CYSTIC ARTERY ANOMALIES

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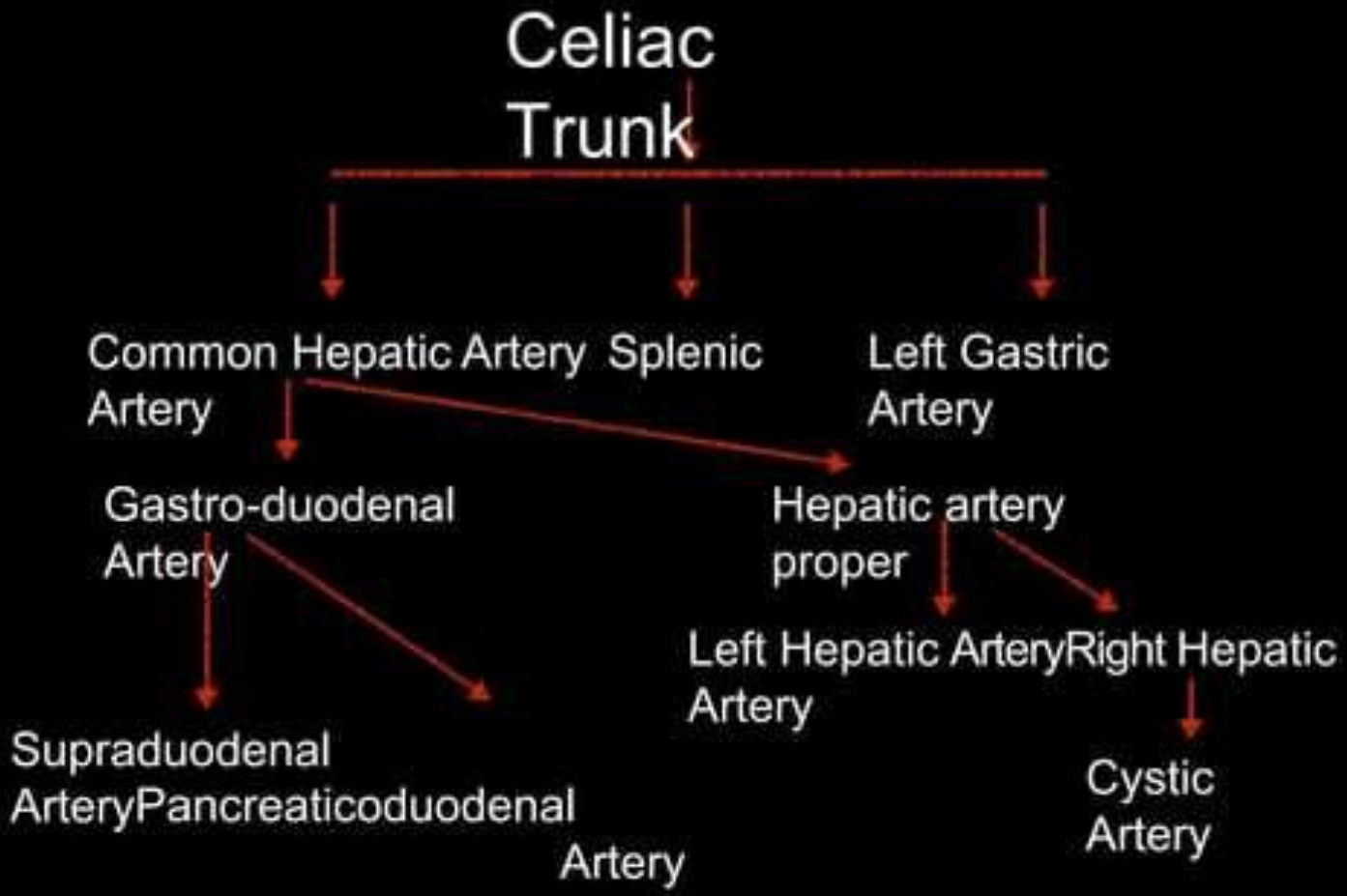
WHY ITSIMPORTANT TO KN OW THE COMMON VARIATIONS

- There are common variations in the relationship of the hepatic artery and origin and course of the cystic artery to the biliary apparatus

- Ignorance of these variations may provoke unexpected haemorrhage or biliary injury during cholecystectomy and may result in bile duct injury during efforts to secure hemostasis.

ARTERIAL SUPPLY OF BILIARY SYSTEM

The usual classic description of the arterial blood supply of the liver , biliary system and pancreas is found in only about 60 to 70 % of specimens


Celiac Trunk
Common Hepatic Artery
Splenic
Left Gastric Artery
Gastro-duodenal Artery
Hepatic artery proper
Left Hepatic Artery
Right Hepatic Artery
Supraduodenal Artery
Pancreaticoduodenal Artery
Cystic Artery

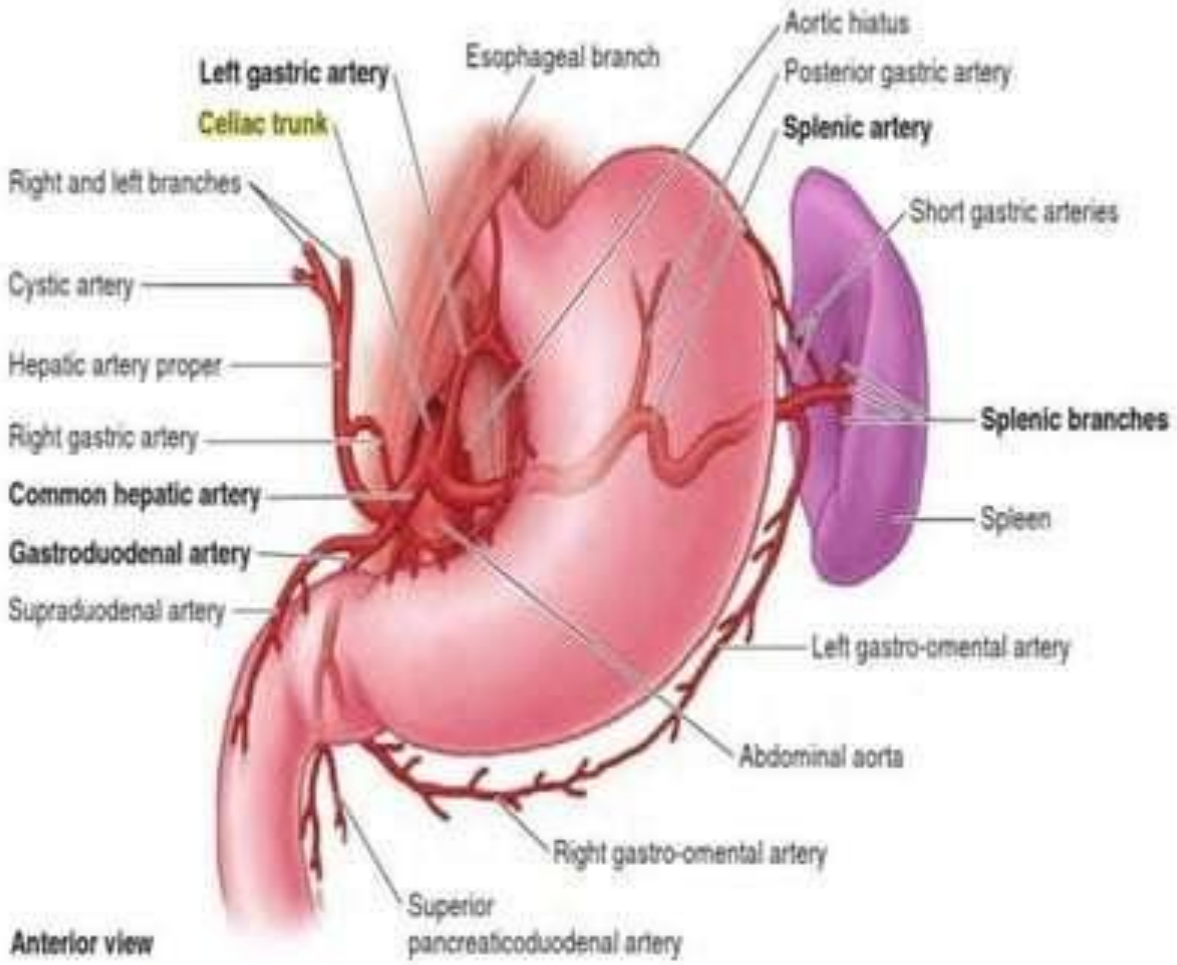


FIGURE 2.40. Arteries of stomach, duodenum, and spleen. The arterial supply of the abdominal part of the esophagus, stomach, upper (superior and upper descending parts) duodenum, and spleen is from the celiac artery. The direct branches of the celiac trunk appear in boldface.

CALOT'S TRIANGLE

Also known as cystohepatic or hepatobilliary triangle

It is an anatomical landmark of special value in cholecystectomy.

First described by Jean-François Calot as an "isosceles" triangle in his doctoral thesis in 1891,

This anatomical space requires careful dissection before the ligation and division of the cystic artery and cystic duct during cholecystectomy

BOUNDARIES

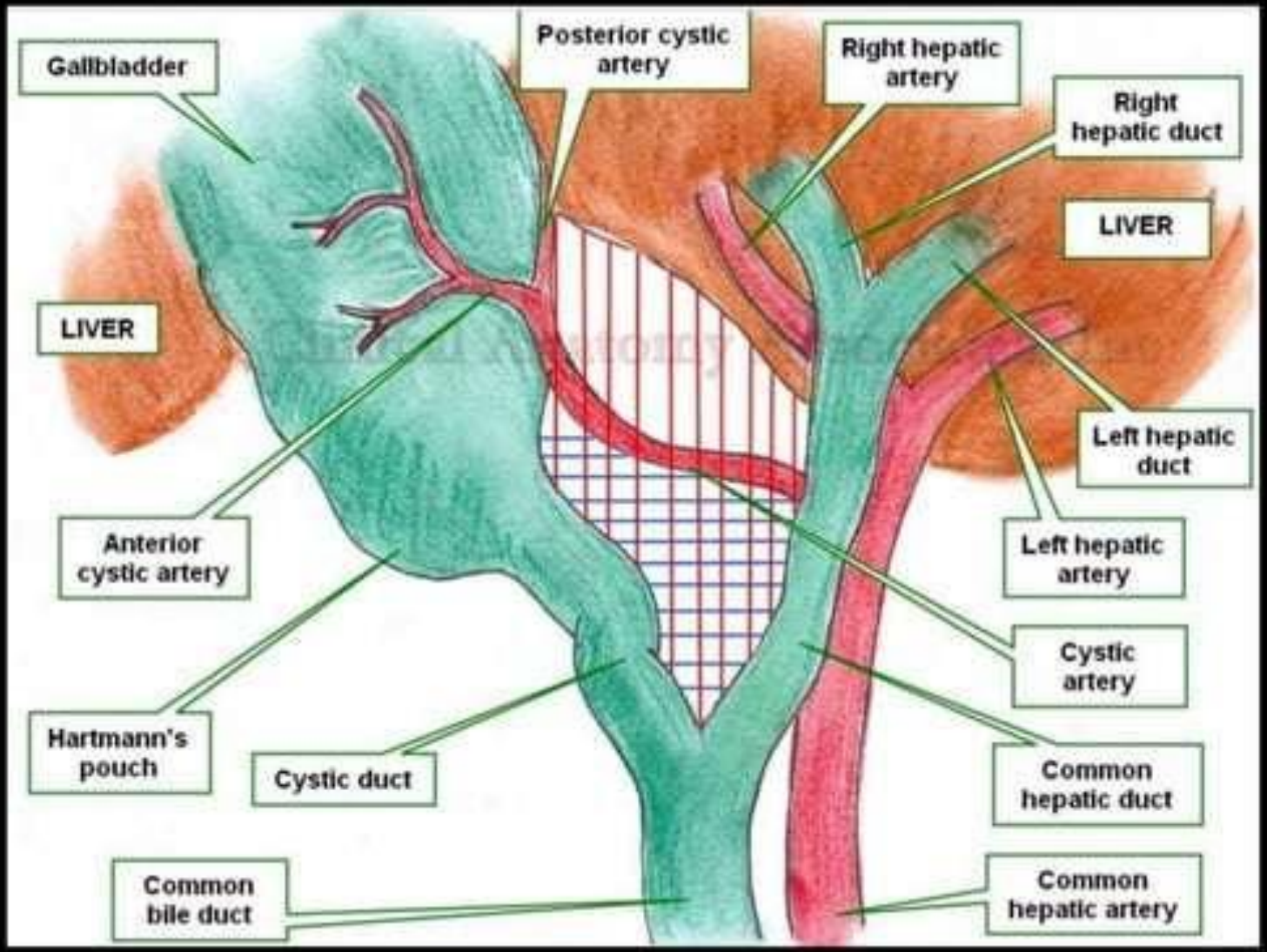
- The triangle is positioned so the apex points towards the liver with the boundaries:
- Right: the cystic duct
- left: Common hepatic duct
- Superior: Cystic Artery

TRIANGLE OF CHOLECYSTECTOMY

- Right : Cystic Duct
- Left : Common Hepatic Duct
- Superior : Inferior surface of Liver

CONTENTS

1. Right hepatic artery
2. Cystic artery
3. Cystic lymph node (of Lund)
4. Connective tissue
5. Lymphatics
6. Occasionally Accessory Hepatic ducts and Arteries


Gallbladder
Posterior cystic artery
Right hepatic artery
Right hepatic duct
LIVER
LIVER
Left hepatic duct
Anterior cystic artery
Left hepatic artery
Cystic artery
Hartmann's pouch
Cystic duct
Common hepatic duct
Common bile duct
Common hepatic artery

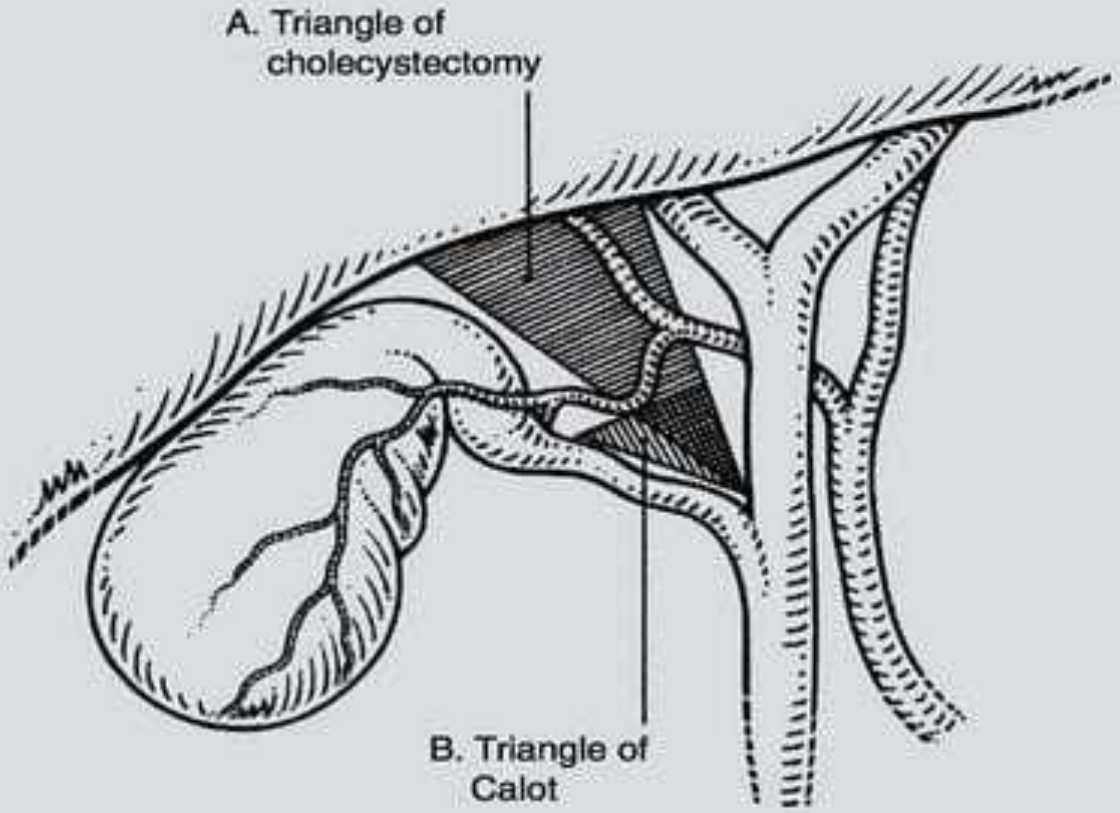


FIGURE 33.1. **A,** Triangle of cholecystectomy limited by the common hepatic duct, right hepatic duct, cystic duct, and inferior liver edge. **B,** The triangle of Calot limited by the common hepatic duct, cystic duct, and cystic artery.

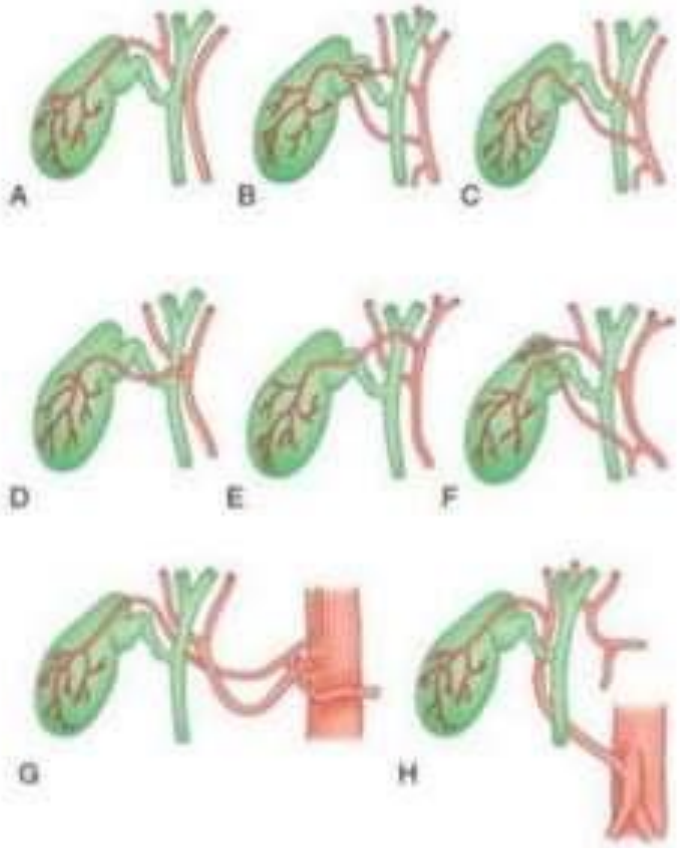
ANOMALIES OF CYSTIC ARTERY

- Origin of Cystic Artery
- Number of Cystic Arteries
- Location or Position of cystic Artery

ORIGIN OF CYSTIC ARTERY

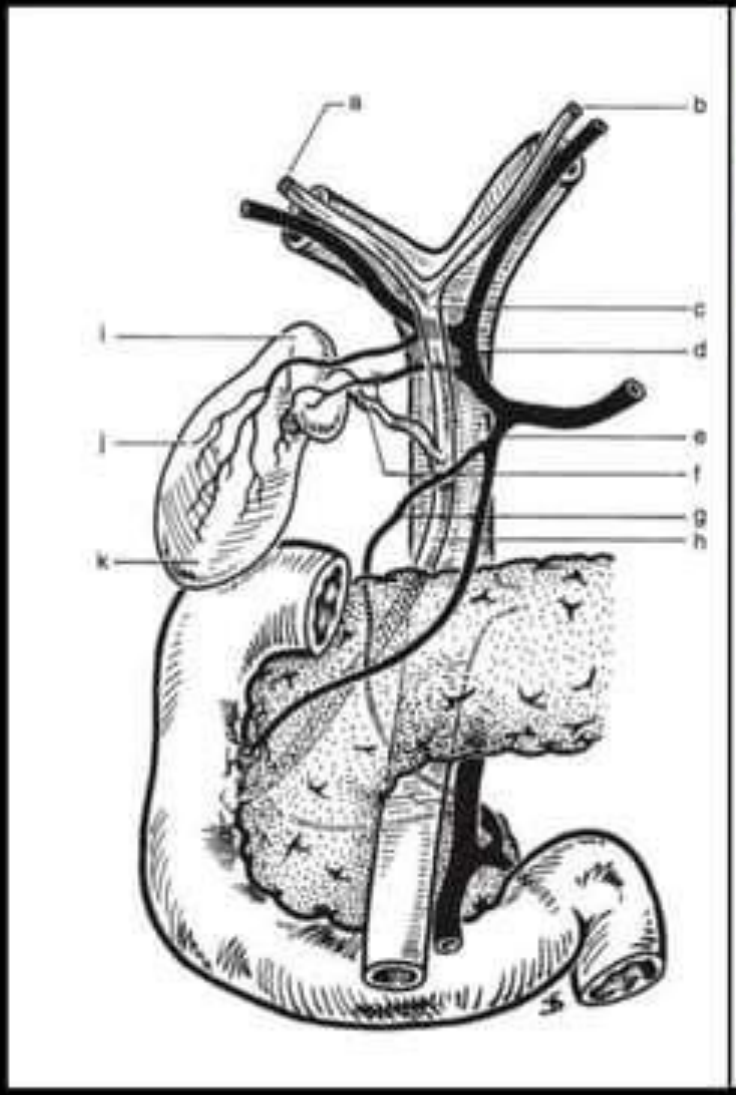
- Right hepatic artery: 65 to 75 %
- Hepatic trunk: 25%
- Left hepatic artery: 5.5%;
- Gastro duodenal artery: 2.6%;
- Superior pancreatico duodenal artery: 0.3%;
- Right gastric artery: 0.1%;
- Celiac trunk: 0.3%;
- Superior mesenteric artery: 0.8%.
- Hepatic artery proper 2.2%'
- Common hepatic artery 0.6 %

Anomalous origin of cystic artery



NUMBER OF CYSTIC ARTERIES

- Single
- Double


a
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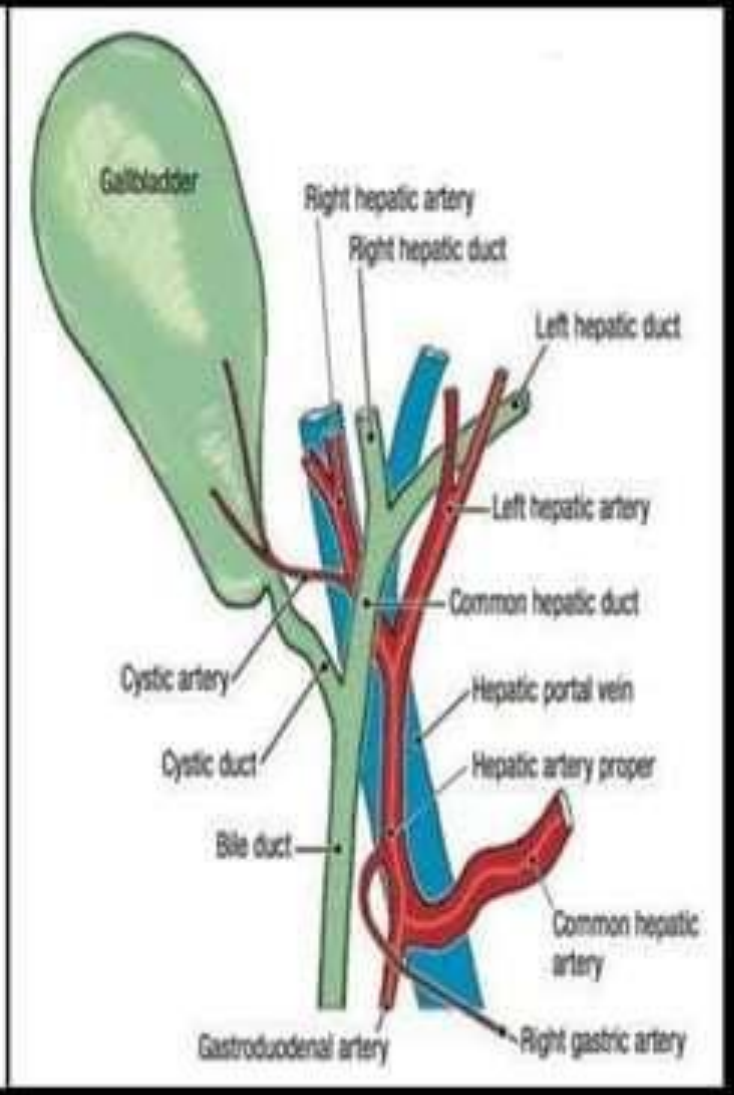

Gallbladder
Right hepatic artery
Right hepatic duct
Left hepatic duct
Left hepatic artery
Common hepatic duct
Cystic artery
Hepatic portal vein
Cystic duct
Hepatic artery proper
Bile duct
Common hepatic artery
Gastroduodenal artery
Right gastric artery

LOCATION AND POSITION OF CYSTIC ARTERY

- On the basis of origin inside or outside Calot's Triangle
- On the basis of position relative to Cystic Duct

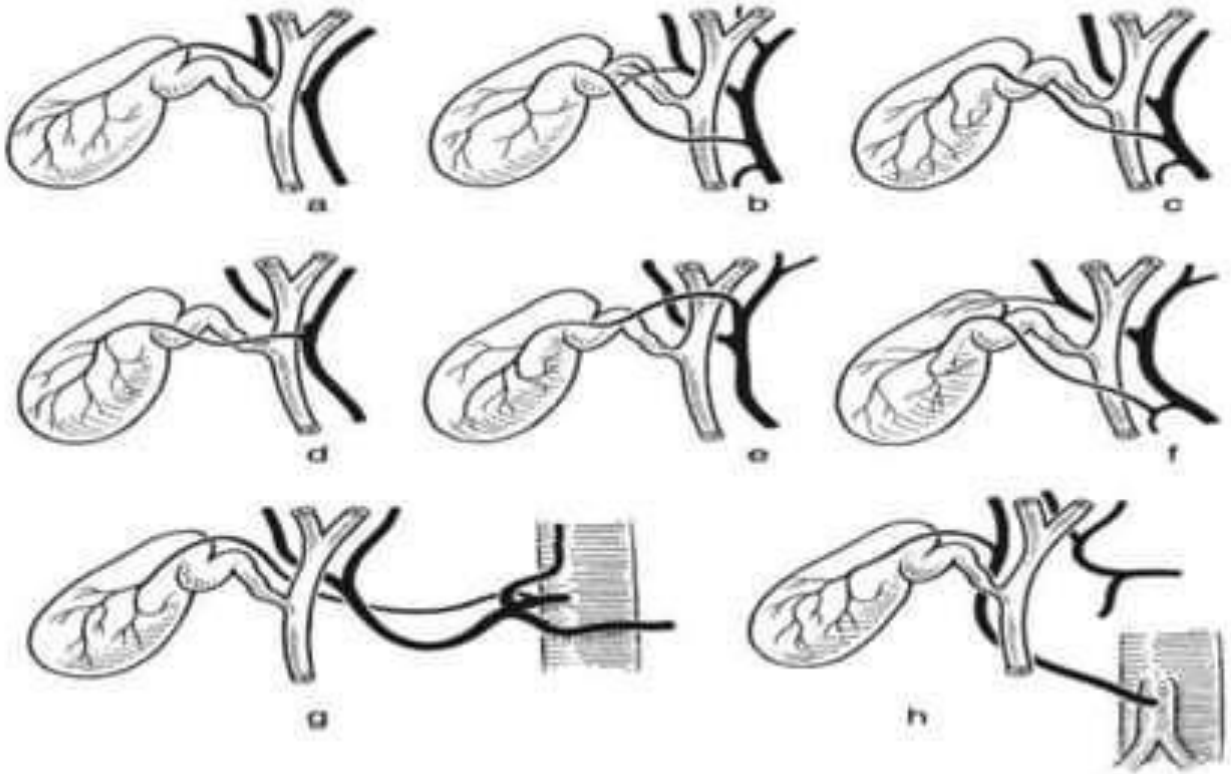


FIGURE 18.22. The main variations of the cystic artery: typical course (*a*); double cystic artery (*b*); cystic artery crossing anterior to main bile duct (*c*); cystic artery originating from the right branch of the hepatic artery and crossing the common hepatic duct anteriorly (*d*); cystic artery originating from the left branch of the hepatic artery (*e*); cystic artery originating from the gastroduodenal artery (*f*); cystic artery arising from the celiac axis (*g*); cystic artery originating from a replaced right hepatic artery (*h*).

- Researchers have divided the different vascular patterns into 3 groups:

- Group 1

Cystic artery or arteries seen in Calot's triangle and no other source of supply is present.

This group is further sub-divided into two groups:

1a Single artery is seen in Calot's triangle (normal anatomy).

1b Two vessels are identified in Calot's triangle.

- Group 2

In this group more than one blood vessel is identified, one within the Calot's triangle and the other artery is seen outside the triangle.

- Group 3

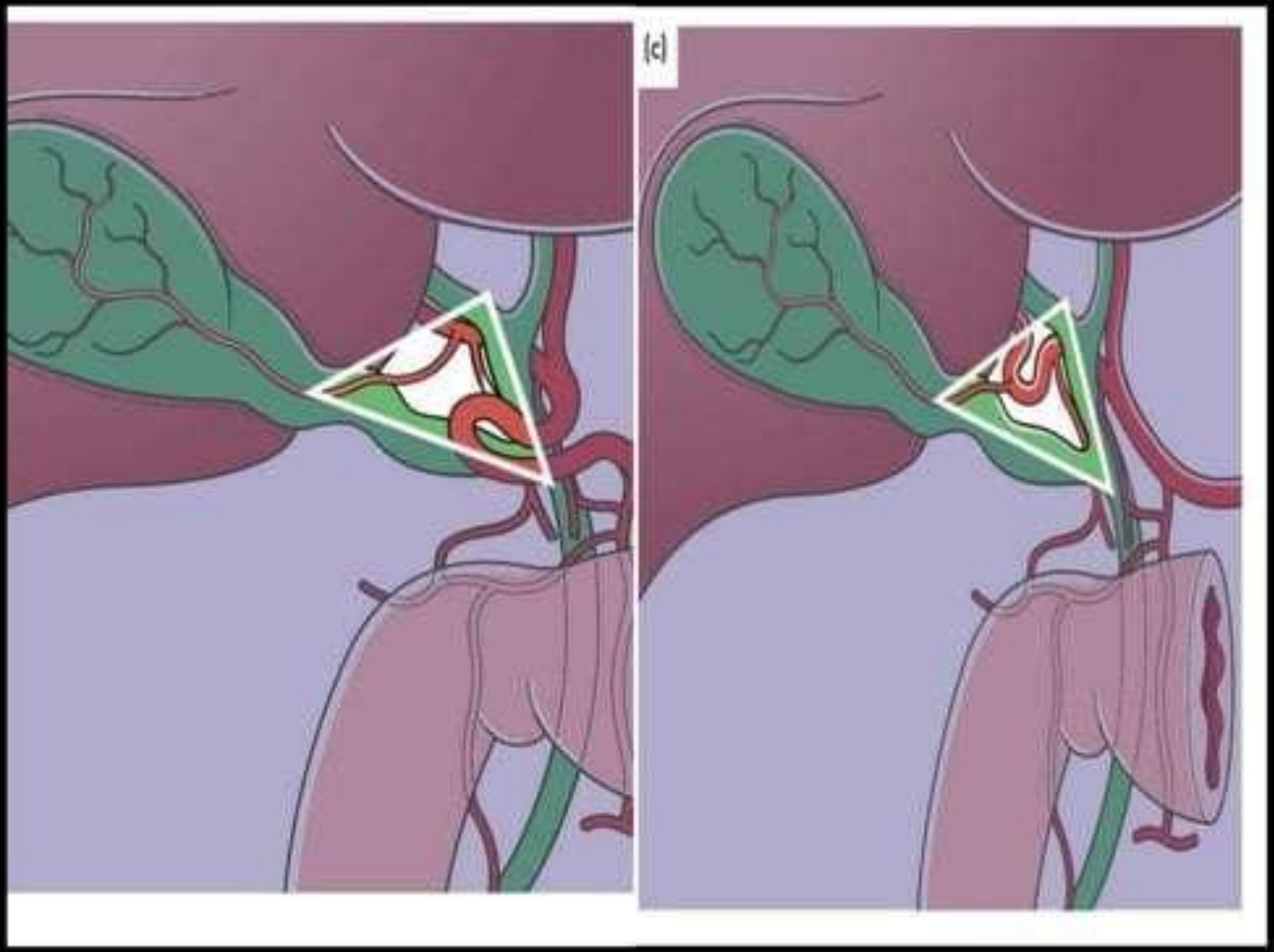
Cystic arteries are only observed outside Calot's triangle. They divided this group based on the number of arterial supplies to the gall bladder.

3a Single artery is visualized outside the triangle.

3b More than one vessel seen outside the Calot's triangle.

CATERPILLAR TURN OR MOYNIHAN'S HUMP

- When the right hepatic artery replaces the cystic artery within the Calot's triangle, and it is tortuous and projects forwards to the right of the (CHD),something like the hump of caterpillar back during progression, and form U-shape loop with a short cystic artery arising from it


(c)

ITS A TREACHEROUS AND DANGEROUS ANOMALY BECAUSE

- It may be mistaken for cystic artery and ligation would result in impaired liver function.
- Since the cystic artery which arises from a caterpillar hump is frequently short it is relatively easily avulsed from the parent trunk (particularly when strong traction is applied) producing brisk bleeding
- It must be emphasized that an Artery resembling the cystic artery in its course and paralleling the cystic duct is not necessarily the cystic artery but may be the right hepatic artery It is therefore essential to visualize the right hepatic artery above and below the origin of the cystic branch

INVESTIGATIONS

- CT Angiography
- MR Angiography
- These investigations are not done routinely so we rely on Intraoperative findings noted during dissection of Calot's triangle or dissection of gallbladder

- It is important for every General surgeon to be familiar with the anatomic variations in the extra-hepatic biliary tree and those of the arterial supply of the gallbladder.

- The variations of cystic artery often make surgeons recognize an error, causing them to abscise incorrectly and, subsequently, leading to a hemorrhage.

DISSECTION DURING CHOLECYSTECTOMY

Dissection should start in the cholecystectomy triangle

The peritoneum covering the hepatoduodenal ligament is incised anteriorly across the region of the Hartmann pouch

It is important to keep the dissection close to the gallbladder and to delineate the junction between the gallbladder and the cystic duct.

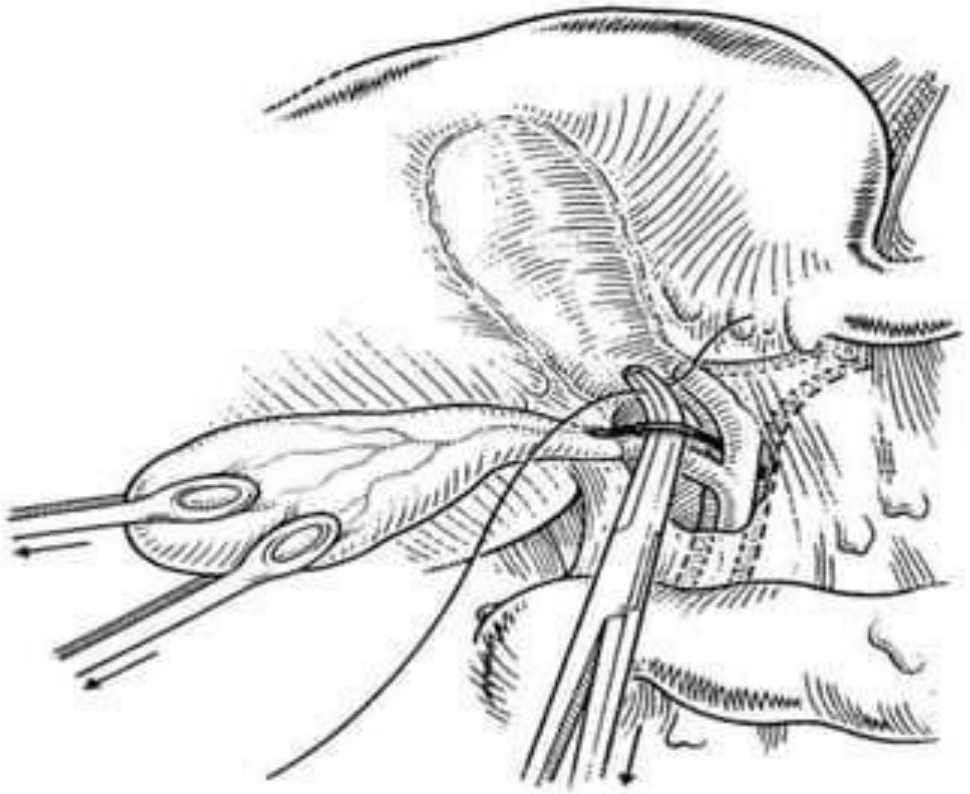
The cystic artery is normally found just above the cystic duct

It is important to dissect the artery toward the gallbladder to see its final distribution into the gallbladder wall to prevent inadvertent ligature of an aberrant or anterior right hepatic artery.

At this stage, the junction of the gallbladder infundibulum with the cystic duct and the distribution of the cystic artery into the gallbladder wall should be clearly visible.

ANTEGRADE CHOLECYSTECTOMY

- If Anatomy is not clearly visible then funds down cholecystectomy should be performed
- A plane is developed medially and laterally to dissect the gallbladder away from the liver.
- It is important to complete this dissection posterolaterally to facilitate lateral retraction of the gallbladder to best expose the cystic duct and artery.
- Cystic Artery is encountered as the medial dissection is continued toward the triangle of Calot.
- In the region of the infundibulum, the cystic artery is seen to enter the gallbladder wall
- After ligature and division of the cystic artery close to the gallbladder wall, thus protecting the right hepatic artery, the infundibulum is dissected free down toward its junction with the cystic duct



GURE 33.11. As the anterograde dissection progresses toward the llbladder neck medially, the cystic artery is identified, ligated, and vided.

LAPROSCOPIC CHOLECYSTECTOMY

First Fine-tipped dissecting forceps are used to dissect away the overlying fibroareolar structures from the infundibulum of the gallbladder

It is important to identify clearly the structures forming the sides of the triangle of Calot the standard ventral aspect, and its reverse (dorsal) aspect

The hepatocystic triangle is maximally opened and converted into a trapezoid shape by retracting the infundibulum of the gallbladder inferiorly and laterally, while maintaining the fundus under traction in a supe- rior and medial direction.

After clearing the structures from the apex of the triangle, the junction between the infundibulum and the origin of the proximal cystic duct can be identified clearly. Curved dissecting forceps are helpful in creating a window around the posterior aspect of the cystic duct to skeletonise the duct itself.

It is generally unnecessary and potentially harmful to dissect the cystic duct down to its junction with the CBD.

Next, the cystic artery is separated from the surrounding tissue by similar blunt dissection. If the cystic artery crosses anterior to the duct, the artery may require dissection and divi- sion before approaching the cystic duct.

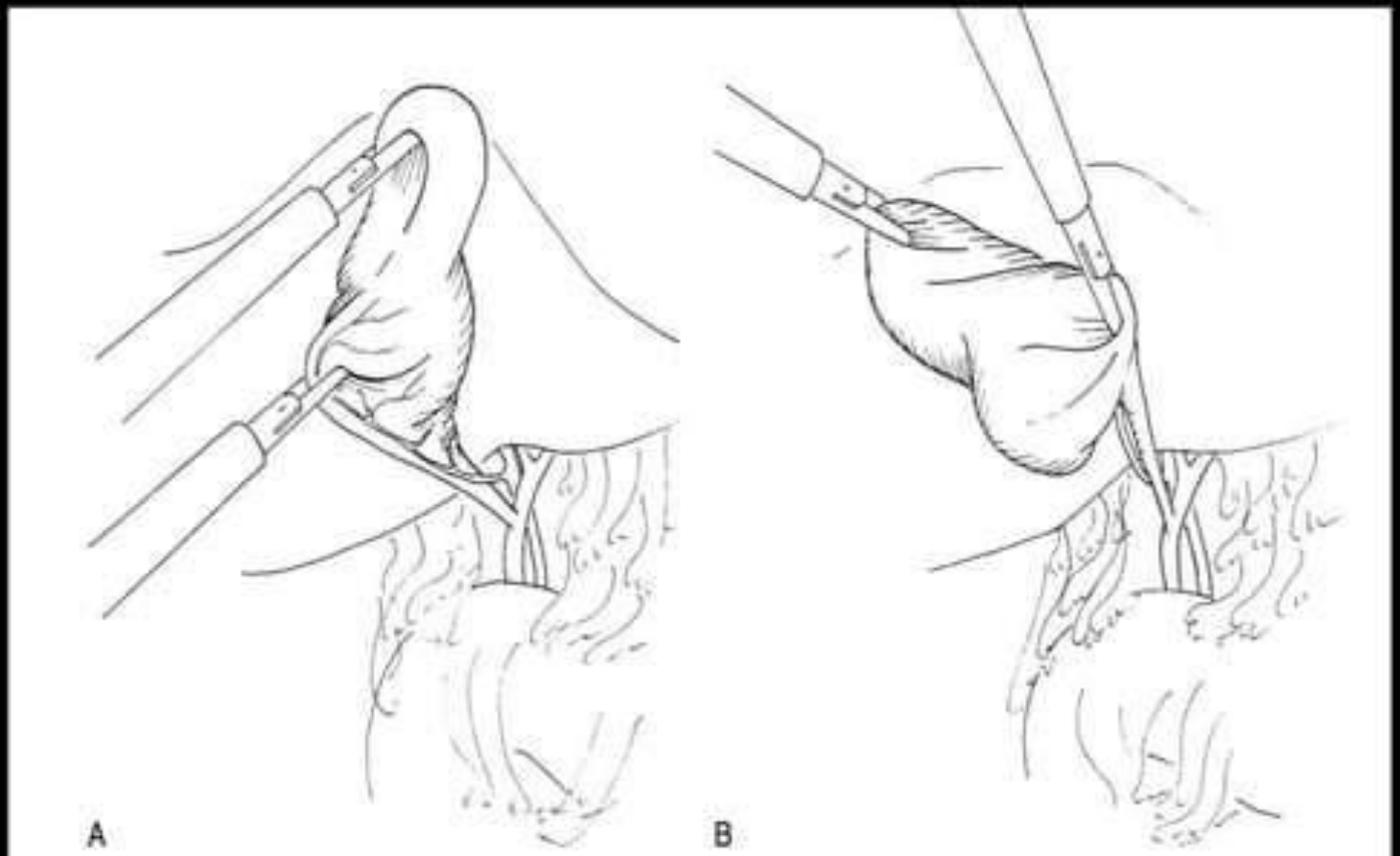


FIGURE 34.6. Proper gallbladder retraction for exposure of Calot's triangle (**A**) and reverse Calot's triangle (**B**). *(Courtesy Quality Medical Publi ing, St Louis, MO.)*

HEMORRHAGE IN CALOT'S TRIANGLE

Hemorrhage in the cholecystectomy triangle represents a potential danger, because attempts at hemostasis by placing clamps with obstructed and insufficient view may result in inadvertent clamping of the right or common hepatic artery or of the bile duct

In this situation, the surgeon should first attempt to control the hemorrhage by digital

compression or by clamping the hepatoduodenal ligament

Grasping the bleeding vessel should be done with precision so as to limit the risk of including another structure in the ligature.

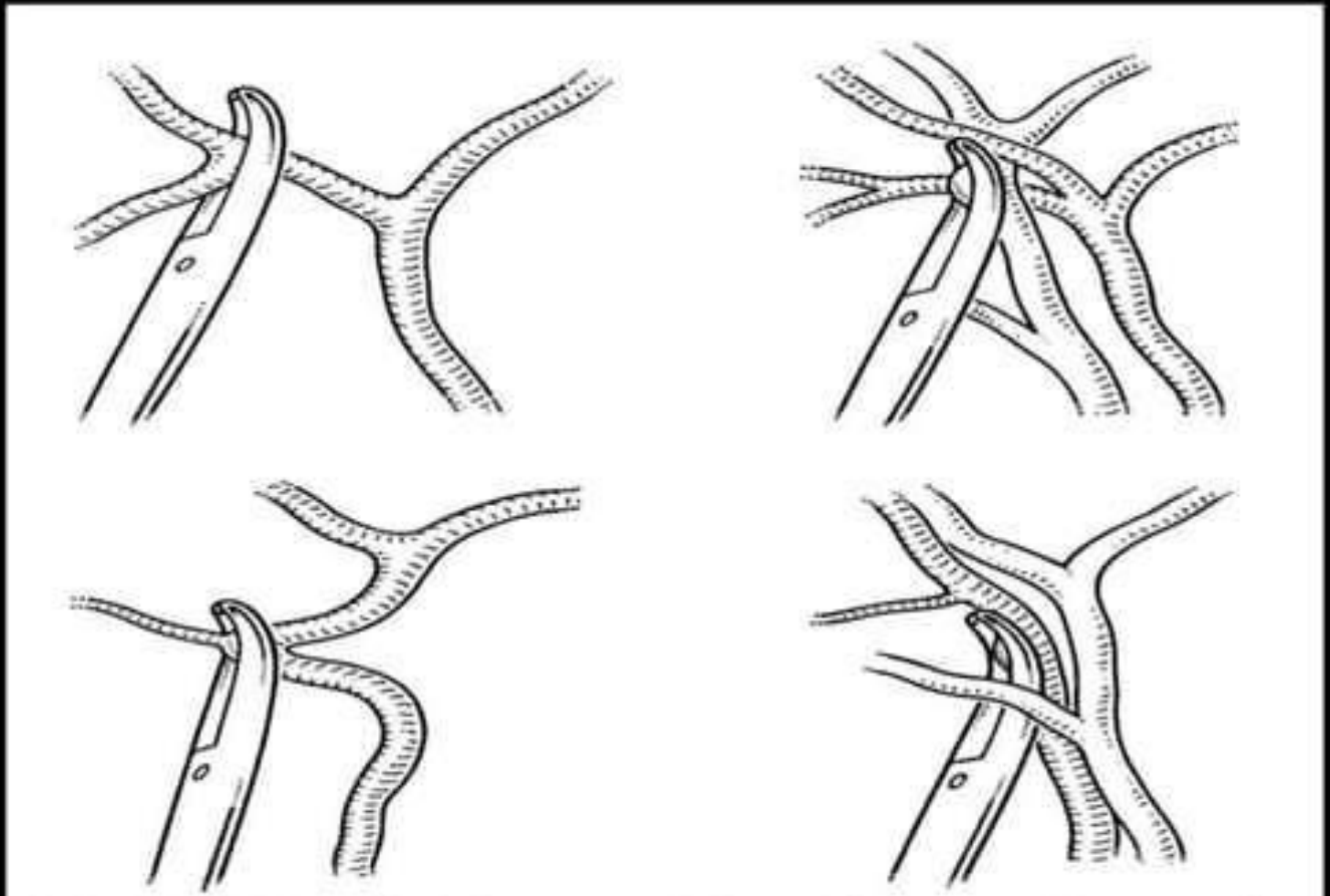


FIGURE 33.14. Blind placement of clamps for hemostasis can result in injury to the hepatic artery or bile duct.

IMPORTANT ANATOMICAL LANDMARK OF OPERATIVE FIELD

1. Infundibulum (Hartman's pouch)

- The most important anatomical landmark to start dissection of the cystic duct is the infundibulum of gallbladder.
- The junction of the neck of the gallbladder with the cystic duct should always be identified and visualised prior to further dissection.
- The dissection of Calot's triangle can be done safely starting at Hartmann's pouch and moving towards the cystic duct

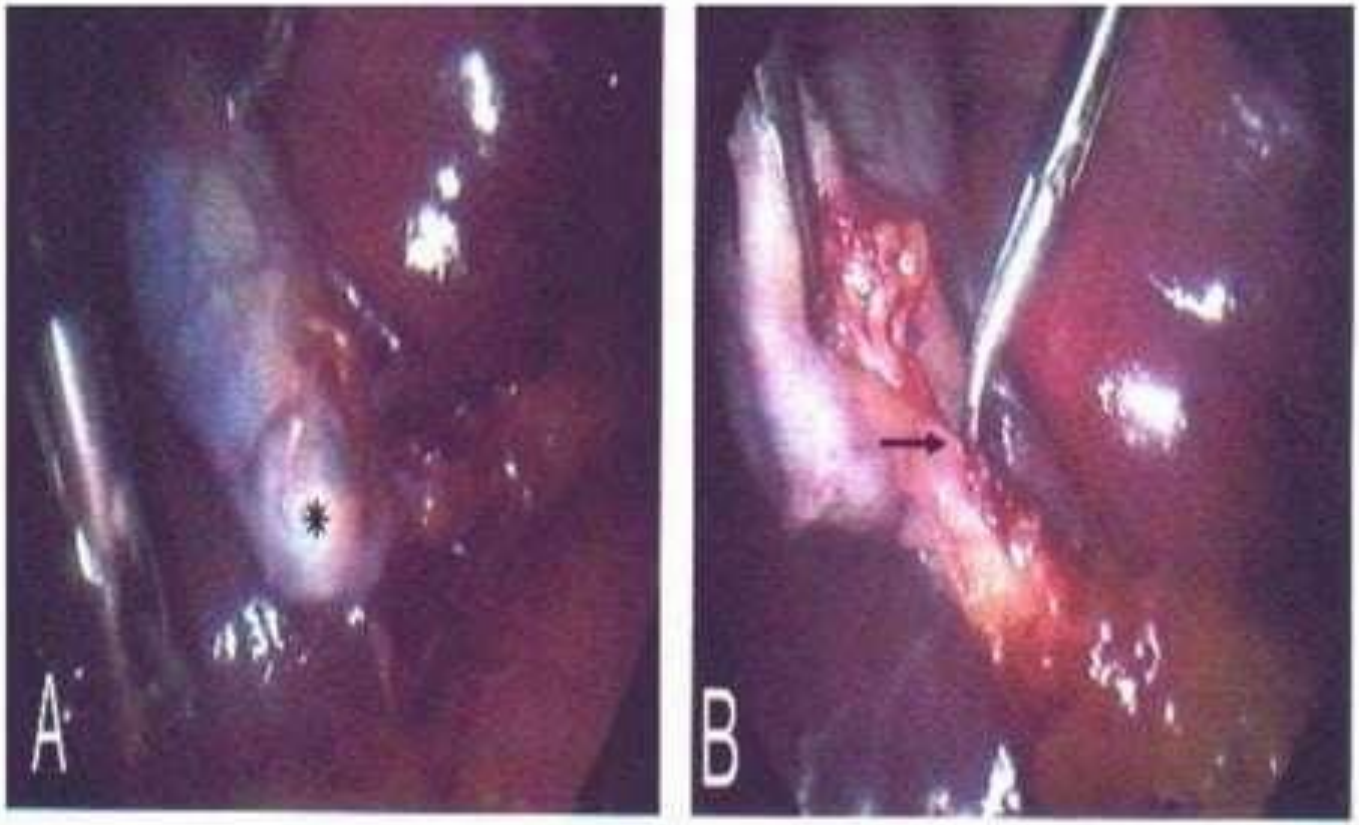


Figure 4-1 anatomical landmark to start dissection of the cystic duct during laproscopic cholecystectomy. (A) Hartman's pouch(*) (B) the junction of the neck of the gallbladder with cystic duct ( ) where dissection of the cystic duct was started.

2. Cystic lymph node

- In Calot's triangle the cystic node (Node of Lund) usually overlaps the cystic artery.
- To be on the safe side, it was found that staying lateral to the node during dissection of the cystic duct and artery reduces the incidence of injury to boundaries and contents of Calot's triangle.
- In other words, the cystic node was used as an end-point in the dissection of Calot's triangle

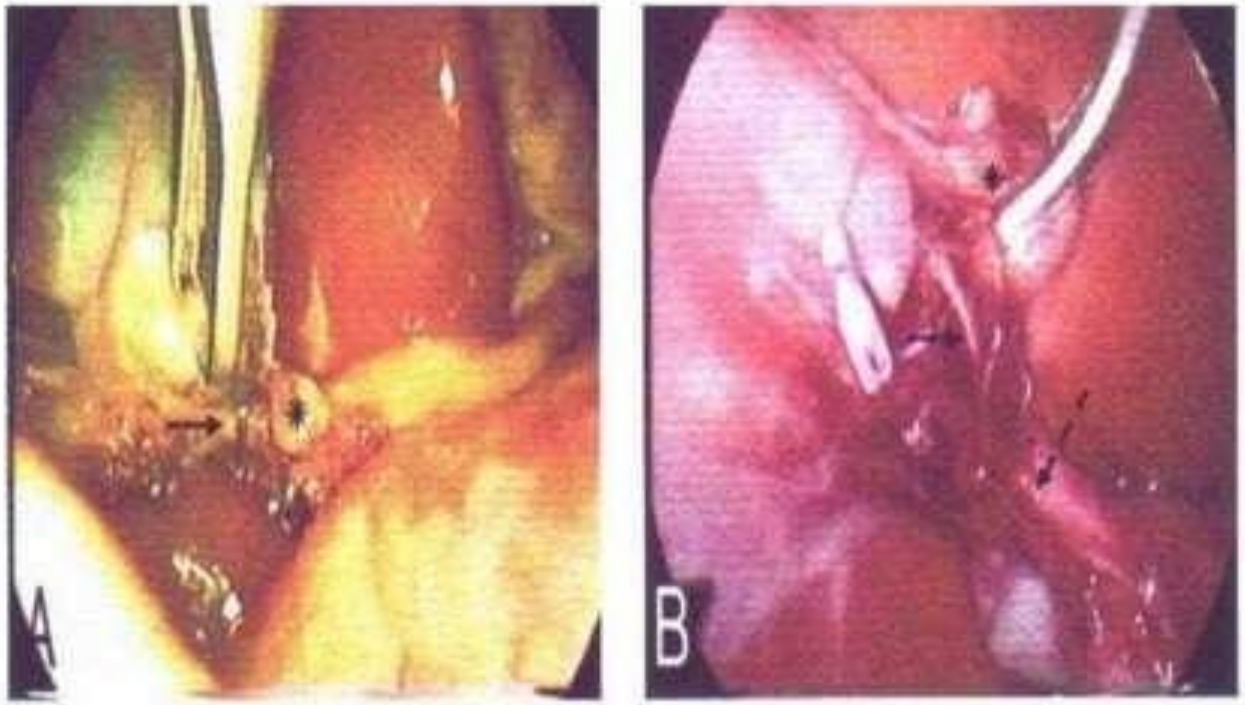


Figure 4-2 cystic lymph node as an anatomical landmark. (A) cystic lymph node (*) overlying the cystic artery (→) : (B) traction on the cystic node(*) reveals the underlying cystic artery (↱) and exposes the boundaries of the calot's triangle. Note the common hepatic duct (the interrupted arrow)at the medial border of the triangle.

3. Superficial Branch of Cystic Artery

- The superficial branch of the cystic artery on the surface of the gallbladder is a good landmark to lead to the site of the parent cystic artery when pathology obscures clear anatomy of the cystic artery

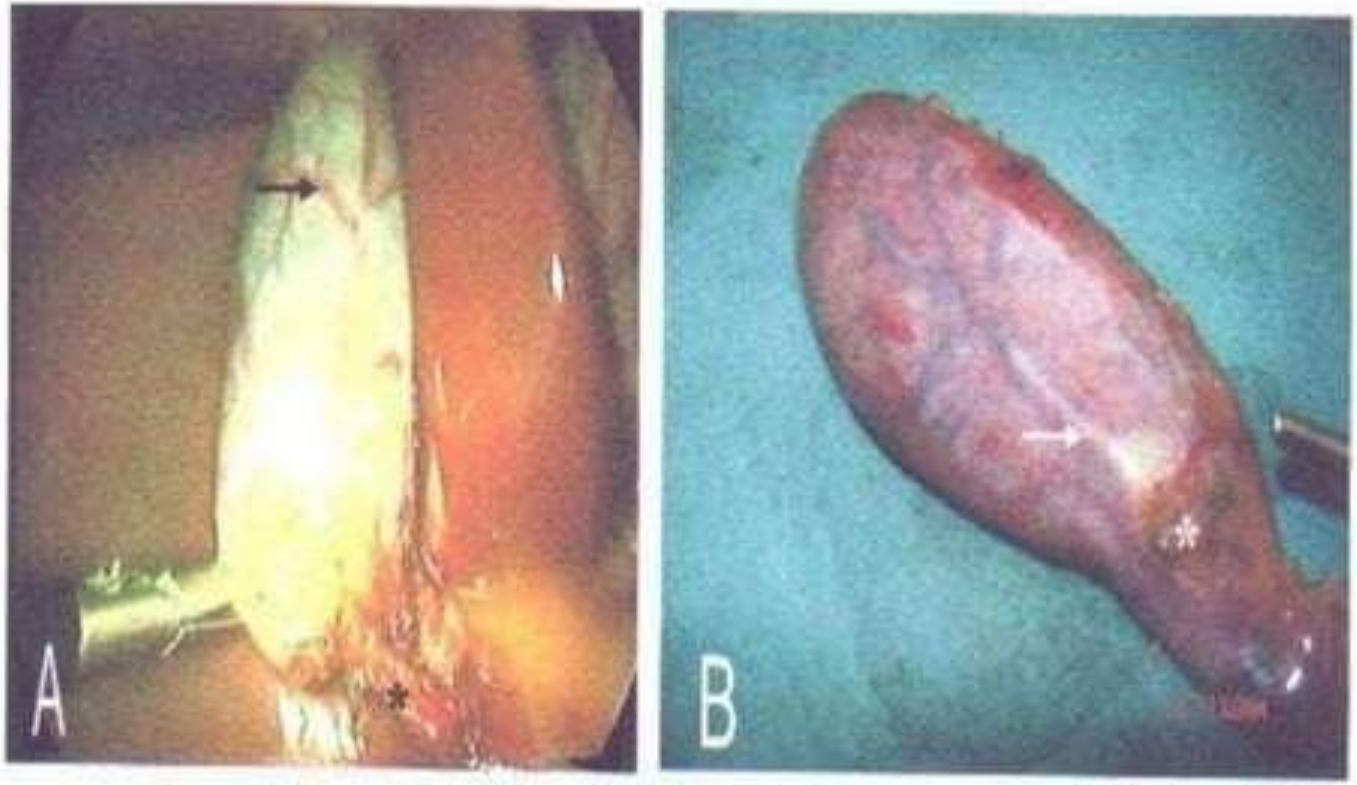
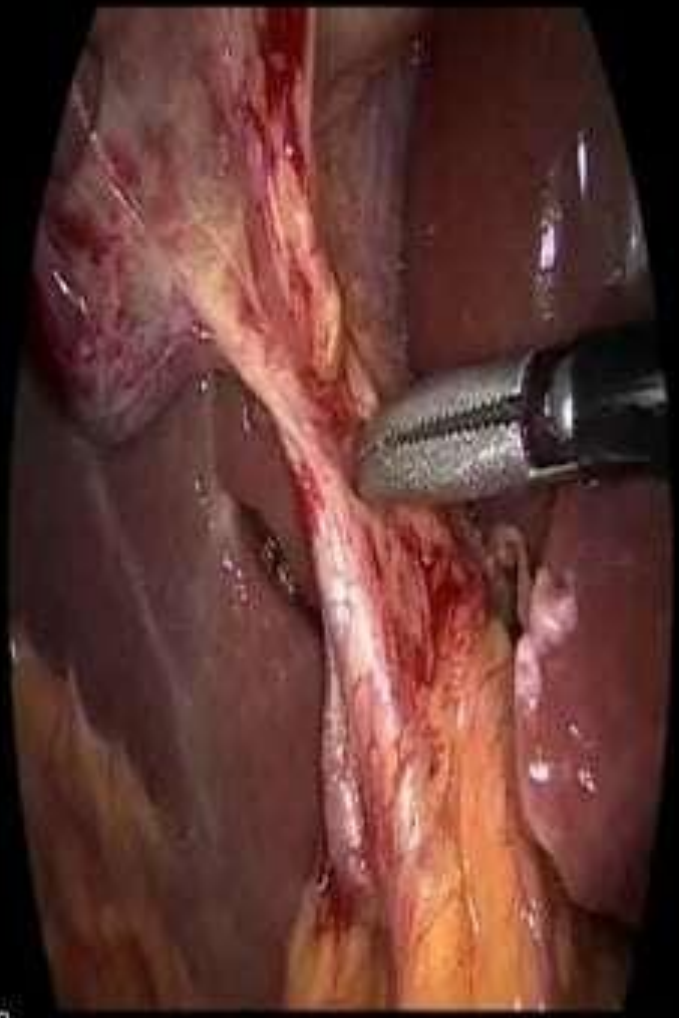


Figure 4-3 the superficial branch of the cystic artery as an anatomical landmark. (A) the superficial branch (arrow) leading to the parent cystic artery(*). (B) extracted gall bladder showing the superficial branch of the cystic artery (→)and it's continuation with clipped cystic artery (*).

- The Rouviere's sulcus is a fissure on the liver between the right lobe and caudate process
- It corresponds to the level of the porta hepatic where the right pedicle enters the liver.
- It has hence been recommended that all dissection be kept to a level above (or anterior) to this sulcus to avoid injury to the bile duct
- Also, this being an 'extrabiliary' reference point it does not get affected by distortion due to pathology



The neck of the gall-bladder is dissected

away from its liver bed, leaving only two

structures entering the

gallbladder: the cystic duct and

artery.

No structure should be divided

until the cystic duct and cystic

artery are unequivocally identified.

This is the "critical view" of safety

essential to prevent bile duct injury

during laparoscopic cholecystectomy

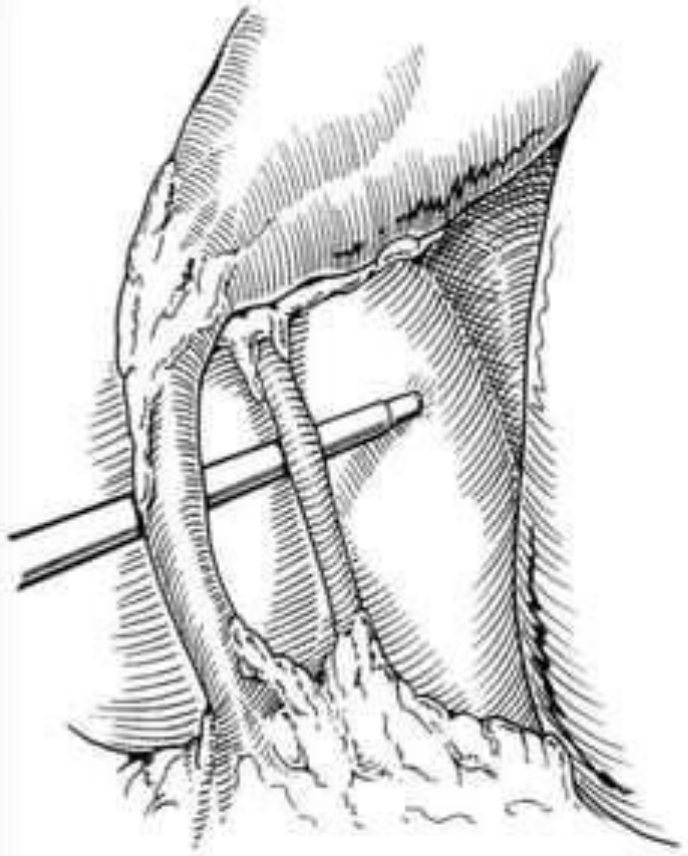


FIGURE 34.7. Critical view. Hepatocystic triangle is dissected free of all tissue except for the cystic duct and artery, and the base of the liver bed is exposed. When this view is achieved, the two structures entering the gallbladder can only be the cystic duct and artery.

The surgeon also occasionally notices only a small cystic artery on the medial aspect of the gallbladder; when this occurs, the surgeon should be alert for a posterior branch leading onto the dorsal aspect of the gallbladder. If great care is not taken, brisk hemorrhage may occur.

The possibility of the presence of a right hepatic artery in the bed of the gallbladder emphasizes the necessity to dissect close to the gallbladder rather than the liver parenchyma.

SOME GOLDEN RULES

1. When the anatomy of the triangle of Calot is unclear, blind dissection should stop.

2. Bleeding adjacent to triangle of Calot should be controlled by pressure and not by blind clipping or clamping.

3. When there is doubt about the anatomy a fundus first cholecystectomy dissecting on the gallbladder wall down to the cystic duct, can be helpful.

4. If the cystic duct densely adherent to the common bile duct and there is possibility of Mirizzi syndrome the infundibulum of gallbladder should be opened and the stone removed and the infundibulum oversewn.

5.Occasionally, the gallbladder bed bleeding profusely, the use of suction and diathermy is advisable for laparotomy and laparoscopic operation.

6.The gallbladder bed may be filled with omentum and a drain placed over the omentum (not between the bed and the omentum).

7. Regardless of the direction of the procedure the junction of the cystic and common hepatic ducts should be identified

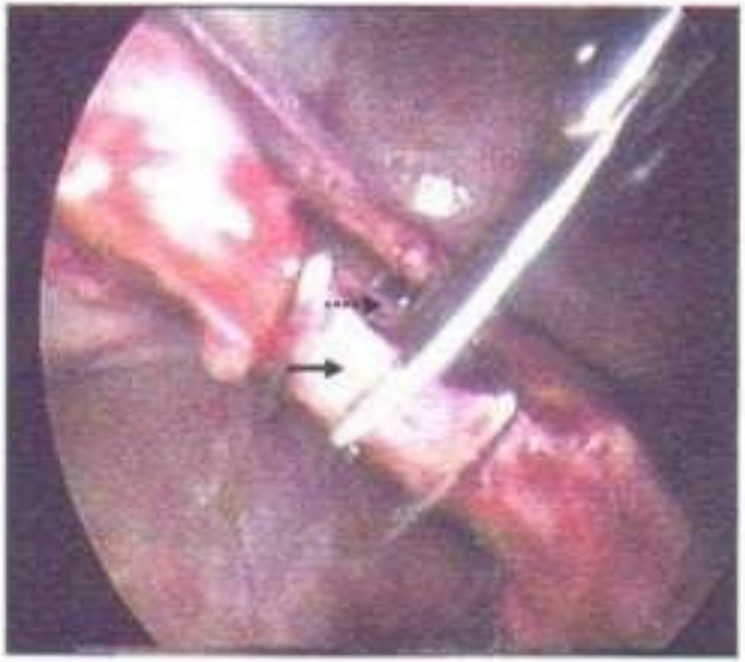


Figure 3-1: The most common configuration of cystic duct and artery encountered in this study. Cystic duct (→), cystic artery (interrupted arrow).

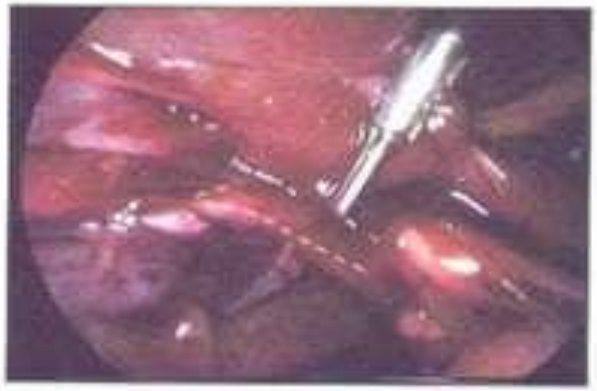


Figure 3-2: Short cystic artery (→) arising from caterpillar right hepatic artery (interrupted line).

Figure 3-5: cystic artery (→) originated from proper hepatic artery (*).Note that the cystic artery lies posterior to the cystic duct (D).

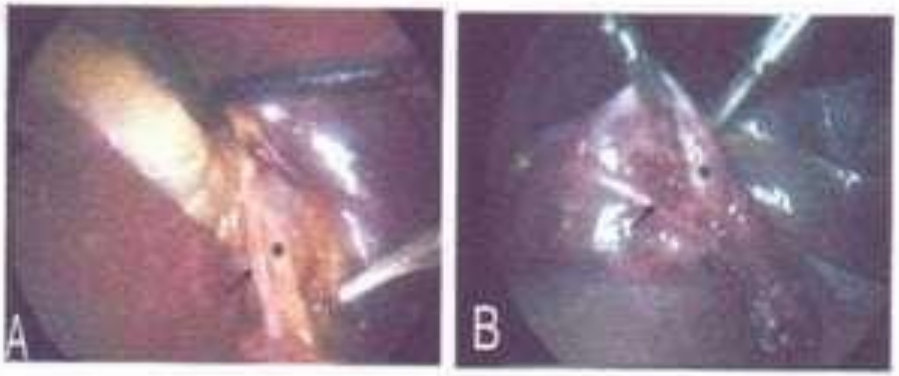


Figure 3-4: (A) Low inserted cystic artery (→) passing infront of the cystic duct (*) ; (B) Low inserted cystic artery (→) passing inferior to the cystic duct (*)

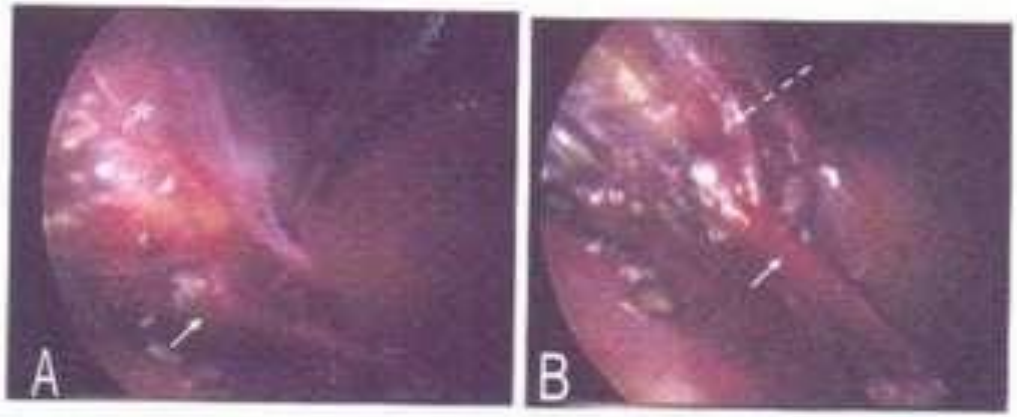


Figure 3-6: (A) right hepatic artery (→) in the bed of the gall bladder (*); (B) cystic artery (interrupted arrow) arising from the right hepatic artery (→) within the bed of the gall bladder.

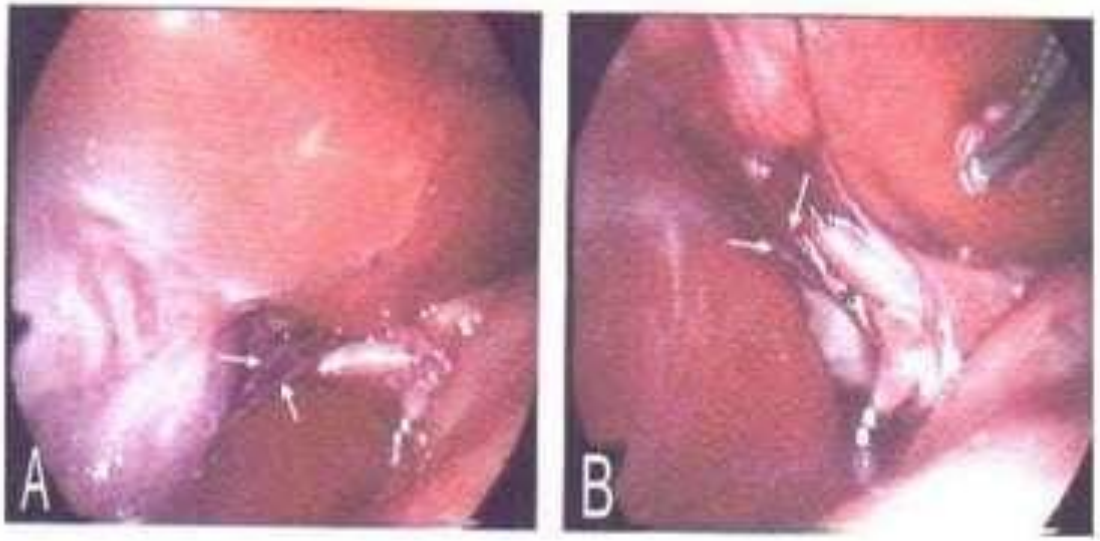


Figure 3-3 early divided cystic artery. (A) The anterior and posterior branches of the cystic artery (arrows) traverse Calot's triangle. (B) Further traction of the gallbladder reveals the two arteries (arrows) arising from a single cystic artery (*) in a Y- shaped configuration.

REFERENCES

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- Blumgart liver and billiary tract surgery
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Thank You

Available at surgicalpresentations