Phase 2 Anatomy Notes and Workbook

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General and Specific Goals for Anatomy Studies in Phase 2

General goal for Anatomy Studies in Phase 2

Anatomy studies in phase 2 logically build upon the basic knowledge of anatomy gained from phase 1 studies. Whereas phase 1 anatomy laid the foundations for knowledge of anatomical terminology and conventions, general structure and function of body systems, and regional anatomy of clinically important body regions, the general goal of phase 2 anatomy is to use a clinical context (e.g. sudden weakness, abdominal pain, acute knee pain) to focus on the clinically relevant structure of specific body parts (eye and orbit, abdominal nerve supply, knee anatomy).

The process of studying these body regions should not just passively provide you with knowledge of the structure of the particular body part. More importantly, you, the student, should be actively acquiring skills in clinical anatomical studies. In other words, you should come to understand and apply the process of learning about human structure in a clinical context. This is essential for you to continue to learn clinical anatomy both in subsequent years of your course and throughout your medical career.

Specific Goals for Anatomy Studies in Phase 2

1. To understand the relationship between thoracic and abdominal organ anatomy and their surface projection.
2. To be able to identify organs and major vessels in sections through the trunk and head.
3. To understand the blood supply of the abdomen and its surgical significance.
4. To understand the nerve supply of thoracic and abdominal organs and the relationship of this to referred pain in common clinical conditions.
5. To understand the anatomy of the head and neck and apply this in the context of neoplasia of those regions.
6. To understand the anatomy of the abdomen and pelvis and apply this in the context of neoplasia of those regions.
7. To understand the anatomy of the urogenital system and apply this in the context of neoplasia of those regions.
8. To understand the anatomy of the eye and orbit with respect to common ophthalmological conditions.
9. To understand the anatomy of the shoulder in the context of musculoskeletal problems in that region.
10. To be able to interpret CT and MRI scans of the brain, identifying major nuclei and pathways.
11. To understand the anatomy of the knee in the context of acute knee pain.
12. To understand the anatomy of the face, scalp and temporomandibular joint in the context of clinical weakness.
13. To understand the anatomy of the vertebral column, dermatomes and sclerotomes in the context of ageing and musculoskeletal degeneration.
SRM for Anatomy classes in the Dissecting Room

Hazards | Risks | Controls
---|---|---
Physical
Cold temperature (16°C)
Sharp bone/plastic
Biological
Fungi, bacteria (tetanus), hepatitis B and C
Chemical
Formaldehyde
Methanol
2-phenoxethanol

|  | Cold Penetrating wound of foot | Wear laboratory coat over appropriate warm clothing
---|---|---
|  | Infection | Wear enclosed shoes with full coverage of the dorsum of the foot
|  | Corrosive/Flammable | Have appropriate immunisation
|  | Irritant/toxic | Do not eat, drink or smoke in the Dissecting Room
|  | Irritant | Do not place anything (e.g. pens, pencils) into your mouth
|  |  | Use disposable gloves when handling wet specimens and do not cross-contaminate models or bones with wet specimens
|  |  | Always wash hands with liquid soap and dry thoroughly with disposable paper towel before leaving
|  |  | Low concentrations of chemicals used
|  |  | Chemicals used in well ventilated area
|  |  | Safety Data Sheets for chemicals available in the laboratory

Personal Protective Equipment required

- Closed in Footwear
- Lab. Coat
- Gloves

Emergency Procedures

In the event of an alarm sounding, stop the practical class and wait for confirmation to evacuate from demonstrators. Then wash your hands and pack up your bags. Follow the instructions of the demonstrators regarding exits and assembly points.

Clean up and waste disposal

- Cover wet specimens with the towels provided. Make sure that towels do not hang over the edge of the table, because this allows fluid to drip onto the floor. Fluids on the floor are a major safety hazard and should be reported to staff immediately.
- Replace stools under the tables in your cubicle.
- Remove your gloves and dispose in the biowaste bins provided.
- Wash your hands and instruments thoroughly with the soap provided and dry your hands with the paper towel.
- Remove your laboratory coat when you leave the dissecting room.

Ethics Approval

This type of practical has been previously considered and approved by the UNSW Human Research Ethics Advisory Panel (HREC09372).

Declaration

I have read and understand the safety requirements for this practical class and I will observe these requirements.

Signature: .......................................................... Date: ..............................

Student number: ..........................................................
ICS A Adult Health 1

P5. SURFACE AND CROSS-SECTIONAL ANATOMY OF THE ABDOMEN AND PELVIS

Prof. K, Ashwell/Dr Priti Pandey

The accompanying notes should be read in conjunction with viewing the video: “Surface anatomy of the thoracic and abdominal viscera” which can be found at http://tv.unsw.edu.au/video/surface-anatomy-of-the-thorax-and-abdomen.

General objective
To understand the surface anatomy and cross-sectional anatomy of the thorax, abdomen and pelvis for the purposes of interpreting clinical findings and radiography.

Specific objectives
1. To identify the surface projections of the major visceral organs and relate these to physical examination of the abdomen.
2. To identify the major organs in horizontal cross-sections of the abdomen and pelvis and relate these to imaging modalities in the same plane (CT and MRI).

A. Surface Anatomy of the Thoracic Viscera

1. Apertures of the Thorax: Superior or thoracic inlet (5 cm antero-posteriorly and 10-11 cm transversely) is bounded by the body of the 1st thoracic vertebra, the medial border of the first ribs and their costal cartilages, and the superior part of the manubrium of sternum. Inferior or thoracic outlet is bounded by the TV12, 12th pair of ribs, costal margins and the xiphisternal joint. Palpate the superior and inferior apertures and mark with a pencil.

2. Thoracic vertebrae (TV): Palpate and count the thoracic spines starting from the 7th cervical vertebra (vertebra prominens) which usually is the first prominent lump when palpating from above downward. Make it prominent by having the subject flex his neck. Spinous processes of TV1 to TV4 are easy to feel and see; those of TV5 - TV12 are much more difficult to palpate. Feel and mark the vertebral border of the scapula (TV2 - TV7 level).

3. Sternum: In the midline palpate the jugular notch at the upper end of the manubrium and between the sternal ends of the clavicle. The notch is usually at the level of the TV2 or TV3. Slide your finger down the midline for about 5cm and mark with a pencil the sternal angle (at TV4 or a disc between TV4 - TV5). It is an important landmark for the lower border of the superior mediastinum and for the level of the 2nd costal cartilage, the starting point from which the ribs should be counted. Palpate and mark with a pencil the xiphoid process lying in the bottom of the infrasternal fossa (epigastric fossa or 'pit of stomach'), at the level of TV9 or TV10.

4. Ribs: The first rib can be felt below and above the medial 1/3 of the clavicle. The other ribs may be palpated by placing your fingertips in your axilla and slowly drawing them back inferomedially over your thoracic cage. Note that the spine of the scapula lies over the 3rd rib or 3rd intercostal space and the inferior angle of the scapula is at the level of the 7th rib and it is a good guide to the 7th intercostal space. The costal margins are palpable with ease. The highest part of the costal margin is formed by the 7th costal cartilage and the lowest part by the 10th costal cartilage. Anteriorly the ribs can be counted, starting from the sternal angle or 2nd costal cartilages, below which is the 2nd intercostal space.

5. Diaphragm: The level of the diaphragm on both sides varies in relation to the ribs and to the vertebrae according to the phase of respiration, posture and the degree of the distension of the abdominal viscera. The diaphragm is highest when the person is supine, lowest when the person is sitting or in an erect position (this explains why patients with difficulties in inspiration prefer to sit up rather than lie down). Mark with a pencil the domes of the diaphragm and the central tendon. In an erect position the right dome should be at the level of the 5th intercostal space in the midclavicular line, the central tendon at the xiphisternal junction, and the left dome at the level of the 6th costal cartilage.

6. Trachea, Lungs and Pleurae: The bifurcation of the trachea is at or below the sternal angle (TV5 or TV6) and slightly to the right. The bifurcation is not fixed and moves downward with respiration. Map the main bronchi obliquely downward for 2.5 cm. The pleural cavity on each side surrounds a lung and is lined by parietal pleura. These two pleural cavities represent separate and closed potential spaces. The parietal pleura which covers the different parts of the thoracic wall and thoracic content can be divided into: (1) costal pleura, (2) mediastinal pleura, (3) diaphragmatic pleura and (4) cervical pleura. The apex of the lung is covered by cervical pleura (dome or cupola) which extends through the inlet of the thorax upwards to the neck of the 1st rib (level of the spine process of CV7). Because the 1st rib slopes downward,
the lungs and the pleura rise about 3 cm above the anterior end of the 1st rib and 1 to 2 cm above the middle third of the clavicle, behind the sternomastoid muscle.

The lines of pleural reflection are sites at which the costal pleura becomes continuous with the mediastinal pleura anteriorly and posteriorly, and with the diaphragmatic pleura inferiorly.

The sternal or anterior reflection: draw a line from the sterno-clavicular joint to the median line at the level of the sternal angle. Then the right margin continues down to the xiphisternal joint, the left margin curves out from the 4th costal cartilage along the margin of the sternum to the 6th costal cartilage.

The costal or inferior reflection is where the costal pleura is continuous with the diaphragmatic pleura near the costal margin. It passes obliquely across the 8th rib in the mid-clavicular line, the 10th rib in the mid-axillary line and the 12th rib towards the spinous process of TV12 (mnemonic: Lungs: 6, 8, 10). During deep inspiration, the apparent level descends at least two intercostal spaces. The oblique fissure of the lung can be drawn on the surface of the thorax from a point about 2.5 cm lateral to the spinous process of TV2 to the 6th costochondral junction (about 5 cm from the anterior median line). When the arm is abducted and the hand placed on the back of the head, the medial border of the scapula approximately indicate the oblique fissure.

The Horizontal fissure of the right lung is indicated by a longitudinal line that runs from the anterior border of the lung along the 4th costal cartilage to the oblique fissure.

7. The Heart: The heart is located in the middle mediastinum, posterior to the body of the sternum and the 3rd to 6th costal cartilages, and anterior to the 5th to 8th thoracic vertebrae.

Feel the apex beat in the 5th intercostal space (sometimes in the 6th) just medial to the mid-clavicular line. The position of the heart can be approximated on the chest by using three landmarks and your fingers: place a fingertip on the sternal angle, right end of the xiphoid process and the apex beat. This gives you a rough indication of the surface projection of your heart. Now, using a pencil, draw the outline of the heart:

- **the right cardiac border**: from the 3rd to the 6th costal cartilage, a finger's-breadth (a bit more than 1 cm) from the right margin of the sternum;
- **the inferior cardiac border**: from the inferior end of the right border, through the xiphisternal joint to the apex beat;
- **the left cardiac border**: from the apex beat to the 2nd intercostal space, about a finger's-breadth from the left margin of the sternum;
- **the superior cardiac border** can be represented by a line joining the 2nd left intercostal space to the 3rd right costal cartilage.

(Note that this method for the surface location of the heart applies only to a person lying in the supine position or to a cadaver. In the erect position the heart is slightly lower).

**Physical examination of the chest**

a. **By Inspection**: General contours of the chest, the respiratory movements, the apex beat which may be visible, or other pulsations.

b. **By Palpation**: The position of the mediastinum can be assessed by determining the position of the apex beat and the trachea.

c. **By Percussion**: The percussion is conducted in the following manner: the middle finger of the left hand is placed firmly on the part which is to be percussed, then the middle phalanx is struck with the tip of the middle finger of the right hand. The stroke should be delivered from the wrist and the terminal phalanx should be perpendicular to the left middle finger.

By percussion we can determine the boundaries between contiguous organs, and it should be performed from the resonant (e.g. lung) towards the less resonant (e.g. heart) organ. Normally the lungs are resonant to percussion and there are areas of dullness over the heart and liver. Impaired resonance is found over consolidated or collapsed lungs. The inferior, left and right borders of the heart may be determined by percussion and by this means the cardiac area (area of cardiac dullness) can be outlined.

d. **By Auscultation**: You will be using the stethoscope, which will amplify the sounds which can be heard over the lungs and the heart. The breath sounds characterized by long inspiratory phase followed by expiratory phase, which can be heard over the lungs. ‘Bronchial' breathing (harsher quality) is heard by listening with a stethoscope over the larynx or trachea.

Heart sounds: are produced by valve closure - the first sound is caused by the closure of the tricuspid and mitral valves, and the second sound by the closure of the aortic and pulmonary valves. The first sound can be well heard at the apex (mitral valve) and over the lower part of the body of sternum (tricuspid valve). The second sound at the right (aortic) and left (pulmonary) intercostal space. The first sound corresponds with the beginning of ventricular
systole, the second sound is sharper and shorter than the first and marks the beginning of ventricular diastole. In some abnormal conditions abnormal heart sounds can be heard. They may be caused by pathological narrowing of the valves (e.g. mitral stenosis), incompetence of the valves, or by distension of the channels.

Surface Anatomy Of Abdominal Walls And Contents

1. **The anterior abdominal wall** is bounded superiorly by the xiphoid process and costal cartilages of the 7th to 10th ribs. Inferiorly on each side by the iliac crest, anterior superior iliac spine, the inguinal ligament and pubic crest and symphysis.

   Note the position of the umbilicus - usually it lies at the level of the disc between the 3rd and 4th lumbar vertebra. Linea alba is indicated by a slight groove in the anterior median line which extends from the xiphoid process to the symphysis pubis. The lineae semilunares are slight surface depressions which indicate the lateral borders of rectus abdominis muscles. To identify the semilunar lines, lie on your back and then sit up without using your arms. This contracts your rectus abdominis muscles making their lateral margins stand out. These lines extend from the pubic tubercles to the costal margins at the tip of nine costal cartilages. The lineae transversae are grooves overlying the tendinous intersections of the rectus abdominis.

2. **Planes and points of reference:** For clinical purposes the anterolateral abdominal wall is divided into nine abdominal regions by two vertical (midclavicular) planes and by two horizontal (transpyloric and transtubercular) planes. The transpyloric plane is situated midway between the xipisternal joint and the umbilicus, at the level of the intervertebral disc between LV1 and LV2 and the 9th costal cartilage (it usually passes through the pylorus of the stomach, hence its name). The transtubercular plane passes through the iliac tubercles and lies at the level of the body of LV5. Additionally there are: the subcostal plane which joins the lowest points of the costal margins on each side and lies at the level of the intervertebral disc between LV2 and LV3, and the transumbilical plane which passes through the umbilicus. In clinical practice it is used, together with the median plane, to divide the abdominal wall into four quadrants.

3. **Palpate on the abdomen:** Anterior superior iliac spine, iliac crest, iliac tubercle (the highest point of the crest is at the level of LV4) posterior superior iliac spine (in the visible dimple at the level of the 2nd sacral vertebral spine), pubic tubercle and crest, inguinal ligament (if palpable).

4. **Large abdominal vessels** (mark them with a pencil):
   - Abdominal aorta: enters the abdomen at the disc between TV12 and LV1 (above the transpyloric plane), descends on the bodies of LV1-4 and bifurcates into the common iliac arteries in front of LV4, i.e. slightly below the umbilicus. In a thin individual who is nicely relaxed, the pulsation may be felt quite easily when abdominal wall is relaxed by flexing the thigh and the legs.
   - Common and external iliac arteries: may be mapped out by drawing a line between ASIS and symphysis.
   - Inferior vena cava: is 2 to 3 cm wide, lies to the right of the aorta. It arises in front of the body of LV5 (transstubercular plane) and ascends to the level of TV8.

5. **Abdominal Viscera**
   - **Stomach:** The surface features of the stomach vary greatly because its size and position change under a variety of circumstances. The cardiac orifice of the stomach is located posterior to the 7th left costal cartilage, about 3 cm from the midline, at the level of the 10th or 11th TV. The fundus of the stomach corresponds to the left dome of the diaphragm. The highest point of the fundus is located posterior to the 5th left rib in the midclavicular line. The greater curvature is usually between the transpyloric and transtubercular planes. The pyloric part of stomach is usually between transpyloric and supracristal (a horizontal plane between the highest points of the iliac crest) planes, about 2 to 3 cm to the right. In the erect position, the location of the pylorus varies from about the level of the LV2 to the level of LV4; in the supine position from LV1 to the LV3.
   - **Duodenum:** draw the superior part of the duodenum superiorly and laterally to the pylorus, the descending part opposite LV1-3 and medial to the midclavicular plane; horizontal part across the midline for about 8 cm; and ascending part at the level of LV2, lateral to the aorta.
   - **Ascending colon:** begins at the transtubercular plane lateral to the midclavicular plane and ascends to the area just below the transpyloric plane. Note that it overlies the lower part of the right kidney.
   - **Descending colon:** descends from the level of the 11th rib (lower border of the spleen) lateral to the midclavicular plane.
   - **Transverse colon:** this forms a loop of variable depth between the right and left colic flexures. Mark it below the horizontal part of duodenum.
   - **Spleen:** is located deep to the 9th, 10th and 11th left ribs. Normally the spleen does not extend below the left costal margin and its anterior tip does not extend farther anteriorly than the midaxillary line. It is usually not palpable unless it is enlarged or is markedly dislocated.
   - **Pancreas:** is located in epigastric and left hypochondriac regions. It lies across the bodies of the upper lumbar vertebrae with its head below the transpyloric line and its tail slightly above it. The tail rests on the lower part
of the visceral surface of the spleen. The splenic artery runs along its upper border to the left, the hepatic artery runs along its upper border to the right.

**Liver:** At the right midaxillary line it lies opposite the 7th - 11th ribs; at the midclavicular line it ascends to the level just below the right nipple (5th rib), then it curves to the left reaching again the level of the 5th rib in the left midclavicular line. It is depressed by the heart in the median plane to the level of the xiphisternal junction. Its sharp lower border crosses the pylorus and the fundus of the gall bladder in the transpyloric plane. The inferior margin of the normal liver is usually not palpable.

**Gallbladder:** Mark the fundus as a pouch projecting downwards from the angle between the right costal margin and the lateral edge of the right rectus abdominis muscle.

**Kidneys:** The levels of the kidneys change during respiration and with changes in posture. Each kidney moves about 3cm in a vertical direction during full movement of the diaphragm. The hila of the kidneys lie close to the transpyloric plane and about 5cm away from the median line. The upper pole of the kidneys is opposite the 12th rib and the 12th TV, whereas the lower pole is opposite the 3rd LV, and about 2cm above the iliac crest. (Note that the right kidney is a little lower than the left kidney).

**Urinary Bladder:** When the bladder is empty, the parietal peritoneum passes from the anterior abdominal wall onto the back of the symphysis. When the bladder is filled, the loose peritoneum is lifted off the abdominal wall some distance above the symphysis. As the bladder fills, it gradually rises into the abdomen proper and it may reach the level of the umbilicus. At birth, the bladder lies in the abdomen proper. During childhood it gradually sinks to the position noted in the adult.

**Cross-Sectional Anatomy Of The Abdomen**

You should use the cross-sectional anatomy program available on the department of anatomy computers during the remaining time in this practical class and in your own time to identify important features at the levels listed below. Remember that sections are viewed as if standing at the foot of the patient’s bed, so the patient’s left is on the right of the screen and vice versa.

**Draw the following levels**

1) - upper abdomen at TV12 to LV1 - identify: rectus abdominis muscle, greater omentum, stomach, splenic flexure of colon, spleen, diaphragm, kidneys, aorta, IVC, suprarenal glands, pancreas, splenic vessels, liver, bile duct. Know the positions of thoracic duct/cisterna chyli, hepatic artery, portal vein.

2) - lower abdomen at LV2 to LV4 - identify: rectus abdominis muscle, greater omentum, transverse colon, jejunum/ileum, external oblique, internal oblique and transversus abdominis muscles, descending colon, psoas major, quadratus lumborum, aorta, IVC, duodenum, kidneys, liver. Know the positions of ureters, para-aortic lymph nodes, sympathetic trunks, mesenteric vessels, renal fascia.

3) - pelvis at sacroccygeal joint (male) - identify rectus abdominis, femoral vessels, psoas major, iliacus, femoral head, pubis, pubic symphysis, ischium, greater trochanter, rectum, prostate/bladder, levator ani, ischiorectal fossa. Know the position of pudendal canal with neurovascular elements, inguinal lymph nodes.

You should concentrate on large structures (major vessels, organs, ducts) since these structures have the greatest clinical significance.

**After completing the above tasks with anatomy cross-sections, you should also test your skills at interpreting CT scans of the lower thorax and abdomen by using the adaptive tutorial “What organ is that?” provided on Moodle through the SmartSparrow platform.**
P6. BLOOD SUPPLY AND INNERVATION OF THE ABDOMEN AND REFERRED PAIN

Prof. K. Ashwell/ Dr. Priti Pandey

This class incorporates viewing of a video on innervation and blood supply of the abdomen and pelvis. This may be accessed out of class time at: http://tv.unsw.edu.au/video/nerves-and-blood-vessels-abdomen

General objective/Aims
To understand the blood supply and innervation of the abdominal wall and gastrointestinal tract and sites of referred pain.

Specific objectives
1. To identify the abdominal aorta and its visceral and terminal branches: the unpaired coeliac, superior mesenteric, inferior mesenteric arteries and their branches: renal, lumbar, common iliac, internal iliac, external iliac, and inferior epigastric arteries.
2. To understand the venous drainage of the abdomen into inferior vena caval and portal systems.
3. To identify the position of the lumbar plexus and its branches, as follows: iliohypogastric and ilioinguinal nerves, lateral cutaneous nerve of thigh, femoral nerve, obturator nerve and lumbosacral trunk.
4. To summarise the principles of innervation of the stomach and intestines, naming the principal visceral plexuses involved. Define the position of celiac, renal, superior and inferior mesenteric, aortic and superior hypogastric autonomic plexuses.
5. To understand the basis of referred pain in the following conditions: acute appendicitis, acute cholecystitis, ruptured spleen, diverticulitis, ureteric calculi, torsion of the testis.

Learning activities
1. With colleagues identify the celiac, superior mesenteric, inferior mesenteric arteries, and their branches, distribution and anastomoses on specimens and radiographs.
2. Identify the major veins of the abdomen (vena caval and portal tributaries).
3. With colleagues, identify the lumbar plexus, its branches and nerves to the anterolateral abdominal wall.
4. Identify the greater splanchnic nerves, lesser splanchnic nerves, pelvic splanchnic nerves, aortic and hypogastric plexuses.
5. Discuss with colleagues and your tutor the basis for referred pain in the conditions listed above under SO5.
6. Watch a video where Prof. Ashwell demonstrates on the specimens (30 minutes).

Lecture Notes:

A. Arterial supply of the Abdomen and Pelvis
The abdominal aorta extends from the abdominal aortic hiatus TV12 to its bifurcation into the common iliac aa at LV4/5 (IVD between). The abdominal aorta has four groups of branches: ventral and lateral (distributed to the abdominal viscera), lateral, posterior and terminal (distributed to the abdominal wall). Note that in this course we are learning the ventral unpaired, posterior unpaired and paired and terminal paired branches.

Ventral (unpaired):
- coeliac
- superior mesenteric
- inferior mesenteric

Lateral (paired):
- inferior phrenic
- middle suprarenal
- renal
- gonadal (ovarian or testicular)

Posterior (paired and unpaired):
- lumbar (paired)
- median sacral (unpaired)

Terminal (paired):
- common iliac.
1) Ventral Branches

With colleagues identify the celiac, superior mesenteric, and inferior mesenteric arteries. Identify their branches, distribution and anastomoses on specimens and radiographs.

The Celiac trunk: The artery of the foregut is the celiac a. or trunk. Celiac trunk arises from the abdominal aorta at the level of T12 and divides into three major branches. These are: left gastric, splenic and common hepatic arteries. See below for pattern of division of celiac trunk.

Note the following aa:

i). Lt gastric artery: supplying the oesophagus and the lesser curvature of the stomach.

ii). Splenic artery: a tortuous artery that runs posterior to the stomach and embedded in the substance of pancreas, giving: Short gastric a. (or arteries) supplying the fundus and far left greater curvature; Lt gastroepiploic a. supplying the greater curvature; pancreatic branches to supply the pancreas; and splenic branches to supply the spleen.

iii). Common hepatic artery: continues to right and gives off a branch, the gastroduodenal artery to become the hepatic artery proper. The hepatic artery proper provides the Rt gastric a. that supplies the lesser curvature of the stomach; and the right and left hepatic arteries. The gastroduodenal artery bifurcates into superior pancreaticoduodenal supplying the duodenum and the pancreas and the Rt gastroepiploic a. that supplies the greater curvature of the stomach. The pyloric sphincter is supplied by the gastric and pyloric aa. (rami of the Rt gastric and gastroepiploic aa).

The superior mesenteric a: arises from the abdominal aorta at the level of L1 vertebra and supplies various parts of the gastrointestinal tract. The superior mesenteric a. supplies the duodenum (from the greater duodenal papilla), jejunum, ileum, caecum, appendix, ascending colon and the transverse colon as far as the left trisection.

The inferior mesenteric a.: arises from the abdominal aorta at the level of L3 and supplies the left 1/3 of the transverse colon, descending colon, sigmoid colon, rectum and anus as far as the pectinate line.
Identify the following branches of superior and inferior mesenteric arteries:

**Superior mesenteric**:
- inferior pancreaticoduodenal (ant. and post. brr)
  - jejunal brr
  - ileal brr
  - ileocolic, giving off the appendicular a.
  - right colic (supplying ascending colon)
  - middle colic (supplying transverse colon)

**Inferior mesenteric**:
- left colic (supplying transverse and descending colon)
- sigmoidal (two or three)
- superior rectal (continuation of inf mesent. a.)

Note, however, the existence of anastomoses between these arteries and each other and with other branches of the aorta.

i) left gastric a. gives off the oesophageal brr around the (lower), abdominal part of oesophagus.

ii) anterior and posterior branches of the superior pancreaticoduodenal aa (from coeliac trunk) anastomose with the anterior and posterior branches of the inferior pancreaticoduodenal (from superior mesenteric artery) around the head of the pancreas and 2nd part of the duodenum.

iii) **Marginal artery** is formed by the anastomoses between the branches of superior and inferior mesenteric arteries. Marginal artery extends from the caecum to the sigmoid colon. Arteries that feed the marginal artery are the ileocolic, the right, middle and left colic arteries, and the sigmoidal arteries. (Gardiner, Gray, O’Rahilly, 1986)

iv) superior rectal a. (from inferior mesenteric) with middle rectal (from internal iliac) and/or inferior rectal (from internal pudendal off internal iliac).

**II) Dorsal Branches**

i) **Lumbar aa.**
There are usually four lumbar arteries on each side. They pass anterior to the 4 upper lumbar vertebral bodies, pass behind the sympathetic trunks to supply the posterior abdominal wall. The Rt lumbar arteries pass posterior to the IVC. Each artery has spinal (to the vertebral canal and contents), ventral (to body wall) and dorsal (to dorsal muscles, joints and skin) branches.

ii) **Median sacral a.**
This is a small posterior branch, which leaves the aorta slightly above its bifurcation and descends anteriorly to the midline of LV4, LV5, the sacrum and ends at the coccyx.

**III) Terminal Branches**
The abdominal aorta bifurcates into common iliac aa., in front of and immediately to the left of the midline, at the level of LV4. Each common iliac artery diverges to bifurcate near the level of the lumbosacral intervertebral disc into external and internal iliac aa.

The **external iliac a.**
- Gives off the inferior epigastric a. just proximal to the inguinal ligament. This artery ascends medial to the deep inguinal ring (raising the parietal peritoneum as it does so to form the lateral umbilical fold) to pierce the transversalis fascia passing anterior to the posterior layer of the rectus sheath. It divides into numerous branches, which anastomose with the superior epigastric and posterior intercostal aa.
- The external iliac also gives off a deep circumflex a., which arises almost opposite the inferior epigastric and ascends the iliac crest anastomosing with the ascending br of the lateral circumflex femoral, lumbar and inferior epigastric aa.

The **internal iliac a.** The branches of the internal iliac a. are usually divided into anterior and posterior trunk divisions, although this clear separation is often not apparent on our specimens.

i) Branches from the anterior trunk of internal iliac artery include:
- superior vesical a., with several branches. Derived from the umbilical artery of the fetus.
- inferior vesical a.
- middle rectal a.
- uterine a. (no homologue in the male)
• vaginal a. (corresponds to the inferior vesical a of males)
• obturator a. leaves the pelvis via the obturator foramen
• internal pudendal a. leaves the pelvis between the piriformis and coccygeus muscles. It passes deep to the sacrotuberous lig., to enter the pudendal canal in the lateral wall of the ischiorectal fossa (see next lecture). It has several branches: muscular brs, inferior rectal a., perineal a., artery of the bulb of the penis, artery of the bulb of the vestibule, urethral a., dorsal a. of the penis and clitoris, deep artery of the penis and clitoris, scrotal or labial brs.
• inferior gluteal a. leaving the pelvis below the piriformis through the greater sciatic foramen.
  ii) Branches of the posterior trunk of internal iliac artery include:
  • iliolumbar a ascends anterior to the sacroiliac joint and lumbosacral trunk at the medial border of psoas major. It passes deep to the obturator nerve and external iliac vessels, deep to psoas major m. and divides into lumbar branch (representing the 5th lumbar artery, supplies psoas major, quadratus lumborum and erector spinae mm.) and iliac branch (supplies the iliacus muscle).
  • lateral sacral aa., usually superior and inferior brrs.
  • superior gluteal a. largest branch of internal iliac artery, leaves the pelvis through greater sciatic foramen above the piriformis.

B) Venous Drainage of the Abdomen
  i) portal circulation for intraperitoneal part
  ii) systemic veins for the extraperitoneal part

1) Portal Circulation

Portal circulations by definition possess two sets of exchange capillaries. In this case one is in the digestive tube, spleen, pancreas and gall bladder and the other is in the liver sinusoids.

The portal Vein is about 8 cm long and the portal vein and its tributaries have no valves in adult life. The portal vein begins, behind the neck of pancreas, at about the level of LV2 by junction of the splenic vein and superior mesenteric vein. As it reaches the porta hepatis in the liver it divides into Rt and Lt branches. The Rt br. supplies the right half of the liver and usually receives the cystic vein. The Lt br. divides into brs to the caudate, quadrate and left lobes. As the Lt br. enters the liver it is joined by paraumbilical veins, the ligamentum teres (remnant of the Lt umbilical vein.) and is connected to the IVC by the ligamentum venosum (obliterated remnant of the ductus venosus).

Tributaries of the portal vein are the splenic, superior mesenteric, Lt gastric, Rt gastric, paraumbilical and cystic veins.

a) Splenic Vein. has several tributaries:
   short gastric
   Lt gastroepiploic
   pancreatic
   inferior mesenteric (receives the Lt colic and sigmoidal vv)

b) Superior mesenteric Vein. has several tributaries:
   Rt gastroepiploic
   pancreaticoduodenal
   jejunal, ileal
   ileocolic
   Rt colic
   middle colic
PORTA-SYSTEMIC ANASTOMOSES: In the above diagram identify the arrows pointing to the circles demonstrating the anastomoses. Several portal systemic anastomoses have been identified:

<table>
<thead>
<tr>
<th>Site</th>
<th>Portal tributaries</th>
<th>Systemic tributaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>oesophagus</td>
<td>Lt gastric oesophageal vv</td>
<td>oesophageal vv to azygos, accessory hemiazygos vv</td>
</tr>
<tr>
<td>umbilicus</td>
<td>in lig teres (paraurmbilical vv)</td>
<td>epigastric vv</td>
</tr>
<tr>
<td>anal canal</td>
<td>superior rectal vv</td>
<td>middle and inferior rectal vv</td>
</tr>
<tr>
<td>retroperitoneal</td>
<td>venous radicles of colon and bare area of liver</td>
<td>retroperitoneal vv</td>
</tr>
<tr>
<td>liver</td>
<td>patent ductus venosus (br of Lt portal v)</td>
<td>IVC</td>
</tr>
</tbody>
</table>

Raised pressure in the portal circulation (portal hypertension) due to fibrosis and disordered regeneration of the liver (as occur in liver cirrhosis) can lead to retrograde flow from the portal tributaries to the systemic circulation. As a consequence these patients will have oesophageal varices (with the hazard of haematemesis=vomiting blood and/or malaena=dark stools), caput Medusae on the anterior abdominal wall and severe internal haemorrhoids.

2) Systemic Veins
This consists of the inferior vena cava and its tributaries in the abdomen. The IVC has several tributaries:

a) Lumbar veins: 4 pairs which draining the lumbar region and posterior abdominal wall. Near the vertebral column they drain the vertebral venous plexus and are connected by the ascending lumbar V to the common iliac and iliolumbar vv.
b) **Testicular veins:** drain the epididymis and testis, unite to form the pampiniform plexus and ascend with the testicular A. to enter the IVC just below the renal vv (Rt testicular vein) or Lt renal vein. (Lt testicular vein).

c) **Ovarian Veins:** arise from a plexus in the broad ligament to ascend with the ovarian A. much like the testicular veins.

d) **Renal veins:** The Lt renal vein receives venous blood from the **Lt gonadal veins** (ovarian or testicular), as well as the **Lt suprarenal vein**.

e) **Rt suprarenal vein:**

f) **Inferior phrenic veins:**

g) **Hepatic Veins:** enter the IVC as it passes through the superior aspect of the liver.

**Collateral Circulation:** There are two major opportunities for collateral circulation

a) between the superior and inferior epigastric veins.

b) between the lumbar veins and vertebral venous plexus.

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C) **Nerve supply of the Abdomen and Pelvis**

Identify the **greater splanchnic nerves**, **lesser splanchnic nerves**, **lumbar splanchnic nerves** and the **pelvic splanchnic nerves**. Identify the following ganglia and plexuses: **celiac ganglion and plexus**, **aorticorenal ganglion and plexus**, **intermesenteric** and **aortic plexus**, the **superior hypogastric plexus** and the **inferior hypogastric plexus**. Identify the **right and left hypogastric nerves**.
1) Autonomic Supply

The autonomic supply to the abdomen and pelvis is divided into sympathetic and parasympathetic components.

i) Sympathetic supply

- greater splanchnic N. (T5 to 9)
- lesser splanchnic N. (T10, 11)
- lowest (least) splanchnic N. (T12)
- lumbar splanchnic Ns (L1 to 3)
- sacral sympathetic Ns.

ii) Parasympathetic supply

- vagus NN.
- pelvic splanchnic NN. (S2 to 4).

Identify the right and left vagus nerves. Note that the right vagus nerve crosses in front of the first part of the right subclavian artery, behind the SVC and descends in the superior mediastinum at the right side of the trachea and then continues to the oesophagus forming the oesophageal plexus. The left vagus nerve enters the thorax between the left common carotid and left subclavian arteries. It descends in the superior mediastinum, crosses the left side of the arch of aorta and then enters the oesophageal plexus. At the lower part of the oesophagus, the plexus divides into anterior and posterior vagal trunks, which descend through the oesophageal opening (T10). The anterior trunk descends on the anterior aspect of the stomach and gives off branches to the liver and stomach. The posterior vagal trunk descends along the posterior wall of oesophagus, passes through the oesophageal opening and supplies a large celiac branch, which passes to the celiac plexus and to the superior mesenteric plexus. The vagal fibres that enter the celiac and superior mesenteric plexuses supply the stomach, pancreas, liver, small intestine and the large intestine as far as the left colic flexure (i.e. fore- and midgut derivatives).

The autonomic plexuses:

The sympathetic and parasympathetic nerves contribute to form the autonomic plexuses also called the prevertebral plexuses. These plexuses are situated anterior to the aorta and vertebral column and contain the sympathetic ganglia e.g. celiac, superior mesenteric, aorticorenal and the inferior mesenteric ganglia and plexuses.

The celiac plexus contains the paired celiac ganglia and is situated at the level of the T12 and L1 vertebra. It surrounds the root of the celiac trunk and superior mesenteric a. The plexus and ganglia are joined by greater and lesser splanchnic nn, vagus and phrenic n. The celiac ganglia are paired structures, which lie between the suprarenal glands and the celiac trunk origin. The lower part is partially detached and is sometimes known as the aorticorenal ganglion and plexus, and it forms most of the renal plexus. Secondary plexuses derived from or connected with the celiac are the phrenic, splenic, left gastric, suprarenal, renal, gonadal, superior mesenteric, inferior mesenteric, intermesenteric, and aortic.

The aortic plexus connects with the superior hypogastric plexus, which is situated anterior to the aortic bifurcation, LV5 and the sacral promontory. The superior hypogastric plexus is formed from branches from the aortic plexus, and the 3rd and 4th lumbar splanchnic nn. It divides into Lt and Rt hypogastric nn, which descend to the two inferior hypogastric or pelvic plexuses, lying anterior to the sacrum. The inferior hypogastric plexus is formed from pelvic splanchnic nn (parasympathetic from the segments, S2 to 4) and also receives sacral sympathetic nn (postganglionic sympathetic from L1 and L2 segments of the spinal cord) as mentioned above.

Several plexuses arise from the inferior hypogastric plexuses, which include the: middle rectal plexus, vesical plexus, prostatic plexus and uterovaginal plexus.
Autonomic Supply of Abdomen

**Summary of Segmental Sympathetic Supplies**

<table>
<thead>
<tr>
<th>Oesophagus (caudal part)</th>
<th>T5 to 6</th>
<th>Retrosternal/epigastrium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>T6 to 10</td>
<td>Epigastrium</td>
</tr>
<tr>
<td>Small intestine</td>
<td>T9 to 10</td>
<td>Umbilical</td>
</tr>
<tr>
<td>Large intestine to splenic flex.</td>
<td>T11 to L1</td>
<td>Umbilical</td>
</tr>
<tr>
<td>Splenic flex. to rectum</td>
<td>L1 to 2</td>
<td>Hypogastrum</td>
</tr>
<tr>
<td>Liver and gall bladder</td>
<td>T7 to 9</td>
<td>Epigastrium/Rt hypochon.</td>
</tr>
<tr>
<td>Spleen</td>
<td>T6 to 10</td>
<td>Lt hypochondrium</td>
</tr>
<tr>
<td>Pancreas</td>
<td>T6 to 10</td>
<td>Epigastrium</td>
</tr>
<tr>
<td>Kidney</td>
<td>T10 to L1</td>
<td>Posterior lumbar</td>
</tr>
<tr>
<td>Suprarenal</td>
<td>T8 to L1</td>
<td>Posterior lumbar</td>
</tr>
<tr>
<td>Gonads</td>
<td>T10 to 11</td>
<td>Lumbar to groin</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>T11 to L2</td>
<td>Hypogastrum</td>
</tr>
<tr>
<td>Uterus</td>
<td>T12 to L1</td>
<td>Hypogastrum</td>
</tr>
</tbody>
</table>

2) **Somatic Supply:** With colleagues, identify the lumbar plexus, its branches and nerves to the anterolateral abdominal wall.

i) **Thoracoabdominal nn**

   These are brs of T6 to 11 intercostal Ns and are motor to the anterolateral abdominal wall muscles, sensory to the anterolateral abdomen, gluteal region and lateral side of the thigh. T7 supplies the level of xiphoid process, T10 supplies the umbilicus, and L1 supplies the suprapubic region. T8 and T9 supply between xiphoid process and umbilicus and T11 and T12 supply between the umbilicus and pubic symphysis.
ii) Phrenic N.
This is a nerve derived from C3, 4, 5 and supplies the diaphragm and related pleura and peritoneum. It is a mixed nerve with both motor and sensory components.

iii) Lumbar plexus
This extends from spinal nerves L2 to L4, but branches of L1 are often considered with the lumbar plexus. L4 and L5 contribute to the sacral plexus by the **lumbosacral trunk**.

There are several nerves to consider here, but their main significance for this course is as ‘backdrop’ or important posterior relations for visceral structures:
- a) iliohypogastric N. (L1)
- b) ilioinguinal N. (L1)
- c) genitofemoral N. (L1, 2)
- d) lateral femoral cutaneous N. (L2, 3)
- e) femoral N. (L2, 3, 4)
- f) obturator N. (L2, 3, 4)

### Lumbar Plexus

![Diagram of the Lumbar Plexus]

3. **Referred Pain:** Discuss with colleagues and your tutor the basis for **referred pain** in the conditions listed above under SO5: *acute appendicitis, acute cholecystitis, ruptured spleen, diverticulitis, ureteric calculi, torsion of the testis*.

**Materials:** Articulated skeletons; prosected specimens showing branches of the celiac trunk, superior and inferior mesenteric arteries and their major branches; deep dissections of the abdomen and pelvis showing lumbar and sacral plexus. Prosections of deep abdomen and back (new Vincent’s design) to show autonomic ganglia and prevertebral plexuses; deep dissections of the thorax showing thoracic splanchnic nerves, male and female lateral pelvic walls, models of the male and female pelvic organs. Radiographs of abdomen and pelvis.

**Written, compiled and modified from the original notes by Prof. Ken Ashwell**

ICS A  Oncology

P1. SECTIONAL ANATOMY OF THE NECK

Dr. D. Vu

Specific objectives
1. To be able to identify some major structures of the head and neck on anatomical cross sections and CT scans.
2. To review the above structures on prospected specimens and relate them to cross section images.
3. To review lymphatic drainage of the head and neck

Learning activities
1. On prospected specimens of the neck, identify (with the help of your tutor if necessary) the hyoid bone; digastric muscle; infrahyoid muscles; cartilages of the larynx; common, external and internal carotid arteries; internal jugular vein; sternocleidomastoid muscle; thyroid gland and brachial plexus.
2. Study the images of sections of the neck at three levels, hyoid bone, thyroid cartilage and cricoid cartilage. Hold each one against the prospected specimens, imagine a section across the prospected specimen at the level of the print in order to appreciate the relations of the labelled structures and thereby identify them.
3. Listen to a demonstration of your tutor on lymphatic drainage of the head and neck. Read the summary provided.
4. Read the notes on lymphatics of the head & neck in order to locate on the specimens the expected positions of the named lymph nodes listed in the notes, especially the deep cervical nodes, the jugulodigastric and juguloomohyoid nodes.
5. Answer the following questions:

Q1: What vertebral level is section 3? How do you know?
Q2: What muscle is 20 and how do you know?
Q3: What lymph node is found near the muscle 20? If that lymph node were enlarged, hard and not painful, what organ would you check first?
Q4: What structure is 15, and how do you know?
Q5: On the CT scan provided of the neck at the level of the digastric muscle, identify the structures labeled A, B, C and D. Histopathology demonstrated cancer cells in the biopsy of D. Which organ could be the primary cancer?

Materials
MODELS: larynx, tongue
SPECIMENS: superficial head & neck, deep head & neck, deep thorax
SECTION 3: Level of cricoid cartilage
P2. THORAX & LUNGS

Dr. D. Vu

Specific objectives
1. To be able to identify some major structures of the thorax and the hilum of each lung on anatomical sections and CT/MRI scans.
2. To review the above structures on prosected specimens and relate them to sectional images.
3. To review lymphatic drainage of the lungs.

Learning activities
1. On prosected specimens of the thorax, identify (with the help of your tutor if necessary) the aorta and the branches of the aortic arch, superior vena cava and its formation from the brachiocephalic veins, azygos vein, trachea and its relations with the pulmonary trunk and arteries, the heart and its chambers.
2. On the isolated lungs, study their hila and identify (with the help of your tutor if necessary) the main bronchi and their relations with pulmonary arteries and veins at the hila.
3. Study the images of axial sections of the thorax. Hold each one against the prosected specimen at the level of the print in order to appreciate the relations of the labelled structures and thereby identify them.
4. Listen to a demonstration of your tutor on lymphatic drainage of the lungs.
   - The lymph nodes of the lungs include:
     - **Pulmonary** nodes in the lung
     - **Bronchopulmonary/hilar** nodes, at the hilum
     - **Inferior tracheobronchial** nodes, at the angle between the main bronchi
     - **Superior tracheobronchial** nodes at the angle between the bronchi and the trachea
     - **Paratracheal** nodes: on either side of the thoracic trachea
   - Efferents from these nodes join those of the **parasternal** nodes and the **brachiocephalic** nodes to form the right and left **bronchomediastinal trunks**. The left bronchomediastinal trunk end in the thoracic duct, the right BM trunk the right lymphatic duct (at the junction between the internal jugular vein and subclavian vein).
5. Study the axial sections and MRI scans of the thorax and identify the labelled structures.

Materials
- MODELS: torso
- SPECIMENS: Superficial and deep thorax, isolated lungs
THORAX, Axial sections

A

B
THORAX, Axial sections

C

D
THORAX, Sagittal sections

Section A

Section B

Section C
THORAX, Coronal sections

Section A

Section B

Section C
P3a. ABDOMEN & PELVIS

Dr D. Vu

Specific objectives
1. To be able to identify some major structures of the abdomen and pelvis on anatomical sections and CT scans.
2. To review the above structures on prosected specimens and relate them to sectional images.
3. To review lymphatic drainage of the abdomen and pelvis
4. To practice identifying some major abdominopelvic structures and lymph nodes

Learning activities
1. On prosected specimens of the abdomen, identify (with the help of your tutor if necessary) the aorta and its main branches, liver and gall bladder, spleen, stomach, pancreas and duodenum, portal vein, kidneys and suprarenal glands.
2. On prosected specimens of the female pelvis, identify (with the help of your tutor if necessary) the psoas major, iliacus, obturator internus, levator ani, internal and external iliac arteries and veins, sigmoid colon and rectum, bladder, vagina, uterus (note in particular the angles of anteflexion and anteverision).
3. Study the images of sections of the abdomen and pelvis. Hold each one against the prosected specimen at the level of the print in order to appreciate the relations of the labelled structures and thereby identify them.
4. Listen to a demonstration of your tutor on lymphatic drainage of the abdomen and pelvis. Read the summary provided.
5. Read the notes on lymphatics of the abdomen and pelvis in order to locate on the specimens the expected positions of the named lymph nodes listed in the notes.
6. Study the CT scan of the abdomen and the MRI scans of the pelvis and identify the structures labeled A - K

Materials
MODELS: pelvis, torso
SPECIMENS: Superficial abdomen, deep abdomen, sagittal female pelvis

ABDOMEN, Cross section 1
Coronal section

CT scan of the abdomen
MRI SCANS of the Pelvis

Scan 1

Scan 2
P3b. PROSTATE

Dr D. Vu

Specific objectives
1. To be able to identify some major structures of the male and female pelvis on anatomical sections and CT scans.
2. To review the above structures on prospected specimens and relate them to sectional images.
3. To review lymphatic drainage of the pelvic viscera.
4. To discuss anatomy of the prostate on specimens, CT and Ultrasound scans.

Learning activities
1. On prospered specimens of the female pelvis, identify (with the help of your tutor if necessary) the psoas major, iliacus, obturator internus, levator ani, internal and external iliac arteries and veins, sigmoid colon and rectum, bladder, vagina, uterus (note in particular the angles of anteflexion and anteversion).
2. On prospected specimens of the male pelvis, identify (with the help of your tutor if necessary) the rectum, bladder, prostate, seminal vesicle, ductus deferens.
3. Study the images of sections of the pelvis. Hold each one against the prospected specimen at the level of the print in order to appreciate the relations of the labelled structures and thereby identify them.
4. On the model of the male pelvis, identify the bladder, prostate, utricle of the prostate, ductus deferens, seminal vesicle, ejaculatory duct, lateral lobe, median lobe.
5. On the isolated bladder, identify the prostate. If a dissected prostate is available, identify the colliculus seminalis, opening of the utricle and ejaculatory ducts.
6. Listen to a demonstration by your tutor on the old and new divisions of the prostate. The old description in anatomy textbook is as follows: median lobe is the portion of the gland between the urethra and the ejaculatory ducts, lateral lobes, and fibromuscular portion.
7. New zonal anatomy of the prostate currently in use: the glandular part of the prostate is posterior to the urethra and is divided into a central zone and a peripheral zone (common area of prostatic carcinoma). Anterior to the urethra is the fibromuscular stroma. Surrounding the urethra is a small transition zone containing periurethral glands, the site of benign prostatic hyperplasia.
8. Listen to a demonstration of your tutor on lymphatic drainage of the pelvis. Read the summary provided.
9. Read the following notes on lymphatics of the pelvis in order to locate on the specimens the expected positions of the named lymph nodes listed in the notes.
10. Review the sections, CT & MRI scans of the pelvis (from the previous class).
11. Study the sections and MRI scans of the prostate and identify the labelled structures.

Materials
MODELS: pelvis, torso
SPECIMENS: Superficial abdomen, deep abdomen, sagittal female pelvis
PROSTATE: anatomical sections

AXIAL

a

1

2

3

4

b

5

6

7

8

SAGITTAL

1

2

4

6

8

9

CORONAL

7

10

11
P3c. NOTES ON LYMPHATICS OF THE PELVIS

Dr D. Vu

COMMON ILIAC NODES
Rouviere described three chains:
- Lateral chain: on the psoas major, along lateral border of common iliac artery
- Medial chain: along medial border of common iliac artery
- Intermediate chain: Rouviere called it “retrovascular”, behind the artery between L5 and the psoas

EXTERNAL ILIAC NODES
Rouviere described three chains:
- Lateral chain: along lateral border of external iliac artery, between the artery and the psoas
- Medial chain: along medial border of common iliac vessels, on the lowest part of linea terminalis
- Intermediate chain: medial to the artery, in front of the vein

INTERNAL ILIAC NODES
Found near the origin of the branches of the internal iliac artery.
The outlying members of this group include the:
- sacral lymph nodes (along the medial and lateral sacral vessels)
- obturator lymph node: at the deep opening of the obturator canal


LUMBAR NODES
There are four groups: pre-aortic, right and left lateral aortic and retro-aortic.

Pre-aortic group:
- Directly anterior to abdominal aorta
- Receives lymphatic from the viscera supplied by the ventral branches of the aorta which has passes through local groups of lymph nodes (e.g. coeliac, hepatic, pancreaticosplenic nodes…)

Lateral aortic group:
- On the right and left sides of abdominal aorta
- Receives lymph from the viscera and structures supplied by the lateral and dorsal branches of the aorta (e.g. posterior abdominal wall, kidneys, suprarenal glands, ovaries, testes…) and from the iliac nodes (pelvic viscera except the GIT)

Retro-aortic group:
- No particular area of drainage
- ?peripheral members of the lateral aortic groups

INGUINAL NODES
Superficial inguinal lymph nodes:
- The upper group
  - Runs immediately below the inguinal ligament
  - The lateral nodes drain gluteal region, abdominal wall
  - The medial nodes drain the genitalia (including vagina below hymen), anal canal below pectinate line
- The lower group
  - Runs vertically along the terminal part of long saphenous vein
  - Drains the lower limb
All superficial inguinal nodes drain into external iliac lymph nodes

Deep inguinal lymph nodes:
- One to three nodes on the medial side of the terminal part of femoral vein
- Receive deep lymph vessels of the lower limb, glans penis and glans clitoridis
- Drain into external iliac lymph nodes
ICS B Adult Health 2

P1a. ANATOMY OF THE EYE

Dr D. Vu/ Dr E. Tancred

Learning objectives
1. To identify the major components of the bony walls of the orbit
2. To identify the extraocular muscles and the levator palpebrae superioris
3. To identify the ophthalmic artery, ciliary ganglion and major nerves of the orbit
4. To identify the components of the lacrimal apparatus
5. To understand the structure of the eyeball and its three coats

Learning activities
1. Identify the bones contributing to the orbit: frontal, sphenoid (lesser wing and greater wing), zygomatic, maxilla, lacrimal and ethmoid.
2. Identify the features of the orbit: superior orbital fissure, optic canal, inferior orbital fissure, infraorbital groove, canal and foramen, lacrimal fossa, supraorbital notch/foramen.
3. Identify the levator palpebrae superioris, four recti and two oblique muscles of the eye. What nerves innervate these muscles? Deduce from the axes of movement of the eyeball and actions of the extraocular muscles. What nerves supply the extraocular muscles?
4. Identify the optic nerve and notice that it emerges from the eyeball on the medial (or nasal) side of the visual axis of the eye.
5. Identify the nerves which are located just under the roof of the orbit: trochlear, frontal and lacrimal. Identify the ophthalmic artery, the nasociliary nerve which cross over the optic nerve. Identify the oculomotor nerve, ciliary ganglion and the short ciliary nerves.
6. Identify the lacrimal gland, lacrimal punctum and canaliculi, lacrimal sac and nasolacrimal duct. Where does the nasolacrimal duct end?
7. Identify the tarsal plate on the specimens, the lacrimal puncta, bulbar and palpebral conjunctiva on your friends eyelid.
8. On the model of the eyeball, identify the three coats of the eyeball and their components:
   - Outermost: cornea, sclera, limbus
   - Middle: choroid (uvea) which contains blood vessels and nerves
   - Innermost: Retina

   In the choroid layer: identify the ciliary body, ciliary processes, iris, pupil. Where are ciliary muscles located? Discuss how the ciliary muscles can control the thickness of the lens by way of the suspensory ligament of the lens (or zonula). What nerves control movements of the ciliary muscles? Discuss the neural control of the pupil size.

   In the retina: identify the ora serrata, optic nerve, optic disc, branches of the ophthalmic artery, the macula lutea and fovea centralis. Note that the visual axis of the eye falls on the fovea of the macula, lateral to the optic disc, thus the blind spot is on the lateral (temporal) side of the visual axis in the visual field. Demonstrate how you can identify the blind spot of your right eye.

9. On the model of the eyeball, locate the position of Schlemm’s canal (scleral venous sinus), anterior and posterior chamber, aqueous humour, vitreous body.
10. To apply what you have learned in the previous activities, discuss the signs of oculomotor nerve palsy (ptosis, strabismus, dilated and sluggish pupil).
P1b. NEUROANATOMY

Dr E. Tancred

General aim
To review the anatomy and blood supply of the brainstem and cerebellum

Specific objectives
To describe and identify:
1. The gross features of the cerebellum and its major functional subdivisions
2. The blood vessels supplying the cerebellum and consider the effects of occlusion of these vessels
3. The gross anatomical features of the brainstem
4. Vertebral and basilar arteries and their branches
5. Patterns of blood supply to the brainstem
6. The anatomical basis of deficits produced by posterior circulation strokes.

Learning activities
1. With the assistance of your tutor and images in BrainStorm review the gross features of the cerebellum. Using whole brain, and isolated whole cerebellum identify the cerebellar hemispheres and vermis, and the numerous folia on their surface. Note that the folia are all oriented transversely. Recognise the superior and inferior surfaces of the cerebellum and identify the primary fissure on the superior surface. Identify the three anatomical lobes of the cerebellum and sulci (fissures) that separate them:
   (i)  flocculonodular lobe - formed by the nodulus & paired flocculi
   (ii)  anterior lobe - superior surface anterior to the primary fissure
   (iii)  posterior lobe - the remainder of the cerebellar hemispheres
Identify the posterolateral fissure, which separates the flocculonodular lobe from the posterior lobe (on inferior surface).

2. The cerebellum can also be divided on the basis of its connections into functional regions. Delimit the regions which constitute the:
   (i)  vestibulocerebellum - flocculus, nodulus
   (ii)  spinocerebellum - (anterior lobe, most of vermis and paravermal zone),
   (iii)  neocerebellum (pontocerebellum) - (lateral parts of the hemispheres including the tonsils).

3. Inspect the surface of the cerebellum related to the fourth ventricle and identify the three pairs of cerebellar peduncles (superior, middle, and inferior) on both the cerebellum specimen and the dissected brain stem.

4. Review the external features of the brainstem (covered previously in AEB):
   In the medulla: pyramids, olive, gracile and cuneate fasciculi and tubercles, inferior cerebellar peduncle, obex
   In the pons: base of pons, middle cerebellar peduncle, superior cerebellar peduncle, trigeminal nerve, facial nerve, rhomboid fossa (floor of 4th ventricle).
   In the midbrain: cerebral peduncles (crus cerebri), interpeduncular fossa and oculomotor nerve ventrally, and superior and inferior colliculi dorsally, cerebral aqueduct.

5. Identify the major arteries that supply the brainstem. Find the vertebral arteries and trace the branches that emerge from them as you ascend up the brainstem: anterior spinal (if present), posterior inferior cerebellar, basilar, anterior inferior cerebellar, superior cerebellar, and posterior cerebral. Gently lift the basilar artery and observe the numerous deep penetrating branches, the pontine arteries. These can be divided into short paramedian branches and longer circumferential branches. Penetrating branches of the posterior cerebral artery enter the brainstem through the posterior perforated substance in the floor of the interpseuduncular fossa to supply upper midbrain and posterior thalamus.

6. Using Cross-sectional images in BrainStorm, review the major features of 4 key brainstem levels:
   Caudal Medulla (sensory decussation) – pyramids (corticospinal tracts), cuneate and gracile tracts and nuclei, spinothalamic tract, inferior cerebellar peduncle, spinal trigeminal, hypoglossal nuclei, reticular formation (RF)
   Rostral medulla – pyramids, inferior olivary nucleus, medial lemniscus, spinothalamic tract, inferior cerebellar peduncle, reticular formation (RF), nucleus ambiguus, hypoglossal and vestibular nuclei
   Caudal pons – basis pontis (containing pontine nuclei, corticospinal, corticobulbar and pontocerebellar tracts), middle cerebellar peduncle, tegmentum, medial lemniscus, spinothalamic tract, spinal trigeminal and facial motor nuclei)
Midbrain (superior colliculus) – tectum (superior colliculus), cerebral aqueduct, periaqueductal grey matter, medial lemniscus, spinothalamic tract, substantia nigra, crus cerebri (containing corticospinal, corticobulbar and corticopontine fibres)

As you go through these levels discuss the zones of blood supply and indicate on diagrams below, the zones supplied by the following arteries and the key structures in those zones:

Vertebral a. - medulla

Anterior spinal a. – pyramids, medial lemniscus, hypoglossal n. & nucleus

Posterior inferior cerebellar a (PICA) – ICP, vestibular nuclei, spinal trigeminal nucleus, spinothalamic tract, RF, nucleus ambiguus, cerebellum

Basilar a. (paramedian branches) – base of pons including corticospinal and corticobulbar tracts

Anterior inferior cerebellar a. - pontine tegmentum, middle cerebellar peduncle, cerebellum

Superior cerebellar a. – pontine tegmentum, cerebellum

Posterior cerebral a. – midbrain, posterior thalamus, inferior temporal lobe, occipital lobe.
7. Complete the tables below:

**Common Warning Signs of Vertebrobasilar ischaemia**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Ischaemic Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dizziness (vertigo), nausea</td>
<td></td>
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<tr>
<td>Diplopía, dysconjugate gaze</td>
<td></td>
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<tr>
<td>Blurred vision or other visual disturbances</td>
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<tr>
<td>Ataxia (inco-ordination)</td>
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<tr>
<td>Unsteady gait</td>
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<tr>
<td>Dysarthria, dysphagia</td>
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<td>Numbness and tingling</td>
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<tr>
<td>Hemiparesis, quadriparesis</td>
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<tr>
<td>Somnolence (drowsiness)</td>
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<tr>
<td>Headache</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Artery affected</th>
<th>Structures affected</th>
<th>Anatomical clinical feature(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial medulla</td>
<td>Anterior spinal arteries</td>
<td>Corticospinal tract</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medial lemniscus</td>
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<td></td>
<td></td>
<td>CN 12 nucl &amp; n.</td>
<td></td>
</tr>
<tr>
<td>Lateral medulla</td>
<td>Posterior inferior cerebellar artery</td>
<td>ICP, vestibular nuclei</td>
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<td>Spinal trig. nucl/ tract</td>
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<td>Spinothalamic tract</td>
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<td></td>
<td></td>
<td>Nucleus ambiguous</td>
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<td></td>
<td></td>
<td>Descending sympathetic fibres</td>
<td></td>
</tr>
<tr>
<td>Medial pons</td>
<td>Basilar - paramedian (lacunar infarcts)</td>
<td>Corticospinal &amp; corticobulbar tracts</td>
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<tr>
<td></td>
<td></td>
<td>Pontine nuclei &amp; pontoCb fibres</td>
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<td></td>
<td></td>
<td>Facial nucleus</td>
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<td></td>
<td></td>
<td>Abducens nucleus</td>
<td></td>
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<td></td>
<td></td>
<td>(sometimes)</td>
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</tr>
<tr>
<td>Cerebellum</td>
<td>Superior cerebellar artery</td>
<td>SCP Cb nuclei &amp; hemispheres</td>
<td></td>
</tr>
<tr>
<td>Medial midbrain</td>
<td>Posterior cerebral artery, paramedian branch</td>
<td>Oculomotor n.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Cerebral peduncle</td>
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</tbody>
</table>

P2. FACE, SCALP & TEMPOROMANDIBULAR JOINT

Dr D. Vu

SCALP
Observe the five layers of the scalp in prosected specimens. Identify the frontal and occipital bellies of the occipitofrontalis muscle which are connected together by epicranial aponeurosis.

Points of clinical relevance
- Arteries are anchored to the dense connective tissue and cannot retract when cut, so wounds of the scalp bleed profusely.
- Blood and pus can collect and spread freely in the loose connective tissue to extend over the entire dome of the skull.

FACE
Muscles of facial expression: identify the orbicularis oculi, zygomaticus major, buccinator, orbicularis oris and platysma. Be aware of the muscles elevating and depressing the upper & lower lips and angles of the mouth.

Identify the motor branches of the facial nerve emerging from the parotid gland: temporal, zygomatic, buccal, marginal mandibular and cervical. Note that the buccal nerve of the mandibular nerve is a sensory nerve to the skin and mucous membrane of the cheek.

Identify the facial vein and the tortuous facial artery which ends at the medial angle of the eye as the angular artery.

Identify the parotid gland. The parotid duct runs along the lower border of a finger which is placed along the zygomatic arch, hooks around the anterior border of the masseter to open opposite the second upper molar tooth. Secretion of the gland is controlled by the parasympathetic fibres in the auriculotemporal nerve.

TEMPOROMANDIBULAR JOINT
On the temporal bone, identify the mandibular fossa, zygomatic arch, articular tubercle, tympanic plate, styloid process. On the mandible, identify the head, neck body, angle, ramus, coronoid process, mandibular foramen and lingula. On the sphenoid bone, identify the medial and lateral pterygoid plates, spine of the sphenoid.

Articular surfaces: mandibular fossa, head of the mandible
Articular disc: fibrocartilage, attached to the lateral pterygoid muscle anteriorly and elastic tissue posteriorly.
Discuss with your tutor movements of the head of the mandible and of the articular disc when the mandible is depressed.

Ligaments: lateral ligament, stylomandibular ligament, sphenomandibular ligament.
Note: Movements of the mandible include elevation, depression, protrusion, retraction, lateral excursion (side-to-side). Chewing involves all the above movements.

THE INFRATEMPORAL FOSSA
On the skull, identify the boundaries of the infratemporal fossa:
- Medially: lateral pterygoid plate and associated muscles of the pharynx
- Laterally: ramus of the mandible
- Anteriorly: maxilla
- Posteriorly: tympanic plate, styloid process

Contents: Muscles of mastication, mandibular nerve, maxillary artery.
Identify the muscles of mastication and their actions: masseter, temporalis, medial pterygoid and lateral pterygoid muscles.

Of the branches of the mandibular nerve and the maxillary artery, identify the following branches: auriculotemporal (which carries secretomotor fibres to the parotid gland), lingual, inferior alveolar and buccal nerves, middle meningeal artery.

Discuss with your tutor the actions of the muscles of mastication.
Discuss with your tutor the role of the buccinator and digastric muscles in mastication.
P4. INTERNAL ANATOMY OF THE KNEE
Dr D. Vu

DETAILS OF THE BONES AND ARTICULAR SURFACES
Observe the lower end of the femur from the front. On the drawing, identify and label the following features: lateral and medial condyles, epicondyle, patellar surface (extending higher into the shaft than on the lateral side) and tibial surface of the femoral condyles, intercondylar fossa (or notch), medial epicondyle, lateral epicondyle just above the groove for popliteus tendon.

Look at the lower end of the femur from below (as shown in the diagram on the hand-out) and note that the patellar surface is higher on the lateral side to reduce the risk of patellar dislocation but the lateral condyle is shorter anteroposteriorly than the medial condyle.

Observe the upper end of the tibia. Identify the tibial tuberosity, the tibial “plateau” with the medial (longer anteroposteriorly) and lateral condyles (shorter anteroposteriorly), On the posterior aspect of the upper end of the tibia, identify the soleal line limiting the popliteal surface (for popliteus muscle). Identify the articular facet for the fibula (facing lateroinferiorly).

Look at the superior surface of the tibia, note the articular surfaces of the condyles, anterior and posterior intercondylar areas, medial and lateral intercondylar eminences. Compare with the diagram on the hand-out, notice that the articular surface for the lateral femoral condyle is shorter anteroposteriorly.

Observe the patella. Identify the apex (pointing distally), the anterior surface with impressions of the fibres of the quadriceps ligament, posterior surface with a broader lateral articular surface and a narrower medial surface.

Observe the upper end of the fibula. Put the fibula together with the corresponding tibia and appreciate that the fibula is posterolateral and does not articulate with the femur at all. Identify the facet for articulation with the tibia (facing mediosuperiorly and anteriorly), this is a synovial joint. Identify the apex of the head of the fibula (styloid process).

THE CAPSULE
Examine models, prosected and plastinated specimens of the knee joint. Note the extent and attachments of the knee joint capsule, note that it is deficient anteriorly where the patella and quadriceps mechanism are, and it has a hole for the passage of the popliteus tendon.

THE SYNOVIVUM
Some prosections may show the synovium covering the infrapatellar fat pad.

THE MENSICI
Identify the lateral and medial menisci and their attachments to the tibia by their anterior and posterior horns. Note that the horns of the lateral meniscus are attached closer together than the medial meniscus which is more C-shaped.

Identify the transverse ligament connecting the menisci anteriorly. What is the coronary ligament?

Identify the oblique popliteal ligament, an extension of the tendon of the semimembranosus which reinforces the posterior capsule.

THE COLLATERAL LIGAMENTS
Identify the collateral ligaments of the knee and their attachments. Note that the medial collateral ligament overlies directly and is attached to the medial meniscus but the lateral collateral ligament. It is separated from the lateral meniscus by the tendon of popliteus.

THE CRUCIATE LIGAMENTS
Identify the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). Review their attachments to the tibia and femur, note that they are named after their tibial attachment (e.g. the anterior cruciate ligament is attached to the anterior intercondylar area) and that they cross (hence the name “cruciate”) when viewed from the side, but they lie in two planes when viewed from above.

Identify the posterior meniscofemoral ligament which lies on the posterior aspect of the PCL. The anterior meniscofemoral ligament is not visible on our prosections or models.

Discuss the abnormal movement of the tibia in case of rupture of ACL and PCL (drawer signs) and rupture of medial collateral ligament (valgus instability)

CLINICAL ISSUES
Instability due to ligamentous damage (lateral/medial stress test, drawer sign).
Injury to the meniscus (medial meniscus more commonly damaged)

P6. ANATOMY OF THE SHOULDER
Dr D. Vu
THE “SHOULDER COMPLEX”
Movements of the shoulder joints depend on many other joints in addition to the glenohumeral joint: the so-called
scapulothoracic joint, sternoclavicular, acromioclavicular joint and even vertebral column. Explain why.
Elevation of the arm: glenohumeral joint contributes only 2/3, the rest by sternoclavicular and acromioclavicular joints.

GLENOHUMERAL JOINT
Review the basic anatomy of the GH joint (sizes of the humeral head and glenoid fossa, bicipital groove and ligaments: transverse
humeral, coracohumeral, glenohumeral).
Note that the plane of the scapula is ca. 30-45 degrees to the coronal plane, the glenoid fossa faces backward 5-10
degrees relative to the plane of the scapula, and the humeral head is retroverted by ca. 30 degrees, so the glenoid
fossa directly faces the humeral head.
Definition of movements of the GH joint is in relation with the plane of the scapula, not with the anatomical position.
Palpate the tendon of long head of biceps in its groove. Discuss the role of the long head tendon (compression of the
head against the glenoid fossa, guiding the humeral head in elevation).
Rotator cuff tendons fuse with the capsule near their humeral attachments. Discuss their function, especially that of the
supraspinatus tendon.
Bursae around the GH joint: subacromial and subdeltoid, subscapularis, subcoracoid bursa, ...

STERNOCLAVICULAR JOINT
Articular surfaces: bulbous medial end of the clavicle and manubrium sterni.
Articular disk (usually complete).
Ligaments: anterior and posterior sternoclavicular, interclavicular, costoclavicular.
Movements: elevation-depression, protraction-retraction, and rotation around long axis of the clavicle.

ACROMIOCLAVICULAR JOINT
Articular surfaces: flat lateral end of the clavicle and acromion.
Articular disk (usually incomplete).
Ligaments: acromioclavicular ligaments, coracoclavicular ligament (CCL) with its conoid & trapezoid parts,
coracoacromial.
Limited range of movements, upwards and downwards movements at A-C joint allow 20 degrees of rotation between the 2
bones.
Discuss the importance of the CCL.
Discuss the formation of the coracoacromial arch and its functional significance. What is the role of the coracoacromial
ligament in rotator cuff injuries?

CORACOACROMIAL ARCH
Coracoid process + coracoacromial ligament + acromion.
Provides superior stability of the glenohumeral joint.
Discuss the role of the curvature of the acromion & the role of the subacromial and subdeltoid bursae in subacromial
pathology (e.g. “rotator cuff” problems).

“SCAPULOPTHORACIC JOINT”
Palpate the bony features of the scapula: medial border and the inferior angle, coracoid process, acromion, spine. Note
that in resting position of the scapula, it is about 5cm from the midline, rotated upwards 10-20 degrees, the medial
end of the spine and the inferior angle of the scapula correspond to the SP of T3 and T7 vertebra.
Note the varying position of the scapula in protraction, retraction of the scapula (in the horizontal plane), abduction
and adduction of the arm.

PHYSICAL EXAMINATION OF THE SHOULDER
- Must include examination of the neck. Why?
- Must include assessment of all the joints of the shoulder complex.
- Must consider movements of the scapula.
ICS B Aged Care

P1. SPINE, DISCS, DERMATOMES, SCLEROTOMES

Dr D. Vu

Specific objectives

1. To understand the structure of the intervertebral disc and how the force acting on the disc changes in different positions of the body.
2. To understand the concepts of dermatome, myotome, sclerotome and referred pain.
3. To see some examples of IV disc and its pathology on CT and MR scans.

Learning activities

1. Identify the parts of a vertebra (body, pedicle, articular processes and surfaces, lamina, transverse process, spinous process, vertebral foramen) and the parts which contribute to the intervertebral foramen (IVF).
2. Study an articulated vertebral column. Identify the curves of the cervical, thoracic, lumbar spine and the sacrum. Note that the intervertebral discs account for 1/4 of length of the column, and are thinner in the thoracic segment.
3. 

**Intervertebral (IV) disc:** Intervening between two vertebrae are the end plates and the IV disc. The IV disc is made up of a gelatinous nucleus pulposus and a lamellar annulus fibrosus. The bands of the annulus are thinner posteriorly and posterolaterally.

4. Age-related degenerative changes of the IV disc:
   - Nucleus pulposus has less proteoglycans and water, and by the fifth decade, becomes fibrous and merges with the annulus.
   - The annulus develops clefts (tears). Combined flexion and torsion of the vertebral column exerts highest stress on the annulus.
   - Osteophytes are formed at the margin of the vertebral bodies.

When the vertebral column flexes or extends, the disc bulges out on the compressed side. Degenerated disc deforms up to 30% more than normal. Localised protrusion of the disc (disc “hernia”) may compress a nerve root, usually of a segment below it (e.g. protrusion of L4-5 disc usually compresses nerve root L5).

5. Take an example of a person weighting 80kg. About 40kg would lie above the level of L3. Distance is measured in cm and force in Newtons (40kg corresponds to 400N). Suppose that the vertebral muscles act on a point 5cm behind L3. The diagrams in the next page demonstrate different forces acting on the IV disc in different postures and lifting.

6. **Dermatome, myotome and sclerotome**

Each spinal cord segment supplies an area of the skin (dermatome), a group of muscle (myotome), an area of bone and periosteum (sclerotome). (See charts in next 2 pages)

7. **Referred pain:** It has been shown during surgical operation or discography (injection of radio-opaque material into the IV disc) that stimulation of the dorsal root or IV disc can cause pain in the corresponding dermatome. However, referred pain is vague and should only be taken as an indirect guide to, not a specific locator of, the source of pain.

8. Study the CT and MRI scans provided. Identify the osteophytes, and the formation of the IVF.

9. Study the following reviews “IV Disc Mechanics” and "Anatomy of Nerve Root Lesions of Lower Limb”

Materials

**BONES:** Isolated cervical, thoracic and lumbar vertebrae, articulated vertebral column.

**SPECIMENS:** Cervical and lumbar vertebrae showing the discs and ligaments.
When a person stands, a line from his centre of gravity to the ground (vertical midline) passes about 5 cm in front of the centre of disc L3, and his back muscles lie about 5 cm behind it. Hence, the muscle force must equal 400 N in order to prevent his upper body from falling forward. The force acting on the disc is 400 + 400 = 800 N.

When a person sits, his vertical midline passes about 15 cm in front of L3. The muscle’s lever arm is 5 cm (as in standing). Therefore, a force of 1200 N is required for equilibrium to exist. The force acting on the disc will be 1200 + 400 = 1600 N.

(a) 20 cm
Fw x 5 = 500 x 20
Fw = 2000 N

(b) 30 cm
Fw x 5 = 500 x 30
Fw = 3000 N

(c) 40 cm
Fw x 5 = 500 x 40
Fw = 4000 N

**NOTE:**
Dermatome & Solerotome charts are taken from “Examination of the Cranial and Peripheral Nerves”
O. Devinsky & E. Feldmann
Churchill Livingstone 1988
1. RELATIONSHIP BETWEEN SPINAL NERVES AND VERTEBRAE
Cervical nerves exit above the corresponding vertebral body
Nerve C1: emerges b/w occipital & C1
Nerve C2: b/w C1 & C2
Nerve C3: b/w C2 & C3
Nerve C8: b/w C7 & T1
For the rest of the vertebral column, spinal nerves exit below the corresponding vertebral body:
Nerve T1: between T1 and T2
Nerve L4: between L4 and L5
Nerve L5: between L5 and S1

2. REVIEW: HOW SPINAL NERVES ARE FORMED?
Dorsal root with spinal ganglion. Ventral root
Dorsal & ventral roots join on the pedicle to form a spinal nerve.

3. REVIEW: DERMATOMES AND MYOTOMES

<table>
<thead>
<tr>
<th>Dermatomes: this table is adequate for practical purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
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<tr>
<td>L2</td>
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<tr>
<td>L3</td>
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<tr>
<td>L4</td>
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<td>L5</td>
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<tr>
<td>S1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Myotomes: Similar to the scheme of the upper limb, each joint is supplied by 4 spinal segments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIP</td>
</tr>
<tr>
<td>KNEE</td>
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<tr>
<td>ANKLE</td>
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</tbody>
</table>

If you like mnemonics: For testing myotomes from knee to floor
Start at lumbar 3 and 4
Extend the foot and toes all five
for lumbar segments 4 and 5
When all of that extension’s done
turn out the foot for 5 S1
An ankle jerk, and then you are through
to sacral segments 1 and 2

4. REVIEW: PARTS OF A VERTEBRA
Parts of a vertebra: body, pedicle & vertebral notch, articular process
Intervertebral disc: between vertebral bodies, can protrude/bulge out to compress the structures behind it.
5. INTERVERTEBRAL FORAMEN
Intervertebral foramen (IVF) bounded by: bodies, IV disc, pedicles, articular processes
Spinal nerve emerges through the IVF, so any abnormality of the structures forming the boundaries of the IVF can narrow the IVF and compress the nerve which runs through it.
IV disc prolapse causes pressure on the spinal nerve. Depending on the size and location of the IV disk bulge, the spinal cord, one or a few spinal nerves can be compressed.

For this course, we’ll consider only the atypical and simple case of a small disc protrusion at its posterolateral corner, which will compress only one spinal nerve.

6. PATH OF NERVE ROOTS
The spinal cord ends at L1, so lumbar and sacral nerve roots have to descend vertically to reach their level of emergence.
In the diagram, note the relation of the nerve root L5 on its way to its emergence. Protrusion of the disc between L4 and L5 will compress nerve root L5
Similarly, protrusion of the disc between L4 and L5 will compress nerve root L5

7. CLINICAL DIAGNOSIS OF NERVE ROOT COMPRESSION
Disc prolapse/hernia which occurs at the most mobile segments of the lumbar region, b/w L4 - L5 & L5 – S1
Diagnosis is based on the sensory loss (numbness) and pain in the dermatome, and motor loss (weakness) of muscles of the myotome
P4. SECTIONAL ANATOMY OF THE BRAIN
Answers to identifications and questions posed in the above practical classes

AH1 P5. SECTIONAL ANATOMY OF THE ABDOMEN

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Rectus abdominis m.</td>
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<tr>
<td>2. Greater omentum</td>
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<tr>
<td>3. Anterior abdominal wall mm.</td>
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<td>4. Stomach</td>
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<td>5. Gall bladder</td>
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<td>6. Right colic flexure</td>
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<td>7. Portal vein</td>
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<td>8. Hepatic artery and bile duct</td>
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<td>9. Duodenum</td>
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<td>10. Inferior vena cava</td>
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<td>11. Liver</td>
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<td>12. Right adrenal gland</td>
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<td>13. Body of T12 vertebra</td>
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<tr>
<td>14. Right crus of diaphragm</td>
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<tr>
<td>15. Abdominal aorta with origin of coeliac trunk</td>
<td></td>
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<tr>
<td>16. Left crus of diaphragm</td>
<td></td>
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<tr>
<td>17. Median arcuate ligament</td>
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<td>18. Left kidney</td>
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<td>19. Spleen</td>
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<td>20. Left adrenal gland</td>
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<tr>
<td>21. Splenic vein</td>
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<tr>
<td>22. Pancreas (head)</td>
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<tr>
<td>23. Descending colon</td>
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<tr>
<td>24. Jejunum</td>
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<tr>
<td>25. Left colic flexure</td>
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</tbody>
</table>

**Structures Labeled On The Sections Of The Abdomen**

1. Inferior vena cava
2. Aorta
3. Right crus of the diaphragm
4. Gastro-oesophageal junction
5. Spleen
6. Transverse colon
7. Left lung
8. Hepatic flexure/Right colic flexure
9. Splenic flexure/Left colic flexure
10. Duodenum (Second part)
11. Head of the pancreas
12. Gall bladder
13. Right suprarenal gland
14. Right kidney (upper pole)
15. Perirenal fat
16. Splenic vein
17. Portal vein
18. Ileum
19. Rectus abdominis
LABELS TO SECTION AT L2

1. Rectus abdominis m.
2. Greater omentum.
3. Transverse colon.
4. Right colic flexure.
5. Superior mesenteric vein.
6. Head of pancreas.
7. Second part of duodenum.
8. Ascending colon.
9. Inferior vena cava.
10. Right renal vein.
11. Right crus of diaphragm.
12. Right kidney

13. IVD L1-L2.
14. Psoas major muscle.
15. Cauda equina.
17. Perirenal fat.
18. Left kidney.
19. Pararenal fat.
20. Left renal artery and vein.
22. Coils of jejunum.
23. Coils of jejunum.
24. Left colic flexure.
25. Linea alba.

LABELS TO SECTION AT L4

1. Linea alba.
2. Rectus abdominis.
3. External oblique.
4. Internal oblique.
5. Transversus abdominis.
6. Right psoas major muscle.
7. Inferior vena cava.
8. IVD L3-L4.
9. Right and Left common iliac artery.
10. Left psoas major muscle.
11. Descending colon.
12. .
13. Ileum.
15. Mesentery.

LABELS TO SECTION AT SACROCOCCYGEAL JUNCTION

1. Rectus abdominis m.
2. Interior of the urinary bladder
3. Pudendal canal
4. Seminal vesicle
5. Ductus deferens
6. Rectum terminal part (before anorectal junction
7. Sacro-coccygeal junction
8. Fat in ischiorectal fossa
9. Obturator internus m.
10. Head of femur
11. Spermatic cord
12. (?) artefact
ONCO P1. SECTIONAL ANATOMY OF THE NECK

STRUCTURES LABELLED ON THE THREE SECTIONS

1. Internal carotid artery
2. External carotid artery
3. Internal jugular vein
4. Hyoid bone
5. Epiglottis
6. (Laryngo)pharynx
7. Sternoleidomastoid
8. Cervical nerve roots
9. Submandibular gland
10. Thyroid cartilage
11. Arytenoid cartilage
12. Vocal fold
13. Vertebral artery
14. An infrahyoid muscle (Sternohyoid muscle)
15. Common carotid artery
16. Deep cervical lymph node
17. Cricoid cartilage
18. Thyroid gland
19. Brachial plexus
20. An infrahyoid muscle (Sternothyroid muscle)

Answers to questions posed in notes
Q1: This is about level C6. Clues: Cricoid cartilage is at level C6.
Q2: Sternothyroid. Because it is a deep infrahyoid muscle, it runs from the sternum to the oblique line of the thyroid cartilage. The section is at the level of cricoid cartilage, below the thyroid cartilage, so this muscle must be sternothyroid. If the section was above the level of thyroid cartilage, it would be the thyrohyoid muscle, which is almost the continuation of the sternothyroid muscle on its way to the body of the hyoid bone.
Q3: The lymph node is called jugulo-omohyoid, in the lower group of deep cervical chain. It receives lymphatics from the tongue. A lymph node as described in the question is very suggestive of malignancy, and the first suspect is the tongue
Q4: Common carotid artery. Because it divides into internal and external carotid arteries at the upper border of thyroid cartilage. So when you see thyroid cartilage and cricoid cartilage, it is common carotid, and not external or internal carotid.
Q5: Identification – A: internal jugular vein, B: internal carotid artery, C: external carotid artery, D is the jugulodigastric lymph node. The tonsil could be the primary cancer.

ONCO P2. SECTIONAL ANATOMY OF THORAX

AXIAL SECTIONS
Section A is on the highest, cutting through the left brachiocephalic vein
Section B is lower than section A, cutting through the cross of the azygos vein
Section C is on the left side

1. Left brachiocephalic vein
2. Aortic arch
3. Trachea
4. Thoracic duct
5. Oesophagus
6. Superior vena cava
7. Ascending aorta
8. Trachea bifurcation
9. Descending aorta
10. Cross of the azygos vein
11. Pulmonary trunk
12. Superior pulmonary vein
13. Left main bronchus
14. Left pulmonary artery
15. Azygos vein
16. Right main bronchus
17. Right atrium
18. Right ventricle
19. Left ventricle
20. Mitral valve leaflet
21. Left atrium

MRI SCANS
Scan A (AXIAL) is the highest, cutting through the aortic arch
Scan B (AXIAL) is lower, cutting through the pulmonary artery
Scan C (CORONAL) is at the plane of the ascending aorta

1. Superior vena cava
2. Trachea
3. Oesophagus
4. Aortic arch
5. Ascending aorta
6. Right main bronchus
7. Pulmonary artery (bifurcating into right & left pulmonary arteries)
8. Left main bronchus
9. Descending aorta
10. Edge of inferior vena cava
### ONCO-P2. ABDOMEN & PELVIS

**STRUCTURES LABELLED ON THE SECTIONS OF THE ABDOMEN**

1. Inferior vena cava  
2. Aorta  
3. Right crus of the diaphragm  
4. Gastro-oesophageal junction  
5. Spleen  
6. Transverse colon  
7. Left lung  
8. Hepatic flexure/Right colic flexure  
9. Splenic flexure/Left colic flexure  
10. Duodenum (Second part)  
11. Head of the pancreas  
12. Gall bladder  
13. Right suprarenal gland  
14. Right kidney (upper pole)  
15. Perirenal fat  
16. Splenic vein  
17. Portal vein  
18. Ileum  
19. Rectus abdominis

**STRUCTURES LABELLED ON THE SECTIONS OF THE FEMALE PELVIS**

1. Femoral head  
2. Acetabulum  
3. Obturator internus  
4. Obturator nerve and vessels (in obturator canal)  
5. Levator ani (pelvic floor)  
6. Femoral artery  
7. Bladder  
8. Uterine cervix  
9. Vagina  
10. Rectum  
11. Uterus (body)  
12. Labia majora  
13. Pubic symphysis

**CT & MRI SCANS**

A. Liver  
B. Right kidney  
C. Abdominal aorta  
D. Para-aortic lymph node (Cancer of the ovary)  
E. Psoas major  
F. Rectum  
G. External iliac lymph node  
H. External iliac vein  
I. Obturator internus  
J. Femoral vein  
K. Superficial inguinal lymph node

### ONCO P3. PROSTATE

**PROSTATE SECTIONS**

1. Bladder  
2. Rectum  
3. Ductus deferens  
4. Seminal vesicle  
5. Levator ani  
6. Symphysis pubis  
7. Colliculus seminalis  
8. Ejaculatory duct  
9. Prostatic urethra  
10. Corpus spongiosum  
11. Corpus cavernosum

**PROSTATE CANCER – MRI**

A. Transition zone  
B. Prostatic urethra  
C. Central zone  
D. Ejaculatory duct  
T. Cancer in peripheral zone  
E. Colliculus seminalis  
LSV: left seminal vesicle  
Arrow: blood vessels