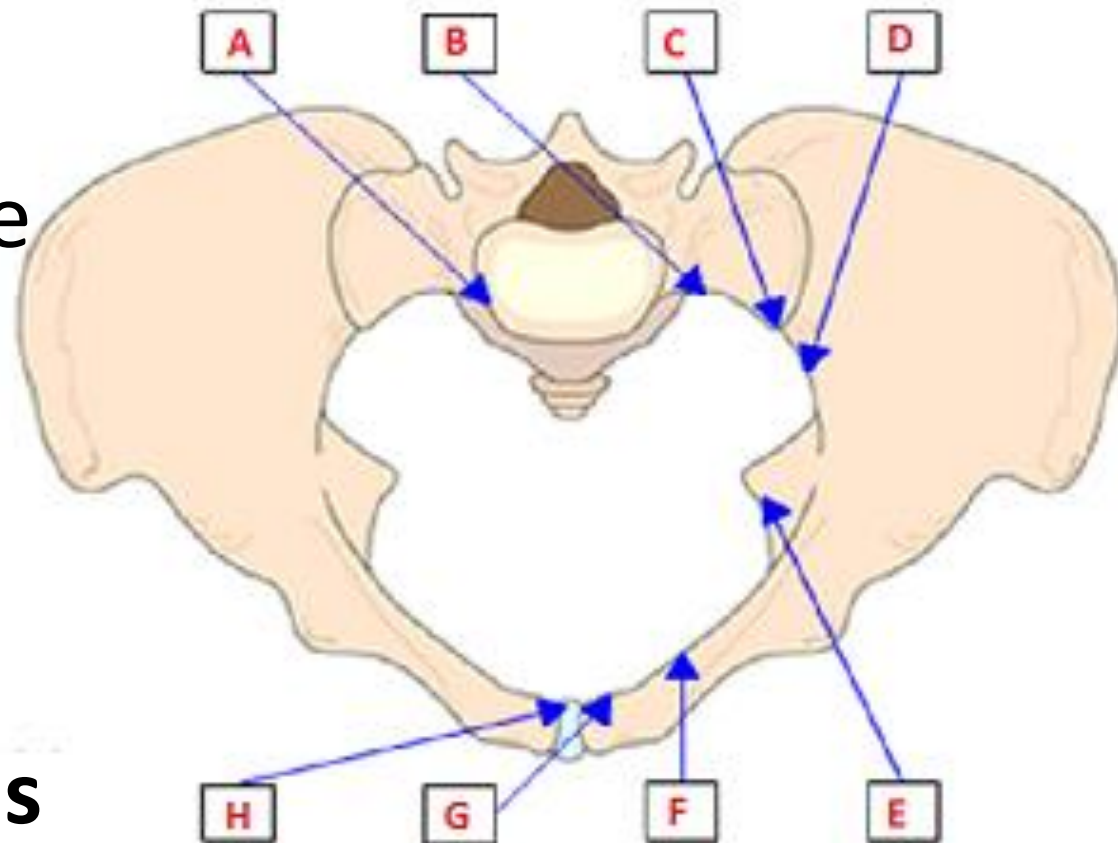


Class Discussion on Implication Ossification of Hip Bone

- At birth, these 3 component bones are separated by hyaline cartilage
- They join each other in a Y-shaped portion of cartilage in the acetabulum
 - **When do these composite bone approximate?**
 - **When is fusion completed?**

Pelvic Brim...1

- **Sacral promontory, ala of sacrum, arcuate line of the ilium, iliopubic eminence, pectineal line of pubis, pubic crest & symphysis pubis**



Pelvic Brim...2

- It is the inlet of the pelvis which divides the pelvic cavity into false & true pelvis
- No muscle crosses the pelvic brim.
 - Discuss the clinical implication of this
- The plane of the brim is 55-60 ° above the horizontal

The inlet has its longest dimension from side to side, whereas at the outlet the longest dimension is anteroposteriorly

The upper sacrum is stabilized by the iliolumbar ligaments via its attachment to the 4th & 5th lumbar vertebra & the lower sacrum by the sacrospinous & sacrotuberous ligaments attachments to the posterior iliac spines & ischial tuberosities

Pelvic Brim...4

- The brim is oval in shape:
 - Anteroposterior diameter (true conjugate)
~11.25-11.5 cm
 - Transverse diameter ~12.5-13.5 cm

Pelvic Outlet

- Lower border of the symphysis pubis, ischial tuberosities & tip of the coccyx
- The subpubic arch has an angle of $\sim 85^\circ$

Pelvic Cavity/Canal

- The pelvic canal is curved , the post wall is longer than the anterior
- The most roomy zone with almost round shape
TD ~13.5 cm
APD ~12.5 cm

PELVIC SHAPE...1

1-GYNECOID

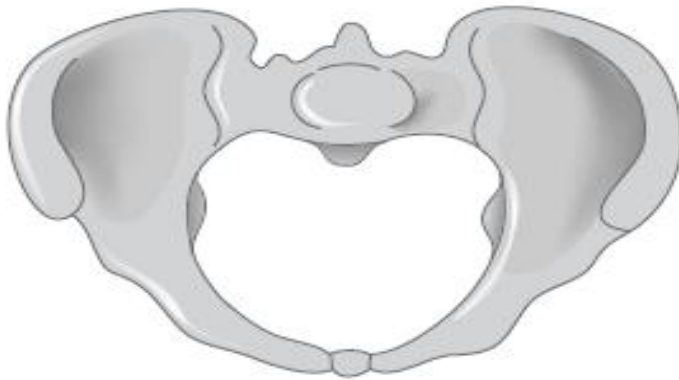
- Typical female pelvis found in 50% of women
- Rounded—slightly oval inlet
- Straight pelvic sidewalls with roomy pelvic cavity
- Good sacral curve
- Ischial spines are not prominent
- Pubic arch is wide



(a) Anthropoid



(b) Platypelloid or flat



(c) Gynaecoid



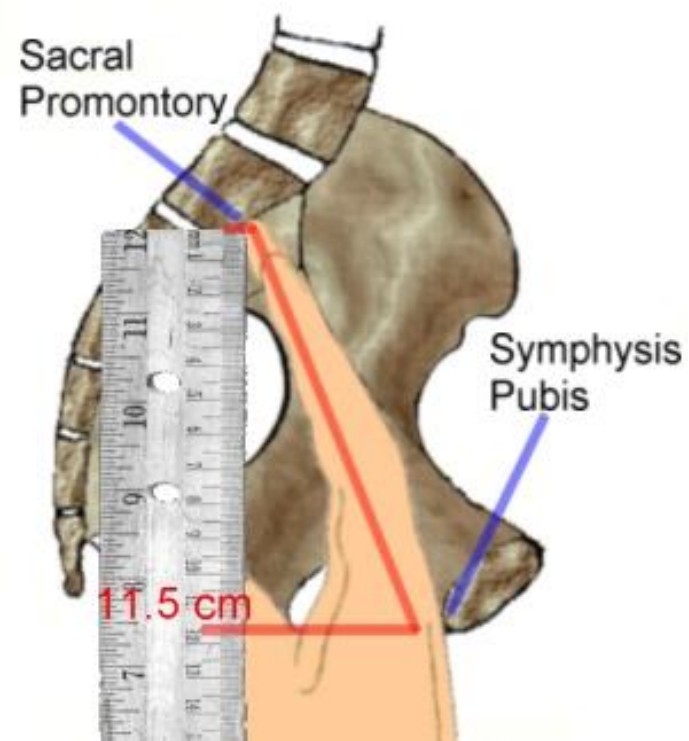
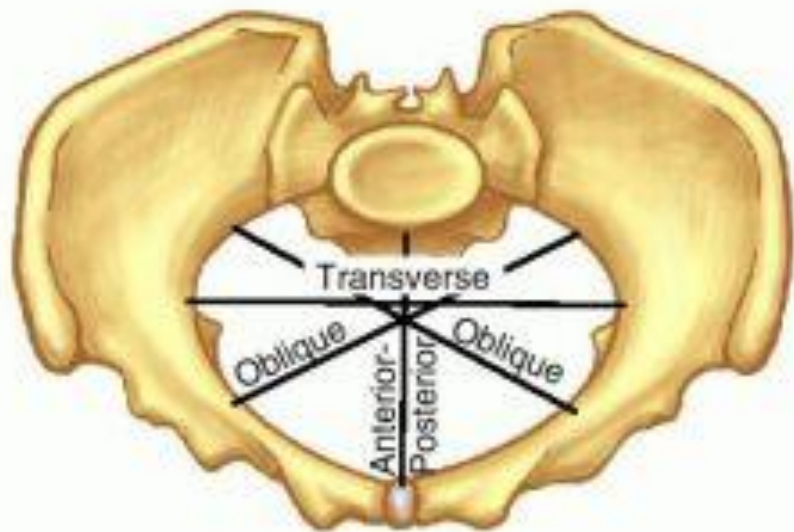
(d) Android

The ideal or gynaecoid pelvis is recognised by its well-rounded oval inlet and similarly uncluttered outlet

PELVIC SHAPE...3

2-ANDROID

- Typical male pelvis found in 1/3 white women 1/6 non-white
- Pelvic brim is heart shaped
- Pelvis funnels from above downwards (convergent sidewalls)
- Narrow pubic arch
- Prominent spines



PELVIC SHAPE...5

3-ANTHROPOID

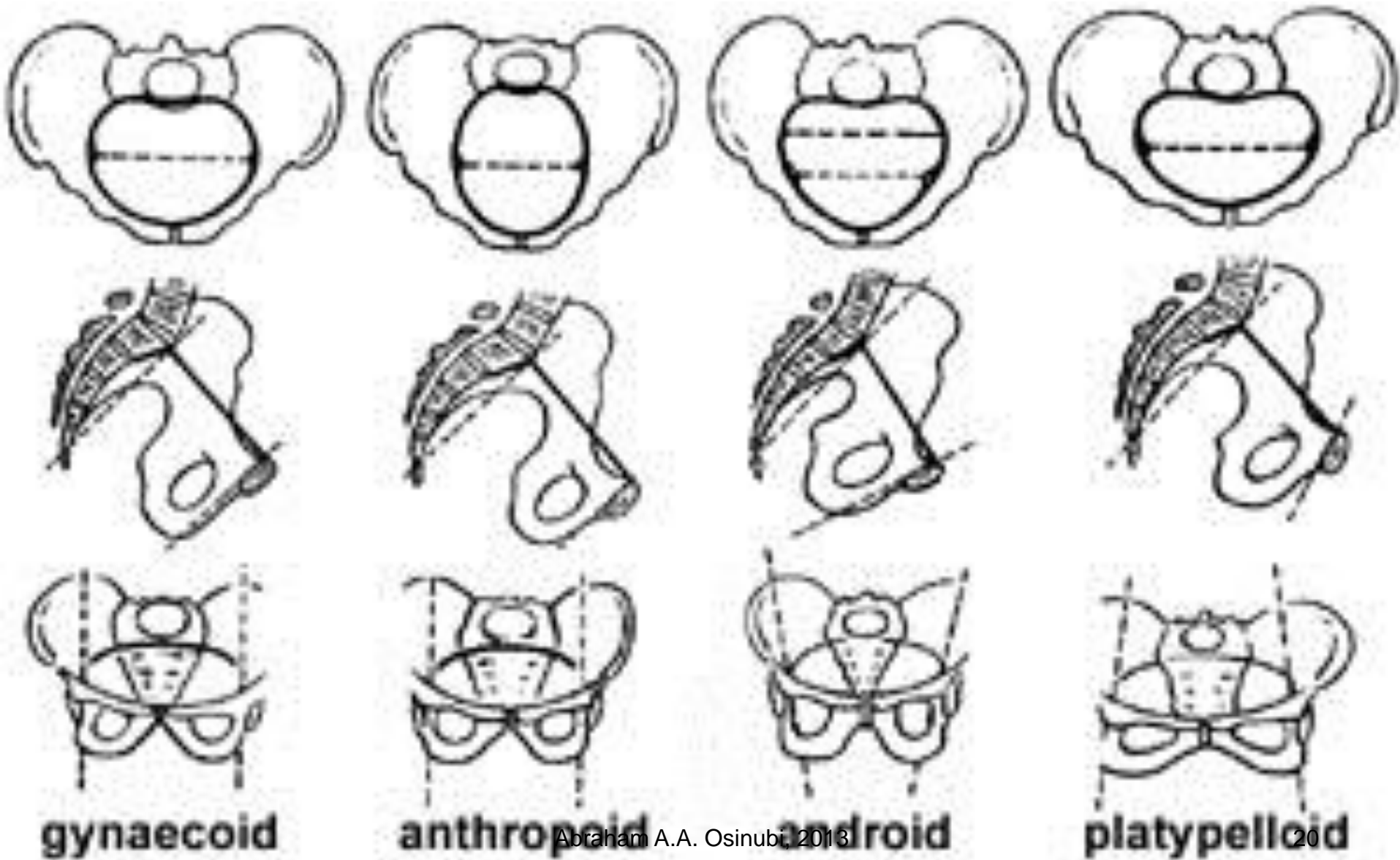
- 25% white women & 50% nonwhite
- Pelvic brim APD > TD
- Long & narrow pelvic canal with long sacrum
- Straight pelvic sidewalls

PELVIC SHAPE...6

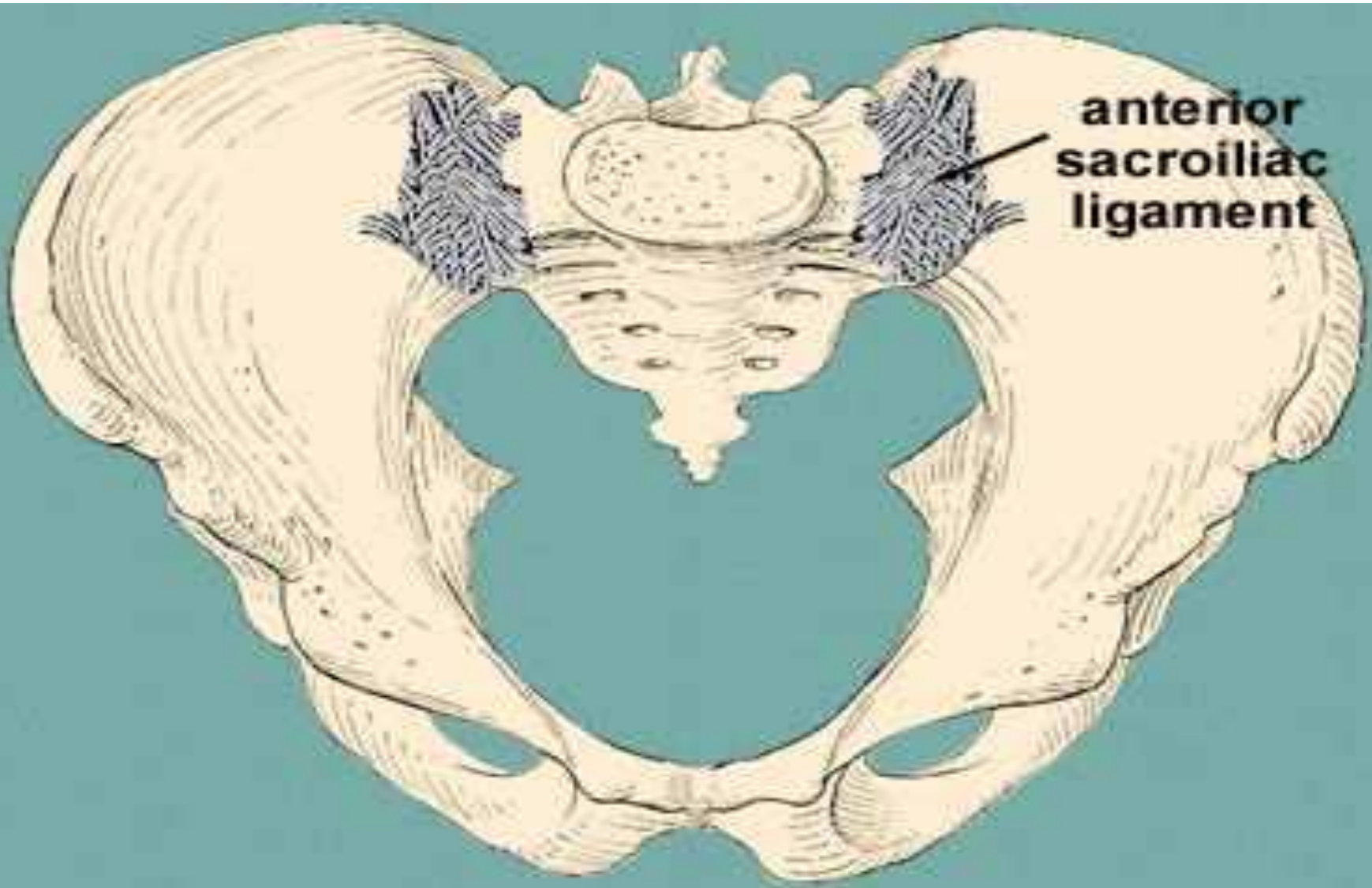
4-PLATYPELLOID

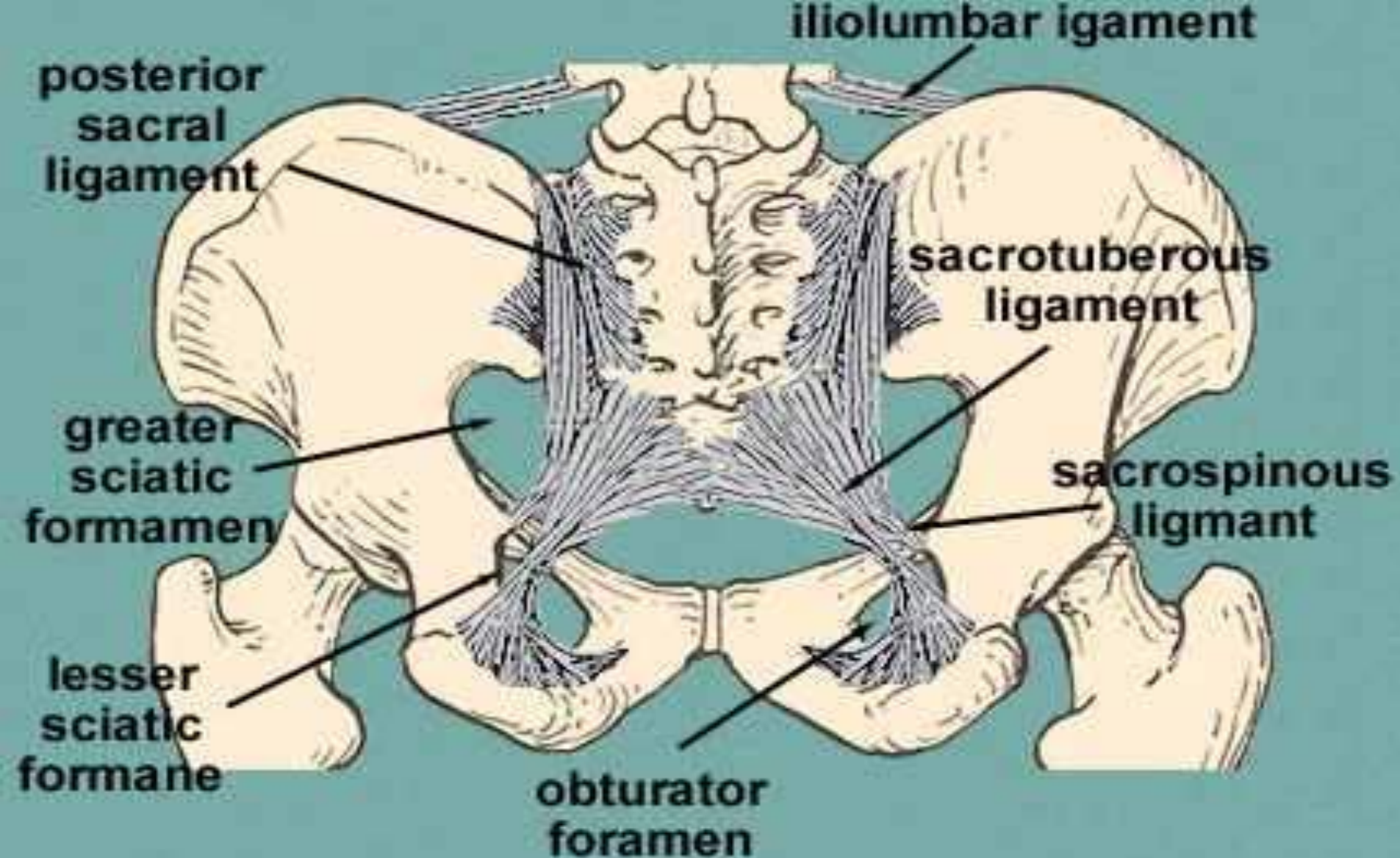
- 3% of women
- Pelvic brim TD >>>APD ➡ kidney shape
- Sacral promontory pushed forwards

Pelvic Shape



Ligaments of the Pelvis





The sacrotuberous and sacrospinous ligaments complete the greater and lesser sciatic foraminae

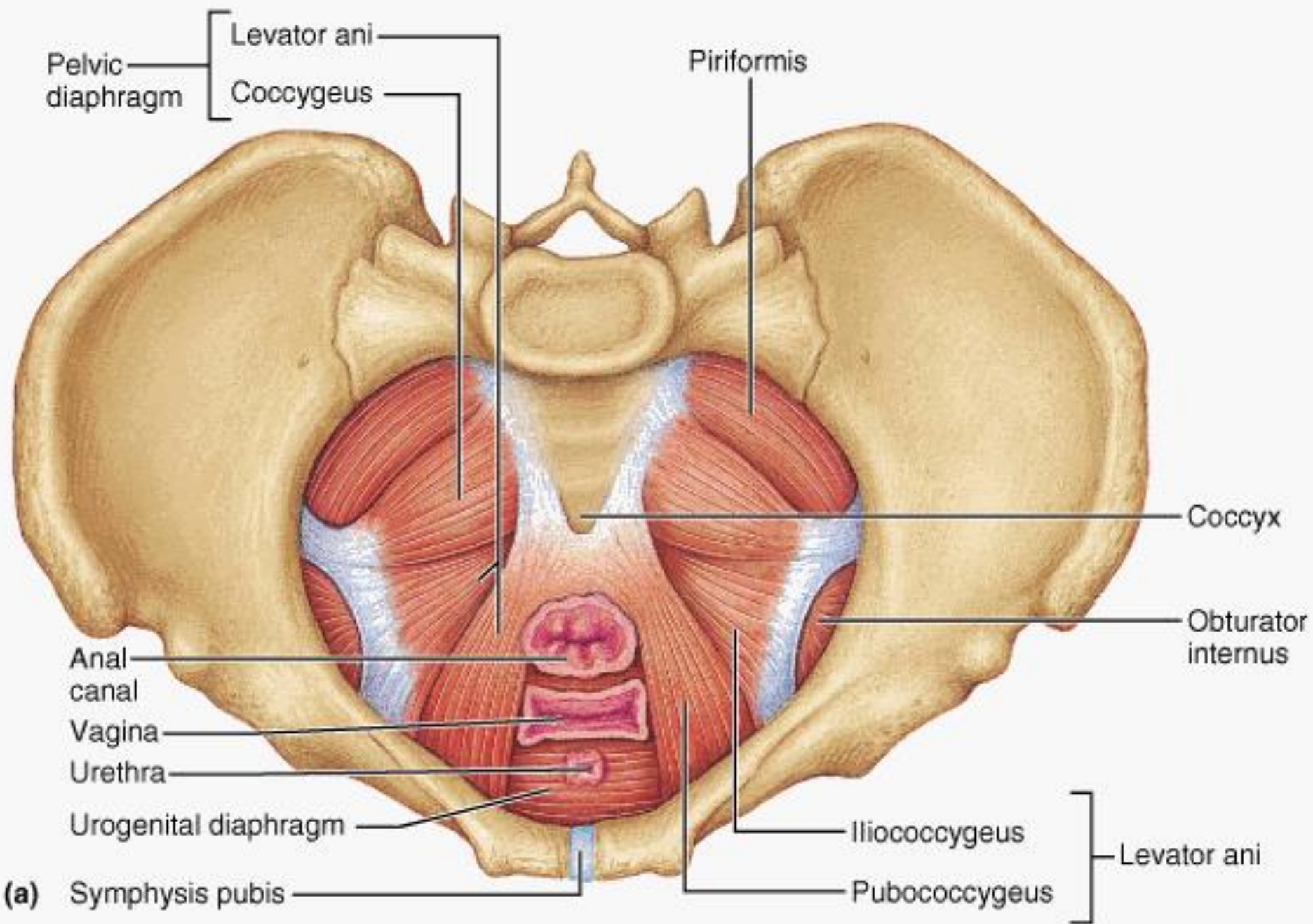
PELVIC DIAPHRAGM

- Fibromuscular funnel-shaped septum that forms the floor of the pelvis.
- Separates pelvis from the perineum.
- Supports contents of the pelvis.
- Perforated
 - in male by urethra & anal canal
 - in female by vagina & anal canal
- Divided into 2 halves- right & left halves

Components of Pelvic Diaphragm

- Consists of superior fascia, muscle and inferior fascia
- Muscle fibres slope downwards & backwards to midline forming a gutter-shaped floor.
- They have a continuous linear origin from the posterior surface of the body of pubis in front across the white or tendinous arch of the obturator fascia to the spine of ischium and from one lateral wall to the other.

- The muscle consists of the levator ani (LA) and coccygeus muscles.
- LA consists of 2 parts:
 - Pubococcygeus (PC)-main part
 - Iliococcygeus- posterior part of LA
- Therefore, LA & coccygeus may be regarded as one morphological entity divided into
- Pubococcygeus
- Iliococcygeus
- Ischiococcygeus



The puborectalis is actually a part of the pubococcygeus muscle that wraps around the posterior aspect of the rectum forming a sling that holds the rectum forward in the pelvis.

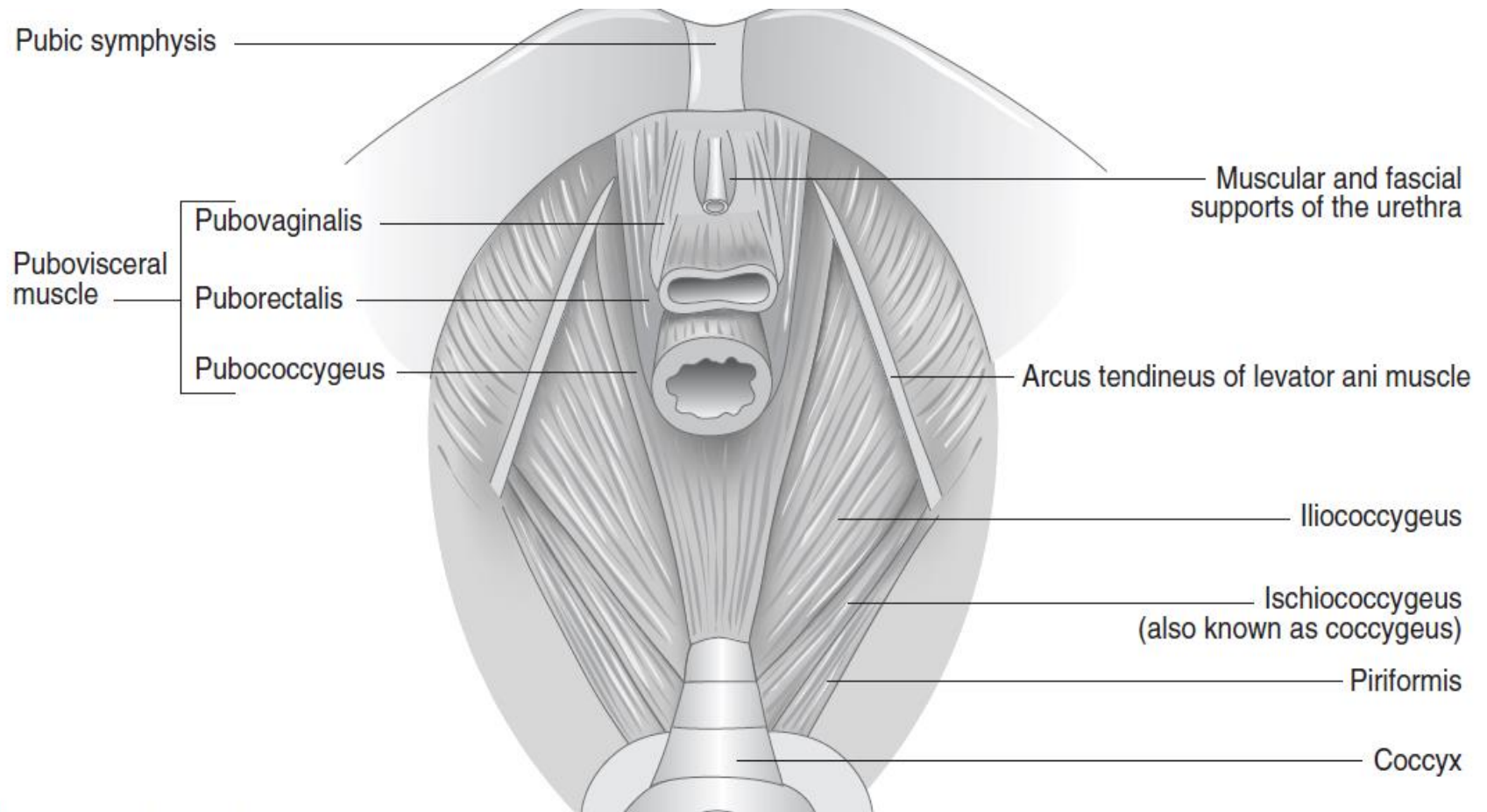
The pubococcygeus and iliococcygeus muscles make up the levator ani. The muscles of the levator ani are important supportive muscles for the midline organs of the pelvis. Any weakness in these muscles can cause clinical problems of urinary or fecal incontinence.

Levator ani muscles /pelvic diaphragm/pubovisceralis are composed of striated muscle fibre. They are covered by fascia on their superior & inferior aspects

The anterior midline cleft in the muscles is known as the urogenital hiatus, through which the urethra, vagina & anorectum pass

Perineal membrane/urogenital diaphragm/triangular ligament. Lies inferior to levator ani & attaches the edges of vagina to the ischiopubic ramus, provides lateral attachments for the perineal body and assists in the support of the urethra. Probably has a greater supportive function when the levator ani muscles are relaxed

Arcus tendineus fascia of pelvis (ATFP) is a linear fascial thickening of the obturator fascia attached anteriorly to pubic bone & posteriorly to ischial spine & is believed to be of great importance in the continence mechanism



- **The perineal body is a central cone-shaped fibromuscular structure which lies just in front of the anus.**
- **The cone is about 4.5 cm high and its base, which forms part of the perineum, is approximately 4 cm in diameter. Anteriorly it fuses with the vaginal wall, the superficial transverse perineal muscles, the perineal membrane and the levator ani muscles insert into it.**
- **Perineal body also affords support to the posterior wall of the vagina.**

- **Integrity of the perineal body and its connections have been thought to be of considerable importance in the supportive role of the pelvic floor.**
- **This explains the concern that obstetricians have had for the welfare of the perineal body in labour, particularly in the second stage when, toward delivery, the pelvic floor stretches considerably & provides a gutter to guide the foetal head towards and down the birth canal.**

Plevic Walls

Anterior wall

- Bodies & Rami of pubis & pubic symphysis

Lateral walls

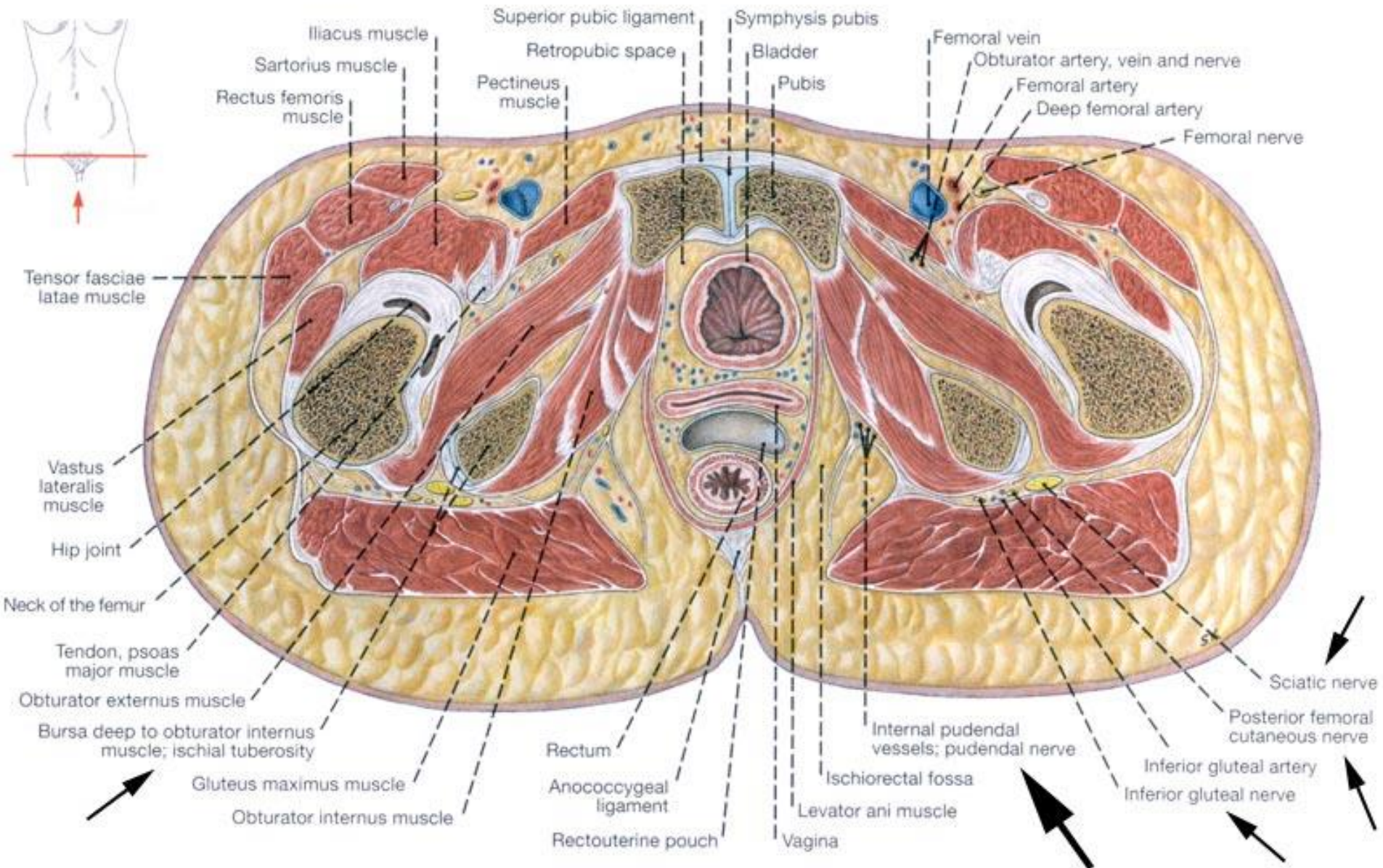
- Pelvic bone, Obturator internus muscle & fascia

Posterior wall

- Sacrum, Piriformis

- **Sectional & Sonographic Anatomy**

Full Pelvis Cross Section, Horizontal, Female



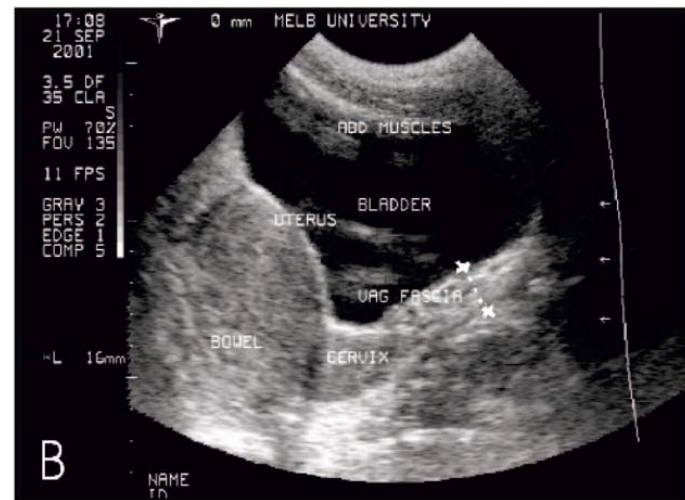
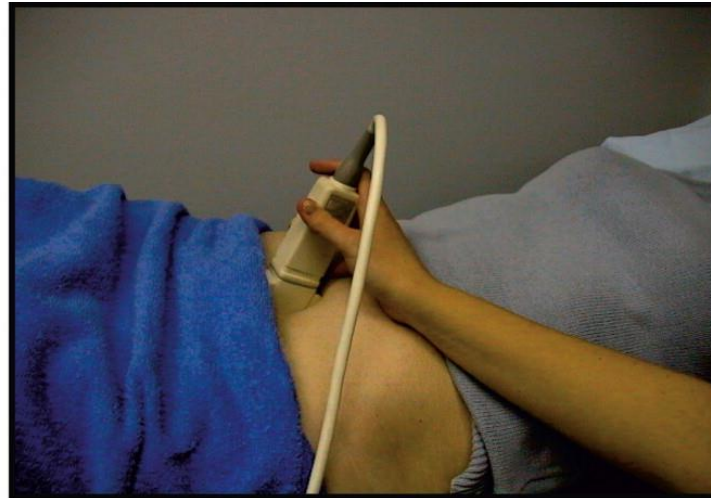
Level 2(II) Ultrasound

- The more-detailed level 2 sonogram/**high resolution ultrasound** (also called an **anatomy scan**) is typically performed between 18 and 22 weeks

Ultrasound and MRI

- Real-time diagnostic ultrasound & MRI have been used to evaluate PFM action during contraction
- Ultrasound can be performed either with the probe placed suprapubically or at the perineum (curved-array ultrasound probe, 3.5 and 5 MHz, and vaginal probe, 7.5 MHz) or with the probe inserted into the vagina or rectum (linear or end-firing probe, 5 and 7.5 MHz)
- MRI can be conventional (2-dimensional image acquisition), ultrafast image acquisition, or 3-dimensional image acquisition

Ultrasonography applied suprapubically.



Bø K , and Sherburn M PHYS THER 2005;85:269-282

Apparatus with multiple functions: measurement of pelvic-floor muscle function with surface electromyography and vaginal and rectal squeeze pressure (Enraf Nonius International, 2600 AV Delft, the Netherlands).



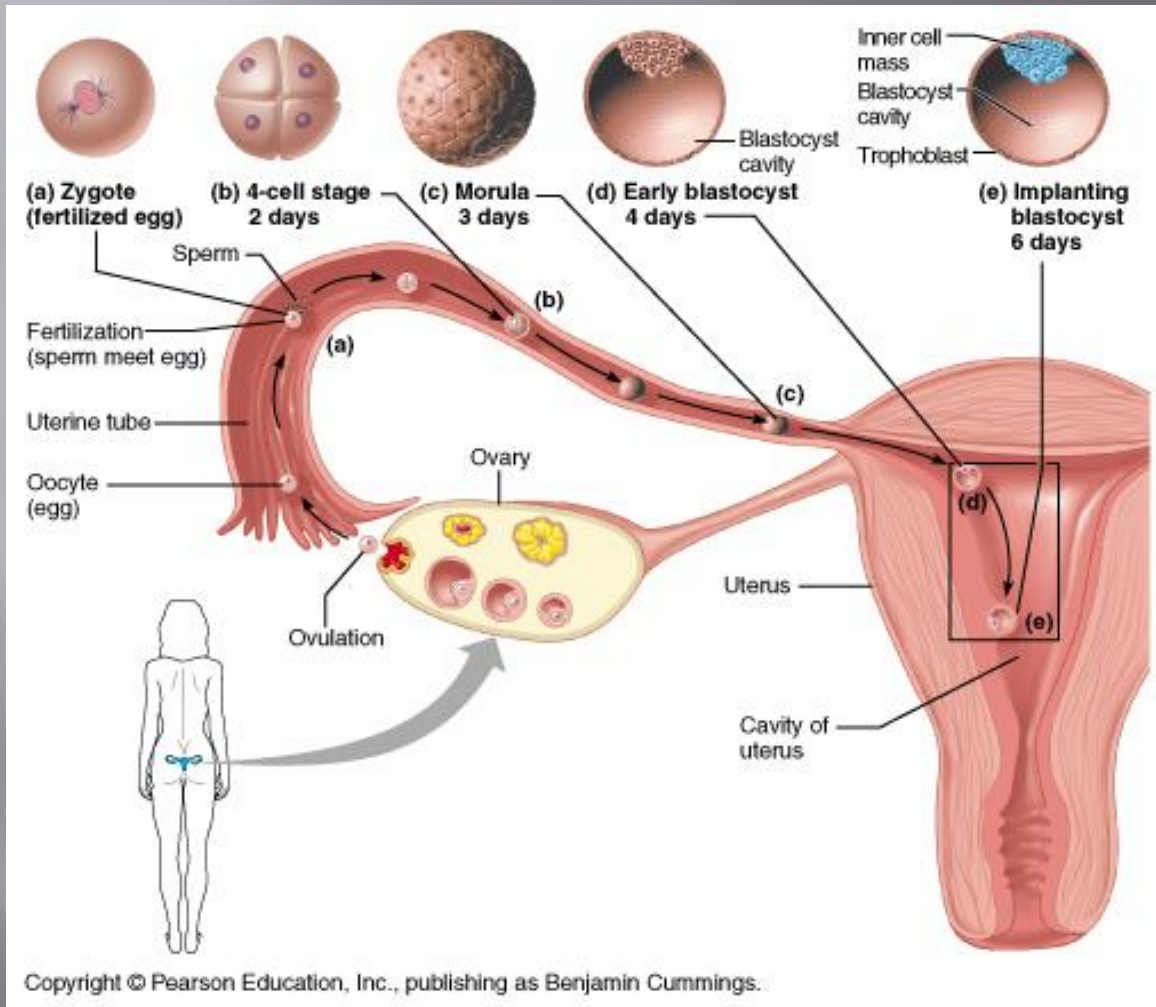
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Level 3 Ultrasound

- Capable of picking up very slight changes & abnormalities in foetus; Women >35 years
- Risk of having child with Down's syndrome &/or other chromosomal abnormalities goes up with age
- Risk of having a child with Down's Syndrome at age 20 is $\sim 1/1667$, risk of any chromosomal abnormality is $1/526$; **At age 35 risk of Down's syndrome goes up to $\sim 1/385$, & risk of any chromosomal abnormality is $1/192$**
- Amniocentesis, Alpha-fetoprotein, HCG levels, Serum Estradiol levels

• **CHANGES IN PREGNANCY**

First week of development

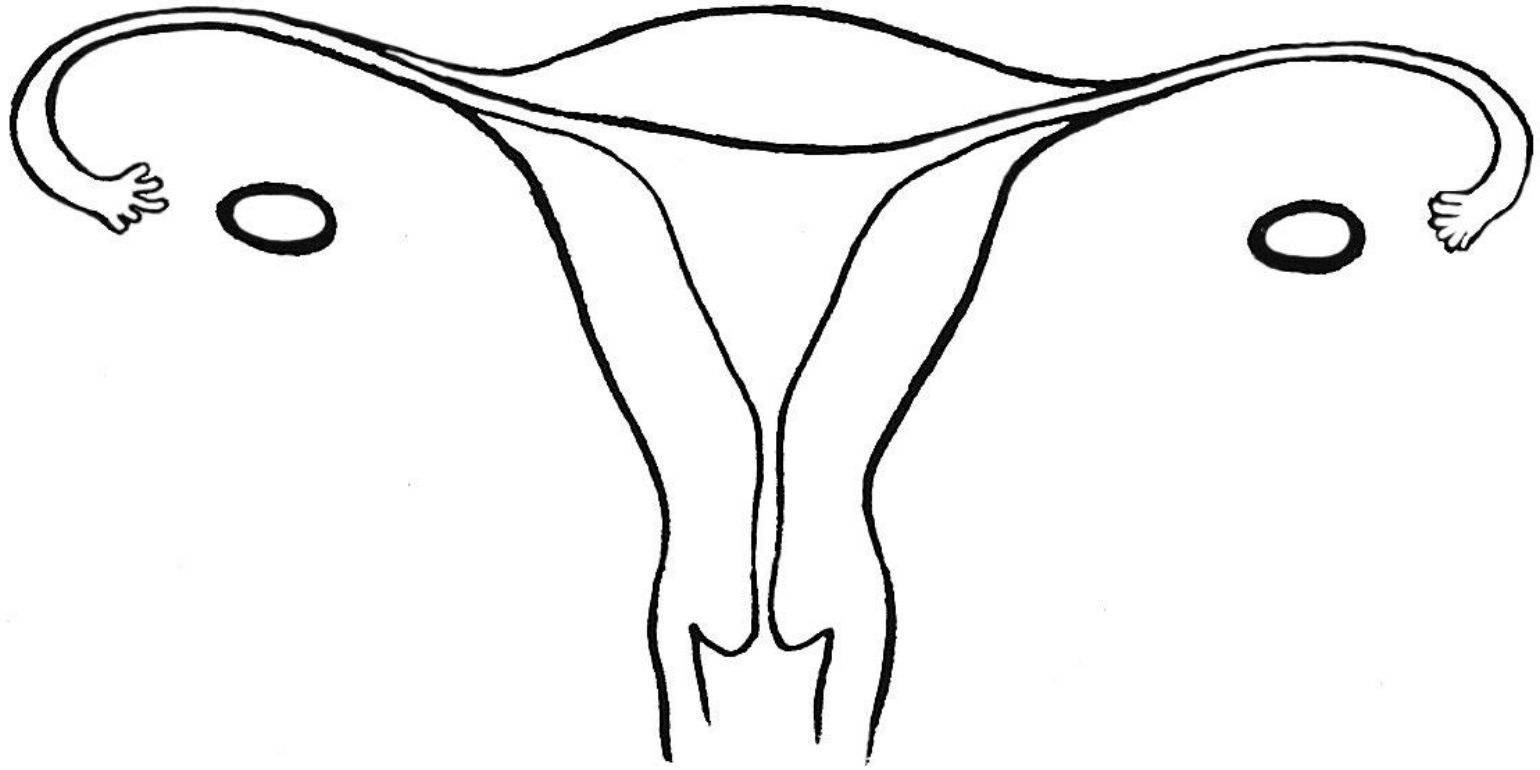


From
oocyte to
blastocyst

Oocyte → (fertilization) → zygote → 4-cell stage (2 days) → morula → blastocyst → inner cell mass (embryo)

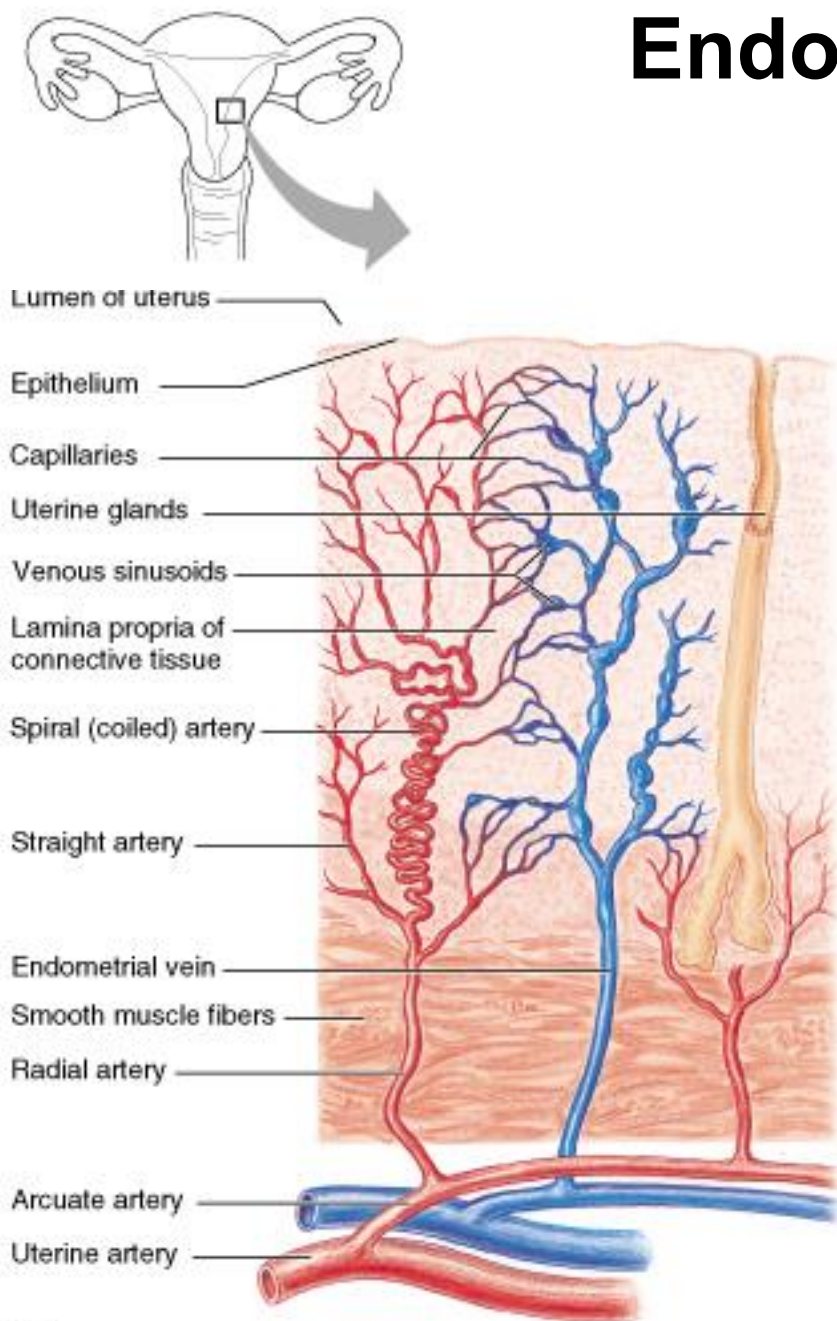
→ Trophoblast (extraembryonic membranes)

Implantation



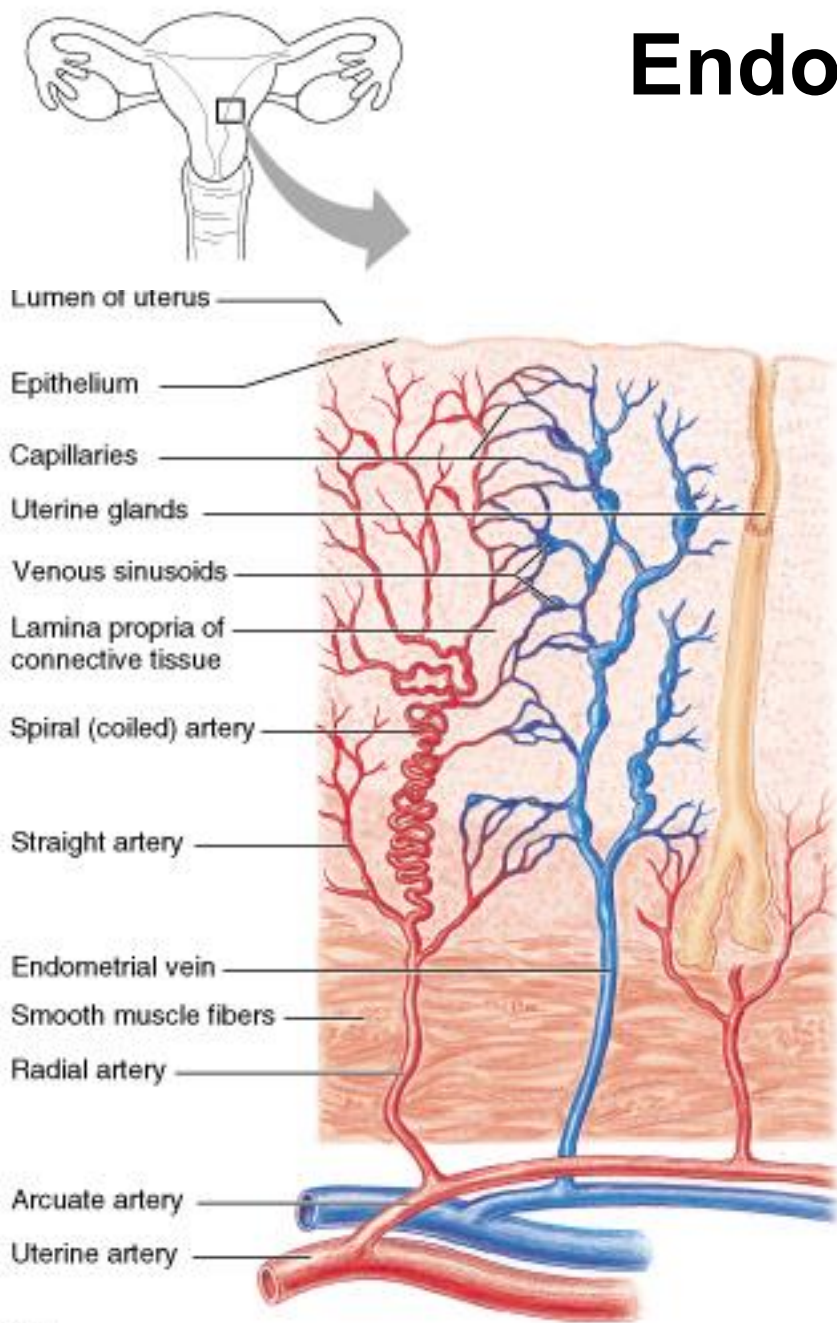
- ▶ Endometrium ready for implantation
- ▶ Blastocyst implants with ICM against uterine wall
- ▶ Ectopic pregnancy--implantation outside built-up endometrium (potential for bleeding since embryo stimulates vascularization)

Endometrium...1



- ▶ Two layers
 - Stratum basalis
 - Stratum functionalis
- ▶ Stratum functionalis builds up each month in response to ovarian hormones
- ▶ Uterine glands secrete glycoproteins-- nutrients for potential zygote--into uterine cavity

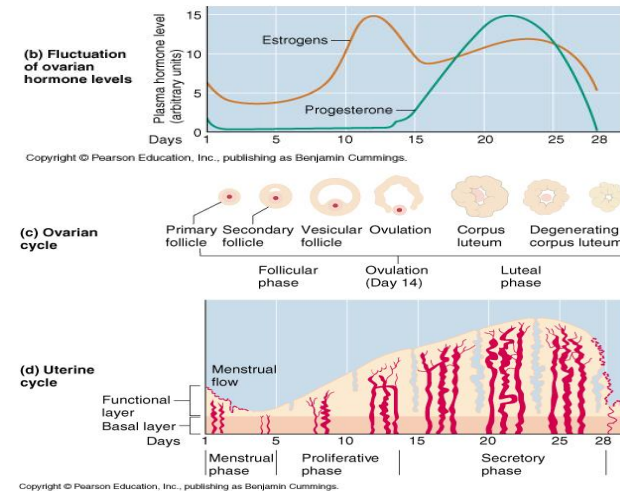
Endometrium...2



- ▶ At menstruation, functional layer self-digests, spiral arteries kink & constrict; cells die.
- ▶ Just before menstrual flow starts, spiral aa. open wide, capillaries burst and functional layer sloughs off.

- ▶ Menstrual Phase (Days 1–5): Sloughed Functional layer of endometrium expelled through vagina as menstrua flow
- ▶ Proliferative phase (Days 6–14): In response to estrogen from growing ovarian follicle, new functional layer elaborates
- ▶ Ovulation (about Day 14)

Endometrium and menstrual cycle



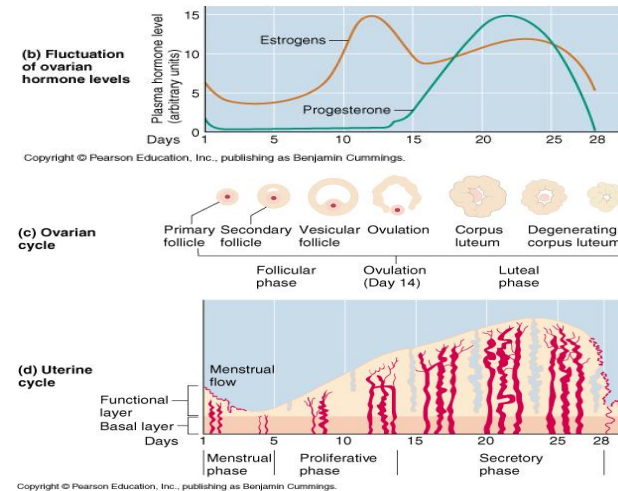
▶ Secretory phase (Days 15–28):

- Spiral aa. Elongate and coil
- Uterine glands secrete glycoproteins
- More estrogen (and progesterone) from corpus luteum

▶ If pregnancy, secretory phase continues due to embryonic estrogen production

▶ If no pregnancy, corpus luteum degenerates, estrogen drops leading to menstruation

Endometrium and menstrual cycle

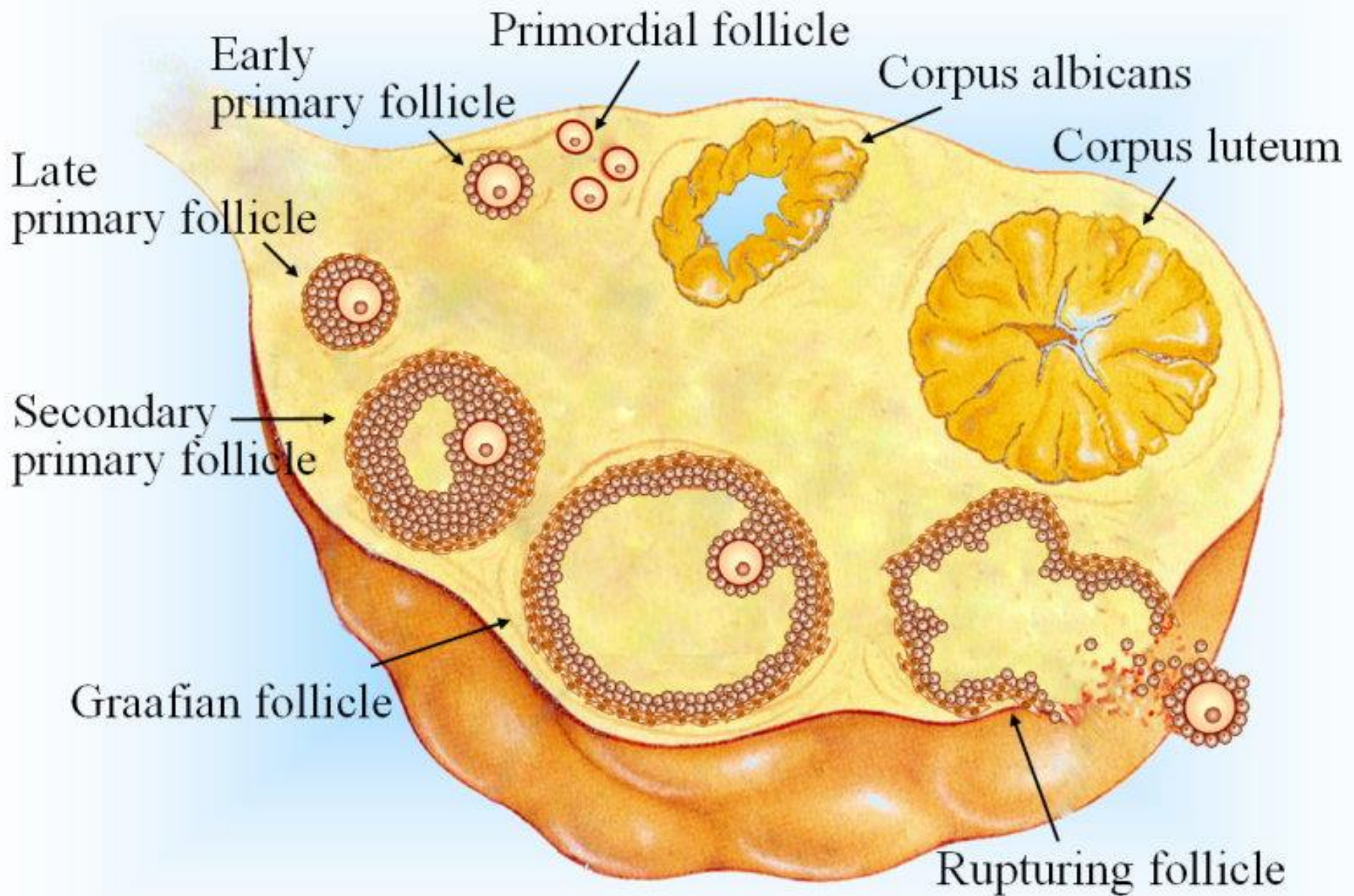


Ovarian Cycle

Corpus Luteum

- ▶ **Corpus luteum** is a temporary endocrine structure in female mammals that is involved in the production of relatively high levels of progesterone & moderate levels of estradiol & inhibin A
 - Estrogen inhibits further release of GnRH & thus secretion of LH & FSH
- ▶ Develops from an ovarian follicle during the luteal phase of menstrual cycle, following the release of a secondary oocyte from the follicle at ovulation
- ▶ The follicle first forms a **corpus hemorrhagicum** before it becomes a **corpus luteum**

- ▶ If the egg is not fertilized, **corpus luteum (CL)** stops secreting progesterone & involutes (~10–12 days); degenerates into a **corpus albicans**
- ▶ If egg is fertilized & implantation occurs, syncytiotrophoblast cells of blastocyst secrete **hCG** by day 9 post-fertilization.
- ▶ hCG signals CL to continue progesterone secretion, maintaining endometrium & providing an area rich in blood vessels in which zygote can develop
- ▶ From this point on, CL is called ***corpus luteum graviditatis***



Changes in Pregnancy

Changes in Pregnancy...1

- Maternal physiological changes in pregnancy are the normal adaptations that a woman undergoes during pregnancy to better accommodate the embryo or fetus.
- They are both anatomical & physiological changes, that is, they are entirely normal, & include cardiovascular, hematologic, metabolic, renal and respiratory changes.
- Become very important in the event of complications

Changes in Pregnancy...2

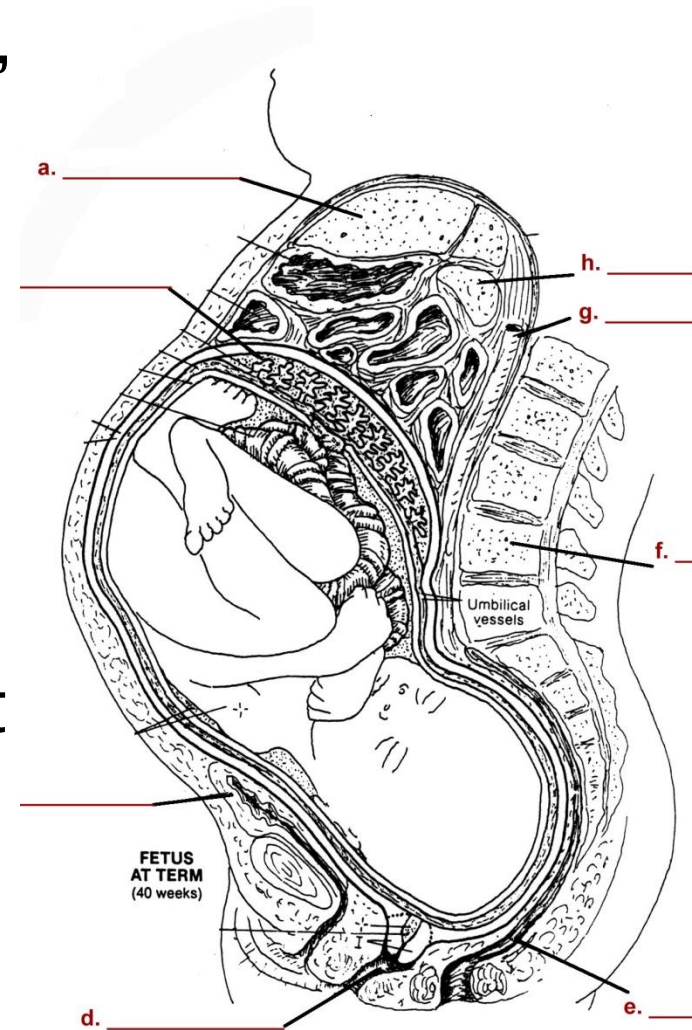
- The body must change its physiological and homeostatic mechanisms in pregnancy to ensure the fetus is provided for
- Increases in blood sugar, breathing and cardiac output are all required
- Levels of progesterone and estrogens rise continually throughout pregnancy, suppressing the hypothalamic axis and subsequently the menstrual cycle

Weight Changes in Pregnancy

- One of the most noticeable alterations in pregnancy is the gain in weight
- The **enlarging uterus**, the **growing fetus**, the **placenta & amniotic fluid**, the **acquisition of fat & water retention**, all contribute to this increase in weight
- Weight gain varies from person to person & can range from **10 to 20 kg**

Pregnancy--changes in female anatomy

- ▶ Shift in organs
 - Bladder, rectum pushed superiorly, squeezed--change in urination, defecation patterns
 - Stomach compressed--eat more often, less at each meal
 - Immune response may change appetite to avoid possible poisons for fetus
- ▶ Postural changes to compensate for anterior weight
- ▶ Breasts enlarge--first milk production



- ▶ By 12 weeks of pregnancy, the enlarging uterus may cause the woman's abdomen to protrude slightly
- ▶ The uterus continues to enlarge throughout pregnancy
- ▶ The enlarging uterus extends to the level of the navel by 20 weeks and to the lower edge of the rib cage by 36 weeks.
- ▶ Changes from an almost solid organ to a thin-walled, hollow organ & can hold 15-20 liters.
- ▶ Increased production of estrogen & progesterone initiates the process of uterine growth. (hypothesis)
- ▶ After the 12th week of gestation, growth is attributed to mechanical distention.

- ▶ Normally, uterus is both **anteverted** (rotated forward) & **anteflexed** (bent forward on itself), in more than **50%** of women
- ▶ In ~**20%** of women it is rotated backwards lying more in relation to the rectum than bladder (**retroverted**) and (**retroflexed**) (bent backwards on itself)
- ▶ It is in this group that the rare complication of **incarceration of uterus** occurs in late first trimester of pregnancy (the uterus is caught in the hollow of the sacrum). The remaining percentages of women have a midposition uterus

- ▶ In pregnancy the uterus is usually **dextrorotated** (rotated to the right side).
- ▶ The fallopian tubes (representing the unfused proximal parts of the Mullerian ducts) are continuous with the uterus, (representing the fused distal portions of the Mullerian ducts).
- ▶ Occasionally various duplications and deletions can occur resulting in a variety of uterine congenital anomalies.

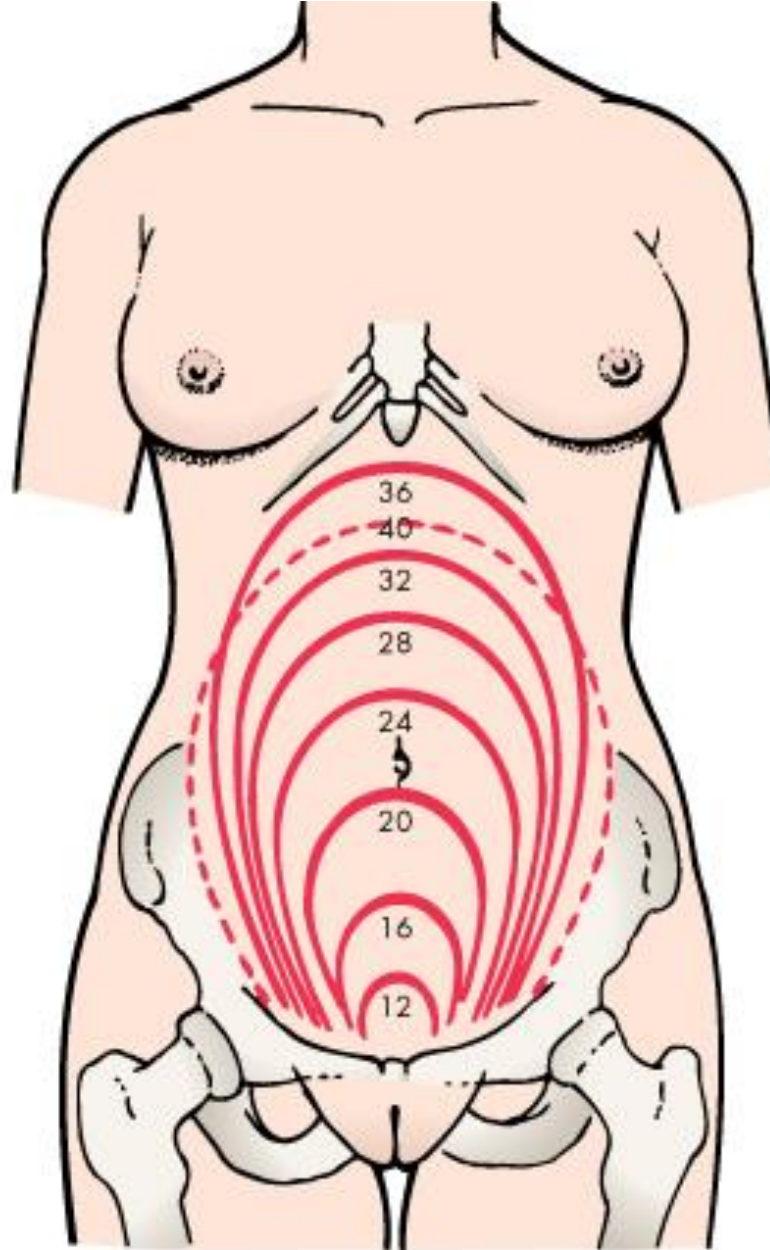


Fig. 14-2 Height of fundus by weeks of normal gestation with a single fetus. (Seidel et al, 2003)

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Cervix

- The prepregnant cervix is firm (like top of ear).
- At 4 weeks biochemical changes occur & cause the cervix to become edematous & congested with blood. Occurs in conjunction with the hypertrophy & hyperplasia of the cervical glands.
- Provides support to maintain an intact pregnancy.
- As delivery approaches, it softens and opens to allow delivery of the infant.

Vagina, Perineum, & Vulva

- Increased vascularization, softening of the connective tissue & hypertrophy of the smooth muscle (in preparation for delivery).
- Vaginal mucosa thickens & the rugae (vaginal folds) become pronounced (to allow expanding without trauma during delivery).
- Increased vaginal discharge, and acidic environment (to prevent growth of many bacterial infections).

Ovaries

- Production and release of follicles from ovaries ceases with pregnancy.
- The corpus luteum is formed within the ovary & secretes progesterone, peaking at 8 days (necessary for maintenance of pregnancy).
- At 6-7 wks the placenta begins manufacturing progesterone, & involution of the corpus luteum begins.

Breast Changes in Pregnancy...1

- Breasts tend to enlarge because hormones (mainly estrogen) are preparing breasts for milk production
 - Glands/alveoli gradually increase in number and become able to produce milk
 - Breasts may feel firm and tender
- During the last weeks of pregnancy, breasts may produce a thin, yellowish or milky discharge (colostrum)
 - Colostrum is also produced during the first few days after delivery, before breast milk is produced
 - This fluid, which is rich in minerals and antibodies, is the breastfed baby's first food.

Breast Changes in Pregnancy...2

- A woman's breasts grow during pregnancy, usually 1 to 2 cup sizes & potentially several cup sizes
- A woman who wore a C cup bra prior to her pregnancy may need to buy an F cup or larger bra while nursing
- A woman's torso also grows and her bra band size may increase one or two sizes.
- An average of 80% of women wear the wrong bra size

Breast Changes in Pregnancy...3

- Once the baby is born & ~50 to 73 hours after birth, the mother will experience her breasts filling with milk ("milk coming in") & at that point changes in the breast happen very quickly
- Once lactation begins, the woman's breasts swell significantly and can feel achy, lumpy and heavy (engorgement)
- Her breasts may increase again in size, by another 1 or 2 cup sizes & individual breast size can vary daily or for longer periods depending on how much the infant nurses from each breast.

Breast Changes in Pregnancy...4

- A regular pattern of nursing is usually established after 8–12 weeks, and a woman's breasts will usually reduce in size, perhaps to about 1 cup size larger than prior to her pregnancy
- Many women and medical professionals mistakenly think that breastfeeding causes their breasts to sag (ptosis)
- The biggest factors affecting ptosis are **cigarette smoking**, a woman's **body mass index** (BMI), her **number of pregnancies**, her breast cup size before pregnancy & **age**.

JOINTS & LIGAMENTS

- The joints and ligaments in the pelvis loosen and become more flexible
- This change helps make room for the enlarging uterus and prepare the woman for delivery of the baby
 - As a result, the woman's posture changes somewhat
- Backache in varying degrees is common because the spine curves more to balance the weight of the enlarging uterus.

The Pelvic Joints

The sacroiliac joints are partly cartilaginous, partly fibrous and are very strong. Despite this, pain is often experienced late in pregnancy as joint mobility increases with softening of the ligaments, and the weight of the pregnant uterus is added to that of the head and trunk.

The lumbosacral joint lies bw L5 & sacrum. Because of the backward inclination of the sacrum, considerable strain occurs here during pregnancy.

In extreme cases (spondylolisthesis), L5 projects downwards into the area of the pelvic brim.

Symphysis Pubis

- The 2 pubic bones are joined anteriorly by fibrous tissue, although a layer of cartilage remains between them.
- It is through this cartilage that the operation of ***symphysiotomy*** is occasionally carried out to increase pelvic diameters in cases of obstructed labour.
- In about **1 in 750** women there is an abnormal separation of the pubic bones- usually associated with a rapid second stage of labour.

- **During pregnancy, the elevated levels of oestrogen, progesterone & relaxin play a major role in increasing the laxity of the pelvic girdle joints.**
- **The hormonal levels do return to normal in the weeks following childbirth, but the time taken will also be affected by breastfeeding.**
- **By 3 to 6 months postnatal, the pelvic girdle should return to its pre-pregnant state**

- **An increase has been found in the width of the symphysis pubis from 4 mm to 9 mm in asymptomatic women on X-ray**
 - **The separation of less than 1cm should be considered normal, a greater separation being considered a partial or complete rupture; this may be up to 12 cm. resulting in tension and pain at the sacroiliac joints or symphysis pubis, or both.**

It has been estimated that the area of the outlet can be increased by as much as 28% in the full squatting position

In squatting, the femora apply pressure to the ischial and pubic rami, thus producing separation outward at the symphysis pubis and an upward and backward rotation of the sacrum

The Sacrococcygeal Joint

- ▣ The **sacrococcygeal joint** is much looser than the others, allowing the coccyx to bend backwards as the fetus passes through the birth canal. Undue displacement may, however, overstretch the ligaments, giving rise to the condition of **coccydynia** or pain, which is especially noticed on sitting.

CHANGES IN PREGNANCY (*ctd.*)

- **Respiratory**

- Increase in maternal O₂ requirements in response to acceleration in metabolic rate & the need to add to the tissue mass in the uterus & breast.

- **Renal**

- Responsible for maintaining electrolyte & acid-base balance, regulating extracellular fluid vol, excreting waste products, & conserving essential nutrients.

Cardiovascular & Hematological Changes in Pregnancy...1

- **Cardiovascular Changes**

- Protect normal physiologic functioning, meet the metabolic demands pregnancy imposes on the body, & provide for fetal growth & development.

Cardiovascular & Hematological Changes in Pregnancy...2

- The woman is sole provider of nourishment for the embryo & later, the fetus, & so her plasma & blood volume slowly increase by **40-50%** over the course of the pregnancy to accommodate the changes
 - Increase is mainly due to an increase in plasma volume thru increased aldosterone.
 - Results in an increase in heart rate (15 beats/min more than usual), stroke volume, & cardiac output
 - Cardiac output increases by **~50%**, mostly during the first trimester

Cardiovascular & Hematological Changes in Pregnancy...3

- **Systemic vascular resistance drops due to smooth muscle relaxation and overall vasodilation caused by elevated progesterone, leading to a fall in blood pressure**
- Diastolic BP consequently decreases 12–26 weeks, & increases again to pre-pregnancy levels by 36 weeks
 - If BP becomes abnormally high, investigate for pre-eclampsia & other causes of hypertension
- Due to increase in plasma volume thru increased aldosterone
- Progesterone may also interact with the aldosterone receptor, thus leading to increased levels
- **RBC numbers increase due to increased EPO**

Cardiovascular & Hematological

Changes in Pregnancy...4

- Cardiac function is also modified, with increased heart rate and increased stroke volume.
- A decrease in vagal tone and increase in sympathetic tone is the cause. Blood volume increases act to increase stroke volume of the heart via Starling's law.
- After pregnancy change in stroke volume is not reversed. Cardiac output rises from 4 to 7 liters in the 2nd trimester.
- Blood pressure also fluctuates. In the first trimester it falls. Initially this is due to decreased sensitivity to angiotensin and vasodilation provoked by increased blood volume. Later, however, it is caused by decreased resistance to the growing uteroplacental bed.

Cardiovascular & Hematological Changes in Pregnancy...5

- Plasma volume increases by **50%** & RBC volume increases only by **20-30%**
 - Consequently, the hematocrit decreases on lab value; this is not a true decrease in hematocrit, however, but rather due to the dilution
- WBC count increases and may peak at over **20 mg/mL** in stressful conditions
- Conversely, there is a decrease in platelet concentration to a minimal normal values of 100-150 mil/mL

Cardiovascular & Hematological Changes in Pregnancy...6

- A pregnant woman becomes hypercoagulable, leading to increased risk for developing blood clots and embolisms, due to.....

Cardiovascular & Hematological Changes in Pregnancy...7

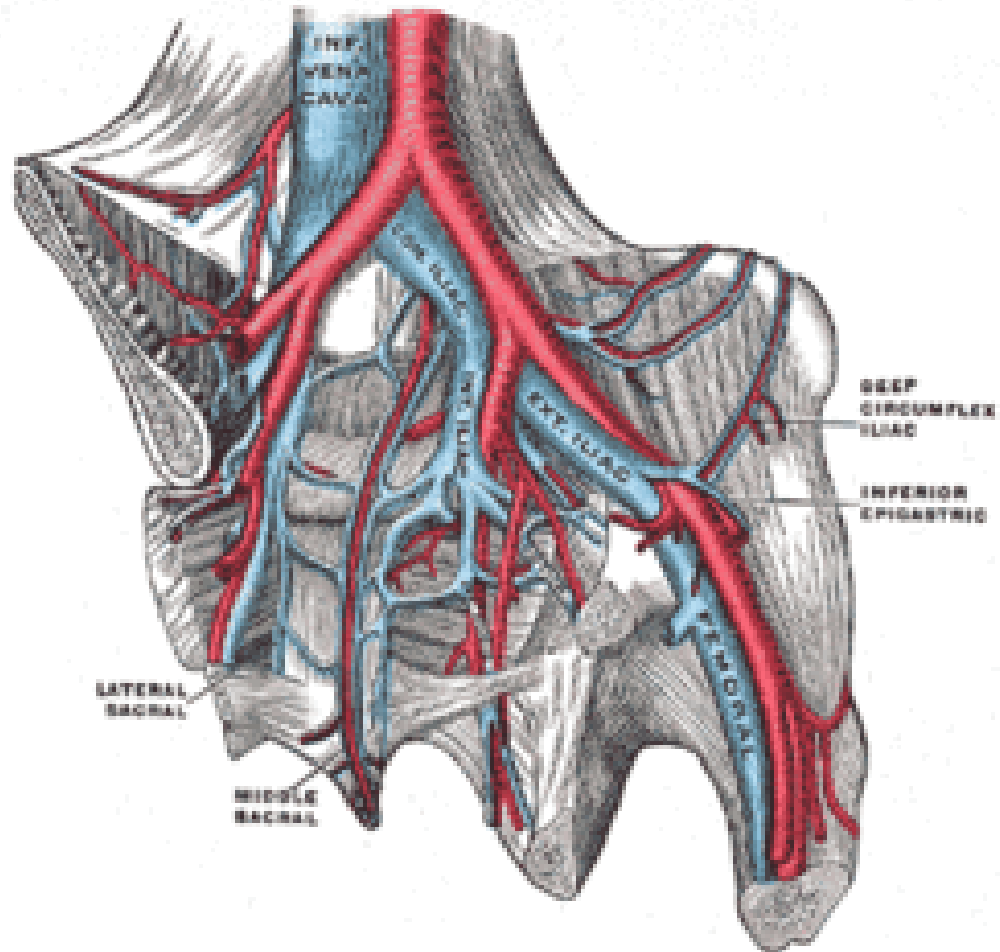
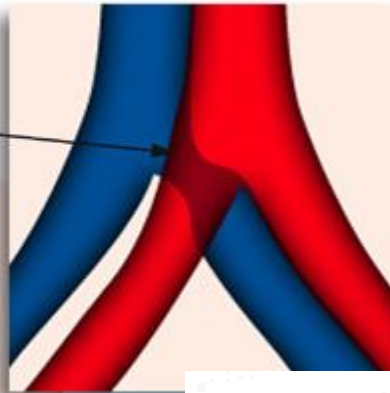
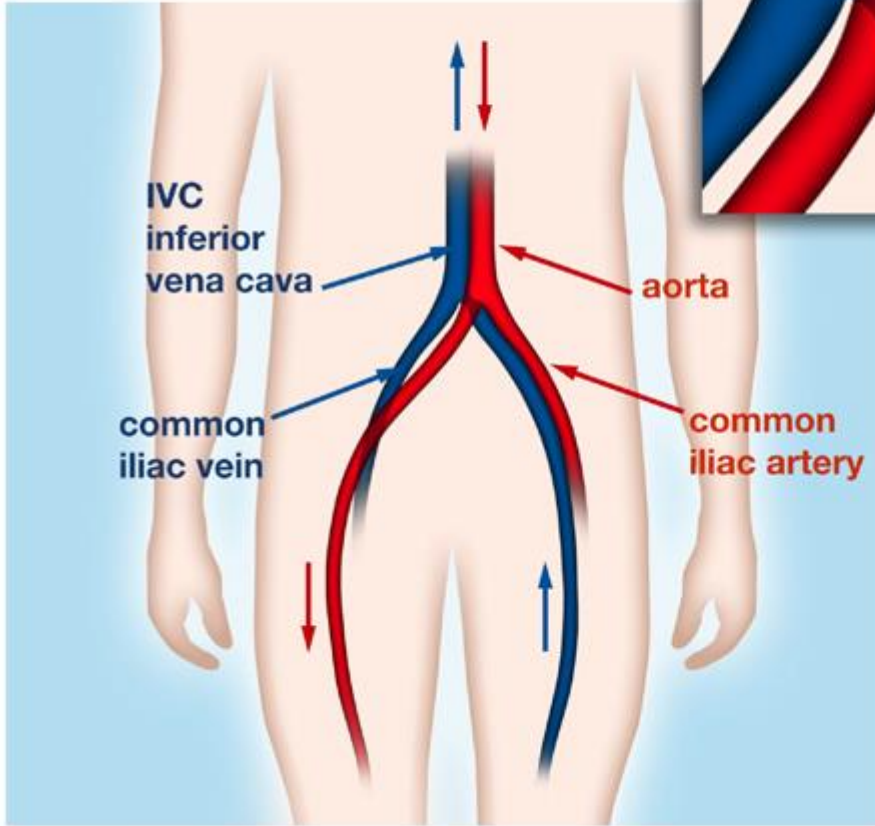
- A pregnant woman becomes hypercoagulable, leading to increased risk for developing blood clots and embolisms, due to increased liver production of coagulation factors, mainly fibrinogen & factor VIII (this hypercoagulable state along with the decreased ambulation (exercise involving legs) causes an increased risk of both DVT & pulmonary embolism)

Cardiovascular & Hematological Changes in Pregnancy...8

- **Women are at highest risk for developing clots, or thrombi, during the weeks following labor.**
- **Clots usually develop in the left leg or the left iliac venous system.**
- **Why?**

May-Thurner syndrome

Narrowed left iliac vein
(by pressure from right iliac artery)



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Cardiovascular & Hematological Changes in Pregnancy...9

- The left side is most afflicted because the left iliac vein is crossed by the right iliac artery. The increased flow in the right iliac artery after birth compresses the left iliac vein leading to an increased risk for thrombosis (clotting) which is exacerbated by the aforementioned lack of ambulation following delivery
- Both underlying thrombophilia & CS can further increase these risks.
- Edema, or swelling, of the feet is common. WHY?

CHANGES OF PREGNANCY (*ctd.*)

▣ Skin

- Alterations in hormonal balance & mechanical stretching are responsible for several changes.

▣ Musculoskeletal

- The gradually changing body & increasing weight of pregnant woman cause noticeable alterations in posture and way of walking.

▣ Neurologic

- Physiologic alterations resulting from pregnancy may cause neurologic or neuromuscular symptoms.

CHANGES OF PREGNANCY (*ctd.*)

■ GI

- A variety of changes occur related to pregnancy.

Endocrine Changes in Pregnancy...1

- Profound endocrine changes are essential for pregnancy maintenance, normal fetal growth, and postpartum recovery.

Endocrine Changes in Pregnancy...2

- Levels of progesterone & estrogens rise continually throughout pregnancy, suppressing hypothalamic axis & subsequently the menstrual cycle
- Estrogen mainly produced by placenta & is associated with fetal well-being
- Women also experience increased human chorionic gonadotropin (β -hCG); which is produced by the placenta.
 - Maintains progesterone production by the corpus luteum.

Endocrine Changes in Pregnancy...3

- The **increased progesterone** production, first by corpus luteum & later by the placenta
- **Prolactin** levels increase due to **maternal pituitary gland enlargement** by 50%.
 - This mediates a change in the structure of the **mammary gland** from ductal to lobular-alveolar.

Endocrine Changes in Pregnancy...4

- **Parathyroid hormone** is increased which leads to increases of calcium uptake in the gut and reabsorption by the kidney
- **Adrenal hormones** such as cortisol & aldosterone also increase.
- **Human placental lactogen** (hPL) is produced by the placenta & stimulates lipolysis and fatty acid metabolism by the woman, conserving blood glucose for use by the fetus
 - **Can also decrease maternal tissue sensitivity to insulin**, resulting in gestational diabetes

Role of Estrogen in Pregnancy

- ◉ Increasing blood flow to the uterus by promoting vasodilation.
- ◉ Changing the sensitivity of the respiratory system to carbon dioxide.
- ◉ Softening of the cervix, initiating uterine activity, and maintaining labor.
- ◉ Developing the breasts in preparation for lactation and secretion of prolactin by the pituitary gland.

Role of Progesterone in Pregnancy

- Prepares uterus for implantation.
- Relaxes smooth muscle
 - **to prevent spontaneous abortion.**
 - **to decrease motility & improve absorption of nutrients.**
- Enlarges the ureters & bladder to increase capacity.
- Works to prevent a maternal immunologic response to the fetus.
- Plays a role in development of the alveoli & ductal system to prepare for lactation.

Relaxin...1

- In females relaxin is produced mainly by the corpus luteum, in both pregnant and nonpregnant females; it rises to a peak within approximately 14 days of ovulation, and then declines in the absence of pregnancy, resulting in menstruation.
- During the first trimester of pregnancy, levels rise and additional relaxin is produced by the decidua.

Relaxin...2

- Relaxin's peak is reached during wk 14 & at delivery.
- Mediate the hemodynamic changes that occur during pregnancy, such as increased cardiac output, increased renal blood flow, & increased arterial compliance. Relaxes pelvic ligaments.
- Believed to soften the pubic symphysis.
- In males, relaxin enhances motility of sperm in semen.

QUESTIONS & COMMENTS

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