2017/2018 Spring Semester

Syndromes of Hepatobiliary Tract and Exocrine Pancreas Disorders

LECTURE IN INTERNAL MEDICINE PROPAEDEUTICS

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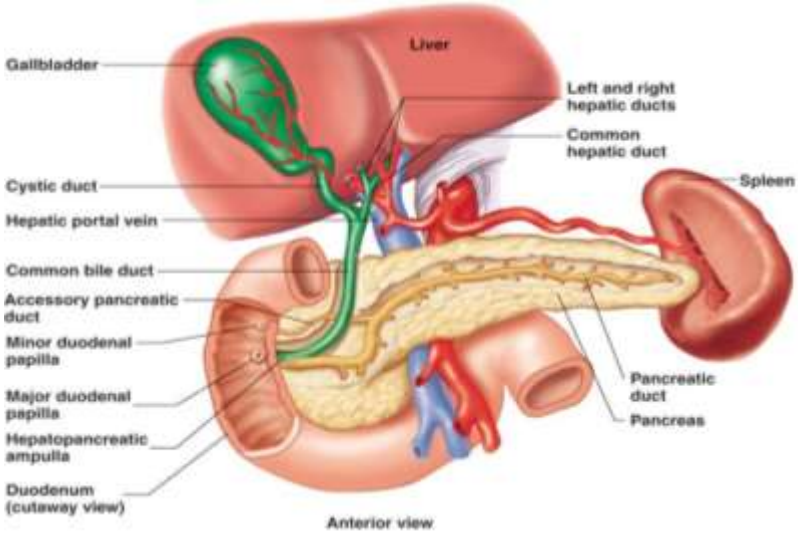
Plan of the lecture

- Spectrum of Hepatobiliary Tract and Pancreas Disorders
- Hepatobiliary Tract
- Exocrine pancreas



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Spectrum of Hepatobiliary Tract Disorders 1

- Bile Ducts and Gallbladder
  - Gallstones
  - Stricture
  - Leaks (of bile, caused from trauma and surgery)
  - Gallbladder Cancer
  - Bile Duct Cancer (cholangiocarcinoma)
  - Cholangitis
  - Cholecystitis

Spectrum of Hepatobiliary Tract Disorders 2

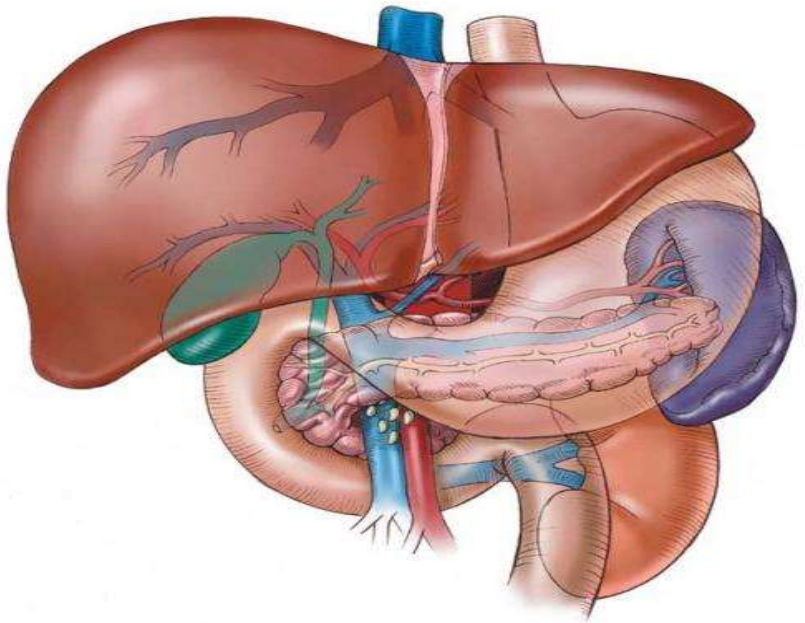
- Liver
  - Liver Tumors (hepatocellular carcinoma, metastatic colorectal cancer, neuroendocrine cancer, other metastatic tumor)
  - Benign Liver Lesions (hepatic cyst, hemangioma, adenoma, focal nodular hyperplasia)
  - Fatty liver, Hepatitis, Liver Cirrhosis

Spectrum of Hepatobiliary Tract and Pancreas Disorders 3

- Pancreas
  - Pancreatic Cancer
  - Acute and Chronic Pancreatitis
  - Pseudocyst
  - Cystic Neoplasms

Hepatobiliary Tract: syndromes

- Gallbladder motility disorder
- Jaundice
- Lver size changes
- Portal hypertension
- Hepatocellular Dysfunction
- Cholestatic syndrome



http://pedemmorsels.com/wp-content/uploads/2015/05/Red-Flags.png http://www.surgicalnotes.co.uk/files/images/liver2.jpg

Gallbladder motility disorder: Definition

- Gallbladder motility disorder is defined as biliary pain in the absence of gallstones, sludge, microlithiasis, or microcrystal disease
- The diagnosis is considered in patients with typical biliary-type pain who have had other causes for the pain excluded
- The prevalence of functional gallbladder disorder among patients with biliary-type pain and a normal transabdominal gallbladder ultrasound is up to 8 percent in men and 21 percent in women

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Cause and mechanisms 1

- The cause is unclear, but it is generally regarded as a motility disorder of the gallbladder
- It may result from an initial metabolic disorder (i.e., bile supersaturated with cholesterol) or a primary motility disorder in the absence, at least initially, of any abnormalities of bile composition

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Cause and mechanisms 2

- It has been noted that patients with functional gallbladder disorder may have abnormal gastric emptying and colonic transit, suggesting a possible generalized gastrointestinal motility disorder
- The hypothesis that disorder is related to abnormal gallbladder motility is the basis for measuring the gallbladder ejection fraction as part of the evaluation

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Clinical signs 1

- Patients present with biliary-type pain, also known as biliary colic
- The liver and pancreas blood tests are normal, no gallstones or gallbladder sludge are seen on imaging, and upper endoscopic examinations are normal
- Despite the name, biliary colic is usually constant and not colicky

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Clinical signs 2

- The classic description is of an intense discomfort located in the right upper quadrant or epigastrium that may radiate to the back (particularly the right shoulder blade)
- The pain is often associated with diaphoresis, nausea, and vomiting
- The pain plateaus in less than an hour, ranging from moderate to excruciating in severity

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Clinical signs 3

- The pain typically lasts at least 30 minutes and then slowly subsides over several hours, with the entire attack usually lasting less than six hours
- While the pain often develops one to two hours after ingestion of a fatty meal, an association with meals is not universal, and in a significant proportion of patients the pain is nocturnal, with a peak occurrence around midnight

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Clinical signs 4

- While nonspecific dyspeptic symptoms, such as indigestion, abdominal bloating, and belching, may coexist in patients with biliary colic, they are not usually relieved by cholecystectomy

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults

Gallbladder motility disorder: Laboratory, imaging, and endoscopic studies

- Patients with functional gallbladder disorder have normal blood tests
- In addition, abdominal imaging is normal, with no evidence of gallstones, gallbladder sludge, or cholesterol polyps
- Finally, patients have normal upper endoscopic examinations

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults
https://upload.wikimedia.org/wikipedia/commons/b/be/Anatomy_of_liver_and_gall_bladder.png

Gallbladder motility disorder: The Rome III criteria for biliary-type pain 1

- Pain is located in the epigastrium and/or right upper quadrant
- Pain is recurrent, but occurs at variable intervals (not daily)
- Pain lasts at least 30 minutes
- Pain is builds up to a steady level

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults
https://edc2.healthtap.com/ht-staging/user_answer/avatars/2172713/large/stringio.jpeg?1422246782

Gallbladder motility disorder: The Rome III criteria for biliary-type pain 2

- Pain is severe enough to interrupt daily activities or lead to an emergency department visit
- Pain is not relieved by bowel movements, postural changes, or antacids

http://www.uptodate.com/contents/functional-gallbladder-disorder-in-adults
https://edc2.healthtap.com/ht-staging/user_answer/avatars/2172713/large/stringio.jpeg?1422246782

Gallbladder motility disorder: The Rome III criteria for biliary-type pain 3

Supportive criteria

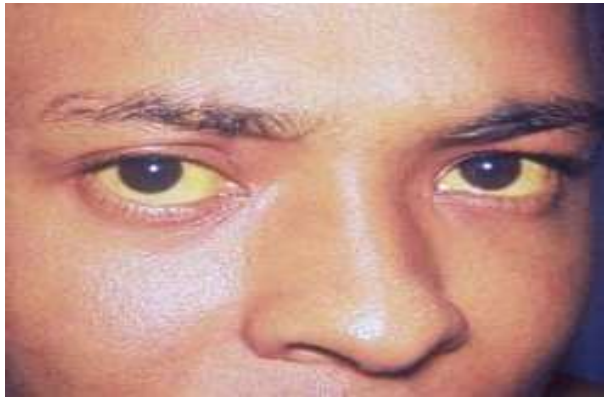
- Pain is associated with nausea and vomiting
- Pain radiates to the back and/or right infrasubscapular region
- Pain awakens the patient from sleep in the middle of the night

Jaundice: Definition

- Jaundice (icterus) is a yellowish pigmentation of the skin, the conjunctival membranes over the sclerae (whites of the eyes), and other mucous membranes caused by high blood bilirubin levels
- Jaundice causes increased levels of bilirubin in the extracellular fluid
- A concentration > 3 mg/dL (>50µmol/L) leads to jaundice

https://en.wikipedia.org/wiki/Jaundice

Jaundice



A concentration > 3 mg/dL (>50µmol/L) leads to jaundice

http://cdn1.medicalnewstoday.com/content/images/articles/165/165749/eye-of-man-with-jaundice.jpg
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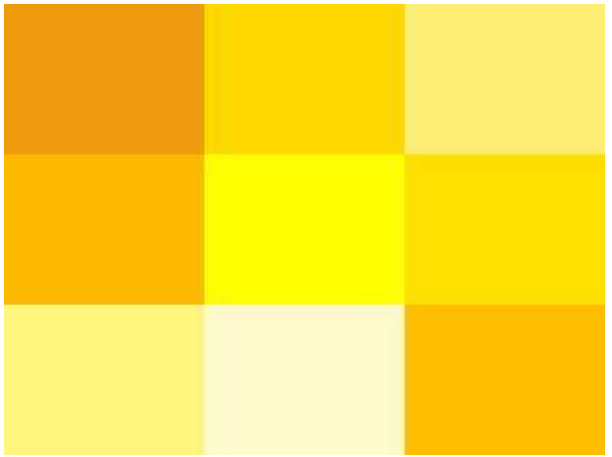
Jaundice: Types

- Pre-hepatic jaundice
- Intra-hepatic jaundice
- Post-hepatic jaundice
- Neonatal jaundice



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Jaundice: Pre-hepatic jaundice 1

- Pre-hepatic jaundice is caused by anything which causes an increased rate of hemolysis (breakdown of red blood cells): severe malaria, sickle cell anemia, spherocytosis, thalassemia, pyruvate kinase deficiency, glucose 6-phosphate dehydrogenase deficiency, diseases of the kidney, defects in bilirubin metabolism etc.

https://en.wikipedia.org/wiki/Jaundice

Jaundice: Pre-hepatic jaundice 2

- The increased breakdown of red blood cells leads to an increase in the amount of unconjugated bilirubin present in the blood and deposition of this unconjugated bilirubin into various tissues can lead to a jaundiced appearance
- In jaundice secondary to hemolysis, the increased production of bilirubin leads to the increased production of urine-urobilinogen

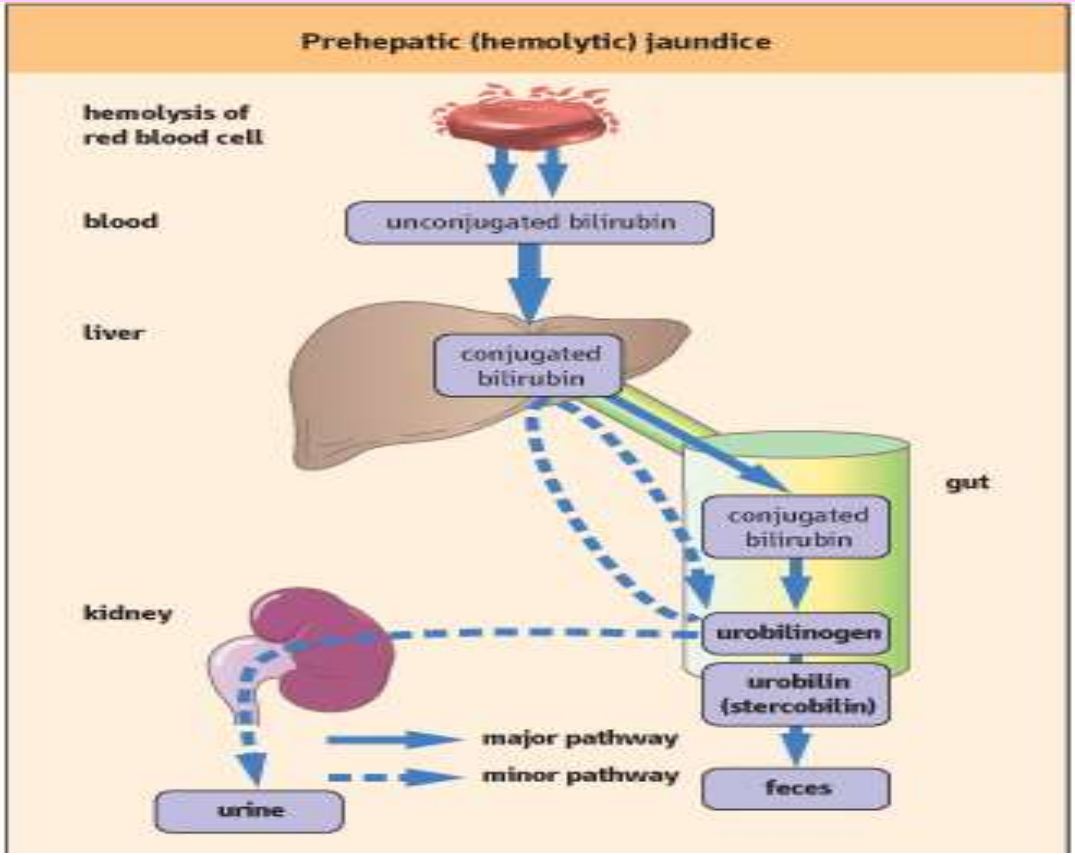
https://en.wikipedia.org/wiki/Jaundice

Jaundice: Pre-hepatic jaundice 3

- Bilirubin is not usually found in the urine because unconjugated bilirubin is not water-soluble, so, the combination of increased urine-urobilinogen with no bilirubin (since, unconjugated) in urine is suggestive of hemolytic jaundice

https://en.wikipedia.org/wiki/Jaundice

Jaundice



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Jaundice: Intra-hepatic jaundice 1

- Intra-hepatic jaundice can be caused by acute or chronic hepatitis, hepatotoxicity, cirrhosis, drug-induced hepatitis and alcoholic liver disease
- leading to an increase in plasma conjugated bilirubin because there is impairment of excretion of conjugated bilirubin into the bile

https://en.wikipedia.org/wiki/Jaundice

Jaundice: Intra-hepatic jaundice 2

- The blood contains an abnormally raised amount of conjugated bilirubin and bile salts which are excreted in the urine
- This conjugated bilirubin is then returned to the blood, probably by rupture of the congested bile canaliculi and direct emptying of the bile into the lymph leaving the liver

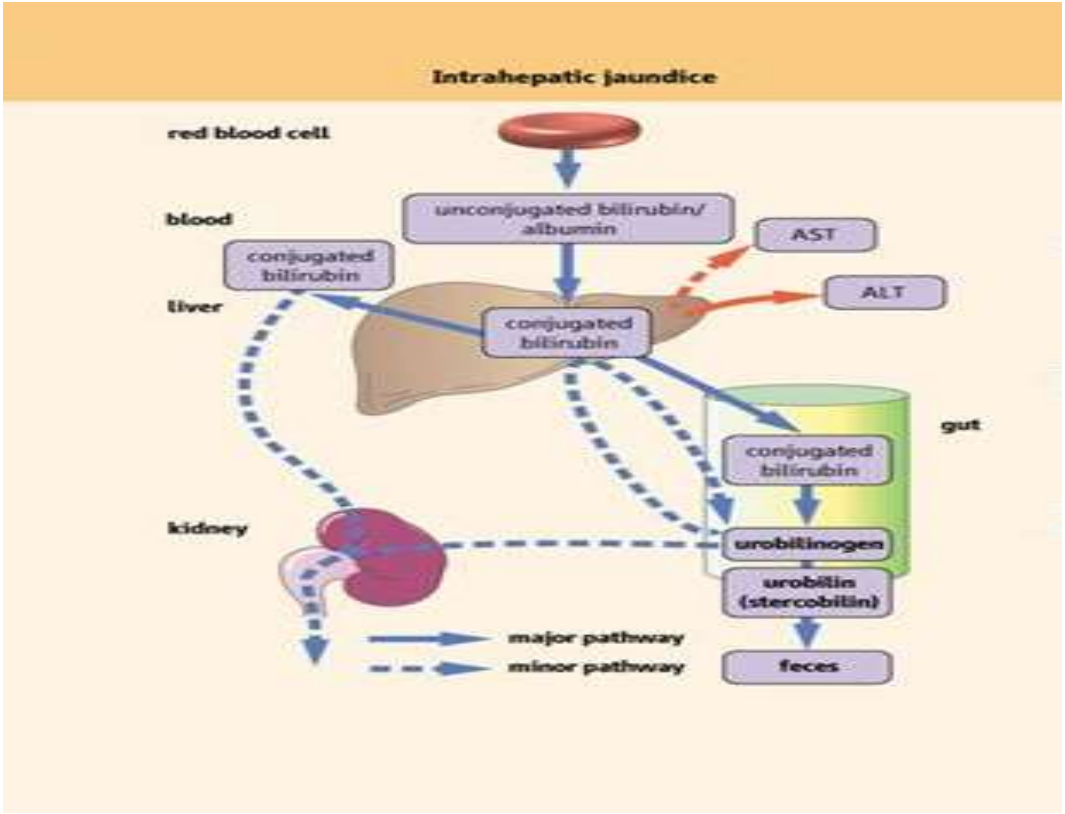
https://en.wikipedia.org/wiki/Jaundice

Jaundice: Intra-hepatic jaundice 3

- Thus, most of the bilirubin in the plasma becomes the conjugated type rather than the unconjugated type, and this conjugated bilirubin which did not go to intestine to become urobilinogen gives the urine the dark color

https://en.wikipedia.org/wiki/Jaundice

Jaundice



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Jaundice: Post-hepatic jaundice 1

- Post-hepatic (obstructive) jaundice, is caused by an interruption to the drainage of bile containing conjugated bilirubin in the biliary system
- The most common causes are gallstones in the common bile duct, and pancreatic cancer in the head of the pancreas
- A group of parasites ("liver flukes“) can live in the common bile duct, causing obstructive jaundice

https://en.wikipedia.org/wiki/Jaundice

Jaundice: Post-hepatic jaundice 2

- Other causes include strictures of the common bile duct, biliary atresia, cholangiocarcinoma, pancreatitis, cholestasis of pregnancy, and pancreatic pseudocysts
- In complete obstruction of the bile duct, no urobilinogen is found in the urine, since bilirubin has no access to the intestine and it is in the intestine that bilirubin gets converted to urobilinogen to be later released into the general circulation

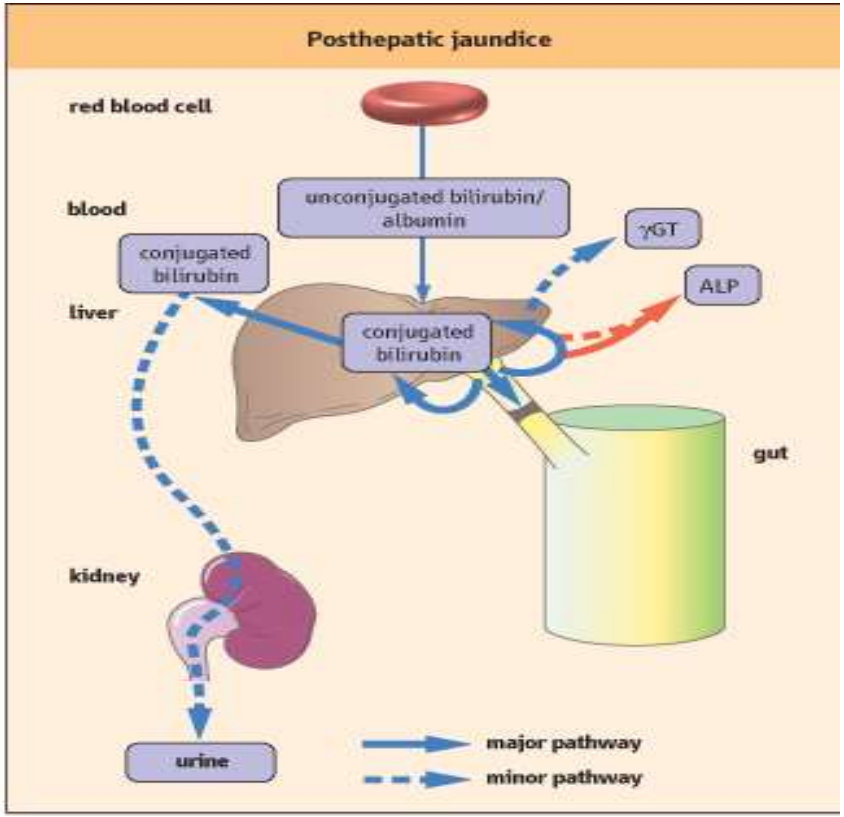
https://en.wikipedia.org/wiki/Jaundice

Jaundice: Post-hepatic jaundice 3

- Presence of bilirubin (conjugated) in the urine without urine-urobilinogen suggests obstructive jaundice, either intra-hepatic or post-hepatic
- The presence of pale stools and dark urine suggests an obstructive or post-hepatic cause
- Patients also can present with elevated serum cholesterol, and often complain of severe itching or "pruritus" because of the deposition of bile salt

https://en.wikipedia.org/wiki/Jaundice

Jaundice



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Jaundice: Neonatal jaundice 1

- Neonatal jaundice is usually harmless and is often seen in infants around the second day after birth, lasting until day 8 in normal births, or to around day 14 in premature births
- Typical causes for neonatal jaundice include normal physiologic jaundice, jaundice due to formula supplementation and hemolytic disorders

https://en.wikipedia.org/wiki/Jaundice

Jaundice: Neonatal jaundice 2

- Serum bilirubin normally drops to a low level without any intervention required
- In cases where bilirubin rises higher, a brain-damaging condition known as kernicterus can occur, leading to significant disability
- A Bili light is often the tool used for early treatment, which often consists of exposing the baby to intensive phototherapy

https://en.wikipedia.org/wiki/Jaundice

Jaundice

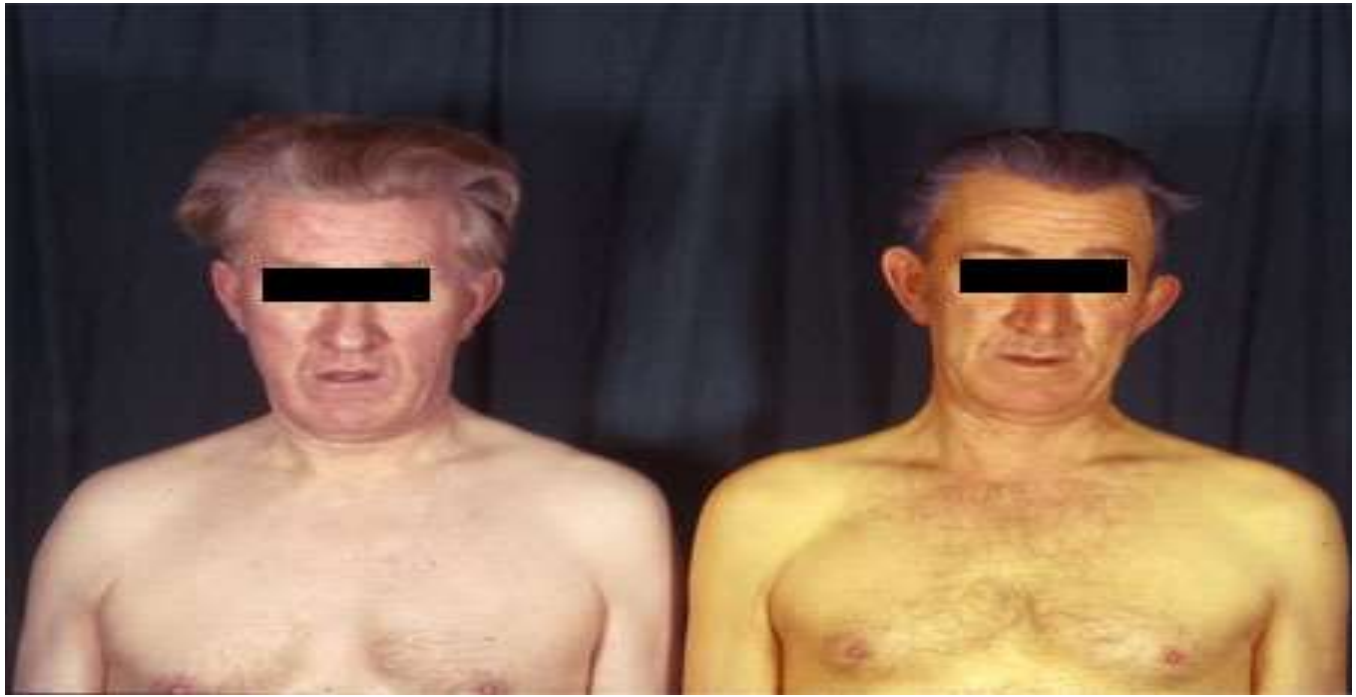
http://i.ytimg.com/vi/QFQzzJsShvQ/maxresdefault.jpg

Jaundice: Symptoms

- Yellowish discoloration of the white area of the eye and the skin
- The conjunctiva of the eye is one of the first tissues to change color as bilirubin levels rise in jaundice
- Urine is dark in colour
- Stools (feces or poo) can be pale in colour

https://en.wikipedia.org/wiki/Jaundice http://www.webmd.boots.com/a-to-z-guides/jaundice

Jaundice



http://www.newhealthguide.org/images/10422217/gilbert-syndrome.jpg

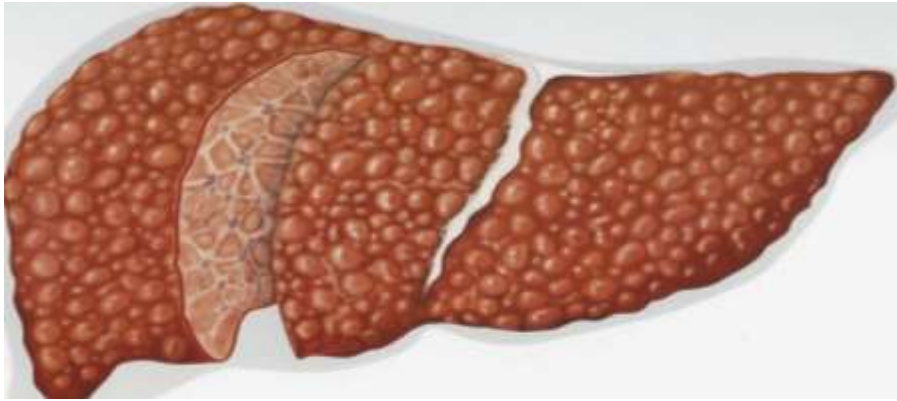
Jaundice: Diagnostic tests

Function test	Jaundice		
	Pre-hepatic	Hepatic	Post-hepatic
Total bilirubin	Normal / Increased	Increased	
Conjugated bilirubin	Normal	Increased	Increased
Unconjugated bilirubin	Normal / Increased	Increased	Normal
Urobilinogen	Normal / Increased	Decreased	Decreased / Negative
Urine Color	Normal	Dark	Dark (conjugated bilirubin)
Stool color	Normal	Normal/Pale	Pale
Alkaline phosphatase levels	Normal	Increased	
Alanine transferase and aspartate transferase levels		Increased	
Conjugated Bilirubin in Urine	Not Present	Present	
Splenomegaly	Present	Present	Absent

https://en.wikipedia.org/wiki/Jaundice

The syndromes of liver size changes

- Enlarged Liver (Hepatomegaly)
- Small for size syndrome



Bridging Fibrosis

http://4.bp.blogspot.com/-qWF0NvZv7WI/Ug4Tb0v-UtI/AAAAAAAACuU/n11clMUW8Cg/s1600/Liver-Stage+4.jpg

Enlarged Liver: Causes

- Alcoholic liver disease
- Congestive heart failure
- Cirrhosis
- Hepatitis
- Liver cancer
- Hyperlipidemias
- Chronic leukocytic leukemia
- Hepatic vein thrombosis (Budd-Chiary syndrome)
- Metabolic syndrome X
- Pericarditis
- Adult-Onset Still's disease
- Hypolipoproteinemia

http://www.healthline.com/symptom/liver-enlarged

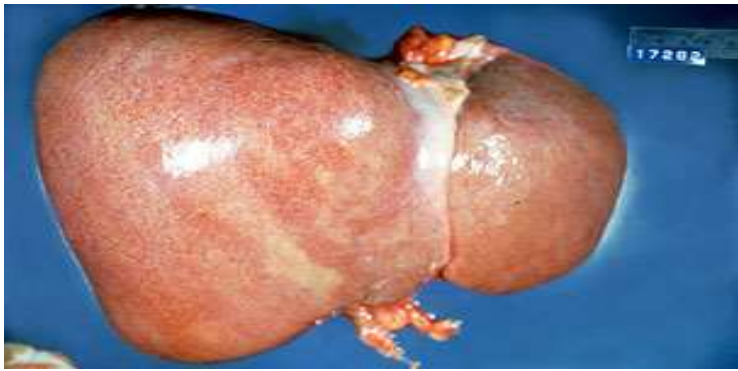
Enlarged Liver: Symptoms

- A feeling of fullness
- Discomfort in the belly
- Depending on the cause of enlarged liver, patient may notice symptoms like:
  - Jaundice
  - Fatigue and weakness
  - Nausea
  - Weight loss

http://www.webmd.com/hepatitis/enlarged-liver-causes#1

Enlarged Liver: Diagnosis

- Physical examination
- CT scan
- MRI
- Ultrasound



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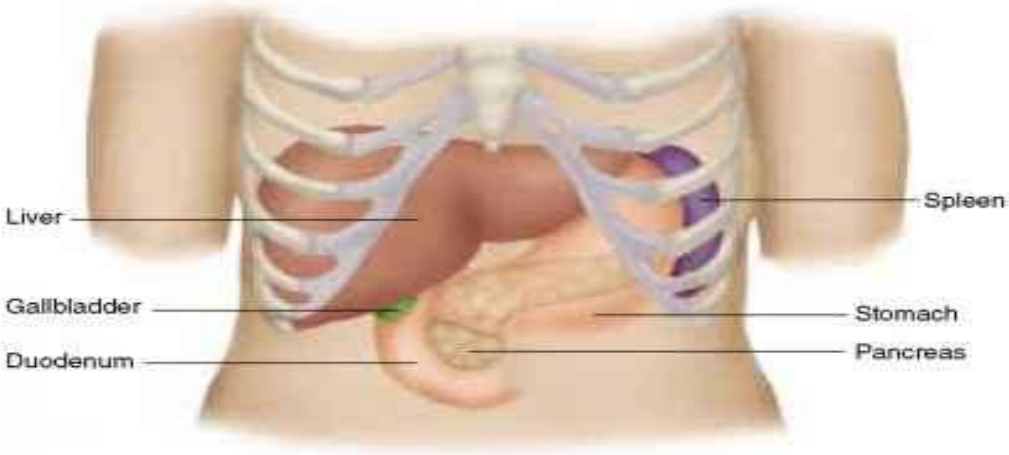
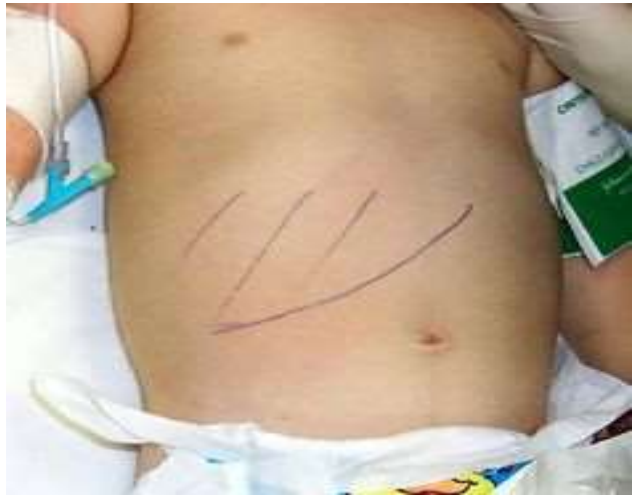
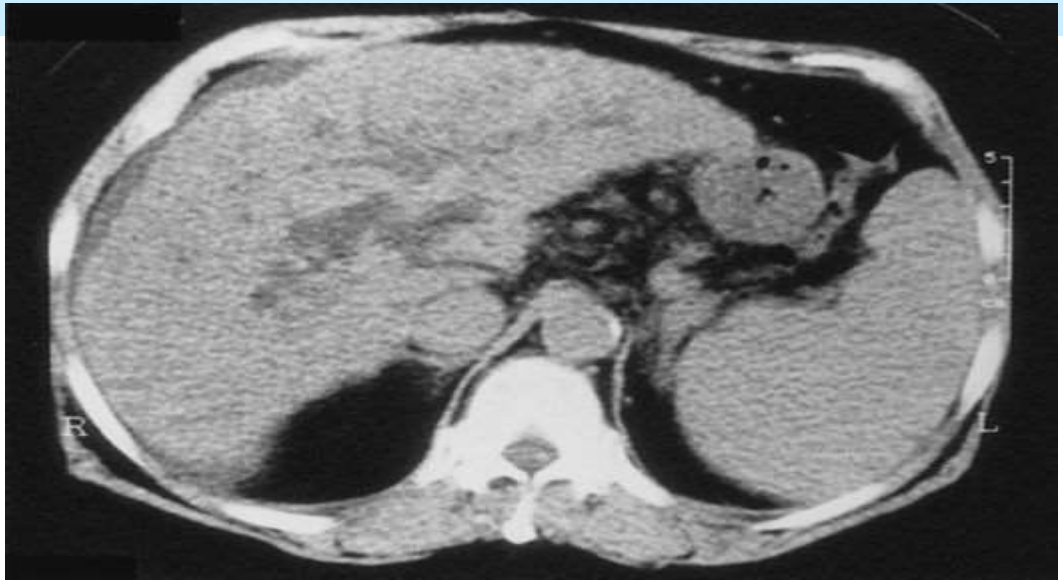
Enlarged Liver: Physical examination





http://www.clicktocurecancer.info/physical-examination/images/1912_239_393-liver-human-costal-edge.jpg https://s-media-cache-ak0.pinimg.com/236x/f2/bf/9d/f2bf9d58da2973e245195c0158218244.jpg

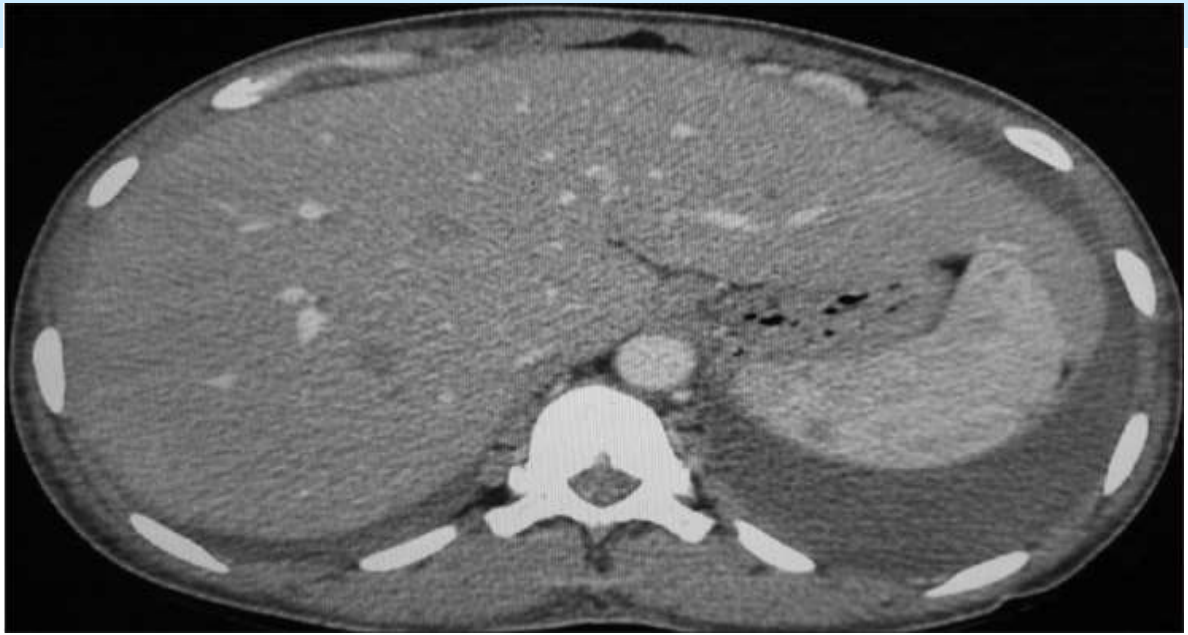
Enlarged Liver: CT scan



Native CT scan shows a slightly lobulated liver contour with ascites and dilated bile ducts and an enlarged spleen

http://www.eurorad.org/mediafiles/eurorad/0000000906/000001_text.jpg

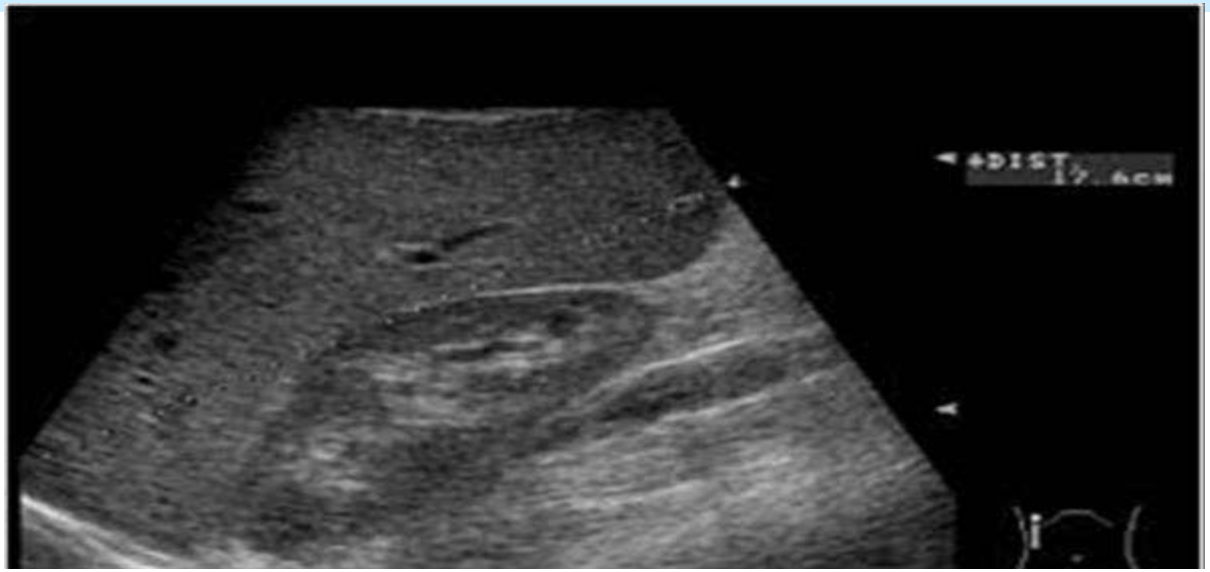
Enlarged Liver: MRI



Hepatomegaly and multiple hypoechoic areas in spleen suggesting splenic involvement

http://www.iitrichology.com/articles/2012/4/3/images/IntJTrichol_2012_4_3_169_100085_u4.jpg

Enlarged Liver: Ultrasound



Hodgkin disease with splenomegaly, hepatomegaly and enlarged mesenteric lymph nodes

http://www.iitrichology.com/articles/2012/4/3/images/IntJTrichol_2012_4_3_169_100085_u4.jpg

Small for size syndrome: Causes 1

- Small for size syndrome - is a condition which causes considerable confusion partly because the term has been extended beyond its original meaning; it was initially used to describe the situation in liver transplantation where a patient develops liver dysfunction and ascites because the donated organ is too small for the recipient

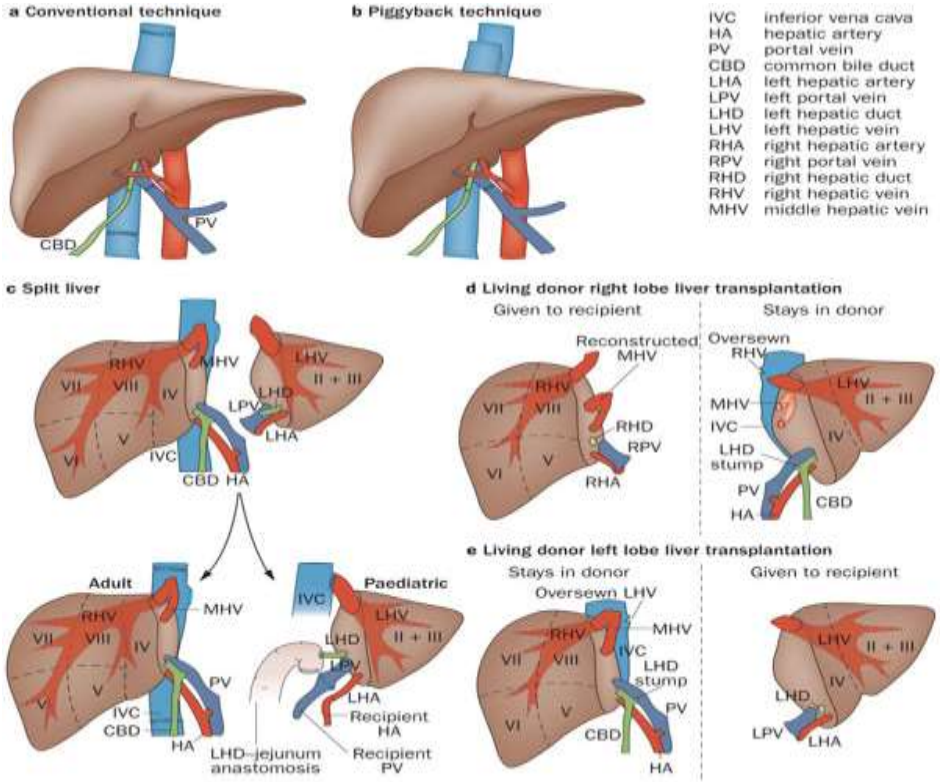
http://www.webmd.com/hepatitis/enlarged-liver-causes#1

Small for size syndrome: Causes 2

- Small for size syndrome - is a condition which causes considerable confusion partly because the term has been extended beyond its original meaning; it is now used variably to describe any circumstance where there is post operative liver failure or dysfunction in a patient who has had liver resection or partial or small graft liver transplantation

http://www.webmd.com/hepatitis/enlarged-liver-causes#1

Small for size syndrome: Liver transplantation



http://www.nature.com/nrgastro/journal/v10/n7/images/nrgastro.2013.88-f1.jpg

Small for size syndrome: Mechanisms

- Small-for-size syndrome can occur in the special situation of partial liver graft transplantation, especially in adult living donor liver transplantation, with resultant size mismatching between graft size and recipient hepato-portal circulation
- Once the partial liver volume graft is subjected to excessive portal inflow, portal hyperperfusion results in the development of the small-for-size syndrome

http://www.webmd.com/hepatitis/enlarged-liver-causes#1

Small for size syndrome: Symptoms

- Excessive ascites
- Hyperbilirubinemia
- Coagulopathy
- Encephalopathy
- Renal dysfunction

Transplant recipients develop symptoms related to the above abnormalities after transplantation and post-transplant prognosis is reported to be less than ideal

http://www.webmd.com/hepatitis/enlarged-liver-causes#1

Portal hypertension: Definition

- Portal hypertension is abnormally high blood pressure in the portal vein system, which is composed of the portal vein, and its branches and tributaries
- Portal hypertension is defined as elevation of hepatic venous pressure gradient to >5mmHg

http://www.merckmanuals.com/home/liver-and-gallbladder-disorders/manifestations-of-liver-disease/portal-hypertension
https://en.wikipedia.org/wiki/Portal_hypertension

Portal hypertension: Causes

- Prehepatic: portal vein thrombosis or congenital atresia
- Intrahepatic: liver cirrhosis, hepatic fibrosis, noncirrhotic causes (schistosomiasis, massive fatty change and diffuse granulomatous diseases)
- Posthepatic: hepatic vein thrombosis, inferior vena cava thrombosis, inferior vena cava congenital malformation, constrictive pericarditis

http://www.merckmanuals.com/home/liver-and-gallbladder-disorders/manifestations-of-liver-disease/portal-hypertension

Portal hypertension: Symptoms 1

- Weakness, tiredness, and malaise
- Anorexia, weight loss (common with acute and chronic liver disease)
- Ascites
- Hepatic encephalopathy
- Increased risk of spontaneous bacterial peritonitis
- Increased risk of hepatorenal syndrome

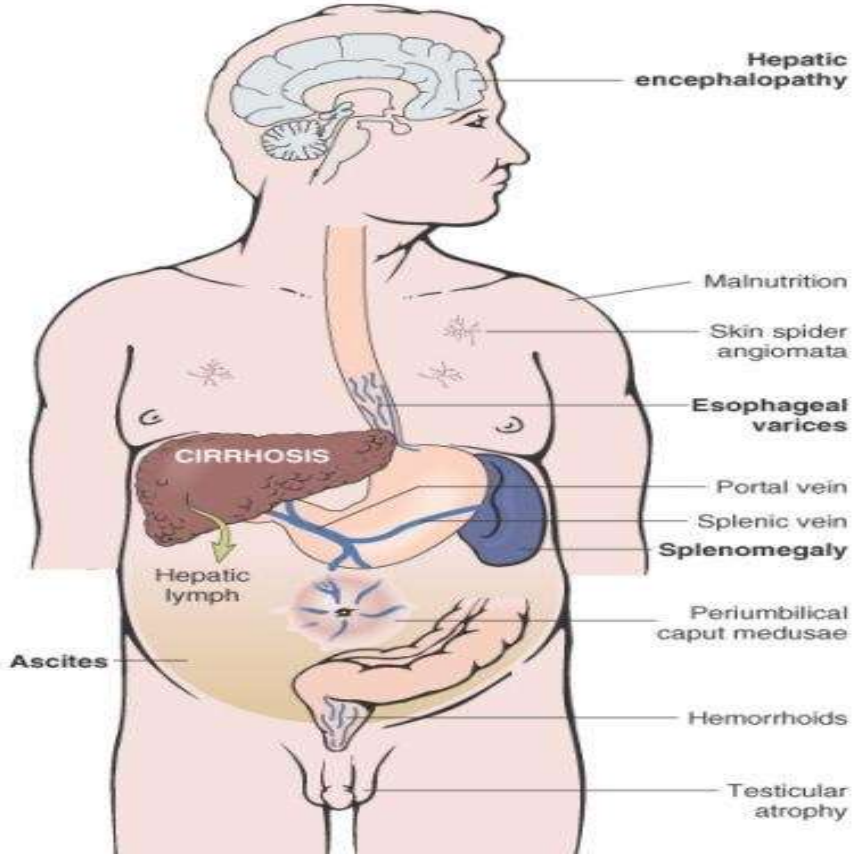
http://https://en.wikipedia.org/wiki/Portal_hypertension

Portal hypertension: Symptoms 2

- Splenomegaly with a consequent accumulation of red blood cells, white blood cells, and platelets, together leading to mild pancytopenia
- Development of varices at portocaval anastomoses: esophageal varices, gastric varices, anorectal varices, caput medusae
- Esophageal and gastric varices pose an ongoing risk of life-threatening bleeding, with bloody vomiting or melena

http://https://en.wikipedia.org/wiki/Portal_hypertension

Portal hypertension: Symptoms



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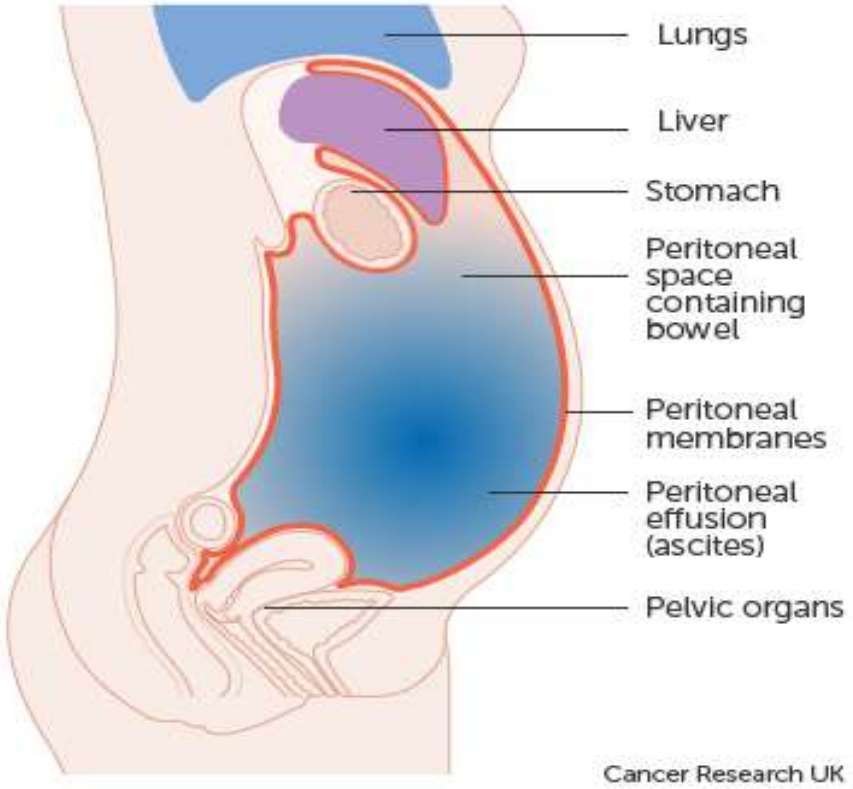
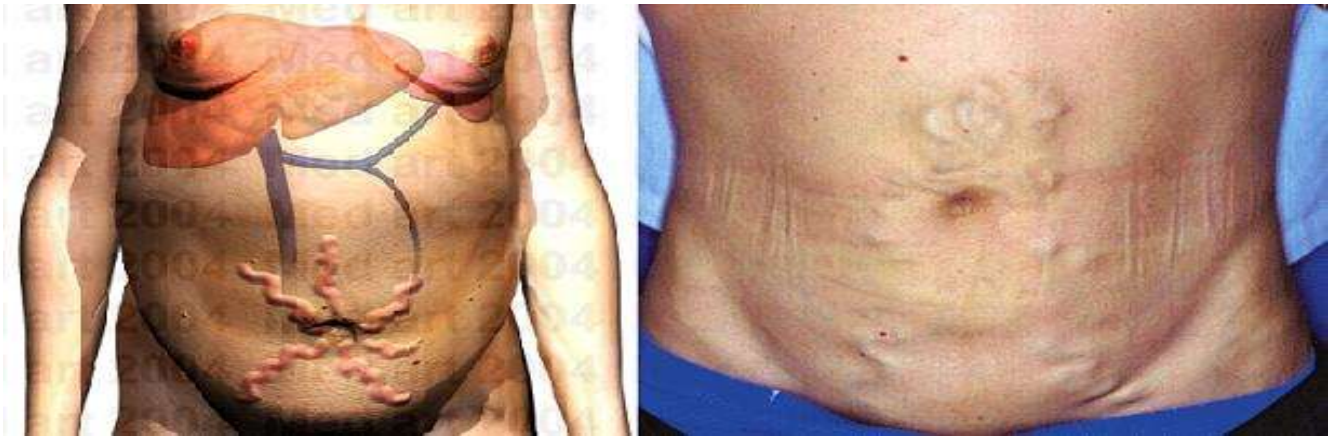
Portal hypertension: Ascites



http://www.cancerresearchuk.org/prod_consump/groups/cr_common/@cah/@gen/documents/image/crukmig_1000img-12046.jpg

Portal hypertension: Caput medusae



http://2.bp.blogspot.com/_ZLpgLTJORxI/TAyqfUsCFDI/AAAAAAAAAyY/zJ1rYz4JNjQ/s1600/img_6_1933_6.jpg

Portal hypertension: Diagnosis 1

- Clinical symptoms
- HVPG (hepatic venous pressure gradient) measurement as the gold standard for assessing the severity of portal hypertension
- HVPG replaced the old one - contrast angiography
- Portal hypertension is defined as HVPG greater than or equal to 5mm Hg and is considered to be clinically significant when HVPG exceeds 10 to 12 mm Hg

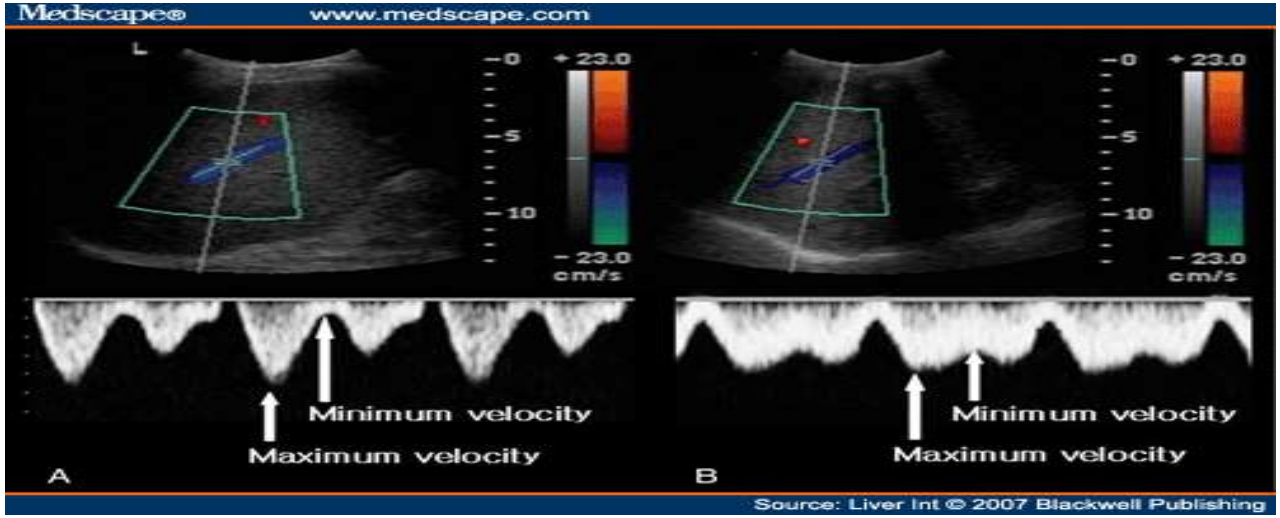
http://https://en.wikipedia.org/wiki/Portal_hypertension http://www.merckmanuals.com/home/liver-and-gallbladder-disorders/manifestations-of-liver-disease/portal-hypertension

Portal hypertension: Diagnosis 2

- Imaging tests
- Liver biopsy and histologic examination
- Hemodynamic measurement of the hepatic venous pressure gradient (HVPG
- Upper GI endoscopy (or, esophagogastroduodeno-scopy [EGD]): A criterion standard for assessment of portal hypertension

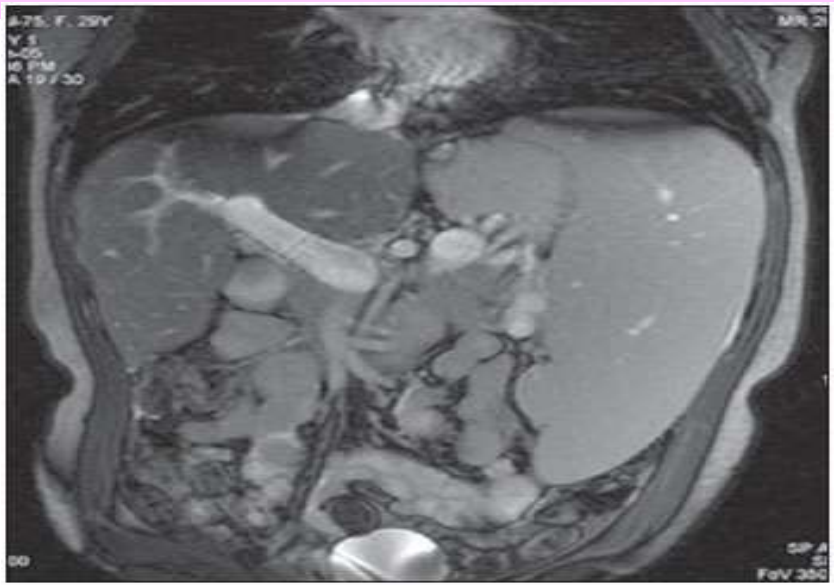
http://https://en.wikipedia.org/wiki/Portal_hypertension http://www.merckmanuals.com/home/liver-and-gallbladder-disorders/manifestations-of-liver-disease/portal-hypertension

Portal hypertension: Hepatic venous pressure gradient



Measurement of damping index (DI) of hepatic vein waveform. (A) A patient with liver cirrhosis showed 0.26 of DI with 7 mmHg of hepatic venous pressure gradient (HVPG). (B) A patient with liver cirrhosis showed 0.72 of DI with 15 mmHg of HVPG.

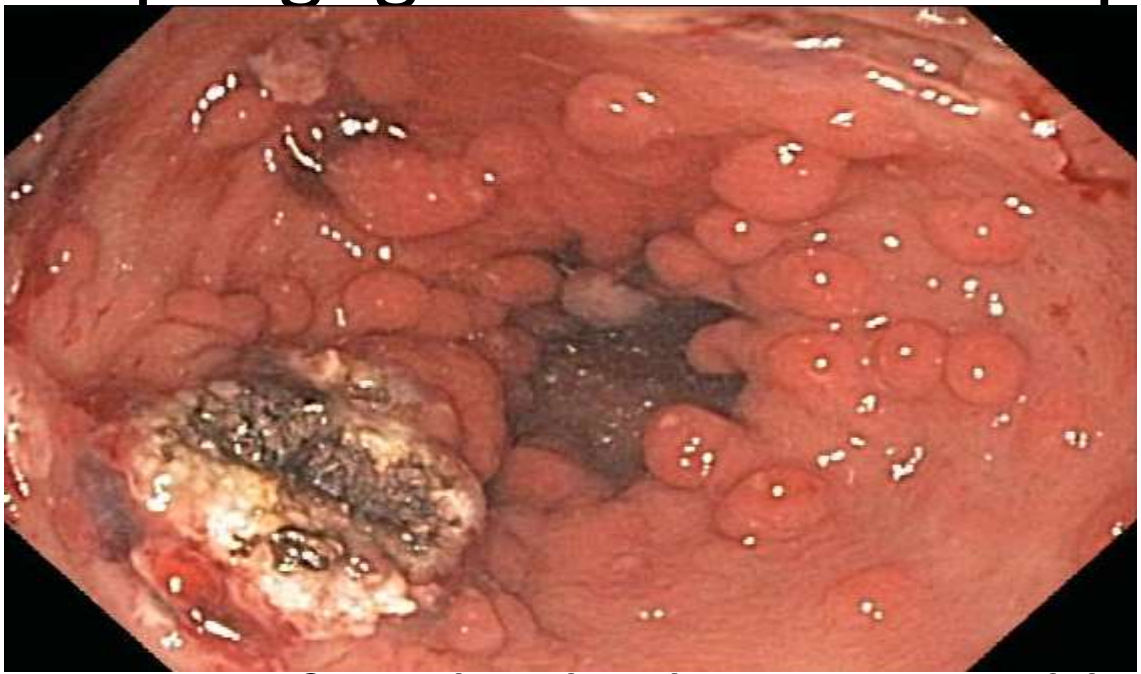
Portal hypertension: MRI



Coronal section plane of the abdomen acquired with the true fast imaging (TRUFI) sequence, used to define the middle segment of the portal vein.

http://www.rb.org.br/imagens/v43n6a05-fig01.jpg

Portal hypertension: Esophagogastroduodenoscopy



Endoscopic view of multiple, large portal hypertensive polyps in the antrum.

http://www.medscape.com/viewarticle/564073_2

Portal hypertension: Laboratory testing 1

- Complete blood count
- Liver function tests (e.g., aspartate aminotransferase [AST], alanine aminotransferase [ALT], bilirubin)
- Coagulation studies (prothrombin time [PT], partial thromboplastin time [PTT], international normalized ratio [INR])
- Blood urea nitrogen, creatinine, and electrolytes
- Arterial blood gas (ABG) and pH measurements

http://https://en.wikipedia.org/wiki/Portal_hypertension http://www.merckmanuals.com/home/liver-and-gallbladder-disorders/manifestations-of-liver-disease/portal-hypertension

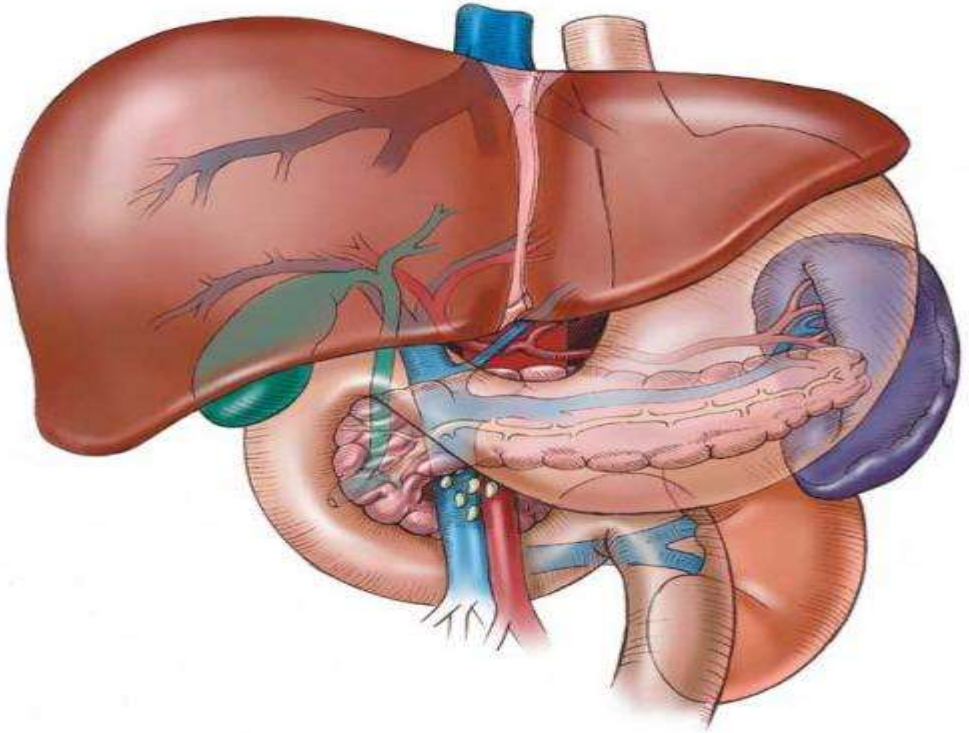
Portal hypertension: Laboratory testing 2

- Hepatic and viral hepatitis serologies, particularly hepatitis B and C serologies
- Albumin levels: Hypoalbuminemia is common
- Antinuclear antibody, antimitochondrial antibody, antismooth muscle antibody
- Iron indices
- Alpha1-antitrypsin deficiency
- Ceruloplasmin, 24-hour urinary copper

http://https://en.wikipedia.org/wiki/Portal_hypertension http://www.merckmanuals.com/home/liver-and-gallbladder-disorders/manifestations-of-liver-disease/portal-hypertension

Exocrine pancreas: Syndromes

- Exocrine Pancreatic Insufficiency
  - Diarrhea
  - Steatorrhea
  - Abdominal pain
  - Symptoms of vitamin deficiencies



http://www.everydayhealth.com/hs/exocrine-pancreatic-insufficiency/know-the-symptoms-of-epi/

Exocrine Pancreatic Insufficiency: Definition

- Exocrine pancreatic insufficiency (EPI) is the inability to properly digest food due to a lack of digestive enzymes made by the pancreas
- EPI is caused by a progressive loss of the pancreatic cells that make digestive enzymes

https://en.wikipedia.org/wiki/Exocrine_pancreatic_insufficiency

Exocrine Pancreatic Insufficiency: Causes 1

- Pancreatic
  - Chronic pancreatitis
  - Cystic fibrosis
  - Obstructions of the pancreatic duct
  - Shwachman-Diamond syndrome (EPI, bone marrow dysfunction, leukemia predisposition, and skeletal abnormalities)

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Causes 2

- Nonpancreatic
  - Celiac disease
  - Crohn disease
  - Autoimmune pancreatitis
  - Zollinger-Ellison syndrome
  - GI and pancreatic surgical procedures

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Pathophysiology 1

- EPI is characterized by a deficiency of exocrine pancreatic enzymes, which results in inability to digest food properly (i.e., maldigestion)
- Because pancreatic lipase accounts for up to 90% of fat digestion, maldigestion of fat is more profound in EPI than maldigestion of proteins and carbohydrates

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Pathophysiology 2

- Fat digestion is not clearly impaired until lipase output decreases to below 10% of the normal level
- Fat malabsorption precedes malabsorption of other macronutrients
- Bile salt precipitation and subsequent adsorption to undigested food reduces the bile salt pool, and this reduction further impairs fat digestion

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Pathophysiology 3

- Undigested fat, rather than being absorbed, is excreted in the feces, leading to steatorrhea
- Another factor that contributes to pancreatic steatorrhea is the presence of neurohormonal disturbances, which result in gall bladder hypomotility and accelerated gastric and intestinal transit
- Malabsorption of fat-soluble vitamins A, D, E, and K may accompany EPI

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Symptoms 1

- Steatorrhea
- Weight loss
- Diarrhea
- Pale, bulky, malodorous stools often float on top of the toilet water with oily droplets and are difficult to flush
- Fatigue

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Symptoms 2

- Flatulence and abdominal distention
- Edema (result from hypoalbuminemia)
- Anemia (can be either microcytic (related to iron deficiency) or macrocytic (related to vitamin B-12 deficiency))

http://emedicine.medscape.com/article/2121028-overview#a8

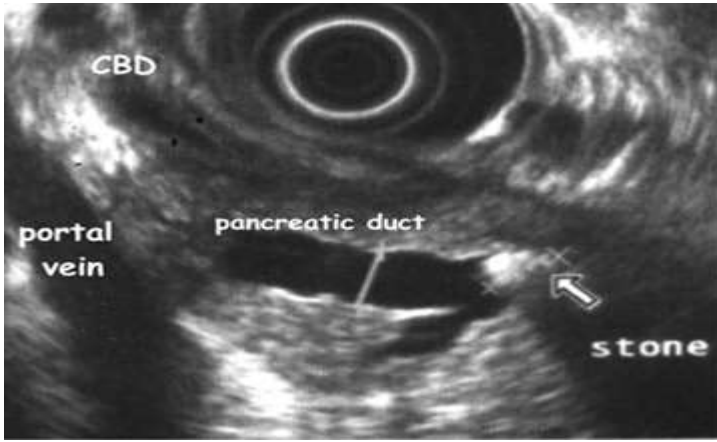
Exocrine Pancreatic Insufficiency: Symptoms 3

- Bleeding disorders (a consequence of vitamin K malabsorption and subsequent hypoprothrombin-emia)
- Ecchymosis
- Metabolic bone disease (vitamin D deficiency)
- Neurologic manifestations: generalized motor weakness, peripheral neuropathy, loss of a sense of vibration and position, night blindness, seizures

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Diagnosis

- Blood tests
- 3-day fecal test
- Fecal elastase-1
- CT scan
- MRI
- Endoscopic ultrasound



http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: 3-day fecal test

- The normal range for fecal fat testing is 7 grams over a 24-hour period
- Normal results for a 72-hour test would be 21 grams

Fecal Stool Test Kits

http://emedicine.medscape.com/article/2121028-overview#a8

Exocrine Pancreatic Insufficiency: Fecal elastase-1 1

Reference concentration to interpret Pancreatic Elastase results after the first month of life:

- > 200 µg elastase/g stool - normal exocrine pancreatic function
- 100-200 µg elastase/g stool - mild to moderate pancreatic insuffiency

Extraction Buffer for Fecal Elastase 1™ Kit

https://en.wikipedia.org/wiki/Pancreatic_elastase

Exocrine Pancreatic Insufficiency: Fecal elastase-1 2

Reference concentration to interpret Pancreatic Elastase results after the first month of life:

- < 100 µg elastase/g stool indicate exocrine pancreatic insufficiency

Extraction Buffer for Fecal Elastase 1™ Kit

https://en.wikipedia.org/wiki/Pancreatic_elastase