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A comparison of the incidence of bile duct injuries in laparoscopic cholecystectomy with and without biliary mapping using methylene blue.

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I. INTRODUCTION

BILE DUCT INJURIES :

Bile duct injuries are third most common injuries encountered in general surgical practice.it is always associated with increased incidence of mortality and morbidity.if it is identified preoperatively and repaired earlier,it carries less morbidity.

With introduction of laparoscopic cholecystectomy,the incidence becomes higher.but with the introduction of novel techniques in surgeries,the incidence has fallen to (0.3-0.6%Vs 0.125%open).

Advancements in lap cholecystectomy to decrease incidence of bile duct injuries are IOC, defining technique for safe cholecystectomy, sophisticated new generation laparoscopic instruments,dye cholangiography..etc..

Types of Injury

- Bile leaks (Usually minor)
- Bile duct transections / stricturing type (Major)

Bile leaks :

Minor, Bile duct injuries occur in a frequency of 0.3% worldwide. Common causes are :-

- Leak from cystic duct stump
- Transected aberrant right hepatic duct
- Lateral injury to the main bile duct.
- Rarely due to unidentified cholecysto hepatic duct

These injuries commonly present in the first week of laparoscopic cholecystectomy with pain, fever and mild hyper bilirubinaemia (up to 2.5 mg /dl) from a bilioma or bile peritonitis.placing a drain relieves from bilioma. Diagnosis should be considered in patients presenting with bloating or anorexia more than few days after laparoscopic cholecystectomy.

Minor injuries can also present very late with bile duct strictures (esp. lateral wall injuries months to years after the procedure).

Bile duct Transections / Stricture:The incidence of these major injuries are 0.55% - 0.6 % world wide ,commonest of these are

1. Clip placement in common bile duct or right heptatic duct
2. Excessive use of monopolar cautery

Usually Recognized late in post operative period. Jaundice associated with pain if cholangitis complicates the situation. Patient might present late (months to years) with cholangitis, cirrhosis and portal hypertension…

Modes of Injury during Laparoscopic Chole cystectomy

Basic two error groups which lead to bile duct injuries are :

Misinterpretation of anatomy

1. Technical Error

Misinterpretation of anatomy:

It is responsible for 70% of Bile duct injuries.surgeon should have sound knowledge regarding anatomy and anomalies of bile duct system in order to avoid iatrogenic injuries.

Technical errors : Technique of 'Safe cholecystectomy' is important for any uneventful cholecystectomies.when fundal traction of gallbladder is given cystic duct comes in line with CBD and parallel to CHD.Giving inferolateral traction of hartman's pouch opens up calot's triangle and moves cystic duct away from CBD and CHD.if inferolateral traction is not given clips are applied inadvertently to CBD and CHD which leads to total transection of CBD without continuity. (Strassberg type E)

Hilar bleeding and its desperate control accounts for many high injuries.

Risk factors for Bile duct injuries :

Experience of the surgeon : The learning curve

This is the most important factor with corresponding to iatrogenic injury to bile duct during laparoscopic cholecystectomy.

Its not only the technical competence of the surgeons but also the excessive fat and adhesions in porta hepatis which makes the dissection difficult and causes iatrogenic injuries.

Anomalies of biliary tract (10-15%) which are not usually identified preoperatively. Most important among them is an aberrant right hepatic duct inserting low into common hepatic bile duct

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mistaken for cystic duct.

Prevention of Bile Duct Injuries in Laparoscopic Cholecystectomy

Techniques that could prevent Bileduct injuries are

1. Thorough knowledge of the anatomy, risk factors and mechanisms of injury.
2. Meticulous technique of safe cholecystectomy.
3. Timely decision for elective conversion to open in the presence of difficulty anatomy.
4. Developing skills of interpreting Intra operative cholangiogram.

Meticulous technique like proper traction, limiting dissection close to gall bladder, Critical window and display of structures in Calot`s triangle usually reduces bile duct injuries.

Roux-en-Y Hepatico Jejunostomy / choledocho jejunostomy :

This is the procedure of choice for major transectional and stricturing injuries.it can be used along with internal stents to avoid anastamotic site strictures.

II. AIM AND OBJECTIVE

- The study was undertaken to compare the incidence of bile duct injuries in laparoscopic cholecystectomy with and without biliary mapping using methylene blue in patients who are admitted in GRH Madurai.

III. REVIEW OF LITERATURE

ANATOMY[3]

Gallbladder lies on undersurface of liver in main liver incissura at right and left lobe junction.gall bladder could either embed in the substance of the liver or suspend by a mesentry.gall bladder is a pear shaped structure.it is 7.5cm-12cm long.capacity is about 25-30 ml.anatomically it is divided in to fundus, body, neck, narrow infundibulum.The muscle fibres arranged in criss cross manner well developed in neck.The mucous membrane contains indentation of mucosa that sink in to the muscle coat called as crypts of luschka.[3]

The cystic duct is about 3 cm in length.lumen is about 1-3mm in diameter.the mucosa of cystic duct is arranged in spiral folds known as the valves of heister.cystic duct joins the supraduodenal segment of common hepatic duct.biliary apparatus anatomy undergo a lot of anomalies.occasionally,cystic duct may join right hepatic duct or even a right hepatic sectorial duct.[3] Common hepatic duct is less than 2.5 cm long.CBD is about 7.5 cm long.it has four parts.

- The supraduodenal portion ,2.5 cm long runs in free edge of lesser omentum.
- The retroduodenal portion.
- The infraduodenal portion lies in a groove or in a tunnel on the posterior surface of pancreas.
- The intraduodenal portion passes obliquely through the wall of the second part of the duodenum.here it is surrounded by sphincter of oddi ,the CBD opens on summit of ampulla of vater.[3].

Calot's triangle or hepatobiliary triangle is a space bounded by cystic duct inferiorly,common hepatic duct medially and the superior border of the cystic artery.this has been modified as area bounded superiorly by inferior surface of liver,laterally by cystic duct and medial border of gallbladder and medially by the common hepatic duct.cystic artery is usually identified within its boundaries.[3]

Knowledge of the variations is essential for performing hepatobiliary procedures.anomalies of hepatic ductal confluence are common.most common among them is variation in insertion of right sectorial ducts.the confluence can be trifurcation of right anterior sectoral,right posterior sectoral,and left hepatic ducts.either of right sectoral ducts can drain in to left hepatic duct,the common hepatic duct,the cystic duct,rarely the gall bladder.[3]

Anomalies of cystic ducts include double cystic ducts draining in to hepatic duct branches,cystic duct can run parallel and enter it more distally,cystic duct can be fused to the hepatic duct along its parallel course by connective tissue.cystic duct can also run a spiral course anteriorly or posteriorly and enter left side of common hepatic duct.[3]

Blood Supply Of Biliary Apparatus[3,21]

Supraduodenal and infrahilar bile ducts bile ducts are supplied by two axial vessels that run at 3 and 9 0 clock positions.these are branches of superiorpancreaticoduodenal,righthepatic,cystic,gastro duodenal and retro duodenal arteries.retropancreatic bile duct derives its blood supply from retro duodenal artery.venous drainage just parallels arterial supply and drains in to portal venous system.[3,21]

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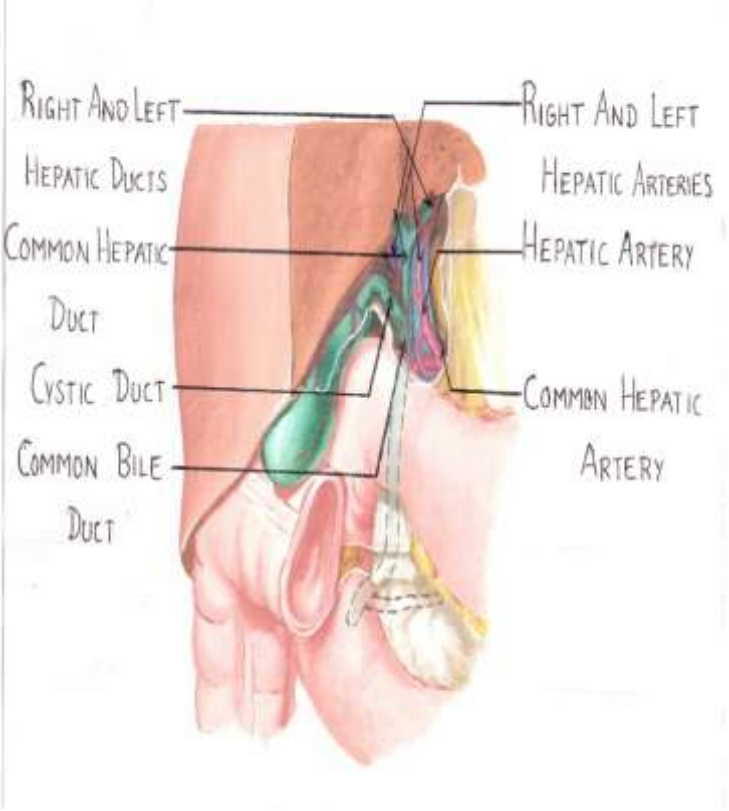
ANATOMY OF THE REGION



PHYSIOLOGY[21]

Bile secretion serves excretion of toxins from body and helps in nutrient absorption from intestines.bile salts combine to form spherical micelles .bile salt along with the cations maintains an osmolality approximately comparable to that of plasma.bile flow is dependent on neural,chemical,humoral stimuli.vagal activity induces bile secretion.cholecystokinin induce biliary tree secretion and gall bladder wall contraction.bile salts once secreted in to bile ,reabsorbed back in to terminal ileum and reaches back liver.this is called enterohepatic circulation.[21]

Bile stored in the gall bladder as an extrahepatic storage system.the gall bladder fills through a retrograde mechanism.with increase in tonic activity of sphincter of oddi in fasting state,pressure increases in common bile duct.this increased pressure allows filling of the lower intraluminal pressure gallbladder ,which is capable of storing up to 600ml of bile daily.the passage of fat,protein,and acid in to the duodenum induces CCK secretion from duodenal epithelial cells.CCK causes gall bladder contraction,with intraluminal pressure up to 300 mmhg.vagal activity also induces gall bladder emptying but is a less powerful stimulus to gallbladder contraction than CCK.[21]

The muscular sphincter which maintains normal phasic tonic activity is inhibited by CCK.coordinated with gallbladder contraction,the relaxation of sphincter allows evacuation of up to of 70% gallbladder contents within 2 hours of CCK secretion.[21]

GALL STONES[21]

Gall stones are the most common biliary pathology.gallstones can be divided in to three Main types.cholesterol,pigment(brown/black)or mixed stones.in USA 80% are cholesterol or mixed stones,whereas in asia 80% are pigment stones.cholesterol or mixed stones contain 51-99% pure cholesterol plus calcium stones,bile acids,bile pigments and phospholipids.[21]

There are many factors which causes gallstone formation.impaired gall bladder function,supersaturated bile,cholesterol nucleating factors,defect in enterohepatic circulation leads to the formation of gall stones.clinically gall stones may be asymptomatic or incidental finding.if symptoms occur,patients complain of right upper quadrant or epigastric pain ,radiate to the

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back.other symptoms include dyspepsia,flatulence,food intolerance to fats and some alteration in bowel frequency.[21]
Diagnosis is achieved by clinical and imaging techniques.definitive diagnosis is obtained only by USG and CT.[21].cholesterol stones occur predominantly due to hypercholesterolemia, dysmotility of gall bladder. pigment stones occur due to hemolysis and dysmotility of CBD.diabetes leads to acalculous cholecystitis.[21]

Symptomatic cholelithiasis and asymptomatic cholelithiasis under special circumstances needs surgical removal of gall bladder…laparoscopic cholecystectomy attained huge popularity when compared to open technique due to faster recovery,cosmetic concern and early return to work….laparoscopic approach crossed an era to overcome its major concern of bile duct injury to prove its credibility.many techniques were used to attain this state including intraoperative cholangiography,methylene blue dye injection…
[21]

Indications For Laparoscopic Cholecy stectomy[25]

1. Symptomatic cholelithiasis
2. Acalculous cholecystitis
3. Gallstone pancreatitis
4. GBpolyp >1cm in diameter
5. Porcelain gallbladder
6. Asymptomatic cholelithiasis due to diabetes mellitus,sickle cell disease,TPN,chronic immunosuppression, incidental.[25]

CONTRAINDICATIONS[25]
Absolute
1.refractory coagulopathy
2.suspicion of carcinoma
Relative
1.previous upper abdominal surgery
2.cholangitis
3.diffuse peritonitis
4.cirrhosis or portal hypertension
5.COPD
6.cholecystoenteric fistula.
7.morbid obesity
8.pregnancy.[25]

The preoperative work up of patients include[25]
1.History of gallbladder disease including nature,severity,duration of symptoms.
2.general physical examination of the patient.
3.per abdominal findings on the basis of clinical examination
4.routine investigations namely complete blood count,coagulation profile,kidney function tests,serum electrolytes, xray-chest, ECG
5. specific investigations namely USG abdomen, LFT
[25]

Preoperative elevated LFTs should raise suspicion of cholangitis,choledocholithiasis,MIRIZZI syndrome.[25]

Usg shows size and number of stones,thickness of gallbladder wall,presence of peri-cholecystic fluid,diameter of CBD and other components of biliary ductal system.[25]

Other investigations including UGI endoscopy,computed tomography,magnetic resonance cholangio pancreatography are useful to evaluate common duct in patients with raises of liver parameters or CBD dilatation on US.[25]

BASIC SET OF INSTRUMENTS NEEDED FOR LAPAROSCOPIC CHOLECYSTECTOMY[25]
1.anaesthesia equipment with monitors
2.operating table
3.Video monitors
4.suction and irrigation
5.electrosurgical unit with grounding pad equipped with current monitoring system.
6.laparoscopic equipment in a cart on wheels
a)light source
b)insufflator
c)camera processor unit
7.instrument table with following laparoscopic instruments
a.No.15 scalpel blade and handle
b.veress needle and hasson's cannula
c.gas insufflations tube
d.fibre optic cable to connect laparoscope with the light source.
e.video camera with cord.
f.set of haemostatic forceps
g.trocars and cannulas
h.atraumatic graspers
i.locking tooth grasper
j.maryland dissectors curved
k.scissors
l.right angle dissector
m.clip applicator with clips
n.L-Hook dissector
o.spatula[25]

patient must be placed in supine position.monitors are placed on right side of the patient near head end.surgeon stands on left side of patient with camera assistant.there is a technique called French technique surgeon can stand between lithotomized legs.staff nurse stands side of the patient.second assistant is needed in four port technique for the retraction of the gallbladder

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fundus during the operative procedure.[25]
Suspicion of zone of significant risk can be made when there is failure to obtain adequate exposure of the anatomy of hepatocystic triangle.[25]
It is always adviced to obtain the advice of second surgeon in which the dissection is stalled.[25]

ERGONOMICS[25]

Left hand should be used.trocars should point towards GB,the blood vessels on the parietal wall should be avoided.the trocar sequence should be modified according to the case.the angle between the right and left hand should be as wide as possible.operating end of instruments should be seen at right angles to telescope.[25]
Liver should be visible through the window.the junction between GB-cystic duct is more important.[25]

THE CRITERIA FOR CONVERSION[25]

Unclear anatomy
Failure to progress
Injuries:vessels,viscera,bile duct

CBD stones could not be managed at the present set Up laparoscopically.[25]

POST OPERATIVE CONSIDERATIONS[25]

check for liver parameters in doubtful situations
HPE report should be followed
Drainage is the solution for leaks
Serial LFT for 6 months should be done for difficult
Cases.[25]

Remember And Must Intra Operatively[25]

Posterior dissection should always to be done.because this enhances cystic duct length..this avoids inadvertent ligation of CBD instead of cystic duct.it is essentially a partial retrograde dissection.[25]
Conversion should not be considered as failure.
Clips should be applied only when we are sure about the anatomy.[25]
The surgery should always be split in to steps and performed.this avoids confusion.[25]
Surgeon should be well aware of his steps of his own technique.
Always left hand is the surgeon
Facilitator should always stand in the right side of the patient[25]

Technique Of Laparoscopic Cholecystectomy[21]

Operative team set up is as shown in figure. It doesn't require patient to be placed in Lloyd Davis position as in French set up, but many surgeons feel less comfortable due less available space.[21]

Access :

Pneumoperitoneum is created by OPEN / HASSON'S TECHNIQUE. A curvilinear supra umbilical incision is placed about 1-1.5 cm in length. Peritoneum is opened through the incision and entry into abdominal cavity is confirmed. A 10 mm Cannula with or without blunt tipped Hasson's Trocar is introduced which should snugly fit to prevent gas leak. Open technique has the advantage of quick access and quick pneumoperitoneum creation.

Veress needle technique or closed technique bears the risk of bowel or vascular injury, takes more time to reach the desired level of pressure (12 mm of mercury) needs patient to be placed in head down position.

After creation of pneumoperitoneum and routine visual inspection of abdominal cavity, a second 10 mm port is placed 2/3rd of the way between umbilicus and the xiphisternum to the right of the midline. A 5 mm cannula is inserted 3-4 cm below the costal margin in the mid clavicular line and a second 5 mm cannula is inserted 4-5 cm below the costal margin in the anterior axillary line. Position can be adjusted as per the need of the surgery.

The supra umbilical 10 mm port is used for the 0 or 30 degree telescope and for CO2 insufflation. Sub xiphoid port is used for dissection with surgeon right hand, whereas the other two 5 mm ports are used for retraction at the fundus (Ant. axillary line) and at the infundibulum (Mid clavicular line)

A 30 degree telescope has the advantage of providing over head view of the field similar to an open surgery.

Gall bladder fundus is grasped and retracted cephalad to expose the sub hepatic area and the infundibulum of the gall bladder. With the mid clavicular line port, infundibulum is grasped and retracted laterally and inferiorly to open the Calot`s triangle and it creates a distinct angle between the cystic duct and common bile duct and hence avoiding their alignment in one line which is the reason of the diaster seen in 'classical injury' as shown.

After adequate exposure of Calot`s triangle the dissection should commence high on the gall bladder initially posteriorly and then anteriorly. One should visualize the '**posterior peritoneum'** covering the '**yellow pad of fat'** and keep the dissection just above it.

As one proceeds inferiorly,the cystic duct is encountered. Junction of cystic duct with gall

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bladder is visible as '**Elephant head'** or '**The Ganesha sign'** .This should be seen during laparoscopic cholecystectomy to avoid injury. At times, there may be an anteriorly placed cystic artery which has to be divided to proceed further.

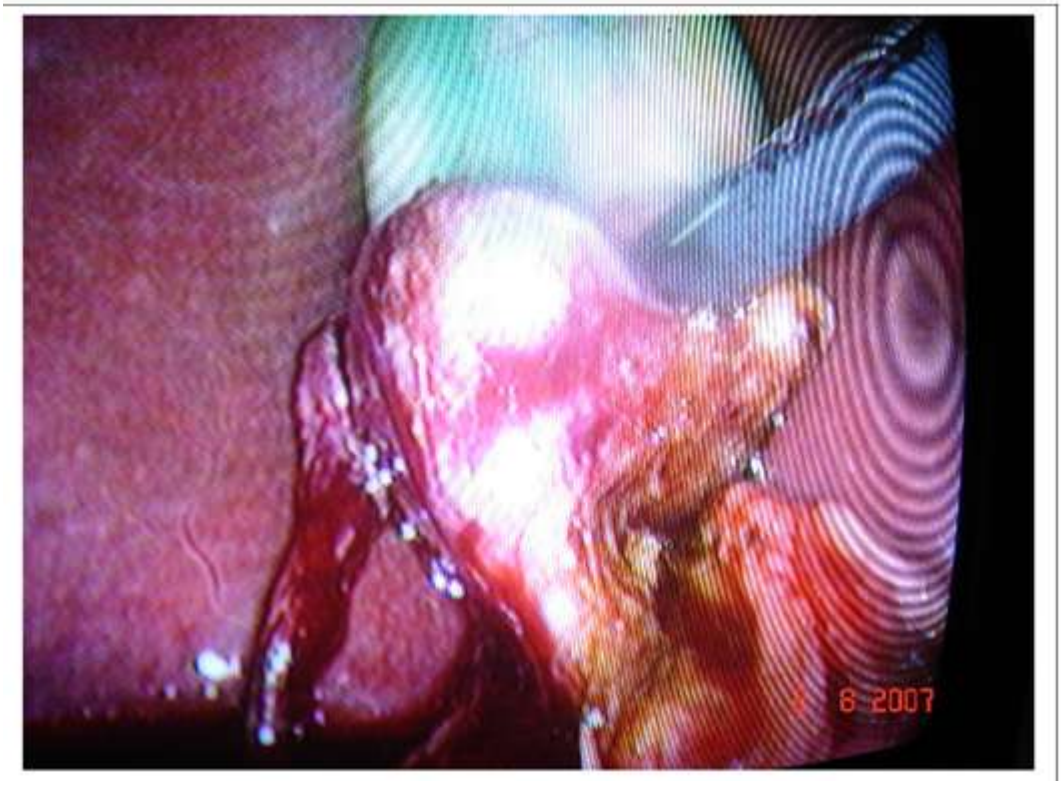
Next step is to create a 'Critical window' in the Calot`s triangle which clearly demonstrate the cystic artery and the duct in loose areolar tissue which bridges the Calot's triangle. Dissection should not proceed beyond '**Rouvier's sulcus'.** It is the only constant landmark in this area and marks the lateral extent of porta hepatis and helps to avoid high bile duct injury.

If cholangiography is planned, it should be done at this stage by introducing cholangio catheter through a small opening in cystic duct.This should be done after placing a clip distally at its junction with gall bladder. Contrast is injected to delineate the biliary tree under fluoroscopic guidance. Though it prevents bile duct injury during further procedure, it cannot prevent injuries which are sustained during dissection described before.

If the anatomy is clear, cystic artery is doubly clipped proximally and distally, divided followed by division of cystic duct between double clips with lateral traction maintained. At times larger branches of cystic arteries need to be ligated or clipped.

An abnormally large cystic artery may suggest the presence of 'Caterpillar hump' right hepatic artery. If it is present the right hepatic artery should be dissected away and clipping the cystic artery which usually arises from angled hump of right hepatic artery. Avulsion of cystic artery should be avoided here.

ELEPHANT HEAD OR GANESHA SIGN



Any haemorrhage should be controlled by compression with adjacent bowel, gauze piece and is accurately identified and ligated or clipped. Blind and desperate attempts to control bleeding, leads to disaster.

Dissection of GB from liver bed should not be callous and as one might miss aberrant cysto-hepatic duct which may cause post operative biliary leak. Dissection is done with scissors or cautery. Gall bladder is removed from abdominal cavity as such or in an endo bag or condom carefully, or bile may evacuated from Gall bladder to ease its manipulation during delivery.

Presence of overriding Hartmann's pouch adherent to common bile duct should raise the possibility of 'Mirizzi syndrome' with cholecysto biliary fistula

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which is usually a strong contraindication laparoscopic procedure.

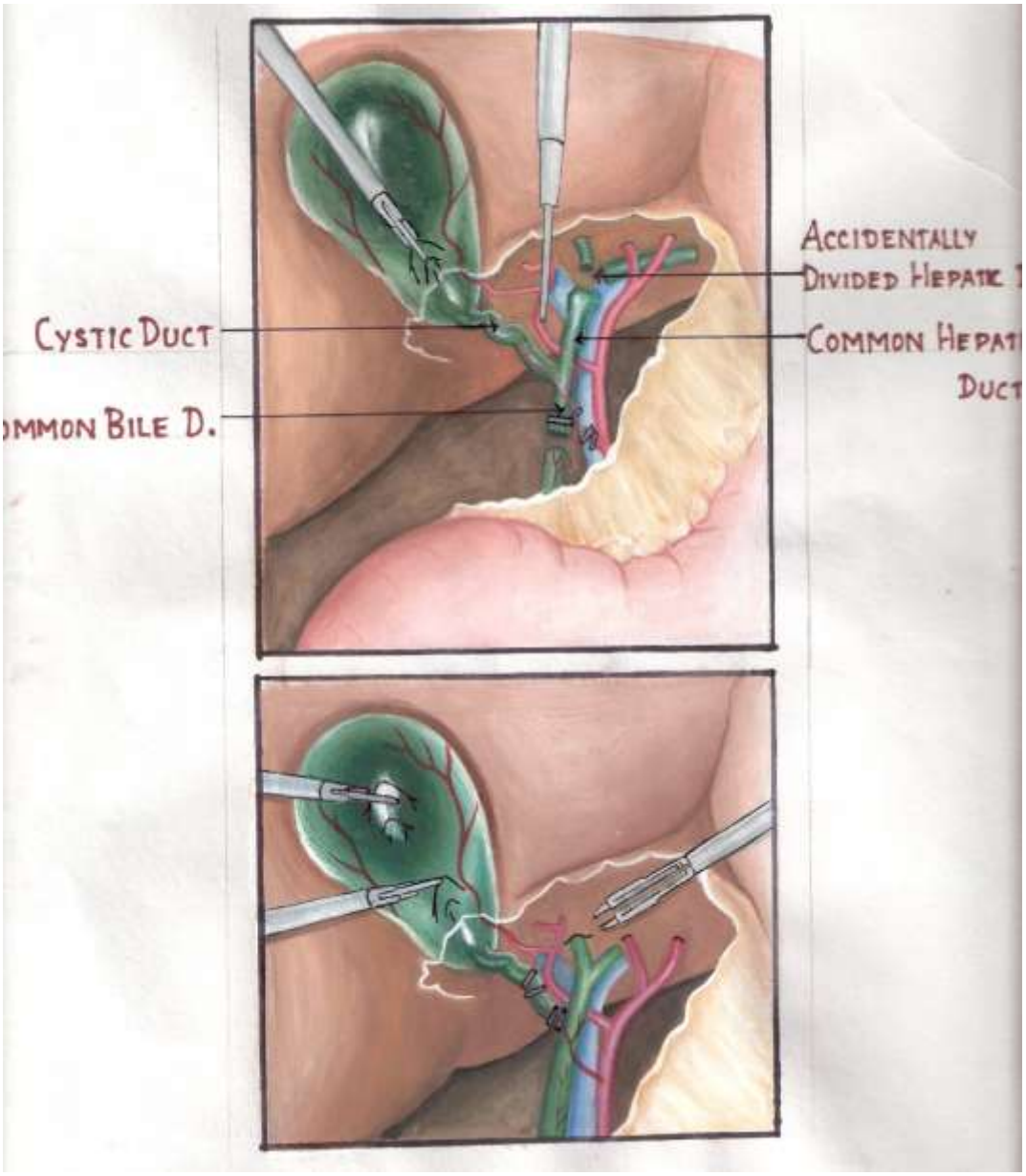
In acute cholecystitis planes may not be as clear as in chronic cases and moreover, tissue may be friable. Dissection is as for other procedure, sharp dissection is used, preferably with scissors. Conversion to open procedure should be strongly considered.

In case of short cystic duct where clips cannot be applied without avoiding lateral wall of CBD, a ligature may be applied avoiding CBD wall or else conversion to open is a better option.

CBD should not be dissected to display its junction with cystic duct as it carries increased chances of injuries.

A suction or tube drain of size 14 is placed in sub hepatic area to detect bile leak. Pneumoperitoneum is let out and port sites are closed.

CLASSICAL LAPAROSCOPIC INJURY TO CBD



Classification of Bile duct injuries :

Commonest used is Corlette –Bismuth classification which classifies major Bile duct transections and strictures of extra hepatic biliary

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type.

Bismuth Classification

Type I -Low common hepatic stricture, length of the stump > 2cm

Type II -Higher strictures Length of the CHD stump < 2 cm

Type III -High hilar strictures – no serviceable CHD but the confluence of right and left hepatic duct is intact

Type IV -Involvement of confluence with no communication between right and left hepatic ducts Fibrosis in between the two ducts may be thin (<1cm) thick (1cm or more)

Type V - Combined common hepatic and aberrant right hepatic duct injury separating both from distal biliary tract.

Advantages of Bismuth classification :

1. Length of the remnant stump determines the type of repair
2. Indicates prognosis, morbidity and chance of recurrence after the indicated repair.

Disadvantage :

- Does not indicate the length of the stricture as in present era small length strictures can be dealt non-operatively.
- Does not include minor biliary tract injuries which require management
- Does not mention the continuity across the injury.

More recently **Strassberg classification,** out lines a comprehensive classification of bile duct injuries which is gaining wider acceptance.

STRASSBERG CLASSIFICATION

Type A :

Bile leak from a minor duct that is still in continuity with common bile duct. Usually from cystic duct stump or gall bladder bed. Does not cause strictures or require tertiary referral.

Type B :

Occlusion of part of biliary tree usually it is aberrant right hepatic duct mistaken for cystic duct. Often asymptomatic may present later with pain and cholangitis.

Type C :

Bile leak from a duct not in communication with distal common bile duct. Usually transection of right aberrant hepatic duct with drainage of bile into peritoneal cavity presents early in post operative period.

Type : D

Lateral injury to extrahepatic bile duct. The hepatic parenchyma remains in communication with the distal end of biliary tree, might result in stenosis.

Type E :

Circumferential injury of major extrahepatic ducts with separation of liver parenchyma from the lower ducts and duodenum. (Type E1- E5 is same as type 1-5 of Bismuth classification).

Bile duct injuries are the most devastating complication occurring in the surgeries involving in the right upper quadrant reg ion.80% of all iatrogenic bile duct injuries occur during cholecystectomy.

Usually bile duct injuries manifest in the post op period.they may manifest in the intra op period.bile leak manifest as peritonitis ,later may manifest with bile stricture and jaundice.bile leakage in the acute setting causes fever,increasing abdominal pain,jaundice,or bile leakage from the incision site.10% bile strictures are recognized within first week.70% are recognized within 6 months of original operation.

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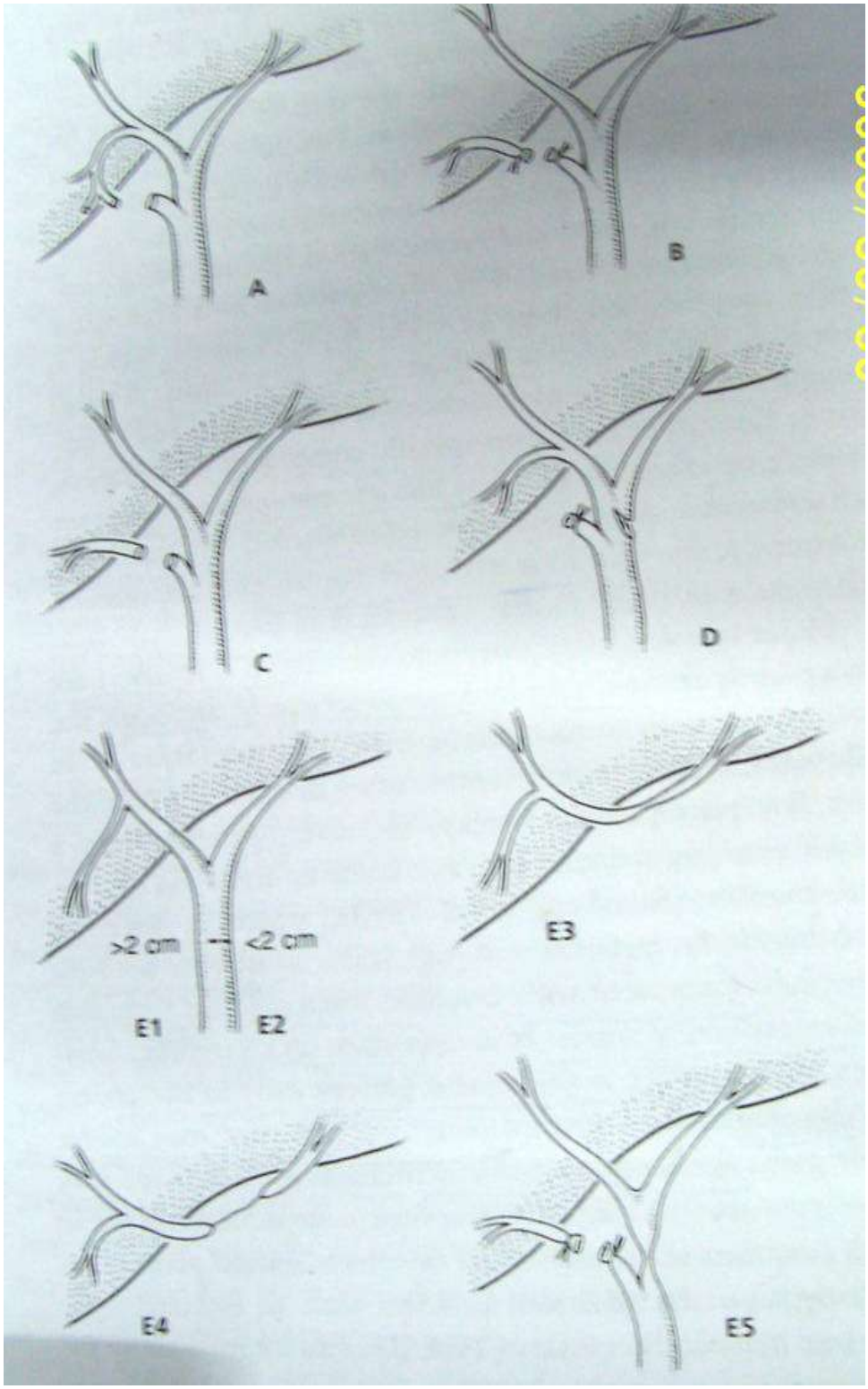
STRASSBERG CLASSIFICATION



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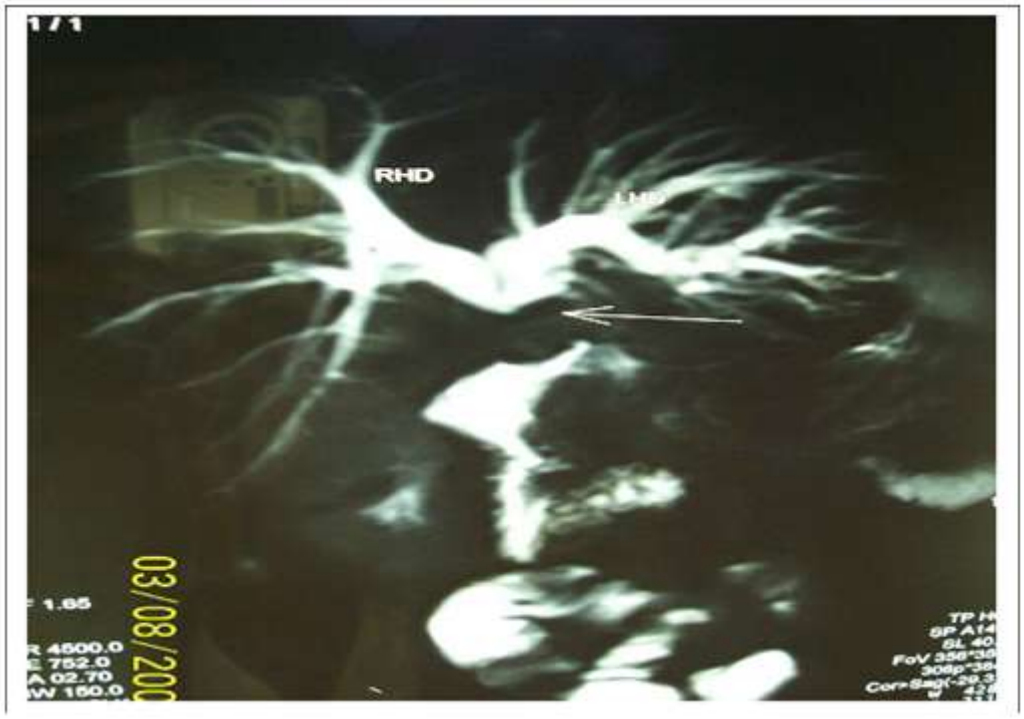
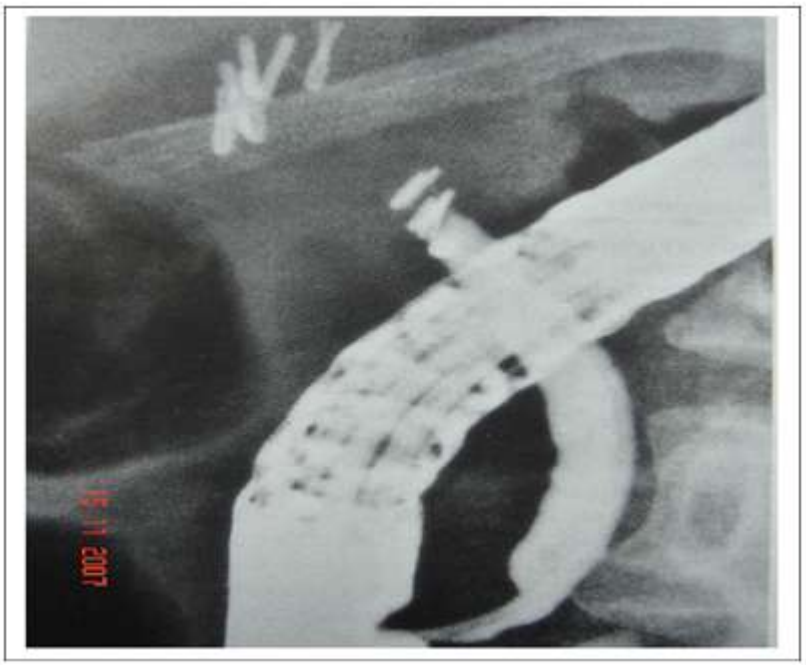
MRCP PICTURE OF TYPE E STRASSBERG BILE DUCT INJURY



ERCP PICTURES OF TYPE E STRASSBERG BILE DUCT INJURY



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Treatment[21]

Recognized At The Time Of Cholecystectomy

If bile duct injury is suspected intraoperatively,conversion to an open operation and use of cholangiography help delineate management.goals for the immediate treatment of bile duct injury include maintenance of ductal length,elimination of any bile leakage that would affect subsequent management,and creation of a tension –free repair.[21]

In the adult,for ducts smaller than 3mm that by cholangiography drain only a single segment or subsegment of liver,simple ligation should suffice for management.ducts larger than 3mm usually drain more than a single segment of liver and thus,if transected,should be reimplanted in to the biliary tree.if the injury occurs in the larger duct but is not caused by electrocautery and involves less than 50% of the circumference of the wall,a T tube placed through the injury,which is effectively a choledochotomy,usually will allow healing without the need for subsequent biliary – enteric anastomosis.[21]

Any cautery based injury,in which the extent of thermal damage may not be manifested immediately,or an injury involving more than 50% of the duct circumference requires resection of the injured segment with anastomosis to reestablish biliary enteric continuity.[21]

Although it is unusual,when the defect is smaller than 1 cm and not near the hepatic duct bifurcation,mobilization with end to end anastomosis of the bile duct can provide acceptable reconstruction.This approach should be accompanied with transanastamotic T tube placement.the tube should be inserted through a separate choledochotomy and not exit the bile duct through the anastomosis.to ensure a tension- free anastomosis,a generous kocher maneuver,mobilizing the duodenum and the head of the pancreas out of the retroperitoneum,is necessary.[21]

More commonly,injuries occur adjacent to the bifurcation or involve more than a 1cm defect between the ends of the bile duct.these injuries require reanastamosis to the gastrointestinal tract.in this setting,the distal end is oversewn and the proximal end debrided to normal tissue.the choice of reconstruction depends on location and extent of injury,history of previous attemts at repair and preference of the surgeon.low injuries to the bile duct can be reimplanted in to the duodenum,although the new choledochoduodenostomy anastomosis risks a duodenal fistula,especially considering that these anastomosis may require significant mobilization to avoid anastamotic tension.[21]

Choledochoduodenostomy allows endoscopic intervention if necessary,but the ROUX-en-Y approach to reconstruction is substantially more versatile and can be applied to injuries throughout the biliary tree.in addition,most injuries to the bile duct occur higher in the biliary tree,close to the hilum,thus not allowing tension free anastomosis to the duodenum.therefore in almost all cases of bile duct injury,a resection of the injured segment with mucosa to mucosa anastomosis using a ROUX-en-Y jejunal limb is preferred.[21]

Transanastamotic stenting has been shown to improve anastamotic patency,with longer duration of stenting providing a more favourable outcome.as concomitant vascular injuries are common,Doppler ultrasonography can confirm adequate hepatic arterial and portal venous flow to the hepatic parenchyma.[21]

Recent data suggest that there is no significant difference in frequency of biliary injuries sustained at teaching hospitals compared with hospitals without residents.because most bile duct injuries and most immediate bileduct repairs occur at centres where biliary reconstruction is performed infrequently,most immediate repairs go unreported in the literature.[21]

however the importance of surgical judgement and experience in biliary reconstruction cannot be overemphasized.although reports of previous failed attempts at reconstruction have not documented injuries successfully managed immediately,they do highlight the value of experience in the treatment of bileduct injuries.[21]

Therefore,when one is confronted with the bileduct injury and no surgeon with experience in biliary reconstruction is available,the most appropriate management strategy is placement of a drain and immediate referral to an experienced centre.[21]

IDENTIFIED AFTER CHOLECYSTECTOMY[21]

DIAGNOSIS AND MANAGEMENT

Patients suffering a bile duct injury who present in the post operative setting are generally found to have jaundice,with an elevated alkaline phosphatase level,or leakage from the injured duct.leakage may be manifested as bilious drainage in to a subhepatic drain placed at the time of operation or bilious drainage from a surgical incision.without a site for external drainage,bile leakage can be manifested as a bilioma,whether sterile or infected,or with biliary ascites.[21]

The diagnosis of iatrogenic bile duct injury is suspected in any patient who presents with

new or increasing symptoms after a laparoscopic cholecystectomy.changes in serum bilirubin and alkaline phosphatase levels can be seen,even in the first few days after injury.symptoms of shoulder pain,postprandial pain,fever and malaise tend to improve after the first few days because a laparoscopic cholecystectomy is generally well tolerated.complaints that persist or increase over time should raise the suspicion of a bile duct injury.[21]

Patients suspected of having an iatrogenic bile duct injury should undergo imaging to assess for a fluid collection and to evaluate the biliary tree.ultrasonography can achieve both these goals,but because percutaneous drainage may be required and anatomic delineation is valuable,cross sectional imaging by CT will generally provide more useful data .some surgeons advocate the use of radionuclide scanning to confirm bile leakage,but with any documentation of a leak,CT will be necessary to plan management.also,ischemia is a common cause of bile duct stricture.in the setting of bile duct injury,20% or more of patients will have concomitant unrecognized vascular injuries.[21]

In the delayed presentation of a bile duct injury ,three major goals guide therapy.first,control of infection with drainage of any fluid collection will minimize the inflammatory process.inflammation in the porta hepatis leads to fibrosis.which acts only to increase stricture formation.broad spectrum antibiotics,decompression of the biliary tree and drainage whether percutaneous or operative ,or any fluid collections achieve this goal.with control of sepsis,there is no urgency for biliary reconstruction.infact,with time resolution of the periportal inflammation will help in durable repair.in addition retraction of the injured bile duct in to the hilum of liver and inflammation in this region makes successful repair in the immediate postoperative setting unlikely.therefore,although immediate reexploration to manage the injury as expeditiously as possible is tempting,successful long term management of bile duct injuries identified postoperatively depends on clear and deliberate preoperative planning of the reconstruction.[21]

A second goal of management is clear and thorough delineation of the biliary anatomy with cholangiography.without preoperative cholangiography,any attempts at repair are unlikely to be successful.the cholangiogram must indicate the intrahepatic anatomy and bile duct bifurcation.for patients with bileduct continuity,ERCP may be possible,but PTC is generally more useful.PTC will demonstrate the intrahepatic biliary tree,identify the location of the injury ,provide drainage of bile,and possibly even allow the leak to close.percutaneous biliary catheters can also be left in place during reconstruction to assist in dissection and to provide drainage perioperatively.PTC can be combined with ERCP as necessary,depending on the site and extent of injury.small bile leaks with bile duct continuity and cystic duct stump leaks can be successfully managed by endoscopic stenting and sphincterotomy.[21]

Third goal of management is to reestablish durable biliary enteric drainage.although a combination of endoscopic and percutaneous biliary dilatations and stenting may establish continiuity,surgical reconstruction has the highest patency rates.to achieve a successful and durable repair,the anastomosis must be performed between a minimally inflammed bile duct to intestines in a tension free mucosa to mucosa fashion.when the anastomosis is within 2cm of the hepatic duct bifurcation or involves intra hepatic ducts,long term stenting appears to improve patency.if the bifurcation is involved ,stenting of both right and left ducts should be performed.when the reconstruction involves common bile duct or common hepatic duct more than 2cm from the bifurcation,stenting is not necessary.therefore a preoperatively placed transhepatic drain or intraoperatively placed T tube will provide adequate decompression in the immediate postoperative period.[21]

At the time of operation,the adhesions of duodenum and colon to the liver should be separated.the porta hepatis can be encircled with a penrose drain.although the bile duct should lie on the lateral border of the porta hepatis ,the marked fibrosis and inflammatory process may make its identification difficult.[21]

Preoperatively placed percutaneous biliary drainage catheters can assist in the dissection.also clips placed in the previous operation may be identified.if necessary a small caliber needle attached to a syringe can be used to aspirate and to identify the bileduct while avoiding inadvertent injury to a vascular structure.once identified,above the stricture only a limited segment of bile duct (<5mm) is dissected free.[21]

Any further dissection of normal duct risks vascular compromise of the segment to be used in the anastomosis .preservation of as much biliary tree as possible remains goal of the reconstruction.next the bile ducts can be opened and percutaneously placed catheters can be introduced through the incision.at this point wire

can be exchanged with catheters for long term silastic stents,if appropriate,or the catheters can be left in place for transanastamotic decompression.the mucosa to mucosa anastomosis can be created in an end to side fashion to the ROUX-en-Y jejunal limb.(21)

In the setting of substantial inflammation at the bifurcation ,another reconstruction option involves anastomosis of the roux limb to the left hepatic duct.as noted the left hepatic duct retains a substantial extra-parenchymal length,allowing an anastomosis in this portion of normal duct.before this section is used for drainage of the entire liver,cholangiography must confirm that the biliary bifurcation is widely patent,thus ensuring drainage of the right lobe across the bifurcation to the left duct system.(21)

INTERVENTIONAL RADIOLOGIC AND ENDOSCOPIC TECHNIQUES(21)

Although long term patency rates are lower than those seen with surgical reconstruction,non operative techniques can be used when the injury has created a stricture in the biliary tree.when the duct remains in continuity,transhepatic management of bile duct strictures can be performed using fluoroscopy,with sedation and local anaesthesia.with percutaneous access to the biliary tree,a wire is used to traverse the stricture.by use of balloon dilatation techniques,the stricture is dilated and catheter is left in place to decompress the system,to allow healing,to document resolution,and if necessary,to guide repeated dilatations.this approach is successful in up to 70% of patients.(21)

Complications, although frequent,are generally limited and include cholangitis,hemobilia and bile leaks requiring repeated intervention.endoscopic balloon dilatation of bile duct strictures is generally reserved for those with primary bile duct strictures or patients who have undergone choledochoduodenostomy for reconstruction because the ROUX limb does not usually allow endoscopic strategies.therefore series are limited but results are encouraging with 88% of patients responding to therapy and a complication rate of 8% from pancreatitis and cholangitis.(21)

OUTCOMES(21)

Successful outcomes can be achieved in patients undergoing biliary-enteric reconstruction after bile duct injury,with many series showing more than 90% of patients free of jaundice and cholangitis.high success rates are generally achieved when injuries are identified early and patients are referred immediately to experienced centres.in several studies,referral to centres performing complex biliary surgery routinely was associated with better long term success.(21)

Surgical reconstruction provides a durable long term management strategy.management of these injury requires a multidisciplinary management and may need percutaneous techniques as well as surgical reconstruction.(21)

Sepsis at the time of reconstruction and biliary cirrhosis are predictors of stricture.in some studies,results were generally better if trans anastamotic stents were used during reconstruction.chronic liver disease and hepatic fibrosis are associated with higher operative mortality and lower success rates.although a devastating complication ,management is highly successful and restores health related quality of life scores to preinjury levels.(21)

GOALS OF THERAPY IN IATROGENIC BILE DUCT INJURY

1.CONTROL OF INFECTION,LIMITING INFLAMMATION

Parenteral antibiotics

Percutaneous drainage of periportal fluid collections.

2.CLEAR AND THOROUGH DELINEATION OF ENTIRE BILIARY ANATOMY

MRCP or PTC

ERCP(especially if cystic duct stump leak is suspected)

3.REESTABLISHMENT OF BILIARY-ENTERIC CONTINUITY

Tension-free ,mucosa to mucosa anastomosis

ROUX-en-Y hepaticojejunostomy

Long term transanastamotic stents if bifurcation or higher is involved.

INTRA OPERATIVE CHOLANGIOGRAPHY

If bile duct injuries are identified earlier and intra operatively,management could be decided earlier and the prognosis also would be good..there are many methods to diagnose it.intra operative cholangiography could be done by many methods.methylene blue cholangiography is one among them…before discussing about methylene blue intra op cholangiography,lets have a look in to other forms of intra op cholangiography.

NEAR INFRA RED FLUORESCENT CHOLANGIOGRAPHY

It involves preoperative intravenous injection of indocyanine green.it works on the principle that ICG is excreted exclusively in to the bile and that protein bound ICG emits light with wavelength of 830 nm when illuminated with near

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infra red light.

In 2005yavuz selimsari et al published an article regarding preventing bile duct injury by using intra op methylene blue dye cholangiography during lap cholecystectomy.his results were between October 2003 and December 2004,overall 46 patients(of which 9 males)with a mean age of 47(between 24 and 74) underwent lap cholecystectomy with methylene blue injection technique.the diagnosis of GB wall thickening confirmed by preoperative usg. Diameters of stones were greater than 1 cm in 32 patients and calculi of various sizes being smaller than 1 cm were documented in 13 cases.number of bile duct injuries related to anatomic misidentification can be decreased and even vanished by using intra op methylene blue injection technique in to the gallbladder fundus intra operatively.

2.in 2001 Arch surg et al published an article regarding common bile duct injury during laparoscopic cholecystectomy and the use of intraoperative cholangiography.it was a retrospective population based cohort study.conducted in Washington state hospital discharge database reports from 1991 through 1998.the rate of CBD injury in LCs performed without IOC was 3.3 per 1000 compared with 2.0 per 1000 in LCs with IOC.

3.medical journal of Babylon 13:2,2016 published an article regarding methylene blue colouration to eliminate bile duct injuries during laparoscopic cholecystectomy.the abstract says a total of 98 patients with symptomatic cholelithiasis were undergone laparoscopic cholecystectomy using methylene blue for delineation of gallbladder.the results showed that mean operation time and hospital stay were 55 min and 26 hrs respectively.no bile duct injury was recorded.it is concluded that injection of methylene blue could be considered as safe ,effective cheap technique to reduce or even eliminate BDIs during LCs.

4.flum DR,et al.JAMA.2003. published article named intraoperative cholangiography and risk of CBD injury during cholecystectomy.retrospective nationwide cohort analysis of medicare patients undergoing cholecystectomy from January 1,1992 to December 31,1999.his results were CBD injuries were found in 2380(0.39%) of 613706 patients undergoing cholecystectomy with IOC and in 5531 (0.58%) of 956655 patients undergoing cholecystectomy without IOC..this study concluded with routine use of IOC may decrease rate of CBD injury.

IV. METHODS AND MATERIALS

Primary Objectives:

1.To derive conclusions about the occurrence of bile duct injuries during laparoscopic cholecystectomy with and without biliary mapping using methylene blue.

Eligibility criteria

A.Inclusion criteria:

1. Patients present with abdominal pain who after evaluation by USG abdomen,LFT,OGD diagnosed to have cholelithiasis in GRH Madurai.
2. Patients good candidates for laparoscopic cholecystectomy
3. Patients consented for inclusion in the study according to designated proforma

B.Exclusion criteria:

1. Patient with features of acute cholecystitis,
2. Patient with cardiac,respiratory ailments unfit for laparoscopic surgery
3. Pregnant ladies,patients age less than 12 years.

4.Patient not consented for inclusion in the study.

Methodology:

The patients presenting with abdominal pain who after evaluation diagnosed to have cholelithiasis and fit for laparoscopic cholecystectomy in GRH Madurai will be recruited in this study.

Following consent, a questionnaire will be filled to record the patient's demographic data, duration of disease,dietary style ,co-morbid illness,drug history and previous history

Study Place: Department of General Surgery, Madurai Medical College,Madurai.

Study design : This is a prospective study comprising of patients of abdominal pain who after evaluation proved to be suffering from cholelithiasis.this is a comparative study.50 patients are chosen..divided in to two groups each comprising 25 people.one group is followed up with lap cholecystectomy without using methylene blue..another group is followed with lap cholecystectomy with using methylene blue.

study Duration : May 2016 to April 2019

Procedure: The patients were seen in surgical outdoor in emergency and routine hours and were diagnosed on the basis of history, clinical examination and investigations like usg abdomen,LFT,OGD,CT abdomen(if necessary)

Methylene Blue Dye Injection to prevent Bile Duct Injuries

Introduction :

Injection of methylene blue is not new to practice of surgery, frequently used to trace sinus

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or fistula during various procedures, sentinel lymph node biopsy and in chromointubation (Tube patency test). In this study Methylene blue is used to delineate extrahepatic biliary tract including Gall bladder during laparoscopic cholecystectomy by coloring them blue.

It's a novel approach with largest series of 46 cases performed in Istanbul Training Hospital, Istanbul. Basic purpose of this technique is to facilitate young surgeons / residents in beginning of their learning curve to execute a SAFE cholecystectomy and to help dissections in 'Difficult cholecystectomies.

Method :

Gall bladder fundus was punctured by Verress needle and all the bile was aspirated. The same amount of 50% methylene blue (saline diluted) was injected into the gall bladder for coloration of biliary tree ie. gall bladder, cystic duct, bile duct and some times duodenum. The puncture site was held through out the operation with toothed grasper through the lateral subcostal port. Gall bladder was removed by subxiphoid port. Methylene blue is aspirated to prevent leak while removal of Gall bladder.

Post operative consideration :

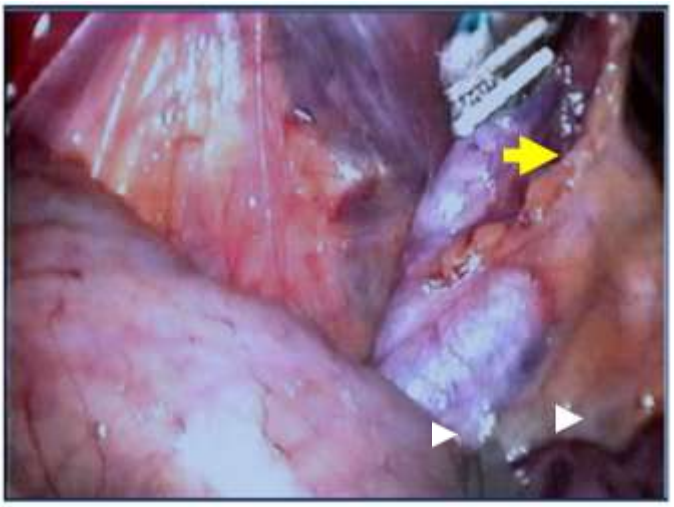
- Patient must be informed that urine may colored blue, as the dye which leaks to duodenum is absorbed and excreted through kidney.
- Ryle`s tube aspirate may be colored blue either intra operatively or post operatively. Confirming patency of common bile duct.

Advantages of Methylene blue injection :

- Safer & faster dissection in Calot`s triangle
- Detection of aberrant anatomy of biliary tract
- To detect bile duct injury (if it does occur) per operatively and enables its repair in the same sitting hence decreasing morbidity of unrecognized bile duct injuries.
- Can supplement Intraoperative Cholangiogram (IOC) interpretation per operatively as it orients surgeon to IOC findings.
- Cost effective, negligible adverse effects and does not prolong operative time.

Disadvantages : Spillage early during the procedure can obscure the field of surgery.

Cystic Stump After Completion Of Cholecystectomy (Note The Blue Dye In The Lumen) Cbd (Arrow Head)



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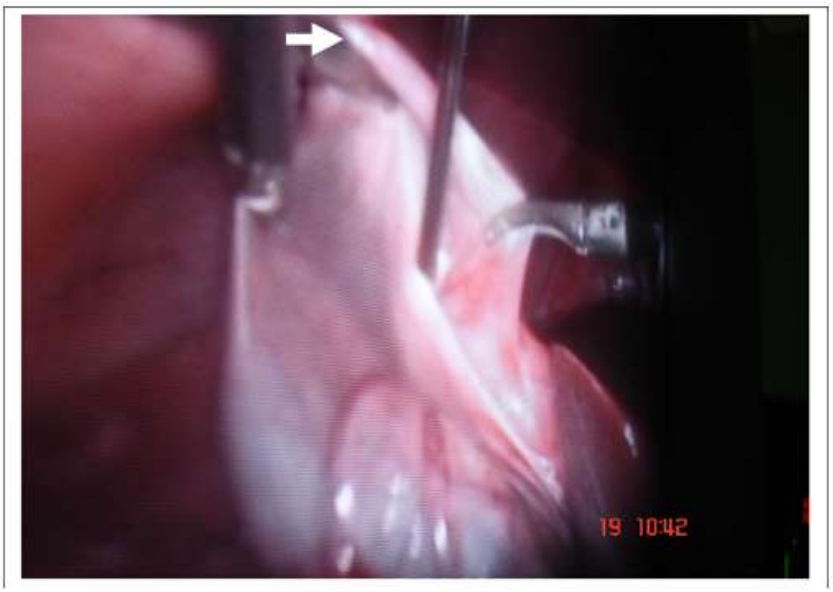
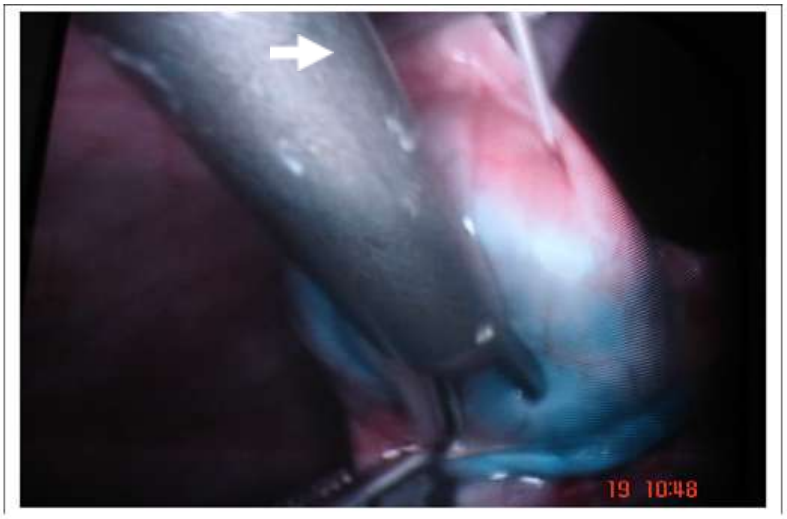
INJECTION OF METHYLENE BLUE DYE INTO FUNDUS OF GALL BLADDER



COLOURING OF GB WITH METHYLENE BLUE



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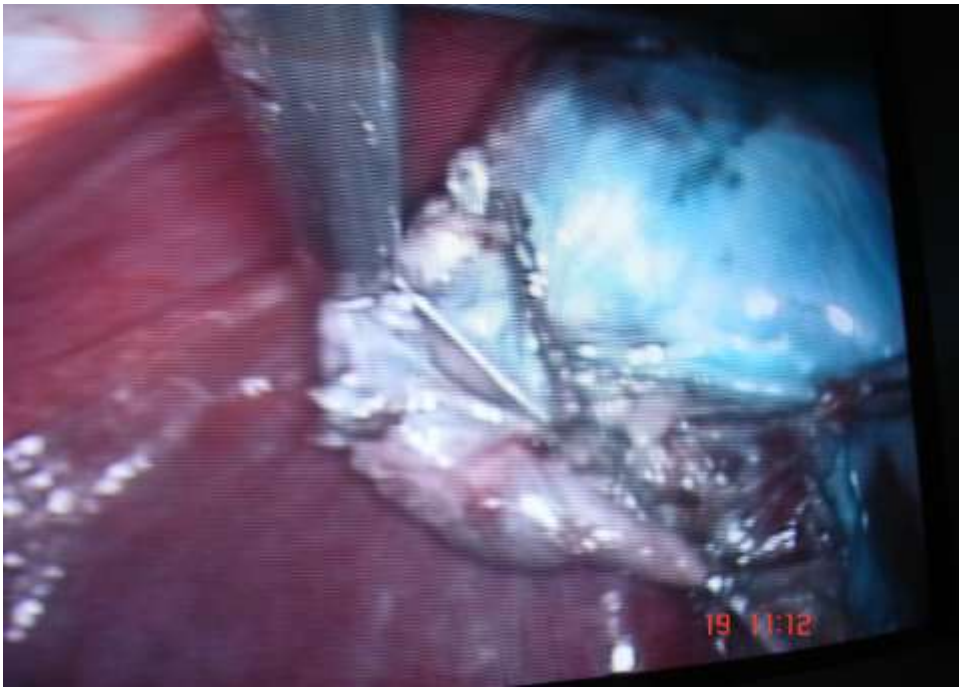
AFTER DIVISION OF CYSTIC ARTERY – JUNCTION OF CYSTIC DUCT WITH GALL BLADDER CLEARLY VISIBLE



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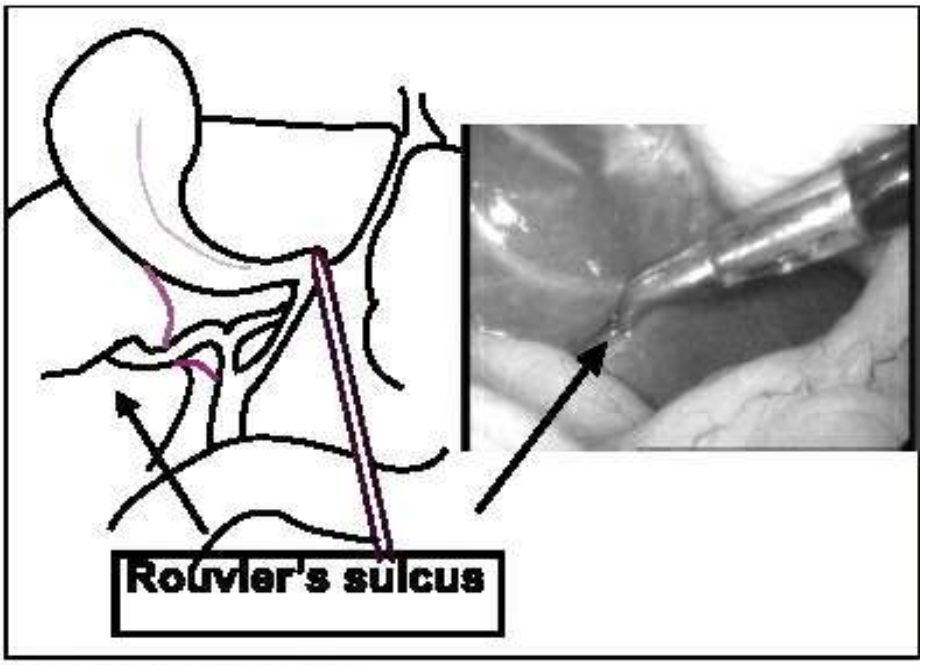

Figure 6: Rouviere's sulcus

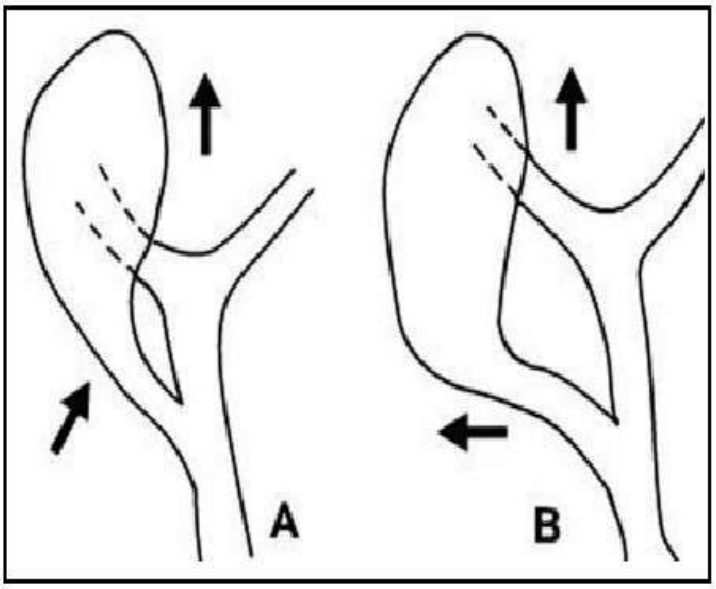

Figure 1: Shows the faulty anterior and medial traction on the Hartman's pouch (A), and the correct lateral and inferior traction(B) to open up the angle between the CD and CHD

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CRITICAL VIEW OR SAFETY WINDOW

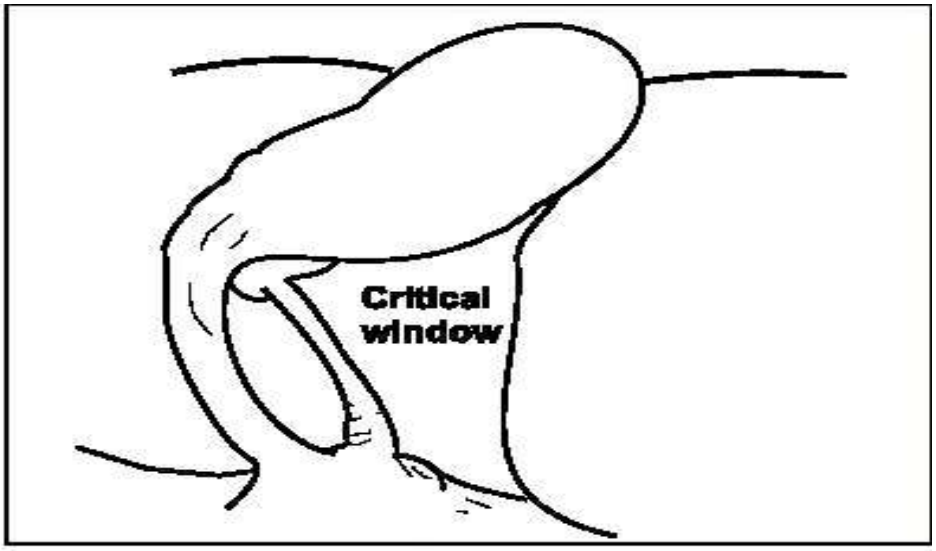


Figure 7: The critical view or safety window

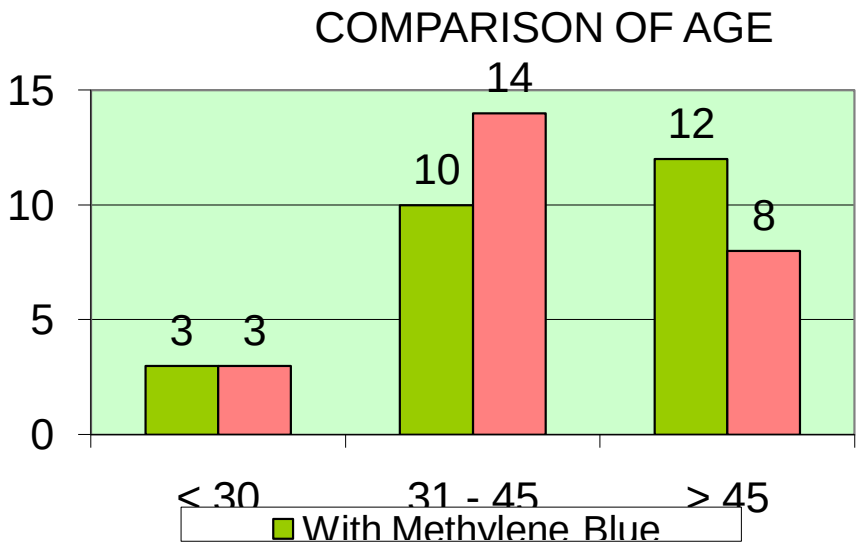
RESULTS

Table 1.

Age	With Methylene Blue	Without Methylene Blue	Total
≤ 30	3	3	6
31 - 45	10	14	24
> 45	12	8	20
Total	25	25	50

First table depicts the age wise distribution of patients that we have chosen for comparative study between bile duct injuries during laparoscopic cholecystectomy with and without biliary mapping using methylene blue.

CHART 1



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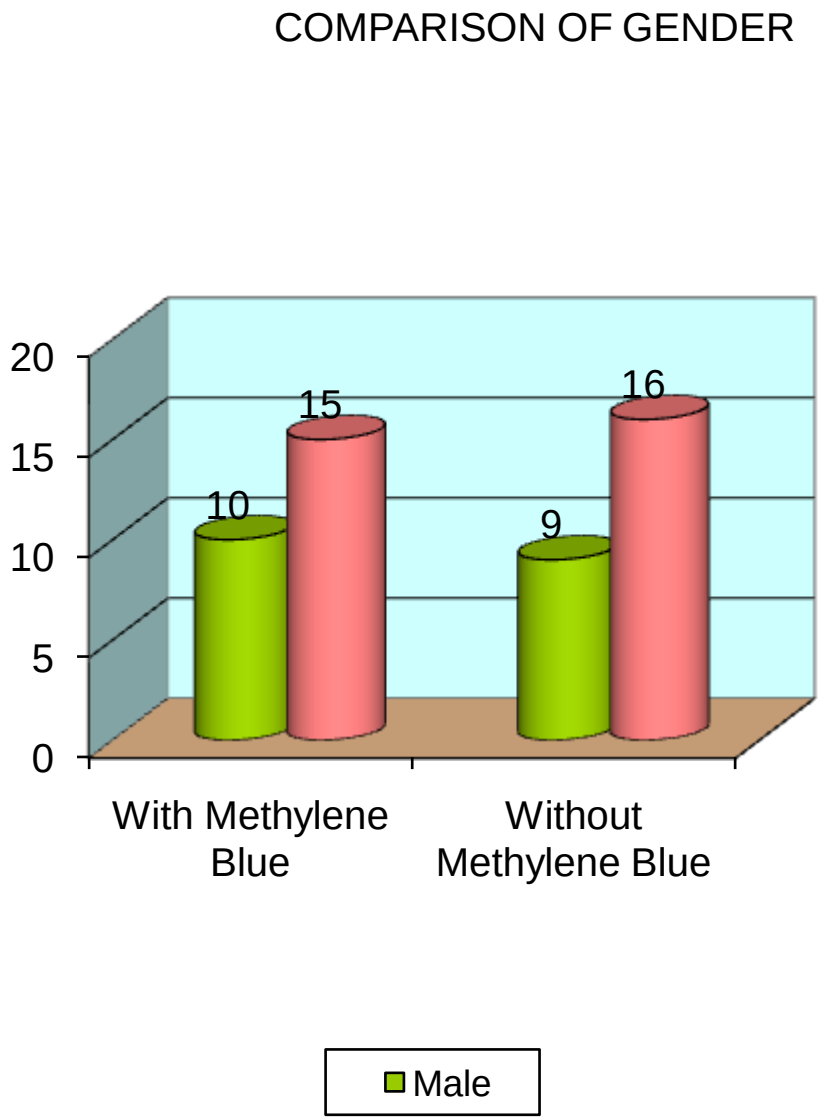
The above chart shows that the patients under the age of 30 chosen for study are minimum.most of the patients chosen for study are between the ages of 31-45.

TABLE 2

Sex	With Methylene Blue	Without Methylene Blue	Total
Male	10	9	19
Female	15	16	31
Total	25	25	50

The above table shows sex wise distribution of patients that we have chosen for comparative study between bile duct injuries during laparoscopic cholecystectomy with and without biliary mapping using methylene blue.

CHART 2



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the above chart shows that most of the patients chosen for study was females.3/5 th of the patients chosen in each group were females.

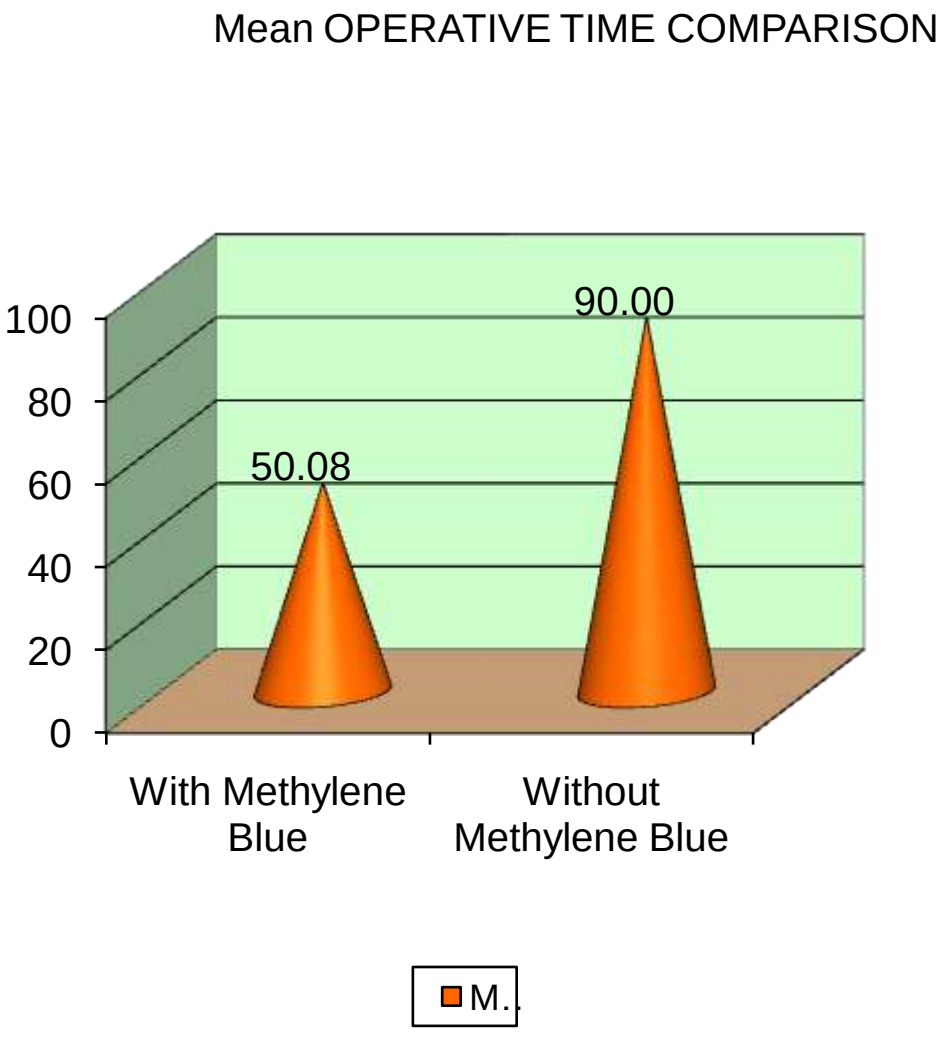
TABLE 3

Operative Time	Mean	S.D	P'
With Methylene Blue	50.08	4.509	
Without Methylene Blue	90.00	7.821	<0.001

Significant

The above table shows that the mean operative time taken for lap cholecystectomy with methylene blue were around 50 minutes.mean operative time for surgery without methylene blue were around 90 minutes.

CHART 3



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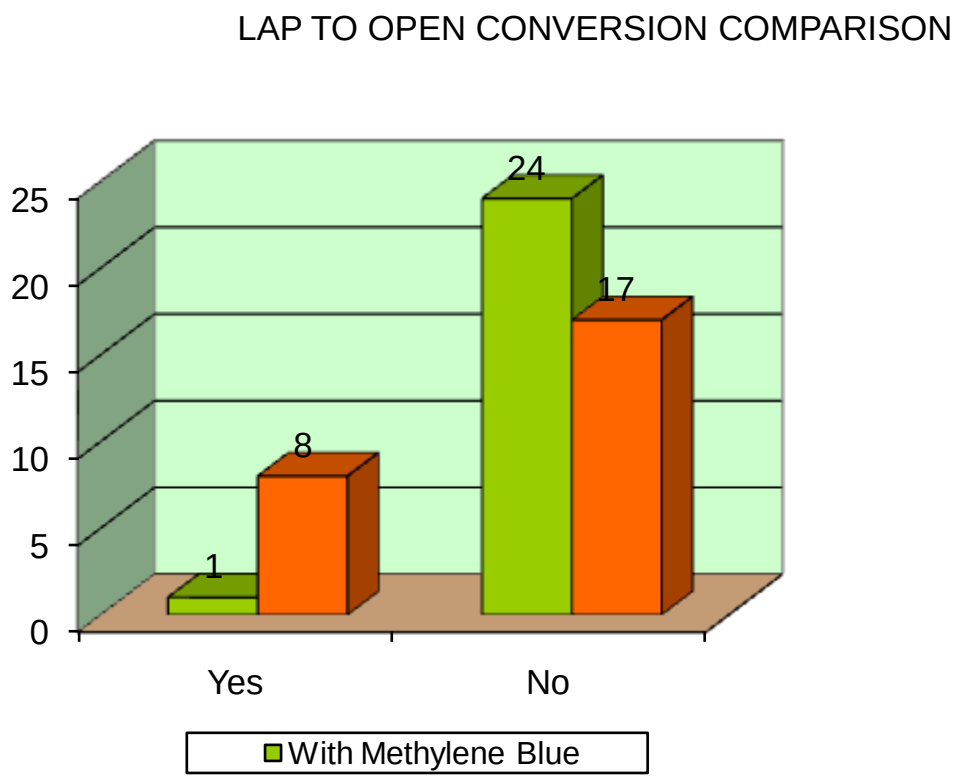
The above chart shows that the prolongation of operative time during laparoscopic cholecystectomy without methylene blue is significant with 1 ½ hours when compared to surgery with biliary mapping which is about 50.0 minutes.

TABLE 4

Lap to Open conversion	With Methylene Blue	Without Methylene Blue	Total
Yes	1	8	9
No	24	17	41
Total	25	25	50
		p value	0.023 Signifi cant

The above table shows the frequency of laparoscopy to open cholecystectomy conversion during lap cholecystectomy with and without biliary mapping using methylene blue.

CHART 4



The above chart depicts that the frequency of lap to open conversion is more in case of laparoscopic cholecystectomy done without methylene blue biliary mapping.this difference proved to be statistically significant.

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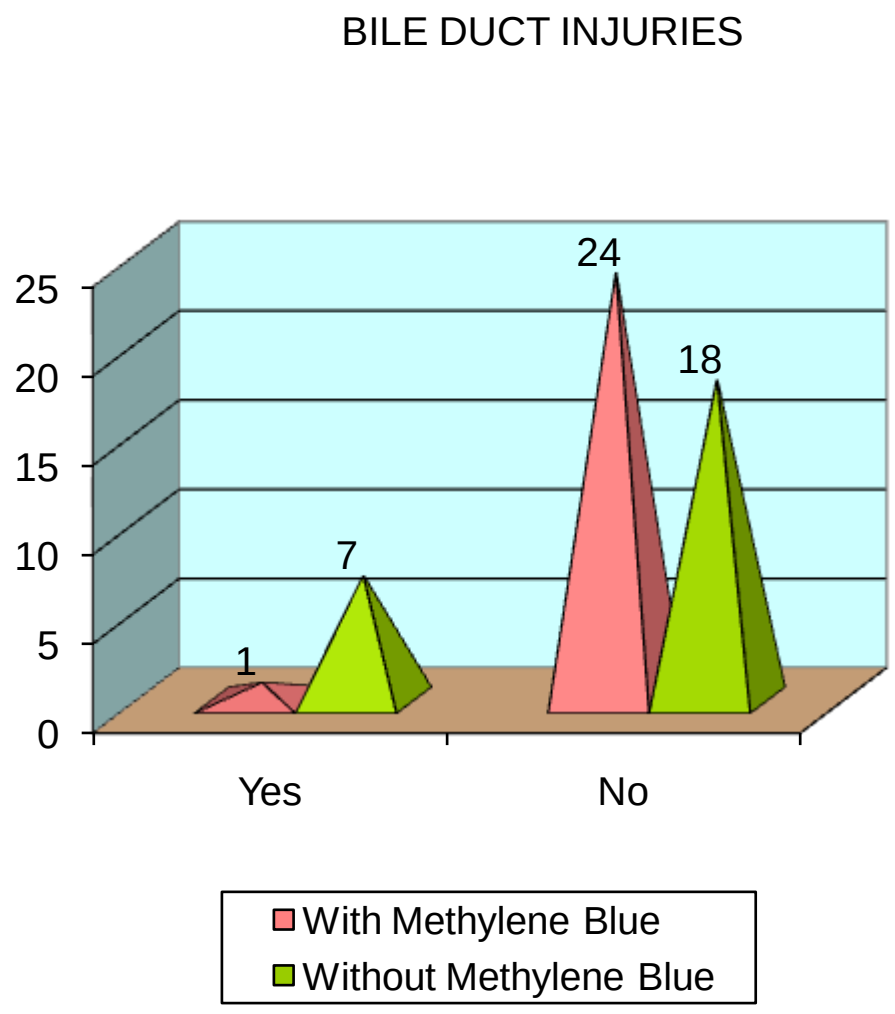
TABLE 5

Bile duct Injuries	With Methylene Blue	Without Methylene Blue	Total
Yes	1	7	8
No	24	18	42
Total	25	25	50
		p value	0.049 Signifi cant

The above table shows the frequency of occurrence of CBD injuries during lap cholecystectomy with and without biliary mapping using methylene blue.

CHART 5



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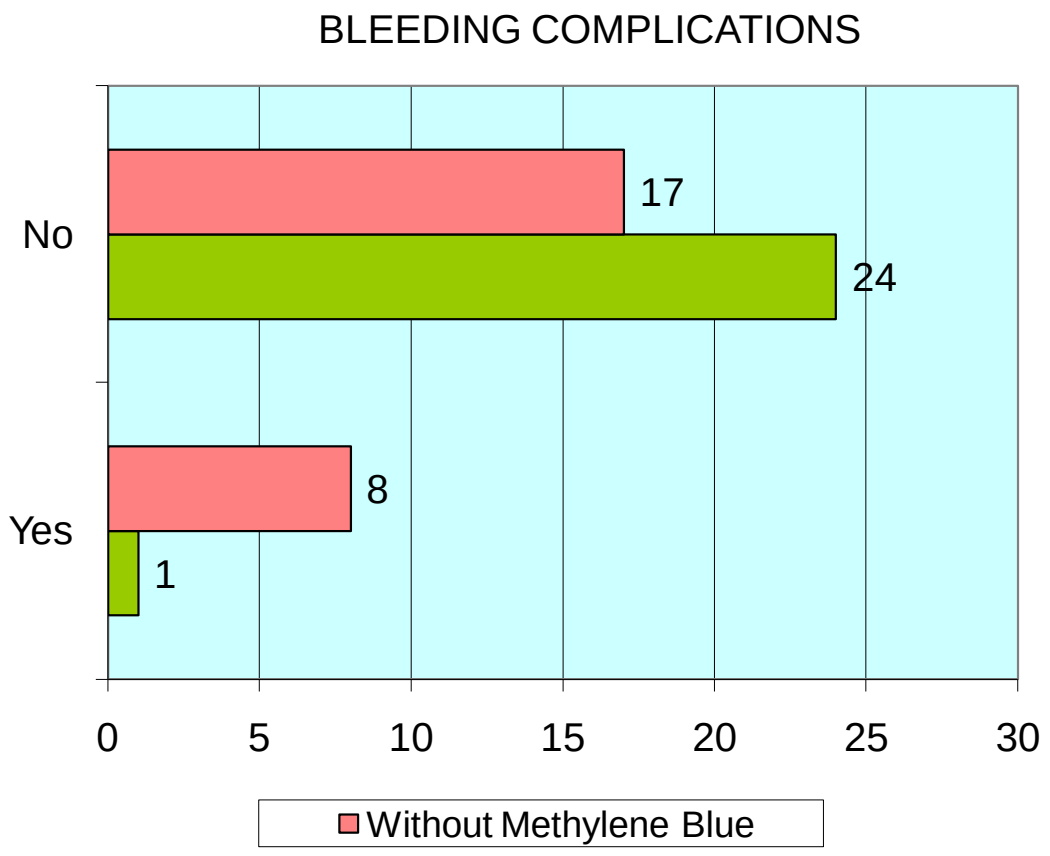
The above chart shows that the frequency of occurrence of CBD injuries during lap cholecystectomy is more in study group containing patients underwent surgery without biliary mapping.

TABLE 6

Bleeding complications	With Methylene Blue	Without Methylene Blue	Total
Yes	1	8	9
No	24	17	41
Total	25	25	50
		p value	0.023 Signif icant

The above table shows the incidence of bleeding complications that occurred between the patients those who underwent laparoscopic cholecystectomy with and without biliary mapping using methylene blue.

CHART 6



The above chart shows that the incidence of bleeding complications is more in patients underwent laparoscopic cholecystectomy without methylene blue biliary mapping .this difference proved to be statistically significant

V. DISCUSSION

The study was conducted among 50 patients those who were admitted in our GRH Madurai with complaints suggestive of cholelithiasis.they are divided in to two groups each comprising 25 patients.one group was

followed up with laparoscopic cholecystectomy with biliary mapping using methylene blue.another group was followed up with laparoscopic cholecystectomy without methylene blue biliary mapping.the results are being discussed here.

Most of the patients chosen for study were found between the ages of 31-45.people chosen below the age of 30 were only 6 patients.3/5 th of the patients chosen were females.

Mean operative time for patients those who underwent biliary mapping were 50.0 minutes.whereas 11/2 hours for those who underwent the surgery without biliary mapping. P value is <0.001.

Out of 25 patients those who underwent surgery with biliary mapping one patient had got converted from laparoscopy to open procedure.whereas 8 patients out of 25 patients from without methylene blue group had got converted from laparoscopy to open procedure.p value is 0.023

Out of 25 patients from methylene blue group one patient had suffered CBD injury.whereas 7 patients from 25 patients of without methylene blue group suffered CBD injury.p value is about 0.049.

Out of 25 patients from methylene blue group one patient had sustained bleeding complications due to iatrogenic injury of blood vessels.whereas 8 patients from 25 patients of without methylene blue group sustained bleeding complications. P value is 0.023.

VI. CONCLUSION

From this study it is confirmed that biliary mapping using methylene blue during laparoscopic cholecystectomy stains the extra hepatic biliary apparatus and makes them conspicuous.this enables the training surgeons in their early phase of learning curve understands the normal anatomy and variations of biliary tree and their associated blood vessels.so the training surgeons can proceed with meticulous dissection of calot's triangle,apply clips over cystic duct and artery without causing damage and in correct time without prolongation of operative time. Chance of conversion from laparoscopic to open procedure is also rare in biliary mapping using methylene blue.

Thus the incidence of Common bile duct injuries could be decreased by using biliary mapping with methylene blue during laparoscopic cholecystectomy.

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