Pathohysiology of ascites

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Ascites

- *Ascites* is of Greek derivation ("askos") and refers to a bag or sack and describes pathologic fluid accumulation within the peritoneal cavity.

- Most patients (85%) with ascites have cirrhosis.

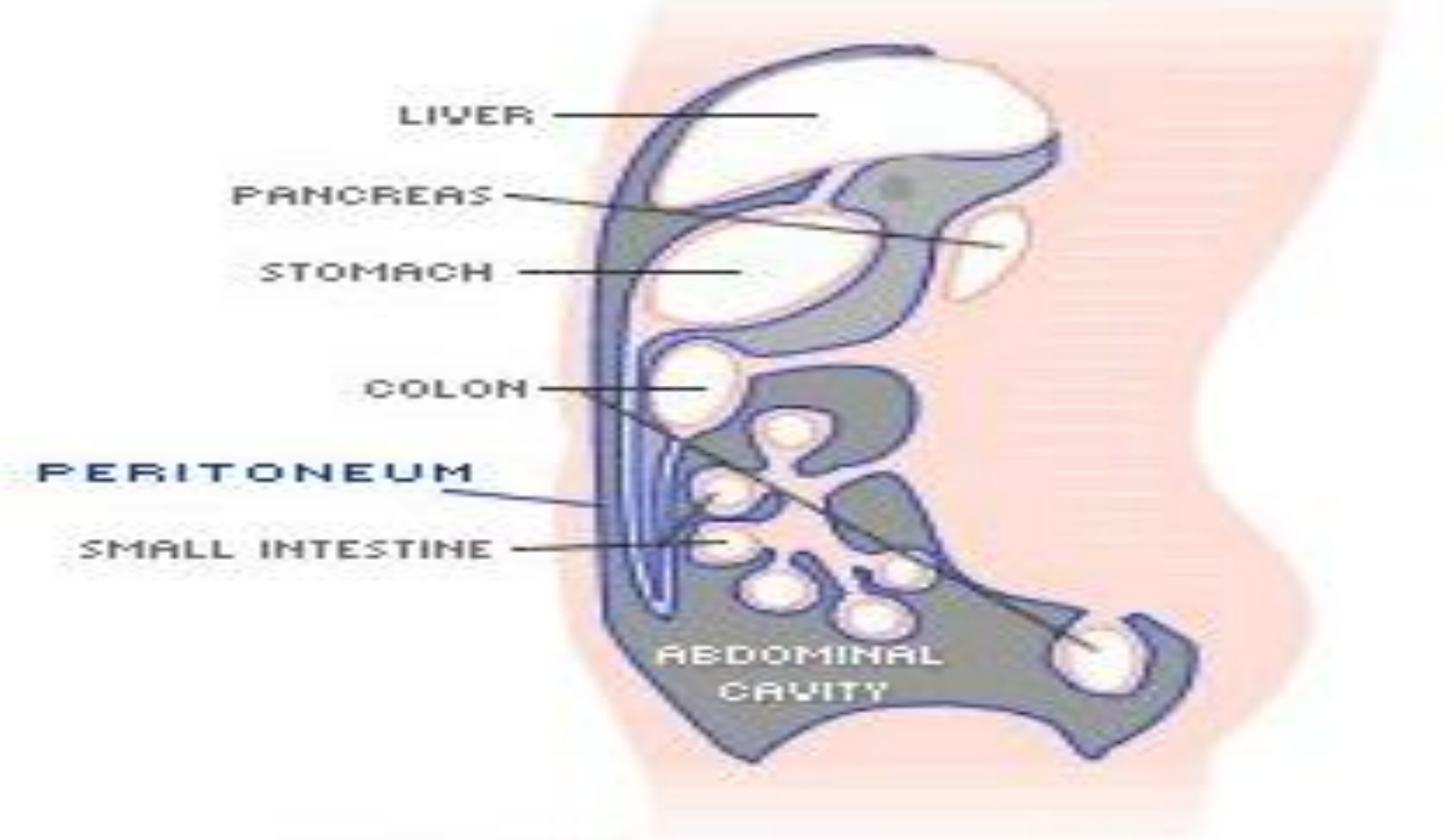
- The most common causes of cirrhosis at the present time are chronic viral hepatitis and alcoholic liver disease.

Peritoneal cavity

- It is a potential space between the parietal peritoneum and visceral peritoneum, the two membranes separate the organs in the abdominal cavity from the abdominal wall.
- Derived from the coelomic cavity of the embryo.
- Largest serosal sac in the body and secretes approximately 50 ml of fluid per day.

Peritoneal Mesothelioma

Abdominal Cavity Showing Peritoneum



PERITONEUM SHOWN IN BLUE

* Image source: http://www.asbestossupport.co.uk

Peritoneal fluid

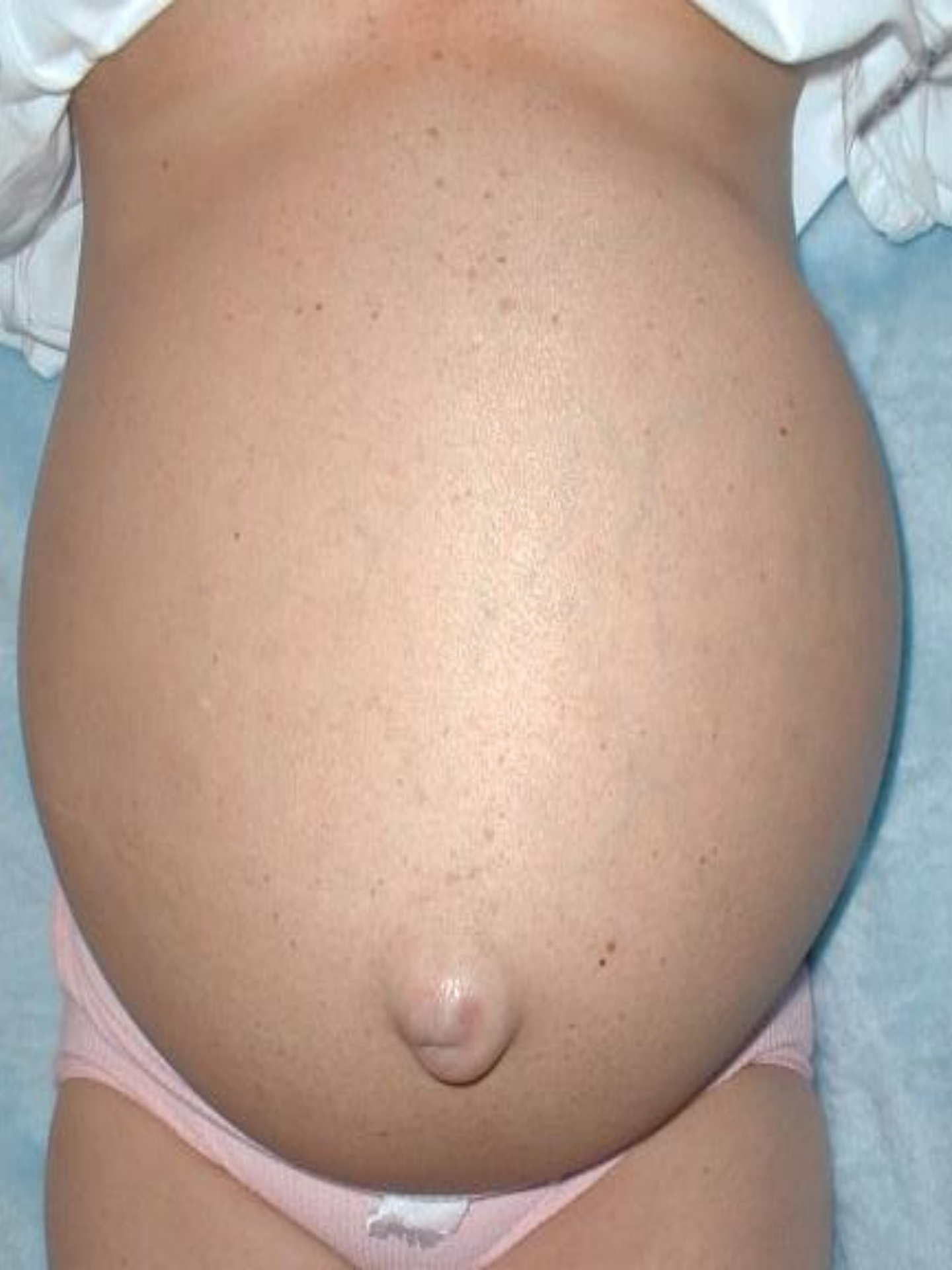
- It is a normal, lubricating fluid found in the peritoneal cavity.
- The fluid is mostly water with electrolytes, antibodies, white blood cells, albumin, glucose and other biochemicals.
- Reduce the friction between the abdominal organs as they move around during digestion.

Ascites

- Cirrhosis
- Infection (TB)
- Malignancy
- CHF
- Nephrotic syndrome
- Pancreatic or biliary ascites

Pathogenesis

- 1-Increased hydrostatic pressure
- 2-Decreased colloid osmotic pressure
- 3-Increase in the permeability of peritoneal capillaries
- 4-Leakage of fluid into the peritoneal cavity
- 5-Miscellinious



Pathogenesis

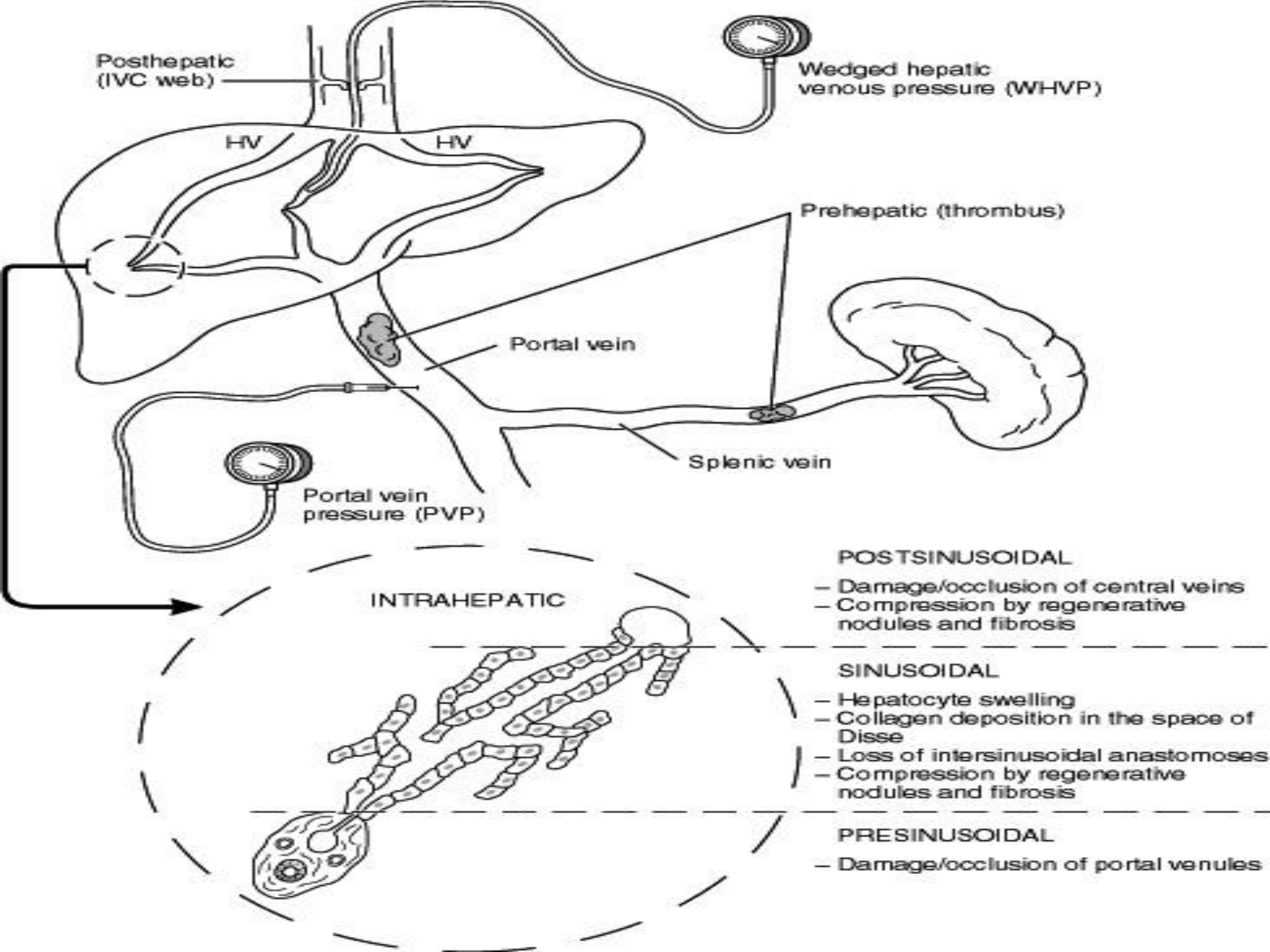
- Cirrhotic Ascites :

  The most recent theory of ascites formation, the "peripheral arterial vasodilation hypothesis," .

This happens as a consequence of portal hypertension.

Introduction

- Portal hypertension> 5 mmHg.
- Approximately 2/3 of the hepatic blood supply is provided by portal venous blood.


Posthepatic
(IVC web)
Wedged hepatic
venous pressure (WHVP)
HV
HV
Prehepatic (thrombus)
Portal vein
Splenic vein
Portal vein
pressure (PVP)
INTRAHEPATIC
POSTSINUSOIDAL
– Damage/occlusion of central veins
– Compression by regenerative nodules and fibrosis
SINUSOIDAL
– Hepatocyte swelling
– Collagen deposition in the space of Disse
– Loss of intersinusoidal anastomoses
– Compression by regenerative nodules and fibrosis
PRESINUSOIDAL
– Damage/occlusion of portal venules

Pathophysiology and Causes

- The pathogenesis of portal hypertension involves the relationship between portal venous blood flow and the resistance to this blood flow within the liver (the portohepatic resistance) and within portosystemic collateral blood vessels (the portocollateral resistance) that form during the evolution of portal hypertension.

The Role of Increased Resistance:

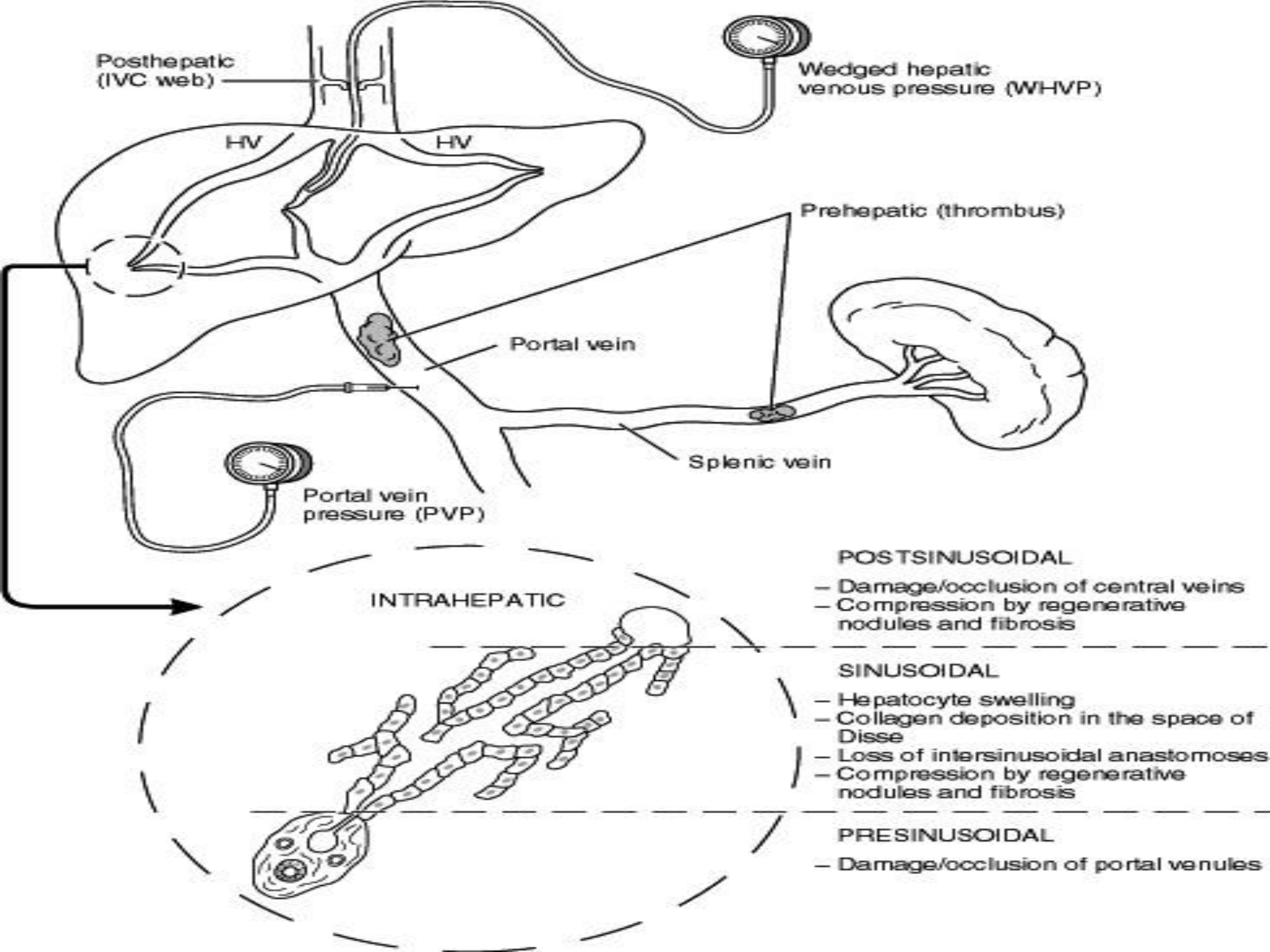
The three major categories of portal hypertension:

1) Prehepatic
2) Intrahepatic
3) posthepatic

In the case of intrahepatic causes

1) presinusoidal
2) Sinusoidal
3) Postsinusoidal

- Most of the relevant information has been provided by direct measurement of pressure in the portal system and indirect estimation of the intrasinusoidal pressure from the WHVP in conjunction with details of the morbid anatomic features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For example:

• In both prehepatic and intrahepatic presinusoidal portal hypertension
(PVP) is elevated with N (WHVP) and (HVPG).

• In sinusoidal and intrahepatic postsinusoidal portal hypertension, the (WHVP) tends to approximate or equal the directly measured (PVP) and the HVPG is increased.

• In posthepatic portal hypertension, the WHVP equals the increased PVP.

***Portal Blood Flow* :**

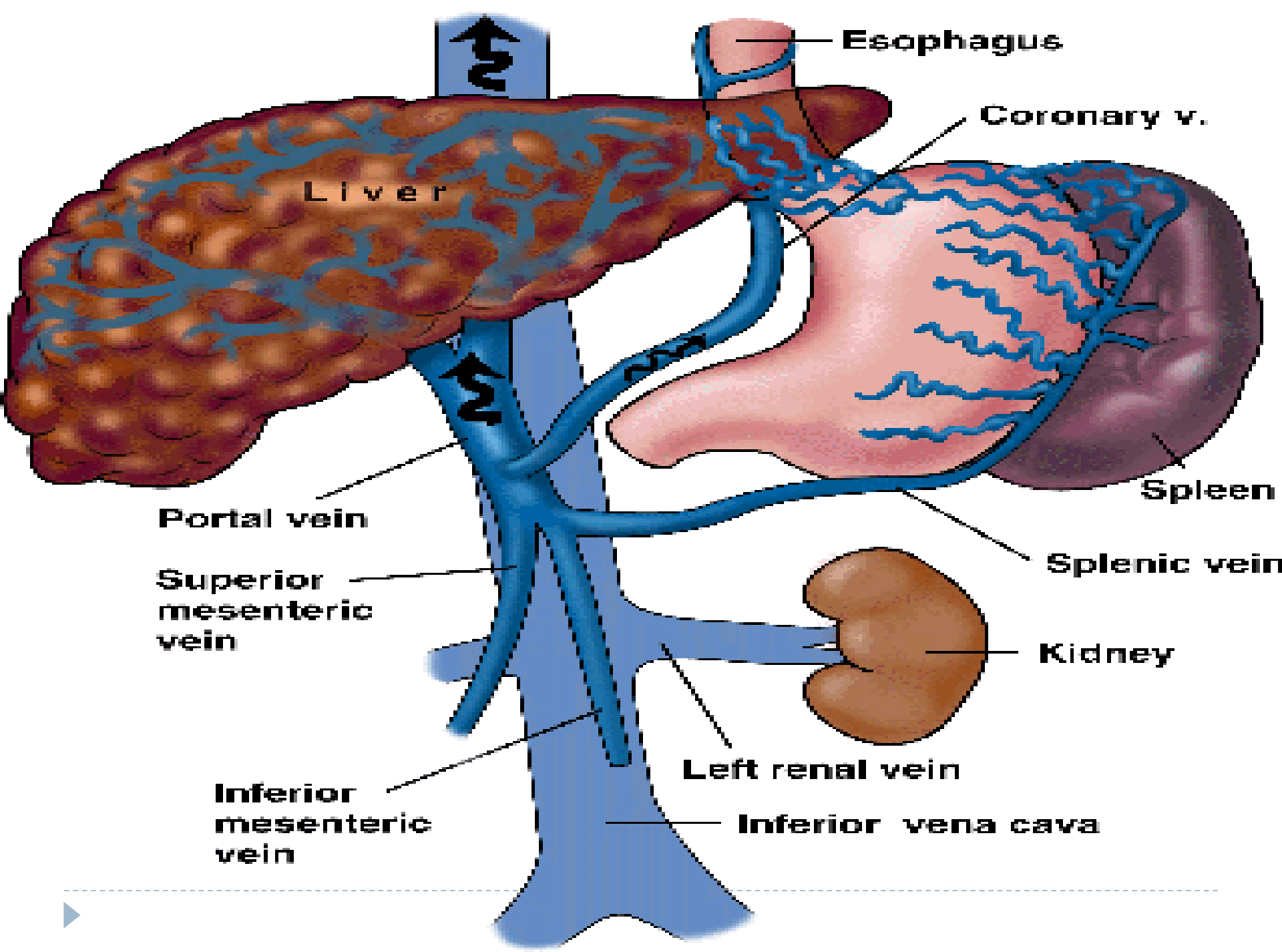
- Primary High Portal Flow States Although uncommon, conditions leading to high-flow states in the portal system (arterioportal fistulas, splenomegaly resulting from myelofibrosis or myeloid metaplasia) are well-recognized causes of portal hypertension.

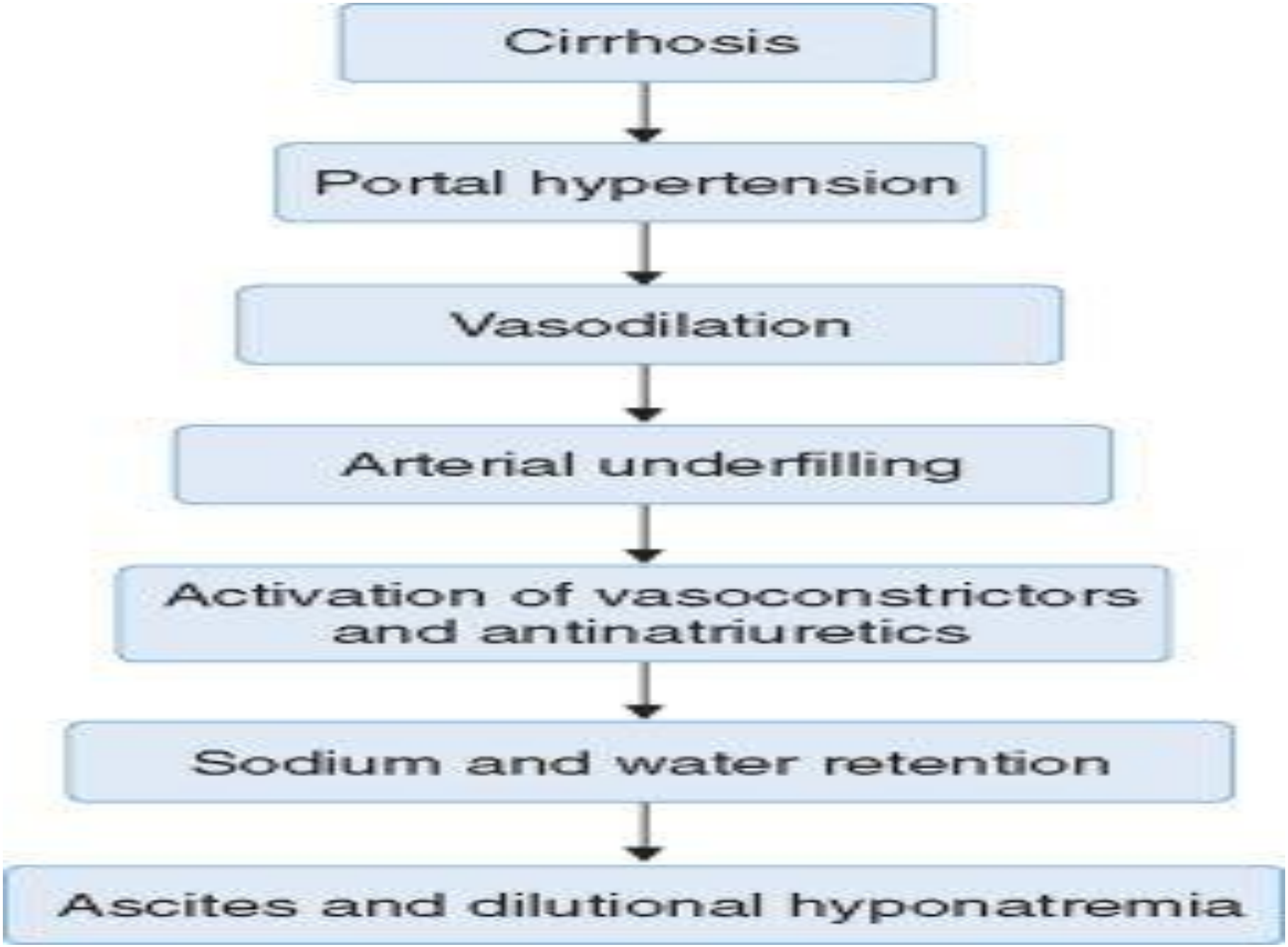
- portal hypertension is maintained during collateral formation by increased portal inflow, and, as a consequence, portal hypertension persists even

  when all portal flow escapes through collaterals.

- Hyperdynamic Circulation of Portal Hypertension its hallmarks are increased cardiac output and reduced arterial blood pressure.

- Collective data from hemodynamic studies in patients with portal hypertension who treated with selective and nonselective B-blockers point to a role for both increased cardiac output (β1 receptor–mediated) and splanchnic arteriolar vasodilation (β2 receptor–mediated) in generating the increase in portal venous inflow .


Esophagus
Coronary v.
Liver
Spleen
Portal vein
Splenic vein
Superior mesenteric vein
Kidney
Left renal vein
Inferior mesenteric vein
Inferior vena cava


Cirrhosis
Portal hypertension
Vasodilation
Arterial underfilling
Activation of vasoconstrictors and antinatriuretics
Sodium and water retention
Ascites and dilutional hyponatremia

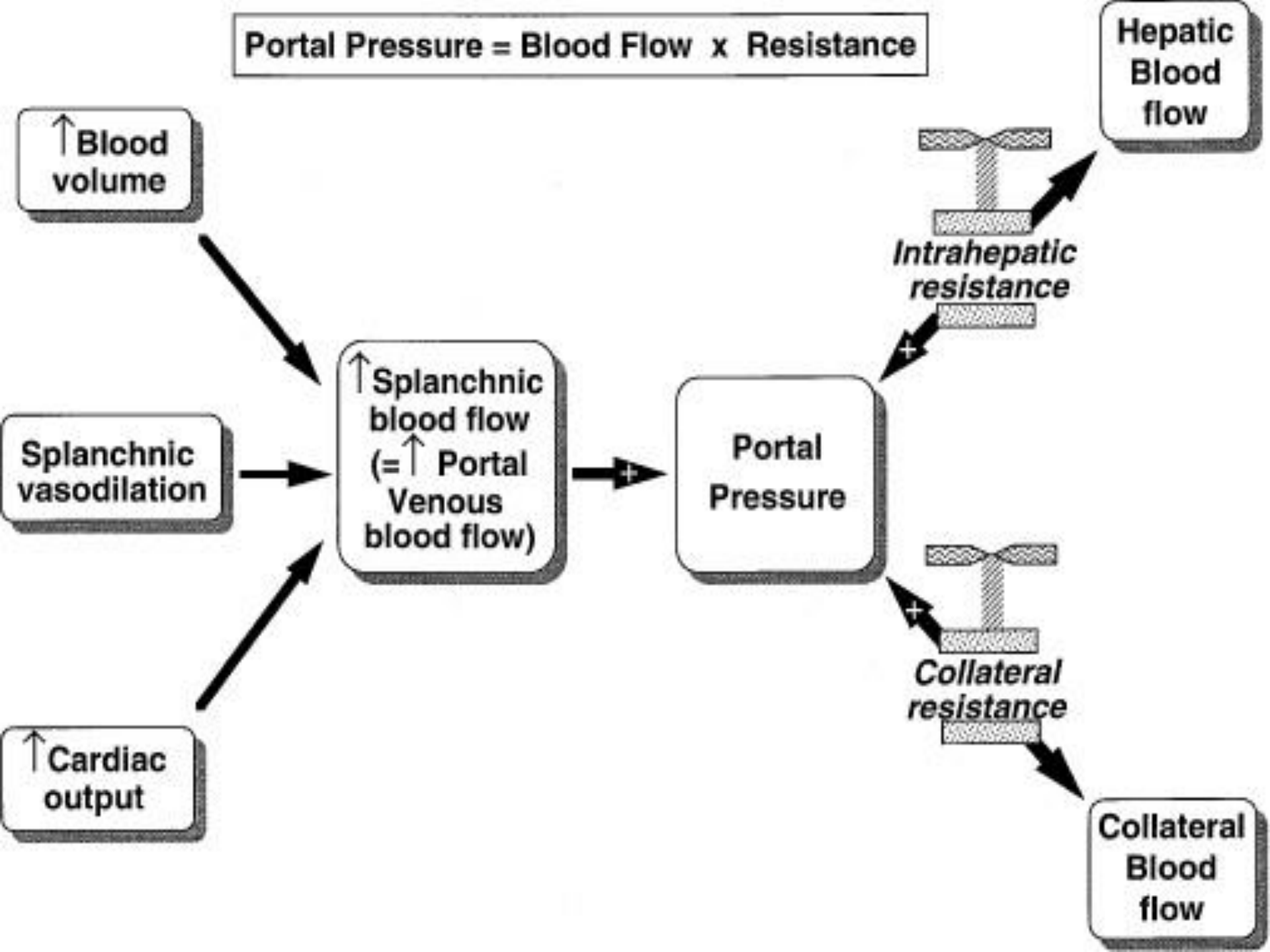
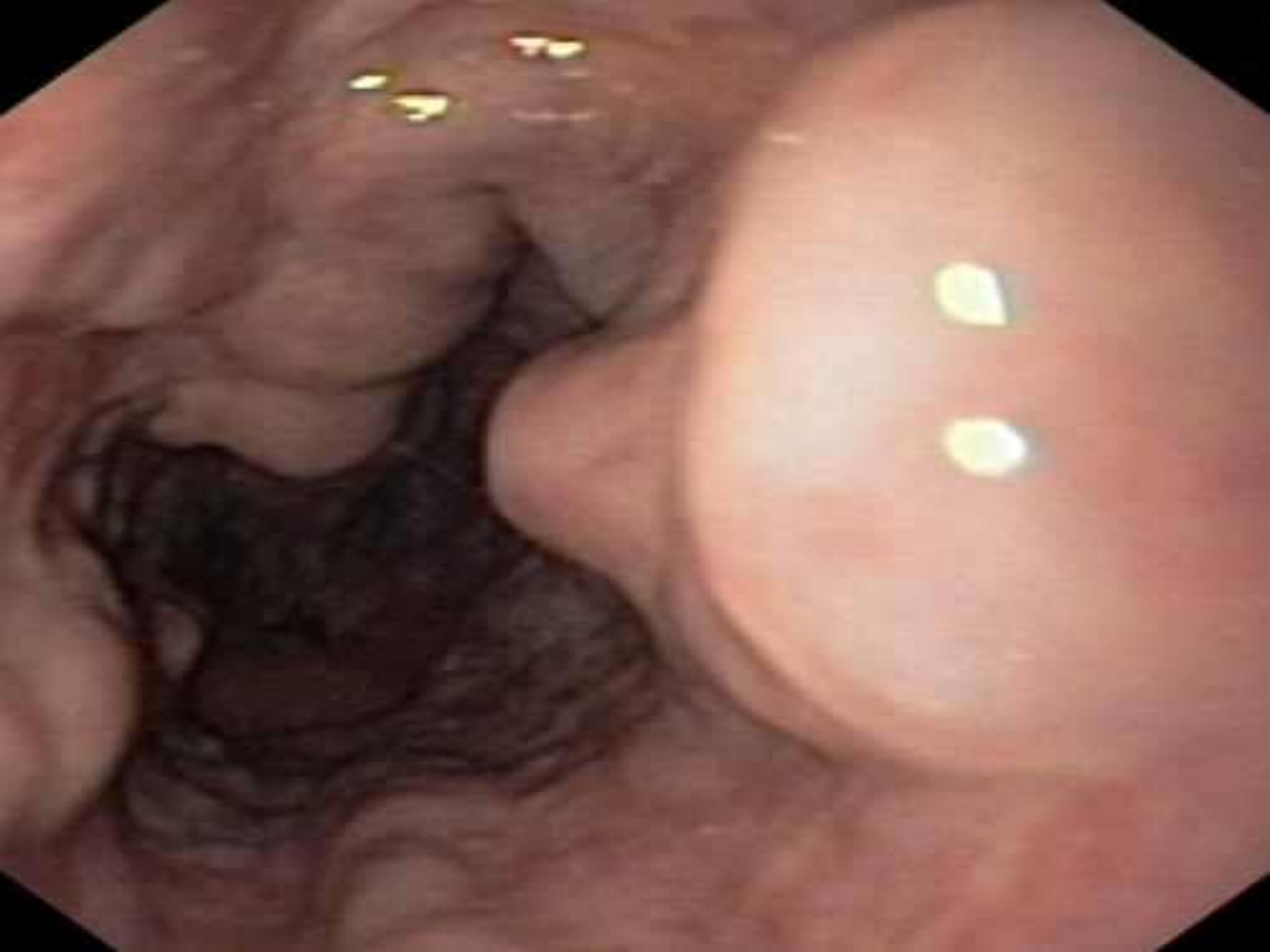

Portal Pressure = Blood Flow x Resistance
↑Blood volume
Splanchnic vasodilation
↑Cardiac output
↑Splanchnic blood flow (=↑ Portal Venous blood flow)
Portal Pressure
Hepatic Blood flow
Intrahepatic resistance
Collateral resistance
Collateral Blood flow

Table 77–1 | Causes of Portal Hypertension

- Primary increased flow
  - Arterial-portal venous fistula
    - Intrahepatic
    - Intrasplenic
    - Splanchnic
  - Splenic capillary hemangiomatosis
- Primary increased resistance
  - Prehepatic
    - Thrombosis/cavernous transformation of the portal vein
    - Splenic vein thrombosis
  - Intrahepatic
    - Presinusoidal
      - Schistosomiasis*
      - Sarcoidosis*
      - Myeloproliferative diseases and myelofibrosis*
      - Congenital hepatic fibrosis
      - Idiopathic portal hypertension (hepatoportal sclerosis)
      - Chronic arsenic hepatotoxicity
      - Azathioprine hepatotoxicity
      - Vinyl chloride hepatotoxicity
      - Early primary biliary cirrhosis*
      - Early primary sclerosing cholangitis*
      - Partial nodular transformation
    - Sinusoidal/mixed
      - Cirrhosis secondary to chronic hepatitis
      - Alcoholic cirrhosis
      - Cryptogenic cirrhosis
      - Methotrexate
      - Alcoholic hepatitis
      - Hypervitaminosis A
      - Incomplete septal fibrosis
      - Nodular regenerative hyperplasia
    - Postsinusoidal
      - Veno-occlusive disease
      - Hepatic vein thrombosis (Budd-Chiari syndrome)
  - Posthepatic
    - Inferior vena caval web
    - Constrictive pericarditis
    - Tricuspid regurgitation
    - Severe right-sided heart failure

*Usually presinusoidal early in the course, often progressing to a sinusoidal or mixed type of portal hypertension when more advanced.



Non portal hypertensive ascites

- Noncirrhotic Ascites :

  Malignancy-related ascites depends on the location of the tumor e.g:

  Peritoneal carcinomatosis produce proteinaceous fluid by tumor cells lining the peritoneum cause extracellular fluid to enters the peritoneal cavity to reestablish oncotic balance.

- In high-output or low-output heart failure (increased hydrostatic preasure)
- Chylous ascites in patients with malignant lymphoma appears to be caused by lymph node obstruction by tumor and rupture of chyle-containing lymphatics.

- nephrotic syndrome where effective arterial blood volume decreased, and the vasopressin, renin-aldosterone, and sympathetic nervous systems are activated (decreased colloid osmotic pressure)

- Tuberculosis, Chlamydia infection, and coccidioidomycosis cause ascites through the production of proteinaceous fluid (increased permeability of peritoneal capillaries)

- pancreatic or biliary ascites, fluid forms by leakage of pancreatic juice or bile into the peritoneal cavity or by a "chemical burn" of the peritoneum.

(leakage of fluid into the peritoneal cavity)

CLINICAL FEATURES

History :

- Ascites frequently develops as part of the patient's first decompensation of liver disease.

It can be associated with other features of liver decompensation such as jaundice or encephalopath.

- Risk factors for viral hepatitis, such as ivdu, blood tx, sex, acupuncture, tattoos, ear piercing, and country of origin.
- NASH from long-standing obesity, many patients who have been obese will spontaneously lose 50 or even 100 pounds after their liver disease decompensate.
- Alcohol intake

- A history of heart failure may raise the possibility of cardiac ascites.
- Tuberculous peritonitis is usually manifested by fever and abdominal pain, > 50% have underlying alcoholic cirrhosis.
- Acute hemorrhagic pancreatitis or hemodialysis.
- Fitz-Hugh–Curtis syndrome caused by *Chlamydia* may cause inflammatory ascites in a sexually active woman.
- Pts with ascites and anasarca in the setting of DM suggest nephrotic ascites.

- Myxedema and serositis in connective tissue disease may be complicated by ascites.

- **O/E:**
- Signs of chronic liver disease
- signs of ascites (bulging abdomen,fank dullness,shiffting dullnes and fluid wave).
- large veins on the suggests IVC blockage, an immobile mass in the umbilicus (the Sister Mary Joseph nodule) is suggestive of peritoneal carcinomatosis.
- Nephrotic syndrome or cardiac failure may have total body edema (anasarca).

Ascites; what should we do?

Serum-Ascites Albumin Gradient (SAAG)	
High Gradient (≥ 1.1 g/dl)	**Low Gradient (< 1.1 g/dl)**
Cirrhosis	Peritoneal carcinomatosis
Alcoholic hepatitis	Peritoneal tuberculosis
Cardiac failure	Pancreatic ascites
Massive liver metastases	Biliary ascites
Fulminant hepatic failure	Nephrotic syndrome
Budd-Chiari syndrome	Serositis
Portal-vein thrombosis	Bowel obstruction or infarction
Veno-occlusive disease	
Fatty liver of pregnancy	
Myxedema	
"Mixed" ascites	

What you need to know,,

Management of Ascites Due to Cirrhosis
1. Treatment of underlying disorder (e.g. alcoholic liver disease, hepatitis B, autoimmune hepatitis)
2. Dietary sodium restriction (less than 2000mg per day)
3. Diuretic therapy (maintain ratio spironolactone 100mg: furosemide 40mg)
4. Therapeutic paracentesis
5. Fluid restriction only if serum sodium <120 mEq/L or symptomatic hyponatremia

Conclusion

- The most common cause of ascites is liver cirrhosis and the pathophysiological mechanism is portal HTN leading to systemic vascular changes.
- Other pathogenesis include

1-Increased hydrostatic pressure
2-Decreased colloid osmotic pressure
3-Increase in the permeability of peritoneal capillaries
4-Leakage of fluid into the peritoneal cavity
5-miscellaneous