

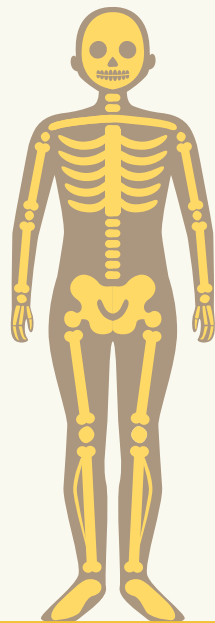
MED439
KING SAUD UNIVERSITY

Revised & Approved



Ultrasound of the Liver and Gallstones

-GNT BLOCK-



Color index:

Black: Main text

Red: Important

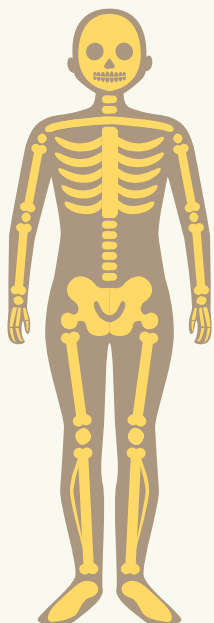
Yellow: Drs notes

Gray: Extra

Objectives

By the end of this lecture you should know:

1. Introduction to Ultrasound (US).
2. Indications of liver and Gallbladder US.
3. Normal anatomy and radiological appearance.
4. Pathology of liver and Gallbladder.
5. Common pathological cases.



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- Introduction to US


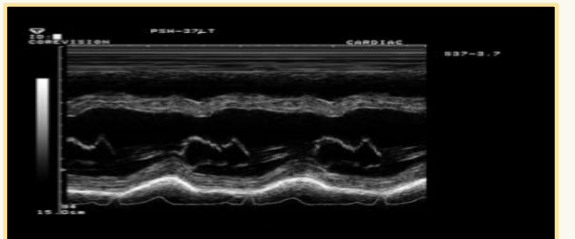
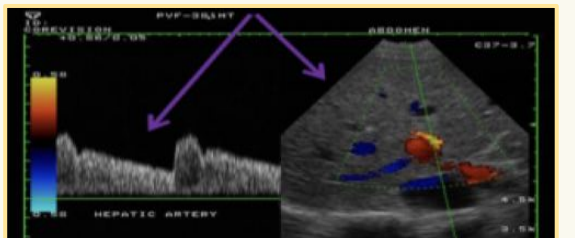
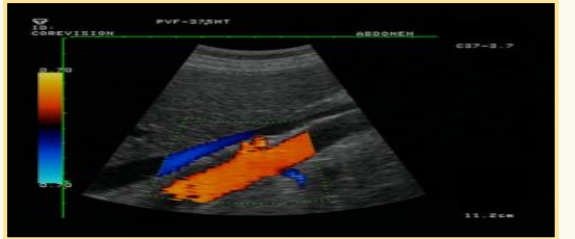
-Definition :

- A diagnostic technique in which high-frequency sound waves penetrate the body, bounce around, and produce multiple echoes; these echo patterns can be viewed as an image on a computer screen.
- (Solid abdominal organs: Spleen, liver, pancreas. and extra abdominal: thyroid lymph nodes).
- Frequency ranges used in medical Ultrasound imaging are 2 - 15 MHz.



Advantages	Disadvantages
1- Non-invasive. 2- Inexpensive. 3- Easy and available. 4- Safe. 5- Non-ionizing, no radiation.	1- Inability to penetrate gas or bone. (the major limitation as we can't see anything beyond the bone) 2- Operator dependant 3- Less sensitive in some situation like if we want to assess the pancreas.

Modes of Ultrasound:

B-mode	It's the most commonly used (B- mode or grayscale), used to assess the anatomy and the structure as you can see in the pic we have the liver and the kidney.	
M-mode	Motional mode (like echocardiograms). it's mainly used in pregnant ladies to assess the fetal heart motion, it's very sensitive so it assess the heart beats flickering of the baby	
Duplex	It will give us more complex image, in addition to the color analysis or the moving objects we actually do waveform analysis of the blood flow and the example in pic is the typical arterial waveform.	
Color Doppler	The second most commonly used, depends on analyzing or reflecting moving materials in the pic we have the blood, if the blood is coming toward the prob then it will show as red and if it's going away from the prob it will be displayed as blue.	

Ultrasound Uses

- **Cardiology:**
 - Echocardiography is an essential tool in cardiology and valvular heart disease.
- **Emergency Medicine:**
 - Trauma patient and Acute abdomen.
- **Gastroenterology:**
 - In abdominal sonography, the solid organs of the abdomen such as the pancreas, liver, gallbladder, bile ducts, kidneys, spleen and appendix, aorta, inferior vena cava.
- **Gynecology:**
 - to assess female pelvic organs, uterus and ovaries.
- **Obstetrics:**
 - Commonly used during pregnancy for dating, anatomical survey and to assess fetal growth.
- **Neurology:**
 - To assess carotid arteries blood flow and stenosis (Carotid ultrasonography)
- **Neonatology:**
 - For basic assessment of intracerebral structural abnormalities, bleeds, ventriculomegaly or hydrocephalus.
- **Urology:**
 - To study a patient's bladder, prostate or testes.
- **Musculoskeletal:**
 - For assessing tendons, muscles, nerves, ligaments, soft tissue masses, and bone surfaces.
- **Vascular system:**
 - To assess patency vs occlusion of arteries (Arterial Doppler), veins (Venous Doppler) and determine the extent and severity of venous insufficiency.

- Normal anatomy and radiological appearance:

-Interpretation :

fluids → Black

Tissue → Gray

Denser Tissue → Brighter than normal

Lights Tissue → Darker than normal

Indications of liver and gallbladder US :	Pathology of the liver:
<ul style="list-style-type: none"> ● Right upper quadrant pain. ● Jaundice. ● High liver function test. ● Fever work up. ● Screening for HCC and metastasis. 	<ul style="list-style-type: none"> ● Size. ● Diffuse liver disease. ● Focal liver disease. ● Hepatic vascularity. ● Biliary system obstruction/pathology.

-Size abnormalities:

1-Hepatomegaly

Causes:

- Infective eg: viral hepatitis.
- Neoplastic eg: metastasis.
- Degenerative eg: Early cirrhosis.
- Raised venous pressure eg: congestive cardiac failure.
- Storage disorder eg: amyloidosis.
- Myeloproliferative disorder eg: polycythaemia rubra Vera.

2-Small shrunken liver (Late cirrhosis)

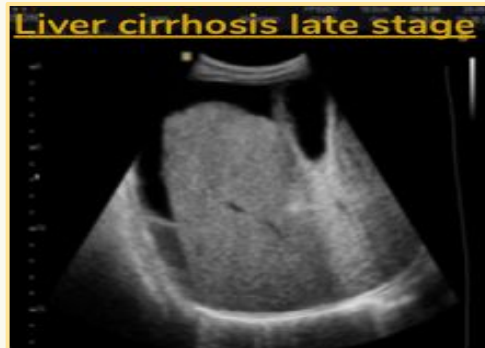
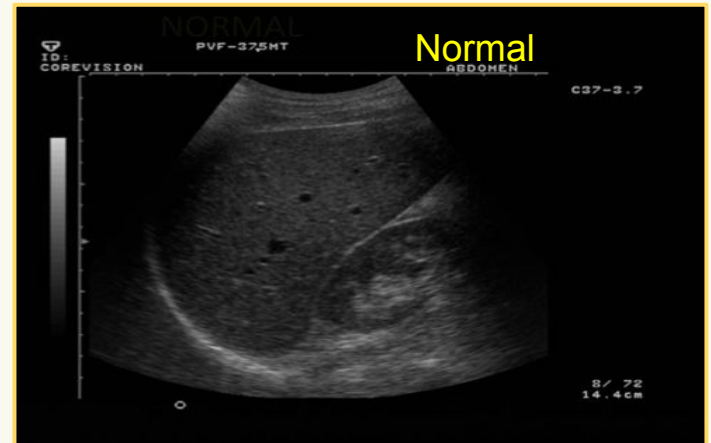
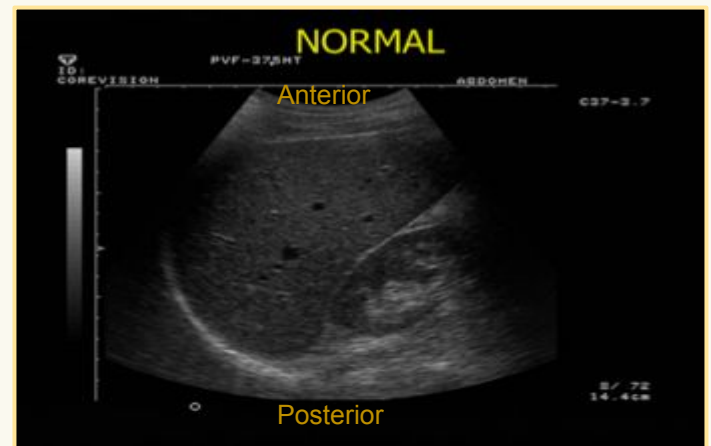
Demonstrated as:

- Shrunken liver with irregular outline. Coming away from the diaphragm.
- Ascites Very common in patients with cirrhosis.
- Portal hypertension Seen as enlargement of portal vein and change in direction of the portal vein.
- +/- Focal lesion. We have we look very carefully for focal lesion.

Normal liver size

15 cm at Midclavicular line It is important to know that :

- In **Early Cirrhosis** → Liver enlargement
- In **Late Cirrhosis** → shrunken liver



The most echogenic thing in US is the bone followed by fat then we have the soft tissue which includes the solid organs like liver, spleen and kidneys and the least echogenic is the fluid that's why we call it non-echoic.

Diffuse abnormality

1-Diffuse increased parenchymal echogenicity (**whiter than normal**) because the fat is very white.

Can be seen in:

- Diffuse fatty infiltration.
- Other infiltrative:
 - Malignant.
 - infectious.
 - Glycogen storage disease.

2-Diffuse decrease in parenchymal echogenicity (**the liver is darker than normal**)

Can be seen in:

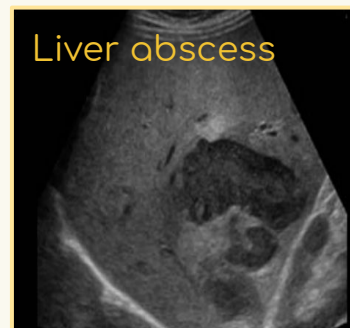
- Acute hepatitis (There's lots of edema going on and the liver is full of fluid and that will decrease echogenicity).
- Other : Malignant infiltration. It can also be called hyperechogenic when it is bright or hypoechogenic when it is dark.



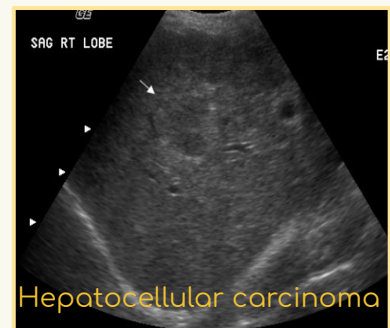
★ Focal liver lesions

"It's important to know the findings of each"

- Benign tumor
 - Hemangioma. (Findings: echogenic nodules in the liver and does not have any vascularity).
- Malignant tumor
 - Primary: Hepatocellular carcinoma. and the major risk factor is cirrhosis. (Findings: cirrhotic liver with irregular boudoirs "irregular outline" and hypoechoic lesion).
 - Secondary metastasis: Colon or breast cancer. (Findings: Lower echogenicity than the liver abscess and mostly nodular "multiple nodular" (and there is internal vascularity which will prove that the center of the lesion is made of soft tissues which contains blood vessels and not fluid or pus).
- Infective:
 - Abscess. (Findings: Lobulated heterogeneous echogenic, low echogenicity in the liver and there is no blood flow in the abscess)
 - Hydatid cyst. (Findings: There is some echogenic material here)
- Congenital
 - Hepatic cyst. the most benign. (Findings: Well defined border "outline" with anechoic center that have posterior acoustic enhancement)



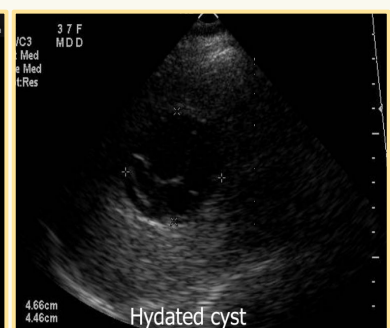
Liver abscess



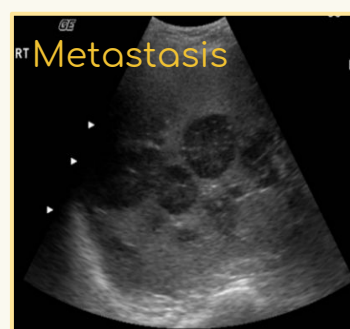
Hepatocellular carcinoma



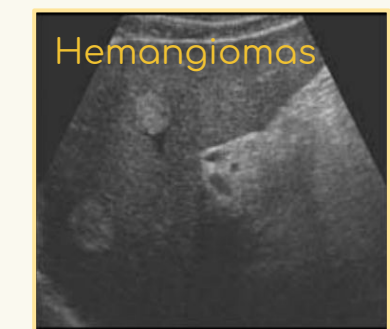
Liver cyst (multiple)



Hydated cyst



Metastasis



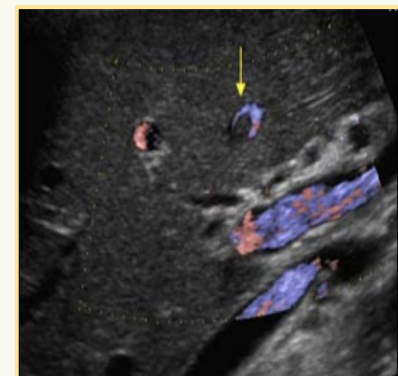
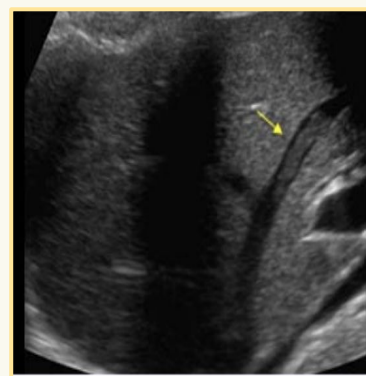
Hemangiomas

Vascular abnormality

- Portal venous system:
 - Thrombosis
 - Portal hypertension
- Hepatic venous system:
 - Thrombosis
 - Budd chiari syndrome

Thrombosis findings: In the center we can see echogenicity (normally it's anechoic) so when we apply a color doppler on it we can see area that are anechoic shows some blood on it BUT the center doesn't.

Hepatic vein thrombosis

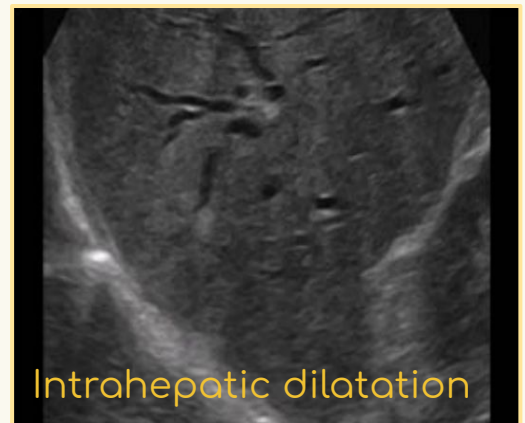


Portal vein thrombosis



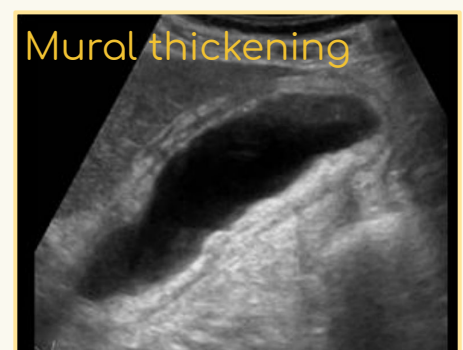
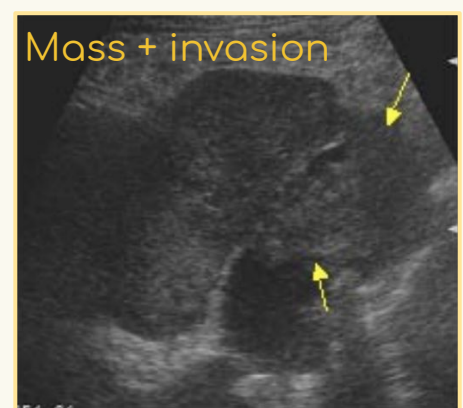
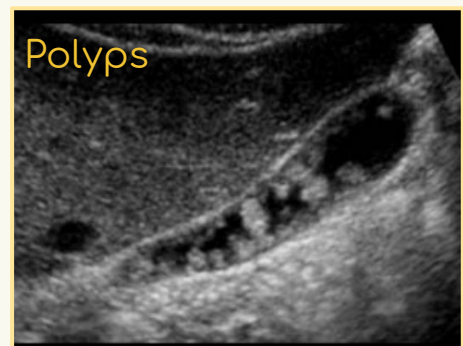
Biliary abnormality

- Normal Intrahepatic biliary radicals:
 - Less than 3mm.
- Normal Extrahepatic (common bile duct):
 - Less than 8mm.
- If it's dilated it will indicate **choledocholithiasis**
- Causes of dilation and obstruction
 - Intra-luminal:
 - Stones and masses.
 - Mural (from the wall):
 - Stricture (benign/malignant).
 - Extrinsic:
 - Compression mass & lymph nodes.



★ Pathology of gallbladder

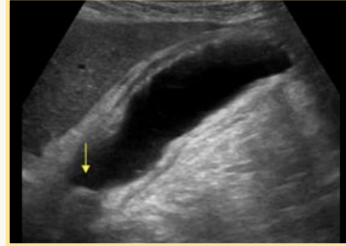
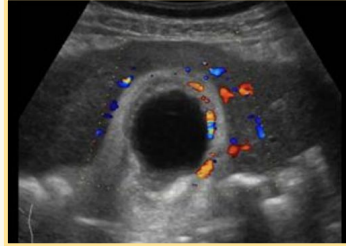
- Intra-luminal:
 - **Gallstones: Acoustic shadowing**, mobile/ non mobile the gallbladder is mainly anechoic because of the biliary juice on it, we can see posterior acoustic shadowing due to calcified stones.
 - Polyps: **No acoustic shadowing**, non mobile because they're not calcified.
 - Mass lesion +/- invasion: Gall bladder carcinoma.
 - **With Wall thickening of gallbladder = acute Cholecystitis**
- **Mural thickening:**
 - Primary:
 - **Cholecystitis.**
 - Secondary:
 - Cardiac failure.
 - Cirrhosis.
 - Ascitis.
 - Hypoalbuminemia.
 - Renal failure.



★ Cases from the slides :

Case One

Middle aged woman presented to the emergency department with fever and right upper quadrant pain. On examination, she looks ill, febrile and in pain with Right upper quadrant tenderness. Labs show elevated liver enzymes and high WBC count.



Interpretation: Thickening of Gallbladder wall above 3mm, Gallbladder distention, Pericholecystic fluid, Hyperemia, Gallstone.

Diagnosis: Acute calcular **cholecystitis**.

Case Two

Middle aged woman presented to the surgical outpatient clinic with 2 years history of recurrent right upper quadrant pain mild to moderate in severity. The pain radiates to the right shoulder and is aggravated by fatty meals. On examination, The woman appears obese and is not distressed, febrile or jaundiced. Labs show normal liver enzymes

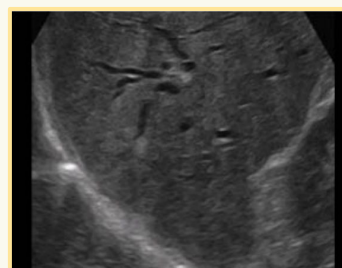
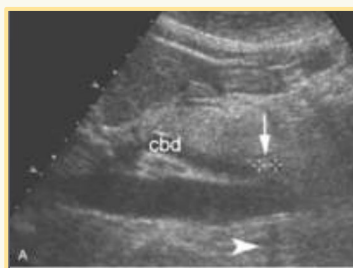


Interpretation: Multiple oval shaped echogenic structures seen within the gallbladder causing **acoustic shadowing**.

Diagnosis: **Gallbladder cholelithiasis**

Case Three

Middle aged man presented to the emergency room with severe right upper quadrant pain and yellowish discoloration of skin and sclera. On examination he looks ill, jaundiced and in pain but not febrile. Labs show elevated liver enzymes.



Interpretation: Dilated intrahepatic and extrahepatic biliary system. Echogenic structure seen within common biliary duct

Diagnosis: Common biliary duct stone causing upstream biliary obstruction (**choledocholithiasis**)

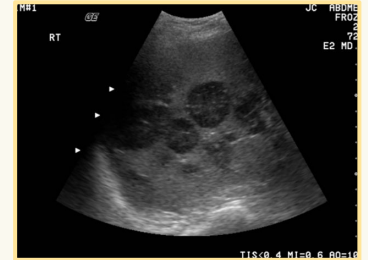
★ Cases from the slides :

Case Four

Old man recently discovered to have colonic cancer presented to primary health care clinic with vague upper abdominal pain. On examination he appears thin & ill but not febrile or jaundiced. Mild abdominal tenderness and enlarged liver with irregular outline is noted. Labs show mild elevation in liver enzymes

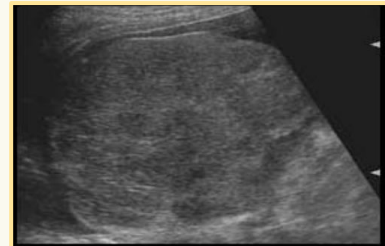
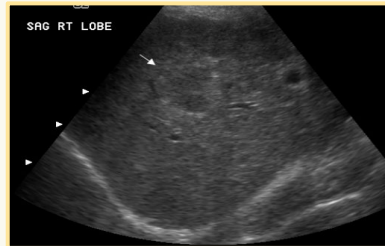
Interpretation: Multiple hypoechoic focal hepatic lesions.

Diagnosis: Metastatic liver lesions "if we put color doppler and we see internal vascularity that will confirm not being an abscess it will be metastasis"



Case Five

Middle aged man who is a known case of Hepatitis C virus for 10 years. He presented to GI outpatient clinic with history of weight loss, indigestion and mild abdominal pain. No fever. On examination, he appeared ill, slim, mildly jaundiced but not febrile. Abdomen: bulging flanks, Dilated tortuous vessels around umbilicus. Mild diffuse abdominal tenderness, Labs show high liver enzymes

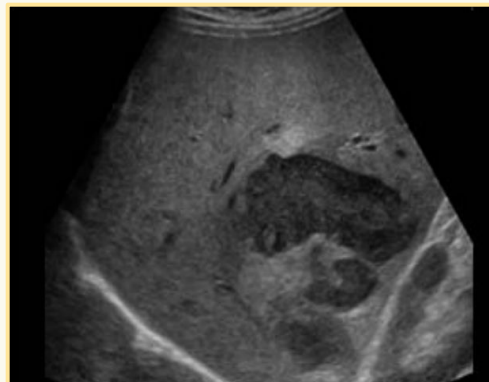


Interpretation: Shrunken liver with irregular outline, Heterogeneous appearance, Focal hypoechoic lesion.

Diagnosis: Cirrhotic liver with Hepatocellular carcinoma.

Case Six

Young man who is known for being an IV drug addict presented to the emergency room with high fever, chills, upper abdominal pain and vomiting. On examination he looks very ill, febrile and in pain. Right upper quadrant tenderness is noted. Labs show high Liver enzymes and high WBCs



Interpretation: Focal hypoechoic liver lesion with ill defined outline.

Diagnosis: Liver abscess.



MCQs

1-what is the advantage of using ultrasound?

A) not Ionizing

B) Less sensitive

C) Operator dependant

D) invasive

2-Which of the following is considered a disadvantage of ultrasound?

A) Inability to penetrate gas

B) Inexpensive

C) Easy

D) Safe

3-Which of the following can shrink the liver?

A) Hepatitis

B) Tumors

C) Late cirrhosis

D) Congestive heart failrure

4- Acoustic shadowing is seen with?

A) Polyps

B) Gallstones

C) Tumors

D) Cirrhosis

5- Which of the following measurements indicate a dilated common bile duct

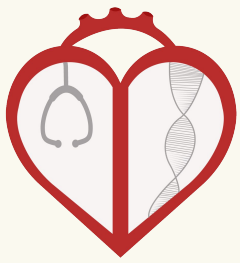
A) 2mm

B) 3mm

C) 6mm

D) 9mm

Answers: 1- A, 2- A, 3- C, 4- B, 5- D



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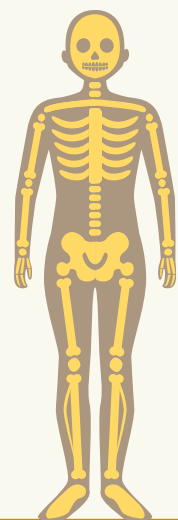
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