

# *Clinical Anatomy of the Biliary Apparatus: Relations & Variations*

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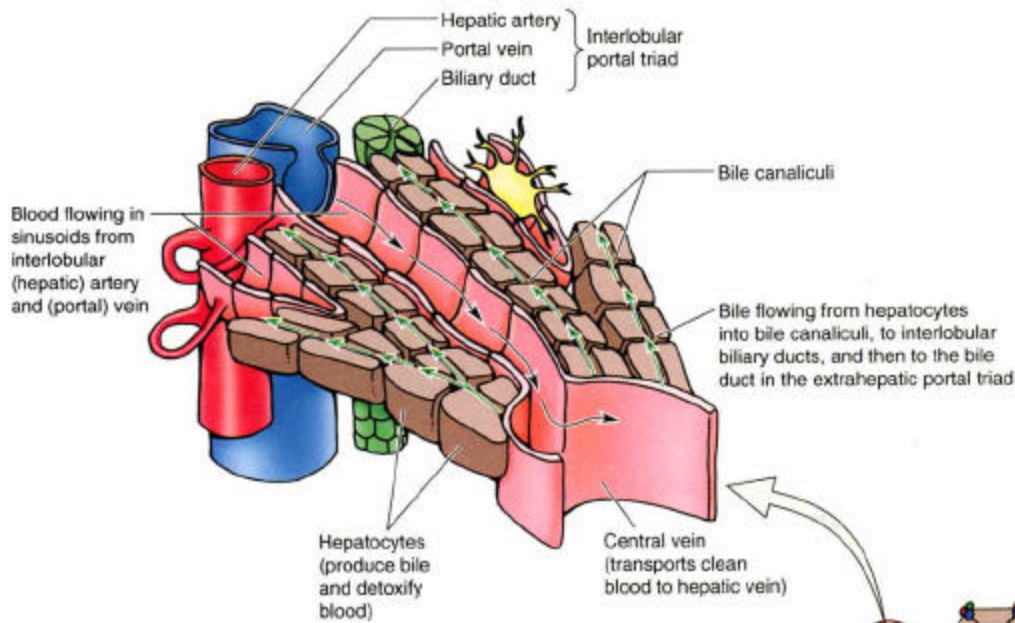
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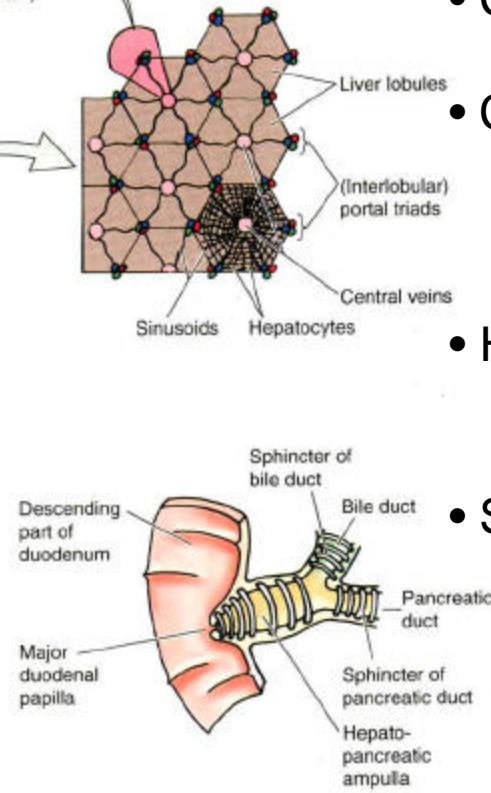
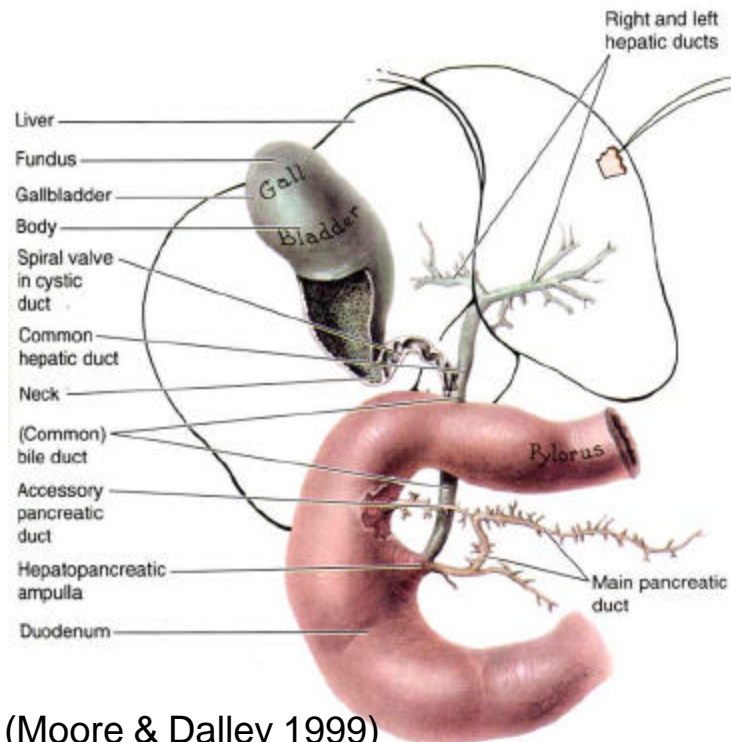
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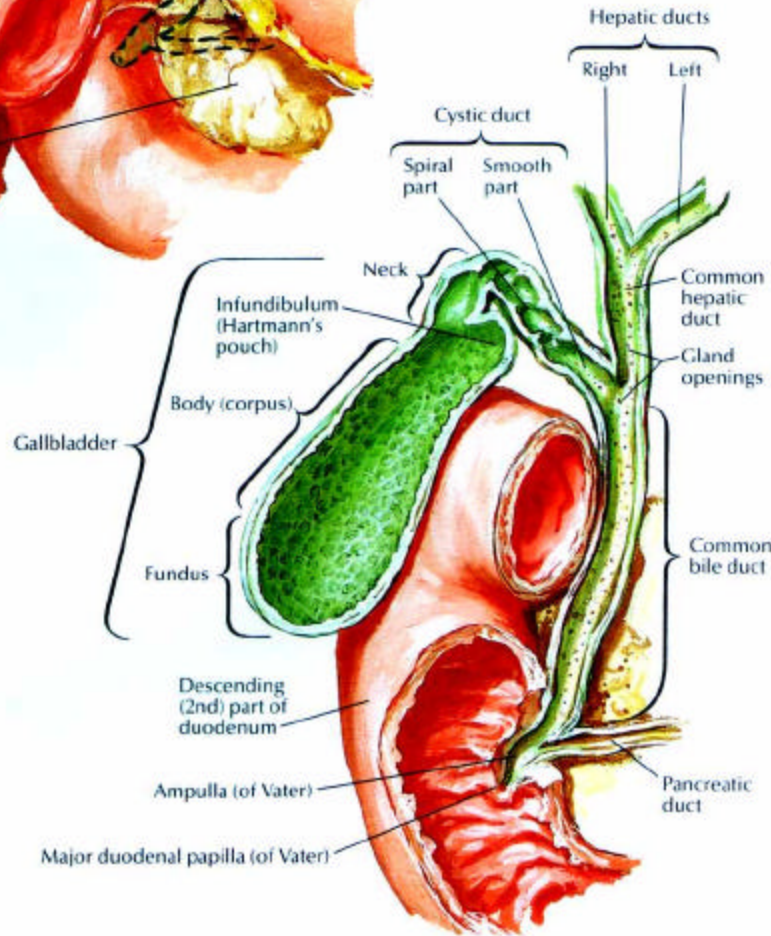
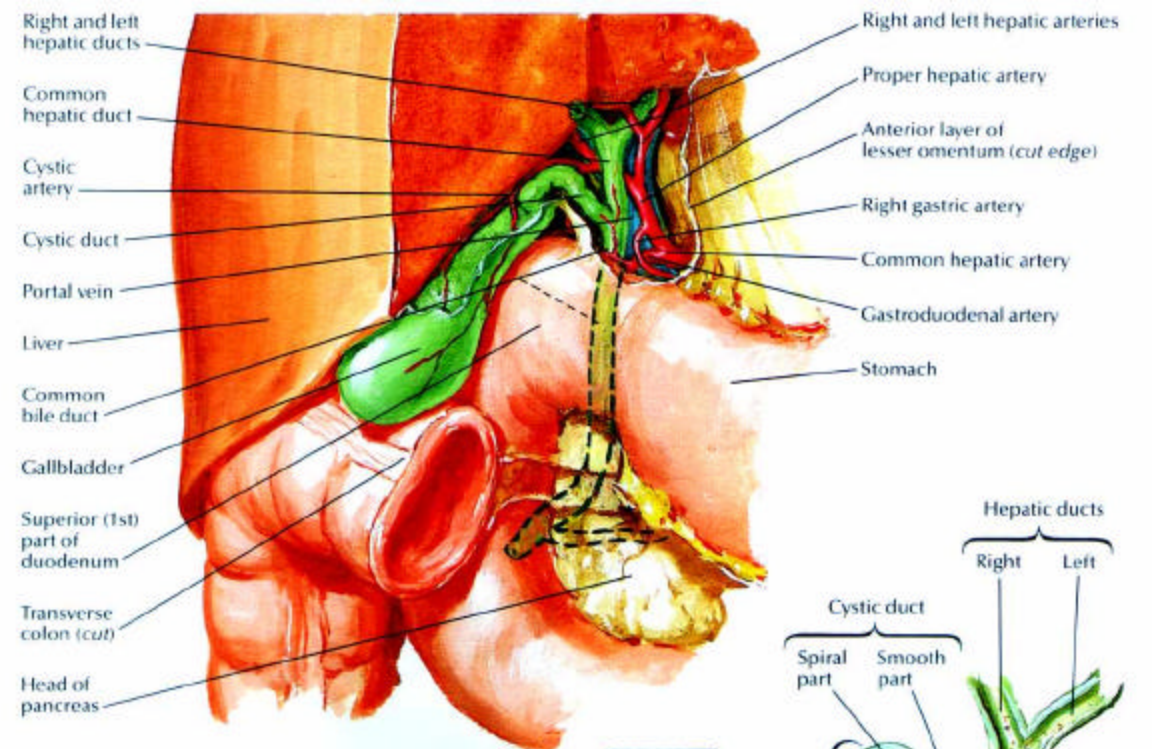
# Anatomical Overview



- Liver lobule: bile from hepatocytes drains to  $S_c$  canaliculi, then to biliary ducts in portal triad
- Biliary ducts in triads drain to right & left hepatic ducts
- Common hepatic duct: union of right & left hepatic ducts
- Common bile duct (CBD)
  - Union of common hepatic duct & cystic duct
  - 5–15 cm in length
- Hepatopancreatic ampulla of Vater: union of bile duct & Wirsung's duct
- Sphincter of Oddi
  - Papillary sphincter: ampulla
  - Pancreatic sphincter
  - Choledochal sphincter

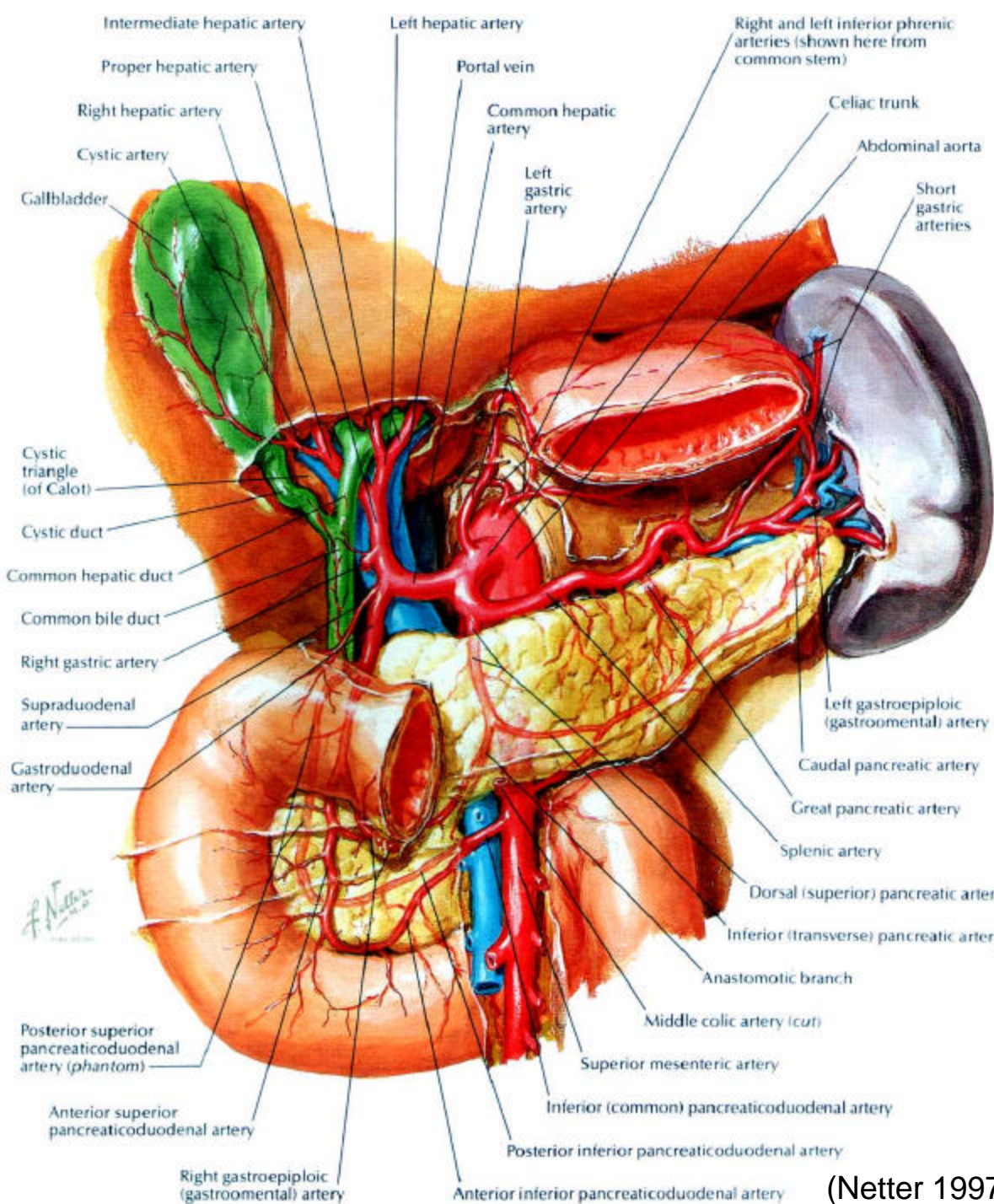


# Anatomical Overview



- Gall bladder
  - Fossa on visceral surface of liver between right & left hepatic lobes
  - Fundus
  - Body (incl. Hartmann's pouch)
  - Neck (spiral valve of Heister)
- Cystic duct

# Anatomical Overview



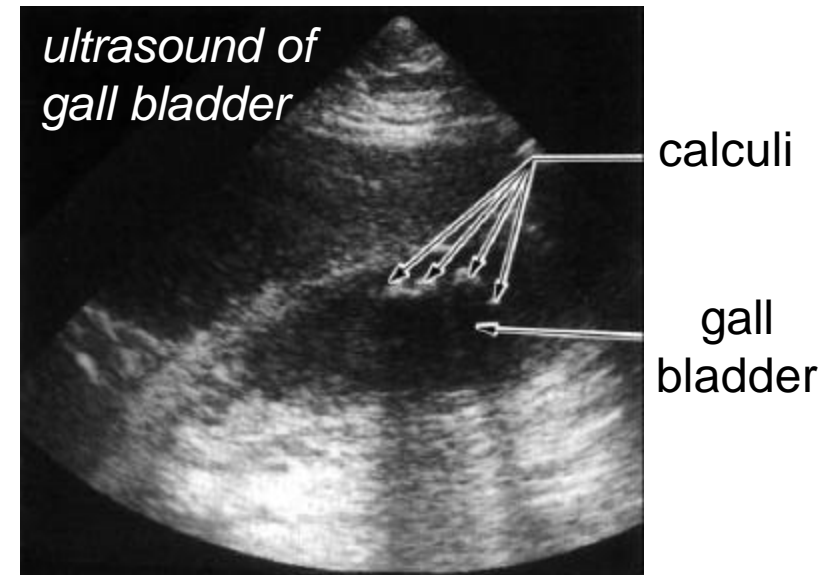
- Peritoneal relations: visceral peritoneum passes over the gall bladder
- Blood supply
  - From celiac axis
  - Cystic artery to gall bladder
    - Branch to peritoneal surface
    - Branch to bare surface
  - Multiple branches to CBD
- Triangle of Calot
  - Cystic duct, common hepatic duct, liver
  - Cystic artery usually within Calot's triangle

(Netter 1997)

# Case Presentation

A 46-year-old woman presents to the ER in acute distress with symptoms of severe pain in the right upper abdominal region. In the past, she had repeated attacks of severe pain in the right upper quadrant, frequently following a heavy meal. These attacks were accompanied by nausea and vomiting. She suffers from indigestion, particularly after eating fatty foods.

*Examination:* She complains of severe, constant pain that started in the epigastric and umbilical regions and then became localized in the right hypochondriac area. The pain radiates around the right chest to and below the inferior angle of the scapula. There is marked tenderness and some rigidity in the right hypochondriac region. She has a moderate fever, and her white count is elevated. Ultrasound reveals multiple stones in the gall bladder.



(Cahill 1997)

*Preliminary Diagnosis:*  
**biliary colic and  
chronic calculus cholecystitis**

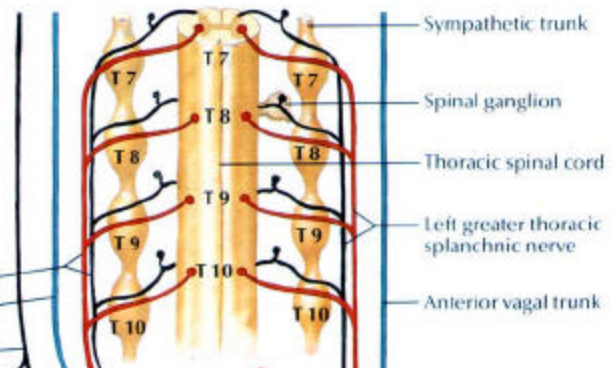
## Questions

- 1. How do you explain the location of the pain in the right hypochondriac region and its typical radiation to the ipsilateral back, particularly to the scapular and infrascapular regions? Why do some patients show ipsilateral pain in the neck and shoulder region?**
2. What is the anatomical basis for the muscular rigidity overlying the affected area?
3. Given the anatomical relations of the gall bladder, what organs are most likely to form fistulas with the gall bladder and hence be the recipient of pus and/or stones?
4. Although surgery on the gall bladder is about as common as that for inguinal hernia and appendicitis, what anatomical fact accounts for the much higher frequency of surgical complications in gall bladder surgery?

Common areas of referred pain in biliary disease

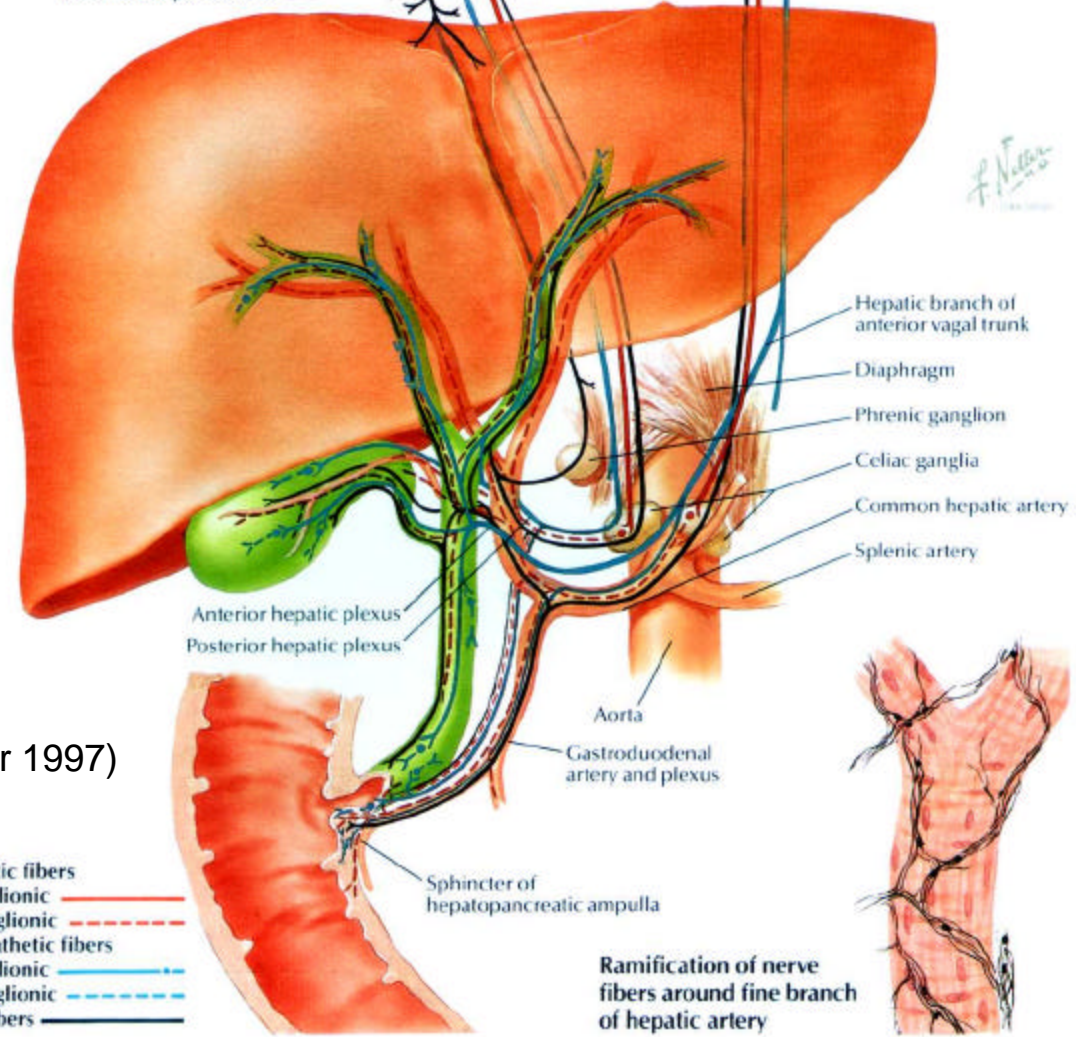


Right greater thoracic splanchnic nerve  
Posterior vagal trunk  
Right phrenic nerve to diaphragmatic and visceral peritoneum



# Nerve Supply

- Afferent (pain)
  - Somatic afferents
    - direct stimulation of nociceptors in parietal peritoneum
    - hypochondriac region: ~T6–T10
    - neck & shoulder
      - diaphragmatic periton.
      - phrenic n. (C3–C5)
  - Visceral afferents
    - ~ T7–T9: run with sympathetic efferents
    - epigastric, right shoulder & infrascapular regions
    - referred pain



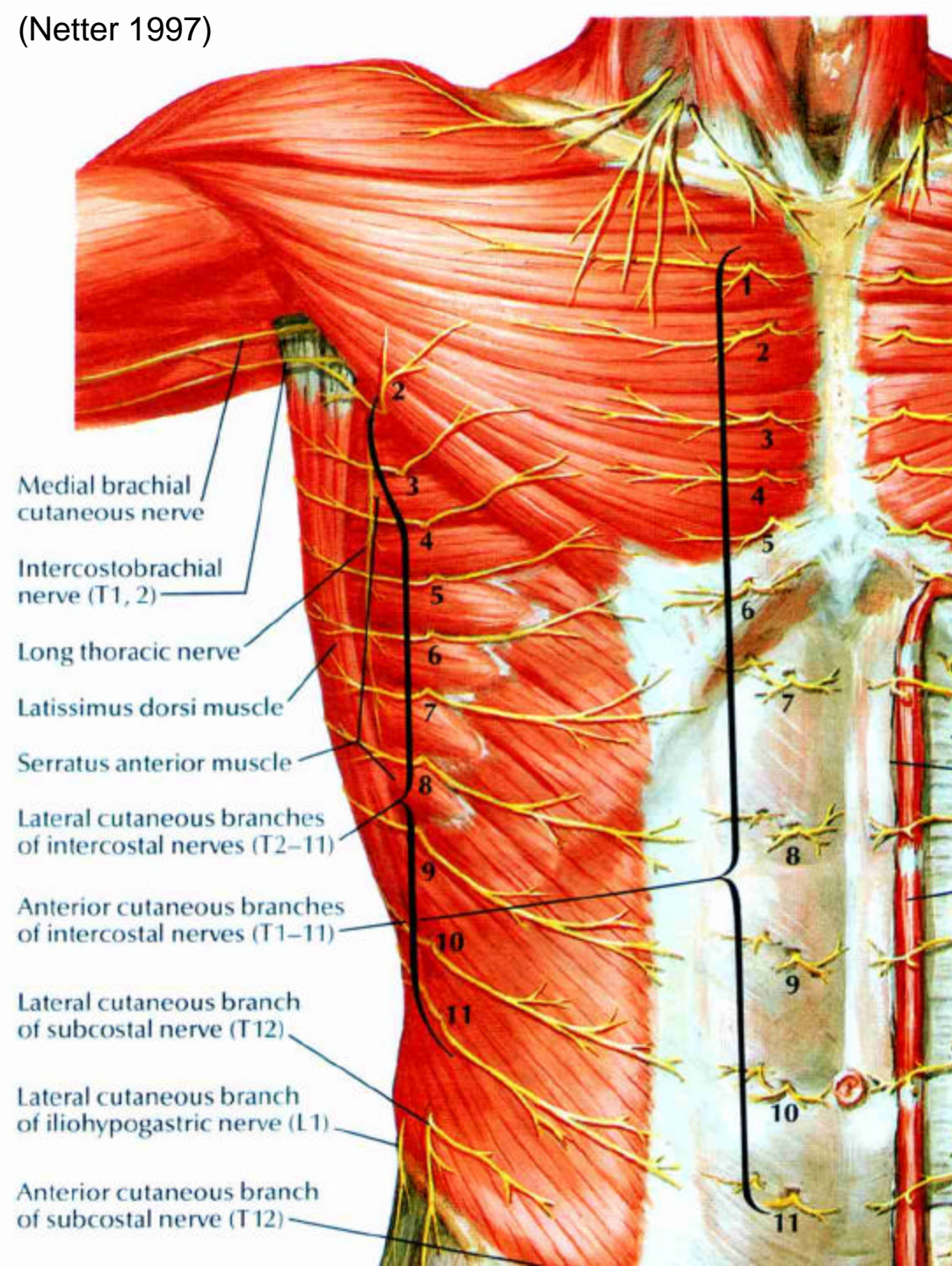
(Netter 1997)

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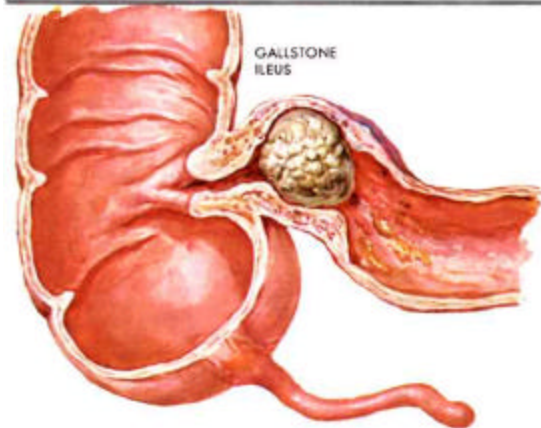
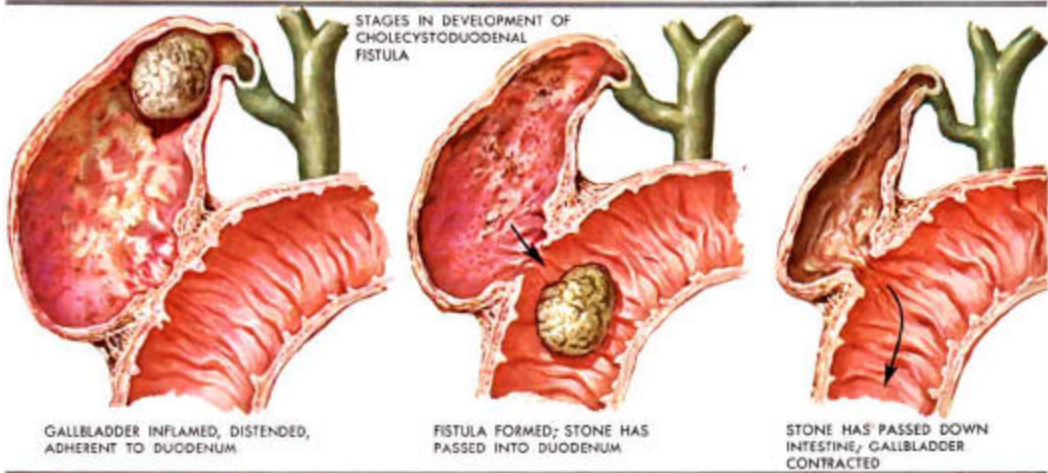
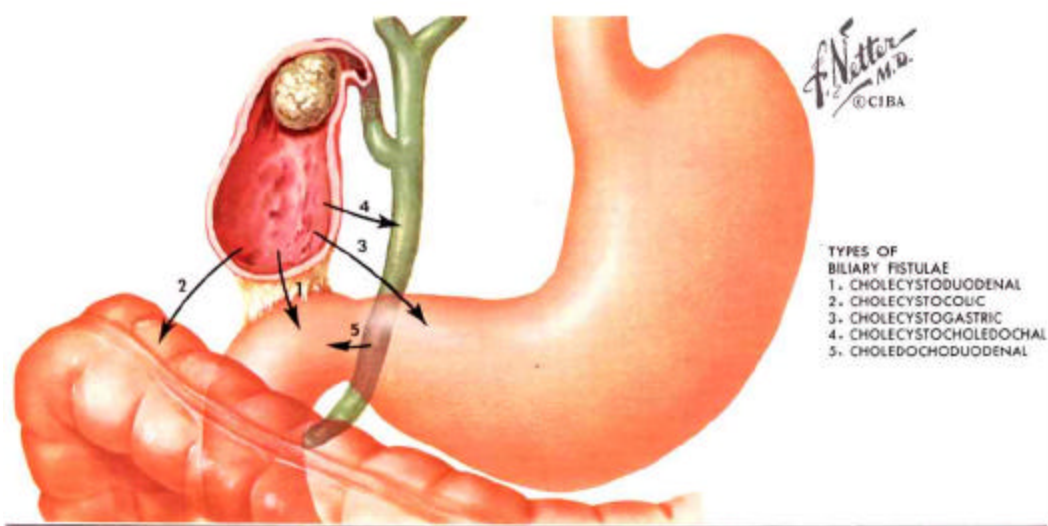


## Muscular Rigidity

- Reflex contraction of abdominal muscles, particularly rectus abdominis
- Afferent limb of reflex arc: afferents in parietal peritoneum
- Efferent limb of reflex arc: efferents to abdominal muscles at the same cord levels (T7–T10)

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## Biliary Fistulae

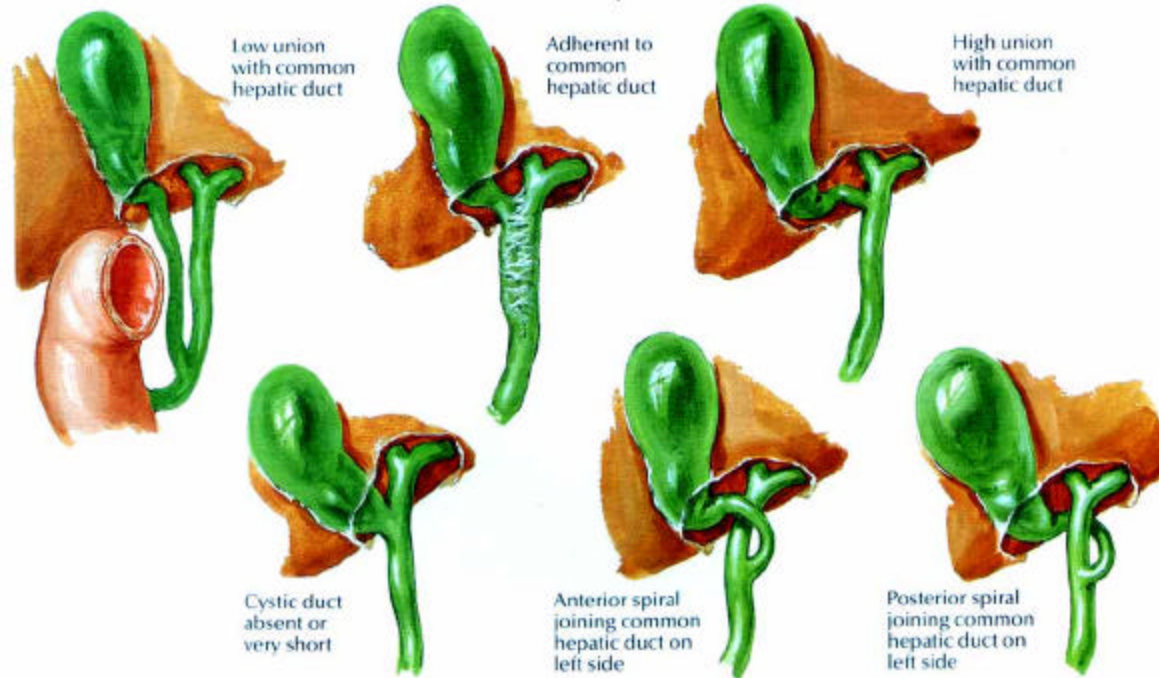
- May result from acute cholecystitis with obstruction of gall bladder neck, coupled with adhesions and abscess
- Potential fistulae with gall bladder: duodenum, transverse colon, stomach, liver, jejunum, peritoneal cavity, anterior abdominal wall
- Potential fistula between CBD & duodenum
- Cholecystoduodenal fistula is most common
  - may obstruct duodenum
  - more likely obstruct ileocecal valve—gall stone ileus

(Netter 1986)

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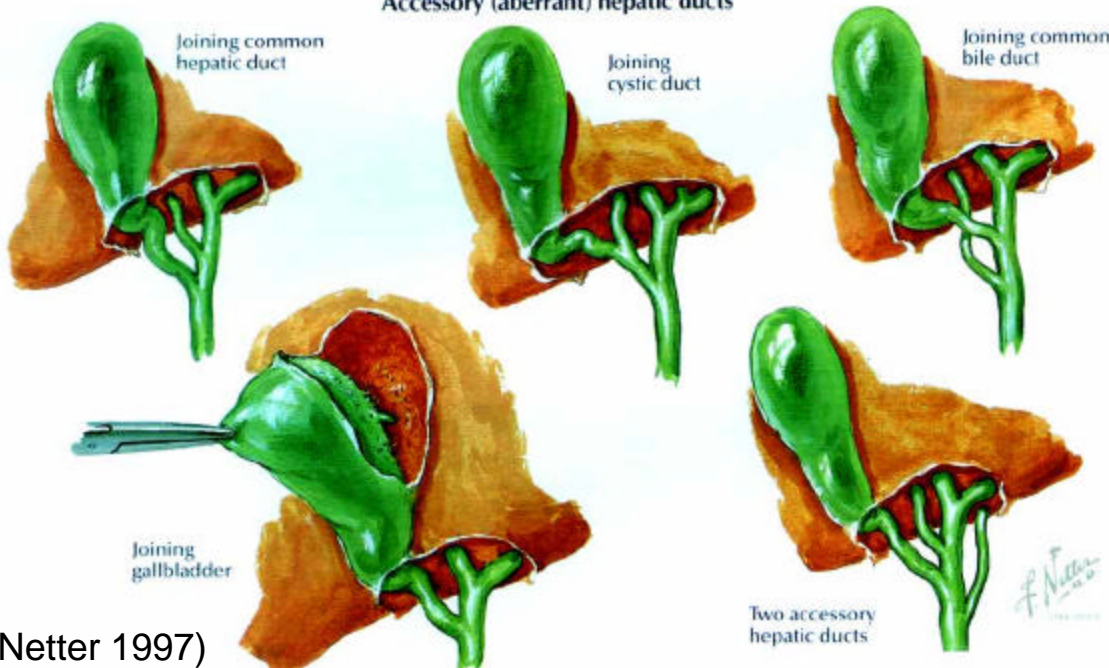
### Variations in cystic duct



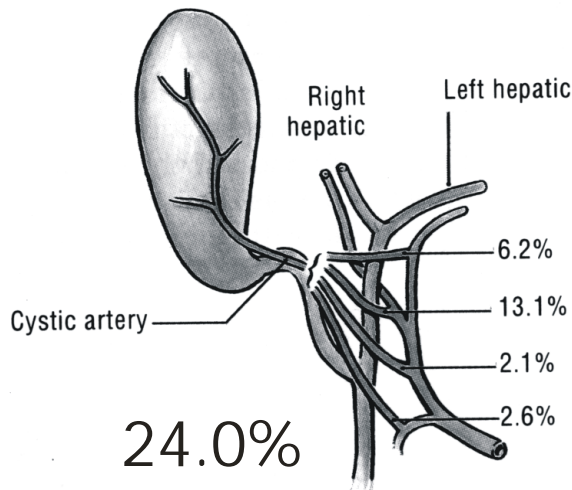
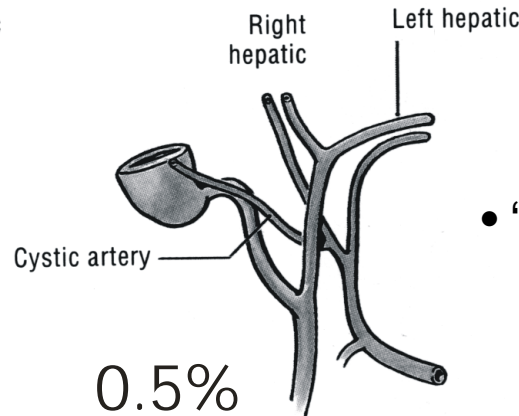
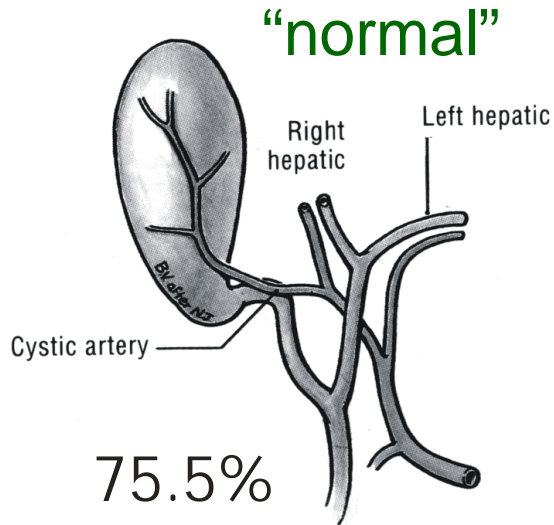
## Extrahepatic Biliary Duct Variations

- Cystic duct length & origin
  - Affects length of CHD, CBD, & size of Calot's triangle
- Aberrant hepatic ducts
  - *Not* "accessory" in that they are necessary for bile drainage
  - Commonly passes through Calot's triangle

### Accessory (aberrant) hepatic ducts

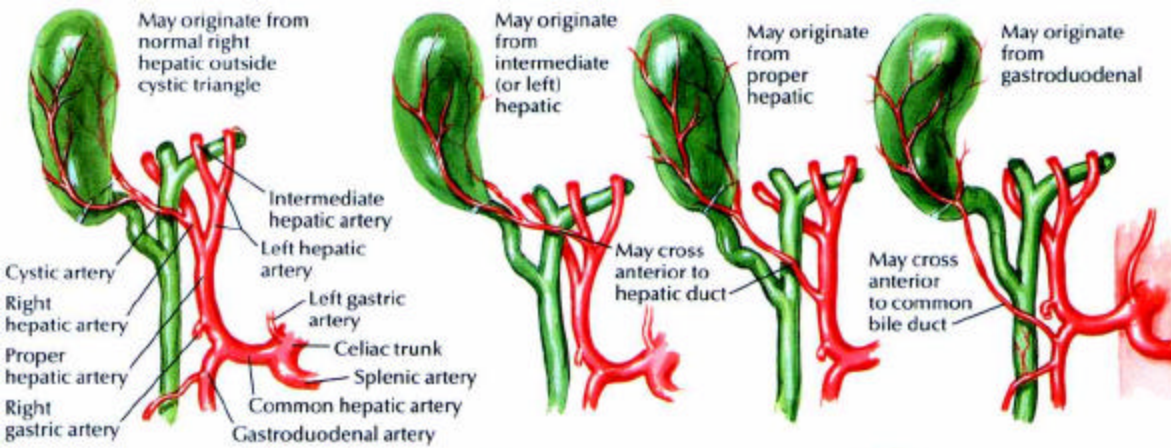


# Cystic Artery Variations

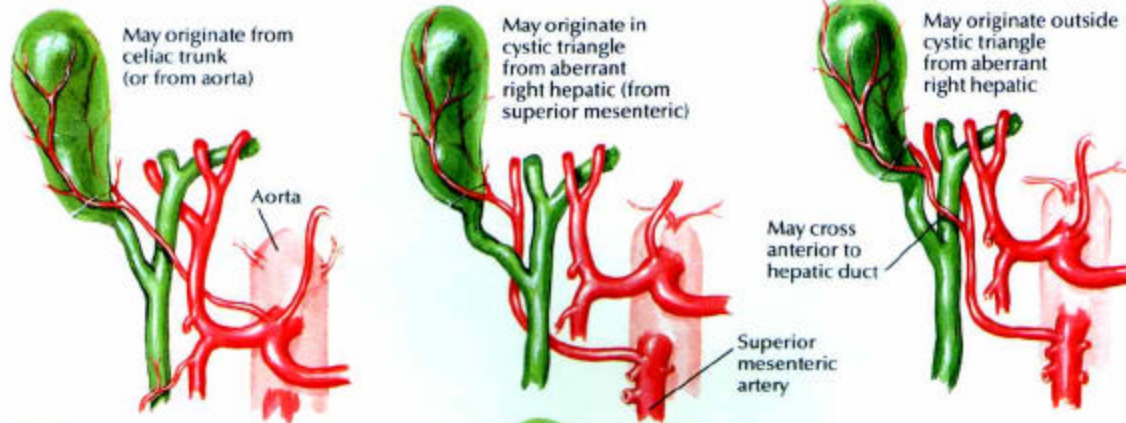


- “normal” situation: cystic artery arises from right hepatic artery within Calot’s triangle which passes posterior to CHD: no arteries cross the CHD
- 24.5% of cases are “variations”
- most variations result in cystic artery arising outside of Calot’s triangle (to the left) and crossing anterior to CHD

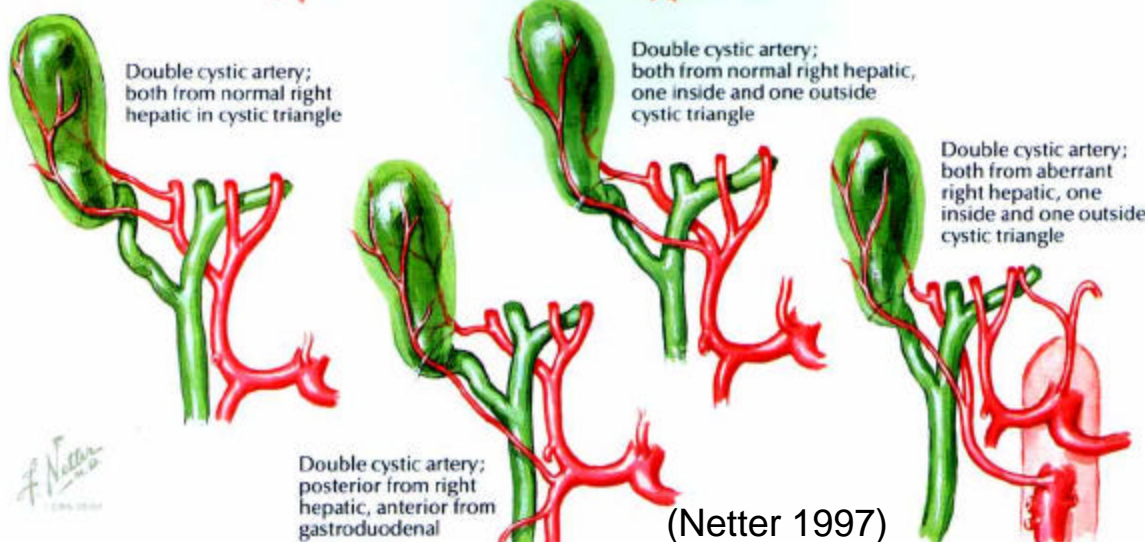
# Cystic Artery Variations



- Arteries originating to the left of Calot's triangle usually cross the ducts anteriorly



- May originate from right hepatic, left hepatic, hepatic proper, gastroduodenal, celiac, superior mesenteric, aorta, etc.



- Anterior & posterior branches may have separate origins

(Netter 1997)

## References

- Cahill, D. R. 1997. *Lachman's Case Studies in Anatomy*. Oxford Univ. Press, New York.
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