

# HPB Surgery

**For Beginners**



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## Preface

The idea of compiling a book arose during a discussion with a colleague about negative feedback from students regarding a series of lectures. I realized that students expect factual knowledge from lectures, and when these expectations are not met, dissatisfaction occurs. This gap can be effectively addressed through a book.

"HPB Surgery for Beginners" is primarily intended for undergraduates and early-career professionals in HPB surgery. It provides a broad overview of all areas of HPB surgery and highlights areas for in-depth reading to help readers expand their knowledge. The book also discusses the transformation and change in thinking required for undergraduates entering this field.

### Objectives

- Introduce medical students to the field of HPB surgery.
- To understand the core areas in HPB diseases.
- To provide a basis for further reading.

## Introduction

### HPB surgery for undergraduate students

#### Being a medical student



We spend almost five years in the medical school as undergraduates. This is nearly 7 - 8% of your life and it is prime time of your life. These five years will transform you into a different person, most of the time without your knowledge. Students come from different backgrounds, with different personalities, skills, and competencies. However, in the end, all are expected to develop uniform and standard qualities which will enable them to take responsibility of a human life.

This transformation will be somewhat a difficult time period in your life. You are neither a doctor nor a lay person and, you will realize this when you start seeing patients in wards. You do not have any authority. Most of the time you are the least important person in the hospital. Yet, you are expected to behave like a doctor. It is this pressure that will ultimately change you. A major part of your transformation will happen during the last three years as a medical student and during the internship period.

Now let us talk about surgery and surgeons. If someone is to become a surgeon, further transformation happens from the level of a medical student and a junior doctor. The training is even more vigorous. Surgeons are trained to think and behave differently to a physician. Opening into a person's body is something dramatic and traumatic. "The first time I assisted with hernia surgery, I fainted". Surgeons are gradually trained to handle this impact. If you were to place yourself in the patient's shoes, the mere thought of cutting and opening into your body will give you chills. A surgeon should be presentable to the patient, so that patients will look up to the surgeon with confidence, thus allowing the surgeon to do

the needful. This is far more intense and dramatic than treating with injections or tablets. During the surgery, a surgeon needs to control the environment around him in the manner desired. A surgeon needs to learn to make decisions quickly; for example, when there is a sudden gush of blood, only a split-second is there for a decision, and one wrong move can be devastating. Surgeons also need to know how to make rational decisions. For instance, when a surgeon is doing a difficult cholecystectomy, and sees a wide tubular structure coming from the gallbladder, it could be either the common bile duct or cystic duct. If it is the cystic duct, it needs to be divided, but division of the bile duct instead will be disastrous. This decision is purely on experience combined with rational thinking which cannot be gained by a brain trained for memorizing. Most surgeons do not have a wealth of knowledge. They know very little, but they are able to use the little they know rationally. A surgeon also needs to be accountable and available. Patients are bound to develop complications from surgery, and when a surgeon makes a cut and inflicts an injury, he is responsible for that patient. This sense of responsibility is inculcated during the surgical training. All of these make surgeons a different breed. Most are authoritative and arrogant with controlling personalities.

Before 1960, we did not know about the structure of DNA, however, today we know enough to modify it and clone a new life. The same could be said about the field of surgery. Many years ago, medical practitioners practiced medicine without dividing it into different branches. Later, medicine was separated into four major disciplines: surgery, medicine paediatrics, gynaecology and obstetrics. Medicine is an evolving discipline. Initially, general surgeons used to perform all types of surgeries. With the advancement of science, more and more discoveries were made. With our current knowledge, it is impossible for one person to take care of everything from head to toe. As a result, sub specialization evolved, and the discipline of surgery started to branch out into different systems.

Hepato-pancreatico-biliary (HPB) surgery is a branch of surgery that observes and treats diseases of the liver, pancreas, and biliary system. Procedures in HPB surgery ranges from the simplest laparoscopic cholecystectomy, endoscopic retrograde cholangiogram to complex living donor liver transplants. Advanced HPB surgery requires fine skills, a deep understanding in the basic sciences, human skills to work in harmony with different specialties and the physical strength to work for long hours. However, all great things start with small seeds. Undergraduates are the future of medicine. No field will advance without new, young, and energetic people to take it forward. Even if one does not become a surgeon, understanding these diseases in the HPB system is an integral part of clinical practice.

## History of HPB surgery

Hepatobiliary surgery is a developing field of medicine. The rapid development started in the late 1960s, with the innovative contributions from Surgeons such as, Professor Henri Bismuth, Late Dr. Leslie Blumgart, Professor Masatoshi Makuuchi, and Late Dr. Thomas Starzl.



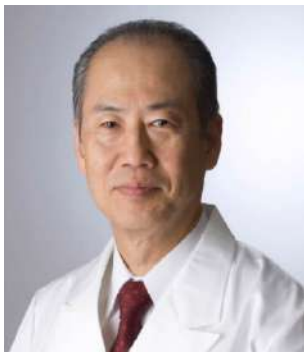
***Professor Henri Bismuth***

A pioneer and renowned international expert in the hepatobiliary field in early 70's



***Late Dr. Leslie Blumgart***

One of the most influential figures in the evolution of modern approaches to liver, pancreas, and bile duct surgery



***Professor Masatoshi Makuuchi***

A pioneer and a living legend in the surgical field in the modern days.



***Late Dr. Thomas Starzl***

A surgeon and researcher who performed the first successful liver transplant on a human patient in the 1960s

# Basic Sciences in HPB Surgery

## Basic Sciences - Anatomy

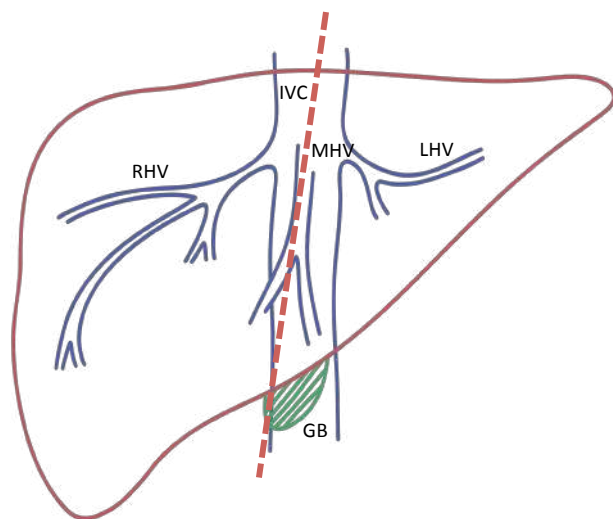


In medical school, we start our learning with Anatomy. I still remember stepping into the anatomy dissection room with fear, respect, and curiosity to observe a dead human body. The strong odor that was there in the dissection room was quite impactful. I still think the dissection room atmosphere has a strong impact on a medical student when they start their career. Nowadays, at times we argue and believe that the time spent on dissection is futile academically. In my view, strong impression made in the dissection hall has an impact in changing a layperson to a medical undergraduate.

Anatomy is the foundation of a surgeon. For a surgeon, it is not the terms that are memorized that is important, but the ability to imagine three-dimensionally. When I close my eyes, I can rotate the liver in my mind in all directions and see what is around the liver layer by layer. This is the only way a surgeon can plan a surgery, expect what is there during dissections, and plan new strategies. As medical students, if you can look at anatomy with mental imagination than merely memorizing the terms, that is more meaningful and long lasting. For this, you can combine your studies with viewing the 3D reconstruction videos that are readily available today. View surgery videos, observe surgeries and draw your own diagrams.

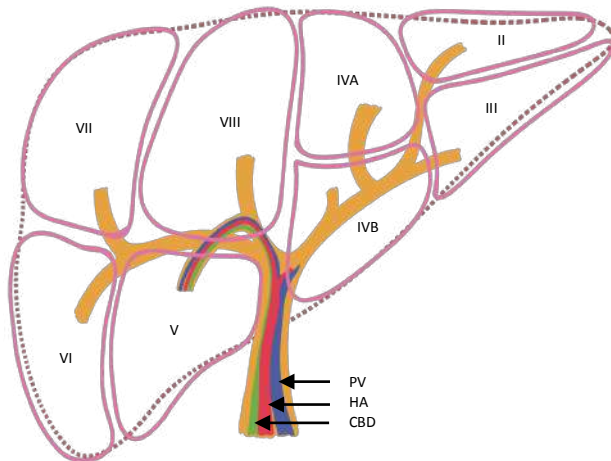
### Anatomy of the liver

- The liver is a soft, fleshy organ weighing about 2% of the body weight.
- The principle plane of the liver lies along the middle hepatic vein, which separates the liver into right and left hemi-livers (Figure 1.A).
- The liver has eight functional segments <sup>(1)</sup>.



**Figure 1.A** – The venous anatomy of the liver. IVC – Inferior vena cava, RHC – Right hepatic vein, MHV – Middle hepatic vein, LHV – Left hepatic vein, GB – Gallbladder.

- Each segment has a pedicle supplying it and each pedicle contains a portal vein, hepatic artery and a branch of the bile duct (Figure 1.B).



**Figure 1.B** – The functional segments of the liver. PV – Portal Vein, HA – Hepatic artery, CBD – Common bile duct

- The Caudate lobe (segment 1) lies deep inside the liver wrapping around the IVC.

- Liver has a dual blood supply –70% of its blood flow is from the portal vein and 30% is from the hepatic artery.

- All the blood draining from the intestines needs to pass through the liver.

- Liver has three hepatic veins (Right, middle & left) all of which drain into the IVC.

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### Reference

- 1) <https://youtu.be/s0M-8tdb3dw?si=MBovlgPRfNYJOLk>



## Basic sciences – physiology



Physiology is the study of bodily functions. It is important to understand normal function in order to interpret and treat abnormal functions. Physiology is a subject with great depth. It is easy to get lost in physiology as the amount of information is vast. For example, if you take nerve conduction, the information can go as deep as ion channels and their functions. The best method to learn physiology is to understand how it happens as a story rather than memorizing and reflecting if it was actually understood or not. Knowledge in Physiology can be understood in layers of depths. If you go into deeper layers without understanding the surface layer, it can be confusing.

### Functions of the liver and its derangements

- Liver has a large functional reserve. As a result, a considerable proportion of the liver can be removed without a significant impact to its normal physiology.
- Patients will not have major clinical manifestations until the disease has involved a significant liver volume.

#### Synthetic function

- **Plasma proteins** – Albumin is synthesized in the liver. A drop in albumin level may indicate liver dysfunction. However, albumin has a half-life of over 10 days.
- **Clotting factors** – Vitamin K dependent clotting factors are produced in the liver. They have a shorter half-life compared to albumin. Liver derangement leads to a rise in INR.

#### Metabolic function

- **Bilirubin metabolism (Figure 2)<sup>(2)</sup>**

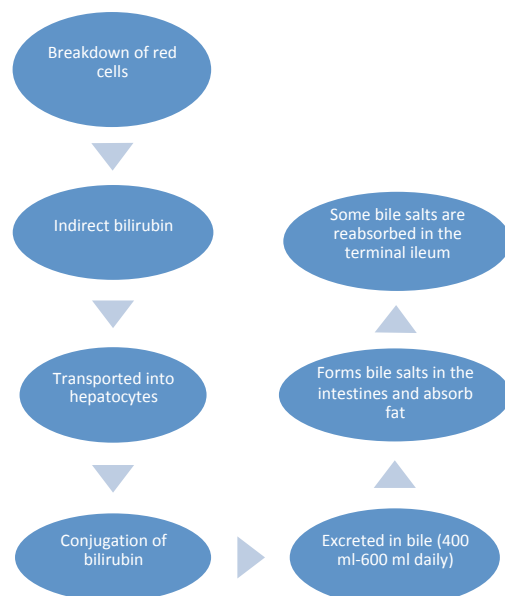


Figure 2 – Bilirubin metabolism

- **Lactate metabolism** – Lactate produced by tissue metabolism is rapidly utilized in the liver. Blood lactate levels start rising very early in liver dysfunction due to impaired metabolism.
- **Gluconeogenesis and glycogenolysis** – The liver is the main organ that mobilizes glucose into circulation. Liver failure will lead to hypoglycemia.



- How does the INR increase in obstructive jaundice?
- Albumin and INR can be used as indicators of liver function. What is the difference between these two as functional indicators of the liver?

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### Reference

- 2) <https://youtu.be/RwvbO-40xvw>

# Symptomatology of HPB diseases

## Clinical assessment of the liver

- The Liver is the largest solid organ but almost all of its volume is hidden under the dome of the diaphragm and the rib cage.
- Hence, the liver can only be palpated when it is significantly enlarged in size or has been pushed down.
- It also has a significant functional reserve and therefore, a significant cell mass needs to be affected before clinical manifestations are seen. For example, if you take a patient with a metastatic tumour in the right lobe of the liver, he will have no jaundice or liver dysfunction. However, this will happen when there are multiple bilateral liver metastases involving almost the entire liver volume.
- Liver injury leads to damage of hepatocytes and cholangiocytes. This releases various cellular enzymes such as AST, ALT, GGT, and ALP.
- Functional damage of the liver can be assessed by looking at the levels of proteins synthesized by the liver or by the molecules metabolized in the liver.



- How does the pattern of change in enzymes give a clue to understand the underlying liver injury?

## Understanding symptoms related to the liver



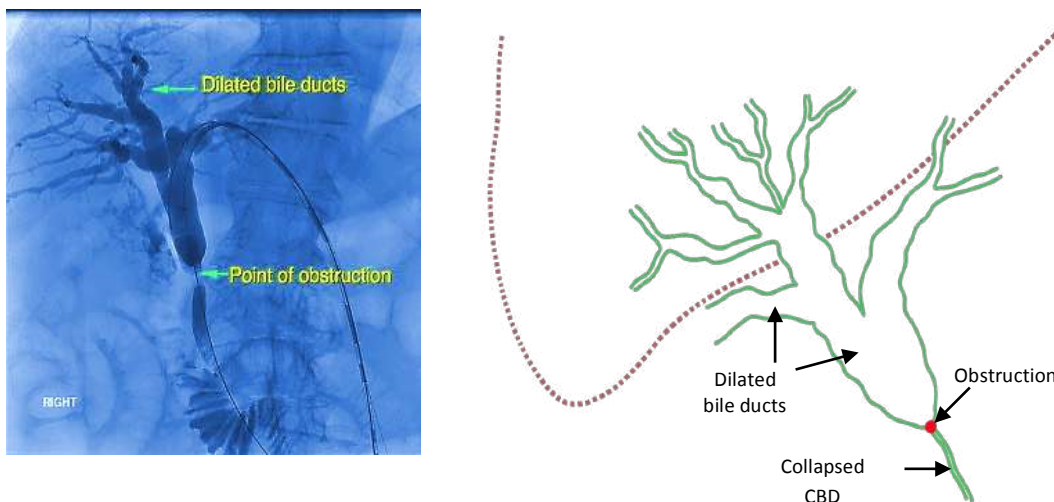
There are no rules in medicine. As medical students we study and try to apply what we have read and memorized as it is, to a patient. However, in biological systems combinations are endless and the end manifestation of a combination is highly individualized. Hence, one should remember that there are no rules in medicine. As an example, a young 25-year-old thin female having a stone impacted in the cystic duct may complain of typical signs and symptoms however, the same stone in a 60-year-old obese

female who has had several surgeries may have a completely different expression of the condition.

As medical students, your objective of learning is to pass the exam. Exam needs remembering and reproducing. Clinical medicine is far from that. As discussed, it is hard to reproduce what you memorized as it is to an individual patient. So, what should we be doing when we study? The focus should shift from memorizing to understanding. Try to understand and imagine how it happens. Then it is easy to work out the endless possibilities that could happen. During the clinical rounds and seeing patients, one should try to apply what they have understood. It is like a detective looking for a clue in a crime scene. He will first gather clues by making observations, then he will think of different scenarios and work out the most likely, by excluding the scenarios one by one, until the criminal is caught. It is both an interesting and exciting procedure. If you think like this, the practice of medicine will also become interesting, but it will take some time for most of us to understand this.

### *Understanding surgical jaundice*

Unlike in medicine, in the specialty of surgery, we deal with focal problems. Surgical jaundice is a focal problem compared to medical causes of jaundice.



**Figure 3** – A: Cholangiogram showing a biliary obstruction. B: Schematic diagram of a biliary obstruction.

- Whenever there is a focal obstruction in the biliary tree, it leads to a rise in bilirubin.
- The obstruction leads to dilatation of the duct system proximal to it.
- Obstruction can happen in any place in the biliary tree, both intra hepatic and extra hepatic.
- If the obstruction is distal, the manifestations are profound.
- The manifestations are proportionate to the tightness and duration of the obstruction.
- Hence, it can vary from a mild rise in bilirubin with mild jaundice or significant rise in bilirubin and deep jaundice. When the duct system is obstructed, the pressure inside

the system builds up. This ductal hypertension is then transmitted to the liver and portal triads which leads to cell injury and release of enzymes.

- When the system is obstructed, it leads to bile stasis and then to cholangitis, particularly if an organism is introduced to the stagnant bile.



- What is the basis behind pruritus?
- Explain how the absorption of fat and clotting systems are impaired in obstructive jaundice.

### *Pain in HPB disease*

- The HPB system has two types of structures: Solid organs including the liver and pancreas. The hollow structures include the biliary duct system and pancreatic duct system. Both these components are pain sensitive.

Pain can arise due to a mechanical obstruction of a hollow structure. Obstruction provokes vigorous contractions leading to episodic pain (colic). Sometimes, there can be inflammation of the hollow structures (e.g., Cholecystitis/cholangitis) and it produces continuous pain.



- If a patient has both obstruction and super added infection, how will it manifest?
- Why is pain not seen in a patient with a malignant bile duct obstruction?

- The pain arising in the liver/pancreatic parenchyma is due to capsular stretch or irritation. This usually causes cell injury and Inflammation and results in continuous pain.



- Why does the pancreatic pain reduce when bending forward?
- How does coeliac plexus block or thoracic splanchnectomy help in chronic pancreatic pain?

## Stone disease of the biliary system

- In Pathology, you must have studied about the principles of stone formation in the presence of nidus, stasis, and super saturation, leading to sedimentation.
- Cholesterol, calcium, and bile salts are deposited around a nidus.



Using this concept, try to understand why the gall bladder, sclerosing cholangitis and biliary strictures can lead to the formation of stones and how the stone composition can affect the treatment of a stone.

### Asymptomatic stones

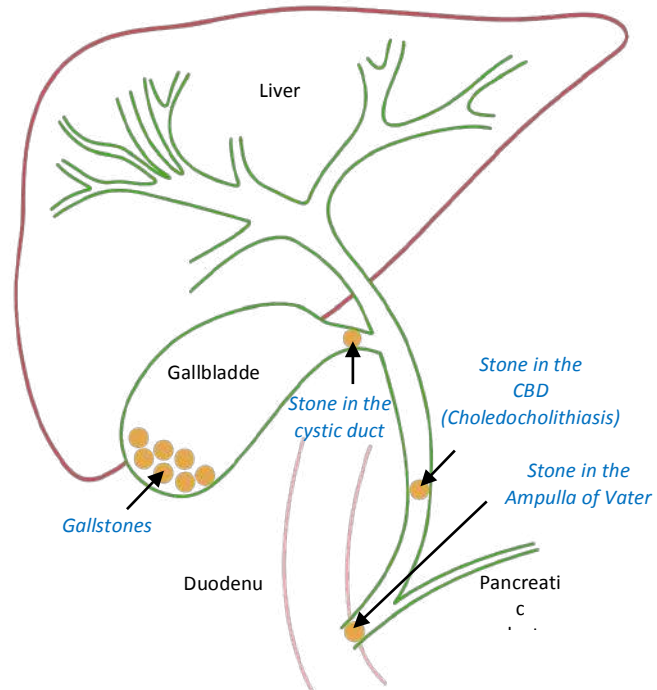


*A treatment is offered to a patient, considering the risks and benefits, especially where surgical procedures are concerned. Surgery inflicts injury on a patient, and one has to be certain that this iatrogenic injury is justified, to yield sufficient results. The treatment can be justified if the condition already has significant implications or has a likelihood of that happening in the future. We also take into consideration the cost of utilization and availability of resources in making these decisions.*

- 10% of the population carries stones in their gall bladders without any symptoms.
- 2.1 million Sri Lankans will have gallstones. If we are to treat these stones, it will require 2.1 million cholecystectomy surgeries.  
Should we operate all these individuals with stones to prevent them developing cholecystitis?

## Symptomatic stones - Biliary colic

- A stone floating in the gallbladder can unexpectedly obstruct the gallbladder outflow (cystic duct or Hartmann's pouch). This will lead to buildup of pressure within the gallbladder and result in biliary colic.
- The impacted stone can result in three scenarios: it may fall back into the gallbladder, releasing the block and relieving symptoms; it can fall into the common bile duct, leading to an entirely different set of symptoms; or it can stay impacted and progress to developing **cholecystitis**.



**Figure 4** – Sites of obstruction in the biliary tree due to gallstones. CBD – Common bile duct.



- Imagine the sequence of symptom progression due to changes in the underlying disease process.

## Acute cholecystitis

- Acute cholecystitis typically begins when a stone blocks the gallbladder outflow.
- The gallbladder responds by distending and contracting, with pain. Eventually it leads to collection and stagnation of bile within the gallbladder. The stones in the gallbladder can harbor organisms. As a secondary event, organisms begin to proliferate in the obstructed bile. This infective, inflammatory process is known as **cholecystitis**.

- Cholecystitis can follow various paths:
  - Infection can be resolved with, or sometimes without treatment. Others, the infection can progress.
  - In extreme cases, the gallbladder may rupture, into the liver (forming a localized abscess) or to the peritoneal cavity (leading to peritonitis and sepsis).
  - In some cases, the omentum forms an inflammatory mass around the gallbladder and limits the infection.



**Figure 5** - Ultrasound image of an impacted gallstone.

At times, the infection in the blocked gallbladder becomes suppurative, and pus accumulates in the gallbladder. This is known as empyema.



- How will imaging help you to detect cholecystitis?
- What features will help you to differentiate biliary colic from cholecystitis?

### *Principles of management*

It is important to understand the core concepts. Details of management is an expansion of the core concepts.

- 1) Resuscitate the patient and control the pain.
- 2) Control of sepsis – Antibiotics/guided drainage of gallbladder/removal of gallbladder
- 3) Prevent recurrent attacks – interval cholecystectomy.



- See some pictures of an acutely infected gallbladder and a normal gallbladder.
- Try to find a video of a hot cholecystectomy.



- The source of infection is the gall bladder, so if the gall bladder is removed the infection can be controlled easily <sup>(3)</sup>.
- However, not cholecystectomy or emergency cholecystectomy is not done in all the patients. If you see a normal gallbladder and an infected gallbladder, you will understand the basis of this decision.
- In some patients it is first treated with antibiotics and removed after a safe interval.

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### Reference

- 3) <https://youtu.be/7ApGq0lIR3k>

## Chronic cholecystitis

- In some patients, the presence of stones in the gallbladder leads to a low-grade persistent infection and inflammation eventually leading to chronic inflammation.
- At times, they may get mild on and off flare-ups of inflammation.
- Eventually, the gallbladder becomes thickened, fibrosed and contracted. The symptoms produced are chronic, vague, and nonspecific. Hence, diagnosis of chronic cholecystitis can be difficult to differentiate from other causes like functional bowel disorders and peptic ulcer disease.



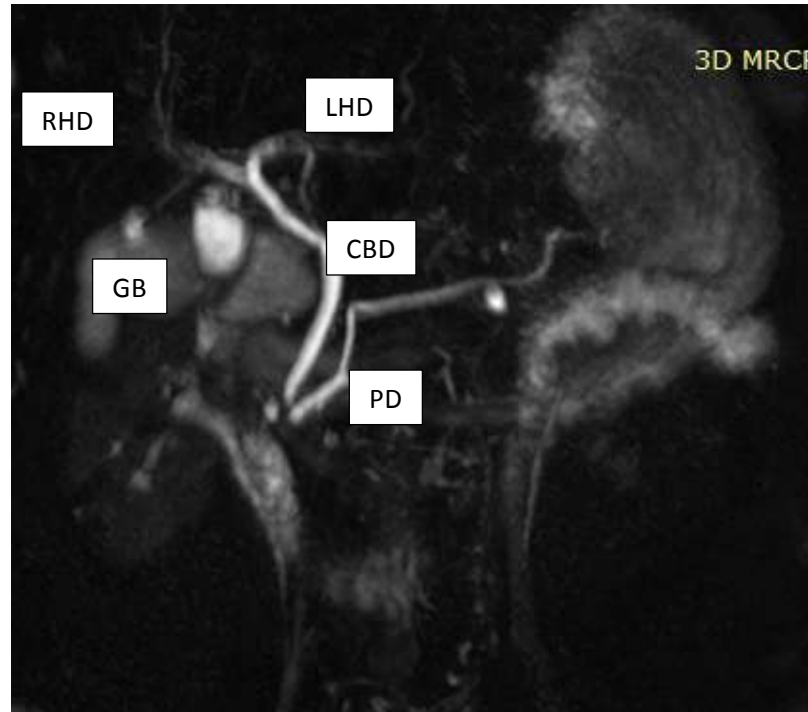
- See a specimen of chronic cholecystitis and try to understand the changes that you may see in imaging.

### Principles of management

- 1) Exclude other causes producing similar symptoms before considering the removal of the gallbladder.
- 2) Demonstrate chronic changes in gallbladder.
- 3) Elective removal of gallbladder.

## Common bile duct

### Common bile duct stones



**Figure 6** – MRCP Image. RHD – Right hepatic duct, LHD – Left hepatic duct, CBD – Common bile duct, PD – Pancreatic duct, GB – Gall bladder

- Stones in the common bile duct (CBD) require treatment.
- A stone can fall from the gallbladder into the CBD, or it can form within the CBD itself (a primary stone).
- *Primary CBD stones* are formed in the presence of bile stasis, and it is a gradual process.
- *Secondary stones* fall into the CBD suddenly, compared to the slow enlargement of primary stones.
- Hence, primary stones are usually painless, and the onset of symptoms is less dramatic.
- Secondary stones in the CBD are dangerous, and can lead to obstruction, jaundice, stasis, cholangitis, and gallstone pancreatitis and therefore, they need urgent treatment.



- Read about “T tube” and how the practice of T tube use has changed.

## Cholangitis

- Any stasis in the biliary system can lead to cholangitis.
- Organisms originating from the GI system can proliferate into the obstructed biliary system under high pressure.
- Consequently, organisms and toxins can enter the bloodstream, causing the patient to deteriorate rapidly.

### *Principles of management*

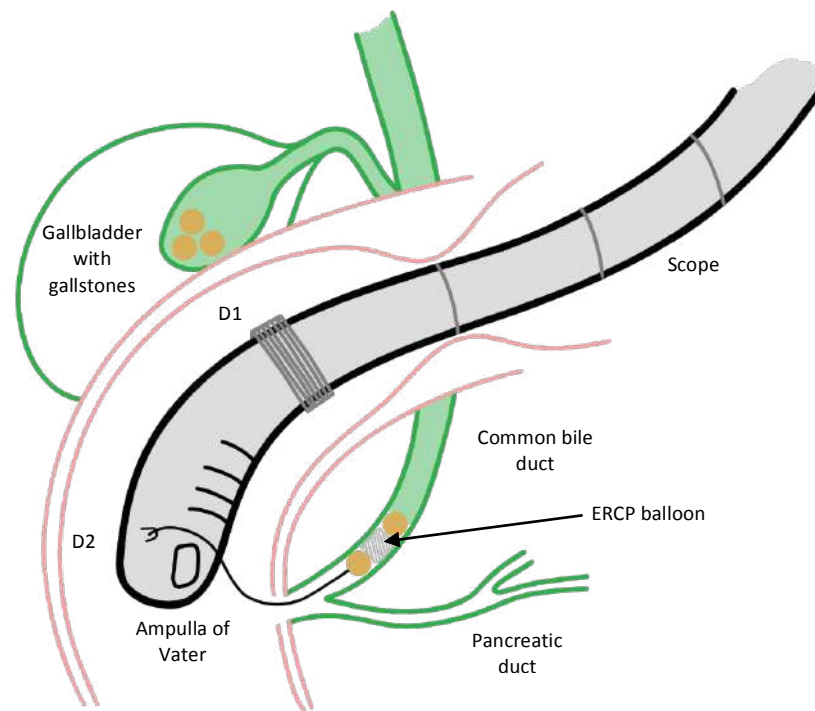
- 1) Resuscitation
- 2) Intravenous antibiotics
- 3) Decompression of the biliary system
- 4) Definitive treatment for the obstruction



- How do you use principles of antibiotic treatment to treat cholangitis?

### *Decompression of the biliary system*

- An obstructed biliary system is deadly. Apart from the previously mentioned acute complications, longstanding obstruction leads to fibrosis of liver and cirrhosis.
- The biliary tree can be accessed proximally or distally to decompress it.
  - 1) *Percutaneous trans hepatic approach*  
Through the skin, dilated bile ducts are approached with ultrasound guidance. Through the dilated system, obstruction can be accessed, stented, or drained <sup>(4)</sup>.
  - 2) *ERCP*  
Through the ampulla, the common bile duct is accessed, and therapeutic procedures can be carried out <sup>(5)</sup>.

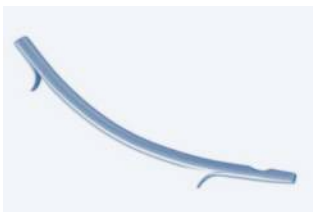


**Figure 7** – Extraction of a stone using ERCP.



- Observe how an ERCP is done. Notice the features of the ERCP scope and also observe different types of accessories used.
- Observe a sphincterotomy. During ward work, see how a patient is prepared for ERCP and how a patient is observed in the ward following the procedure.
- Read about common complications of ERCP.

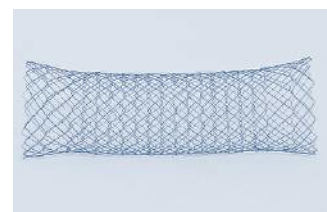
- Biliary stents are placed in order to relieve obstructions. If the cause of the obstruction is a stone, it can be removed.
- However, when there is an obstruction that cannot be removed, stents are placed across the block.
- Stents in the biliary tree cannot be left inside it for long periods of time.
- Different types of stents are used in different situations.



*Plastic stents*



*Covered metal stents*



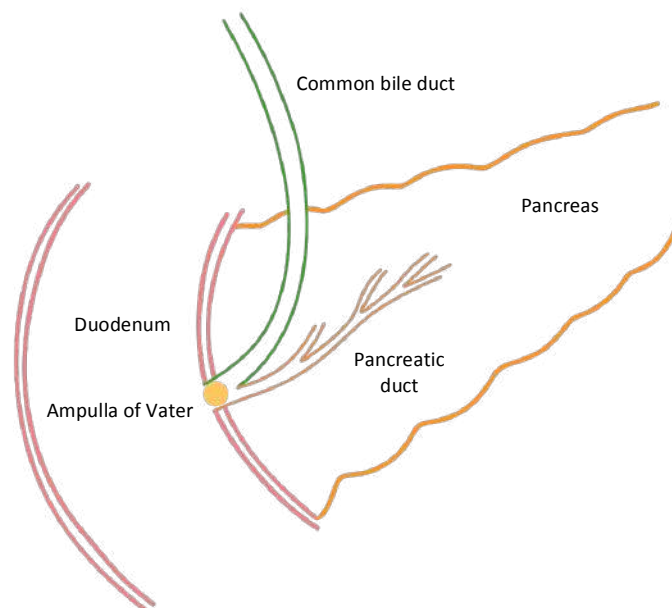
*Uncovered metal stents*

## References

- 4) [https://youtu.be/\\_KIMNahmP9U](https://youtu.be/_KIMNahmP9U)
- 5) <https://youtu.be/4p8Y3MwgawM>

## Gallstone pancreatitis

- Pancreatic duct and bile duct opens into the duodenum through the ampulla of Vater.
- Manipulation of this common opening leads to an alteration in the normal physiology.
- In some patients, passage of a stone through the ampulla can cause a transient obstruction of the main pancreatic duct (MPD), causing increased pressure in the MPD which can then lead to the activation of pancreatic enzymes.
- When a small gallstone passes down the CBD and through the Ampulla of Vater, it can activate the enzymes and cause gallstone pancreatitis.



**Figure 8** – Stone passes into ampulla of Vater.



- Try to explain the physiological basis of the rise in INR with obstructive jaundice and how a correction is done prior to a procedure.

## Cholecystectomy

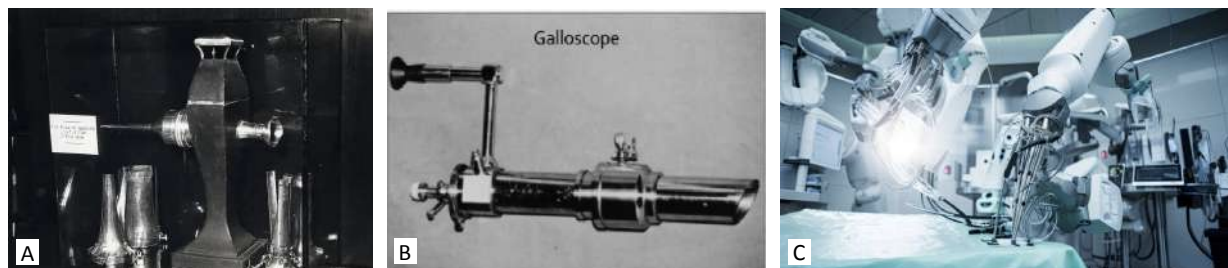
### Evolution of Laparoscopy



The traditional approach in performing surgery was to make large cuts and expose the area of interest. Modern science progress when people ask two basic questions; are we doing it right and can we do it better and start acting on this line of thinking.

In 1797, Philipp Bozzini thought differently and designed a series of mirrors under candlelight to look into the urinary bladder, it was called *lichttilter/light tilter*. When someone comes up with an idea, many others contribute and refine it to make something even greater. Everything that we use today in our life is a result of this collective evolving knowledge that has been passed down from one person to another. However, it is not easy to make a new idea acceptable to the majority.

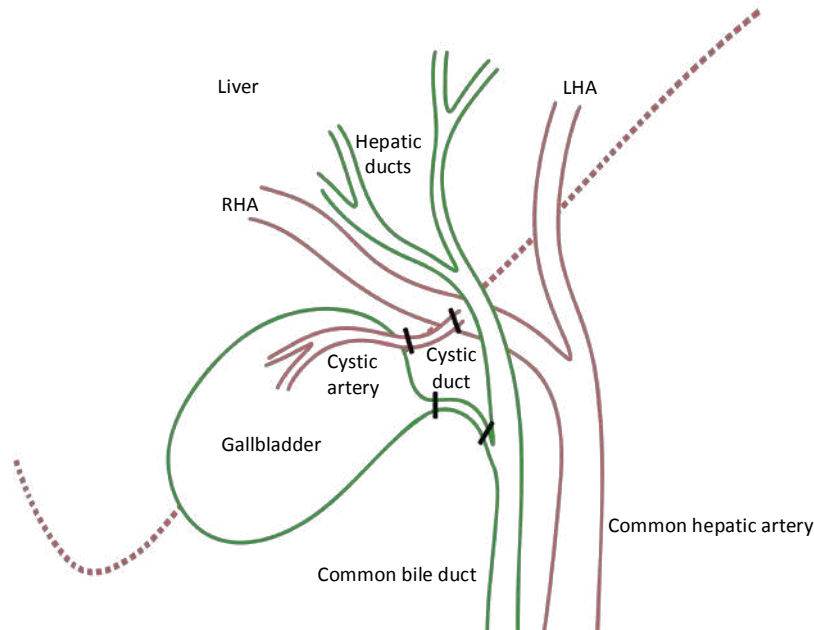
In 1969, Kurt Semm developed a laparoscopy system to perform an appendectomy. The idea was resisted by many of his colleagues. They thought that he had an abnormal brain and as a result, was pressured to undergo a brain scan. However, with time, laparoscopy has become the future of surgery.



**Figure 9** – A, B – Primitive versions of minimal access surgery, C – Modern robotic surgery console

### Laparoscopic cholecystectomy

Laparoscopic cholecystectomy is the **gold standard** for removing the gallbladder. Open surgery is performed when the laparoscopic access and approach is difficult or deemed unsafe.



**Figure 10** – Schematic diagram of a laparoscopic cholecystectomy. Cystic duct and cystic artery are clipped at their proximal and distal ends prior to dissection. RHA – Right hepatic artery, LHA – Left hepatic artery

The basic steps in surgery includes:

- 1) Entering into the peritoneal cavity and creating a pneumoperitoneum.
- 2) Identifying and isolating the gallbladder.
- 3) Dissection of the Callot's triangle.
- 4) Clipping and dividing the cystic artery.
- 5) Identifying and dividing the cystic duct.
- 6) Dissection of the gallbladder from its bed.
- 7) Delivery and closure of the ports.



- Observe and try to identify each step during a laparoscopic procedure when you are doing the surgery appointment.
- Try to work out post-operative complications by observing each step and how to identify complications during the postoperative period.

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### Reference

- 6) [https://pie.med.utoronto.ca/TVASurg/TVASurg\\_content/assets/masterFolders/PB\\_difficultCholecystectomy\\_standard/video/SD/video.mp4?\\_=1](https://pie.med.utoronto.ca/TVASurg/TVASurg_content/assets/masterFolders/PB_difficultCholecystectomy_standard/video/SD/video.mp4?_=1)

## Gallbladder polyps

- Gallbladder polyps are clinically significant as they carry a risk of malignancy.
- The risk of malignancy is predicted by the size and number of polyps.
- Small polyps less than 5 mm can be observed and, the larger ones over 1 cm in size need cholecystectomy considering the higher potential for malignancy.



- What about polyps sized between 5 mm and 1 cm?



## Principles of treating HPB malignancies



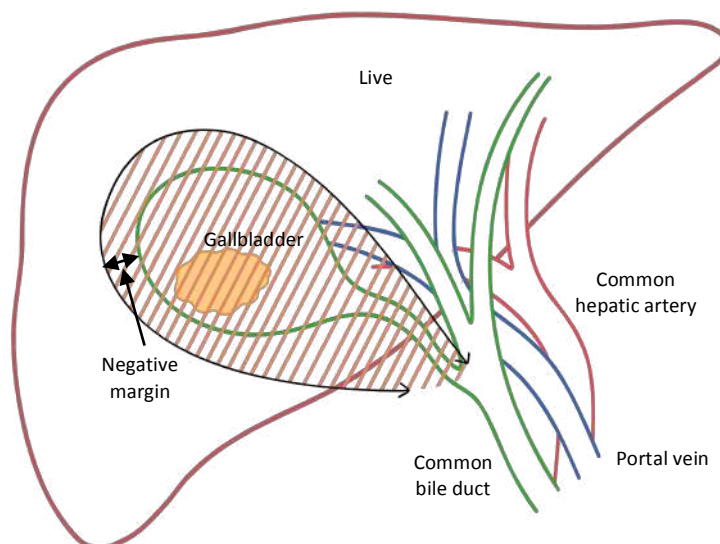
Cancer cells are a group of cells that have changed from their original state. Cells undergo alterations in their original structure and lose their normal function in a gradual process. Once a cell becomes cancerous, its sole intention is to proliferate, invade, and spread.

- **Rapid proliferation:** Cells divide rapidly, and at the same rate, some cells die, leading to a high turnover. These cells are metabolically hyperactive, rapidly growing, pressing, and pushing against normal tissue.
- **Invasion:** In a normal organ, cells are usually limited to a specific boundary. However, cancer cells extend beyond this boundary, a phenomenon known as infiltration. They infiltrate into nearby structures.
- **Spread to other organs:** Some of the cells infiltrate into blood and lymphatics. Eventually, some of these cells can break off and travel with the flow into another organ, where they get lodged and proceed to proliferate and invade that organ. Millions of cell clumps need to break off into the blood for one clump to settle in a different place and grow. In other words, by this time, the tumor has become a systemic disease.
- **Curative resection:** Treatment of cancer is based on the understanding mentioned above. Cancer can be treated with a *curative intent* or *palliative intent*. Curative intent treatment involves the complete surgical removal of the tumour with a safe margin. However, when the tumour has infiltrated a surrounding vital structure that cannot be removed, it is considered unresectable.  
Sometimes, there can be instances where the surgeon removes the tumour, but they may not be 100% sure that it has been completely removed. In such cases, patients may be offered adjuvant treatment (treatment given after the main treatment), such as local radiotherapy to the surgical site.
- **Advanced cancer and palliative treatment:** When a tumour spreads to distant organs or infiltrates organs around it, it is considered to be advanced, and the patient no longer benefits from curative treatment for the local primary site. At this point, the patient is likely to have millions of circulating cancer cells in the blood, with many already growing in different organs. Consequently, these patients cannot be cured through surgery and are primarily treated with systemic therapies such as chemotherapy and immunotherapy. The main intention of this treatment is to prolong survival and delay the appearance of symptoms, a strategy known as *palliative treatment*.

- **Adjuvant systemic treatment:** In instances where a surgeon operates on the tumour but is uncertain about distant metastasis, there is an interim period between microscopic cells entering the blood and macroscopically appearing in distal organs. Standard investigations and scans may not reveal any tumour nodules during this period. To address this, patients are offered adjuvant systemic treatment, to destroy early microscopic disease and potentially offer a cure. This is referred to as *adjuvant systemic treatment*.

## Gallbladder cancer

- These tumours are considered to be highly aggressive and carries a poor prognosis.
- Surgical resection is the only chance of cure. However, surgery is effective only for localized disease.
- Part of the liver is removed with the gallbladder to get a negative margin.



**Figure 11** – Excision of gallbladder with resection margin

- Most patients present late with advanced disease.
- In the presence of dissemination into the liver, spread to distant lymph nodes, and the presence of peritoneal deposits, it is considered advanced and offered palliative systemic treatment.



- What factors are considered when staging a gallbladder cancer?
- Why does carcinoma of the gall bladder present at an advanced stage?

## Bile duct cancer

- Tumours arising in the bile ducts are called *Cholangiocarcinoma*. They present with jaundice.
- Tumours arising in intrahepatic bile ducts are usually mass forming and are called *Intrahepatic cholangiocarcinoma*. These present with a mass.
- Tumors in the right and left ducts, near the confluence, are known as *Hilar cholangiocarcinoma*.
- Surgery is the only curative treatment for Cholangiocarcinoma.
- Tumours located distally in the bile ducts are combined with pancreatic resection.
- Proximal (Hilar) tumors are combined with a liver resection.
- Part of the common bile duct, common hepatic duct, left and right hepatic ducts that lie within the porta hepatis, are closely related to the hepatic artery and the portal vein.
- Bile duct tumours can infiltrate into these structures very easily making the tumour inoperable.

### *Basic steps in managing a Cholangiocarcinoma*

- 1) Understand the extent of the tumor
  - a. Proximal extent into the liver
  - b. Distal extent
  - c. Radial (circumferential) involvement
- 2) Optimization
  - a. Decompress the biliary system depending on the patient's condition
  - b. Optimization of nutrition
- 3) Surgical resection or palliation depending on the assessment



- Try to find out about the imaging investigations that you can do to identify the extent of the tumour.
- How can you palliate their symptoms?

## Choledochal cyst

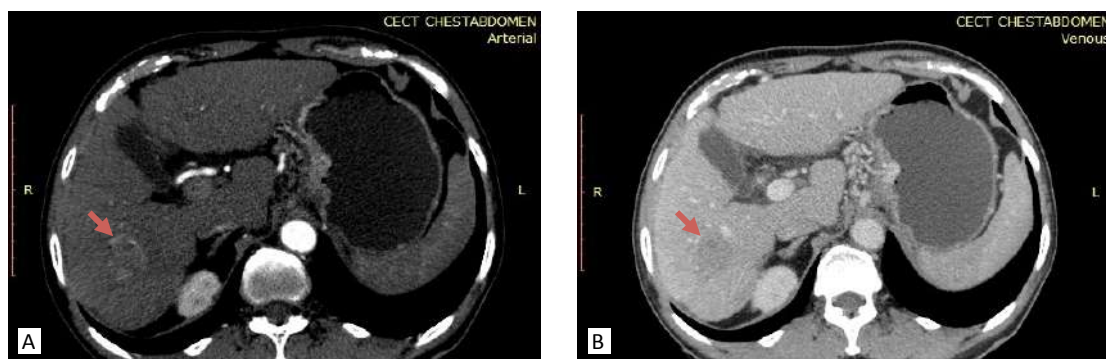
- Usually, bile ducts are dilated when there is an obstruction in the biliary system. As a result, intra ductal pressure will rise leading to duct dilatation.
- However, in choledochal cyst, the primary pathology is within bile duct wall.
- These ducts are abnormally and grossly dilated without an obstruction. Thus, the flow in the duct is stagnant and leads to stasis. This result in bacterial proliferation, cholangitis, stone formation and increases the risk of cancer.
- The treatment is to excise the dilated system and reconstruct using a small bowel loop.



- Find out the different classifications used to describe the extent of choledochal cysts.
- Can we resect all types of choledochal cysts?

## Liver lesions

- 10 % of the population has some form of a lesion in the liver.
- Simple cysts are the most common.
- When a patient presents, they demand an answer as to whether this can be ignored, or whether this needs to be followed-up or removed. In such a case,
  - 1) *Benign lesions* – can be left alone.
  - 2) *Potentially harmful lesions* – may be either removed or followed up.
  - 3) *Already malignant or symptomatic benign lesions* – needs treatment.
- However, sometimes it is a difficult task to find out as to which category the lesion belongs to.
- Ultrasound scan is only a screening tool. It detects the presence of a lesion but provides little information about its diagnosis.
- In evaluating a liver lesion, cross sectional imaging (CT/MRI) is the primary modality of imaging.
- By looking at the imaging characteristics in two different phases of a CT scan, some lesions can be identified confidently.



**Figure 12** – Images of a contrast enhanced CT scan. A – Arterial phase enhancement. B – Venous phase wash off showing the typical pattern seen in hepatocellular carcinoma.

- However, each lesion is unique and not all lesions will have the same imaging characteristics. For example – even though arterial enhancement and wash off is typical of a hepatoma, not all hepatomas will have this typical pattern.



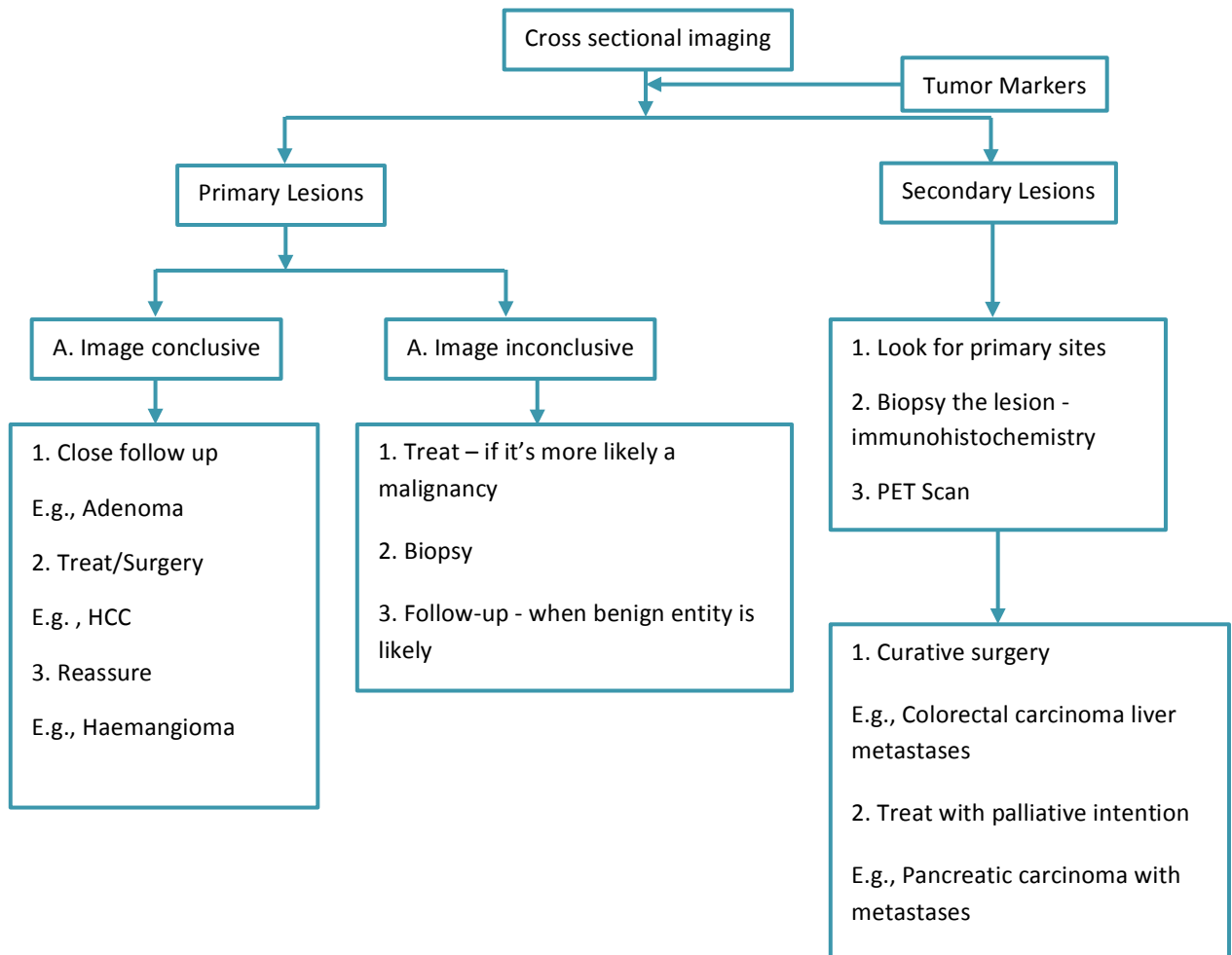
- How do you identify the different phases of a CT scan?
- Arterial phase CT images are taken within 30 seconds and venous phase CT images are taken within 70 seconds after administering venous contrast. How do you explain this?

- Benign lesions – *Adenoma, Focal nodular hyperplasia, Benign cyst, Hamartoma, Haemangioma.*
- Premalignant lesions – *Biliary cystadenoma, Giant adenoma, Dysplastic nodules.*
- Malignant lesions – *Hepatoma, cholangiocarcinoma, rare tumors.*
- Secondary deposits from other primary tumours elsewhere.



- Try to find out the different imaging characteristics you may encounter in these different liver lesions.
- Revise basic pathology about each of these conditions.

**Line of investigating a solid liver lesion**



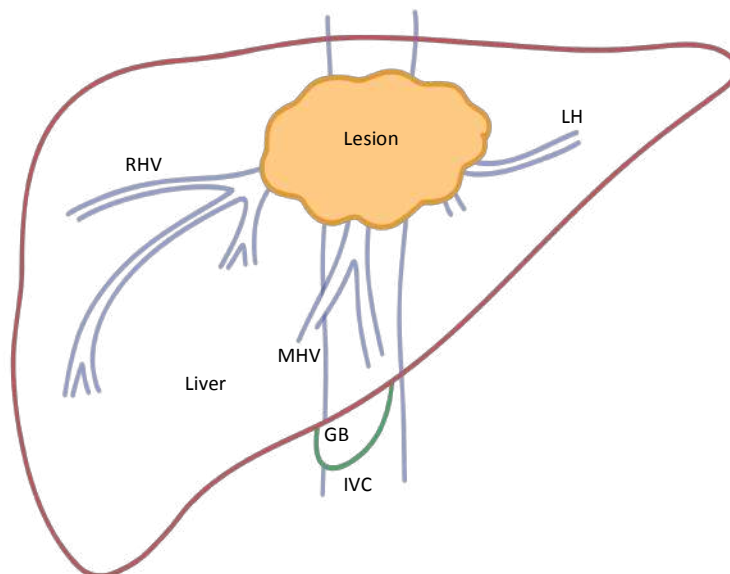


- Read and try to find out how the immunohistochemistry may help to find the primary tumor site.
- Read the principle of using a PET scan and how it detects lesions.
- In what instances are false positive results seen?

### Treatment of a liver lesion

- Primary curative treatment for most of the liver lesions is surgery.
- In order to offer curative treatment for a lesion in the liver, the following needs to be fulfilled,
  - 1) The patient's bodily physiological reserves should be sufficient to withstand the surgery.
  - 2) It should be technically possible to operate and remove the tumor.
 

E.g., If the tumor is infiltrating all three hepatic veins, it is technically not possible to operate.



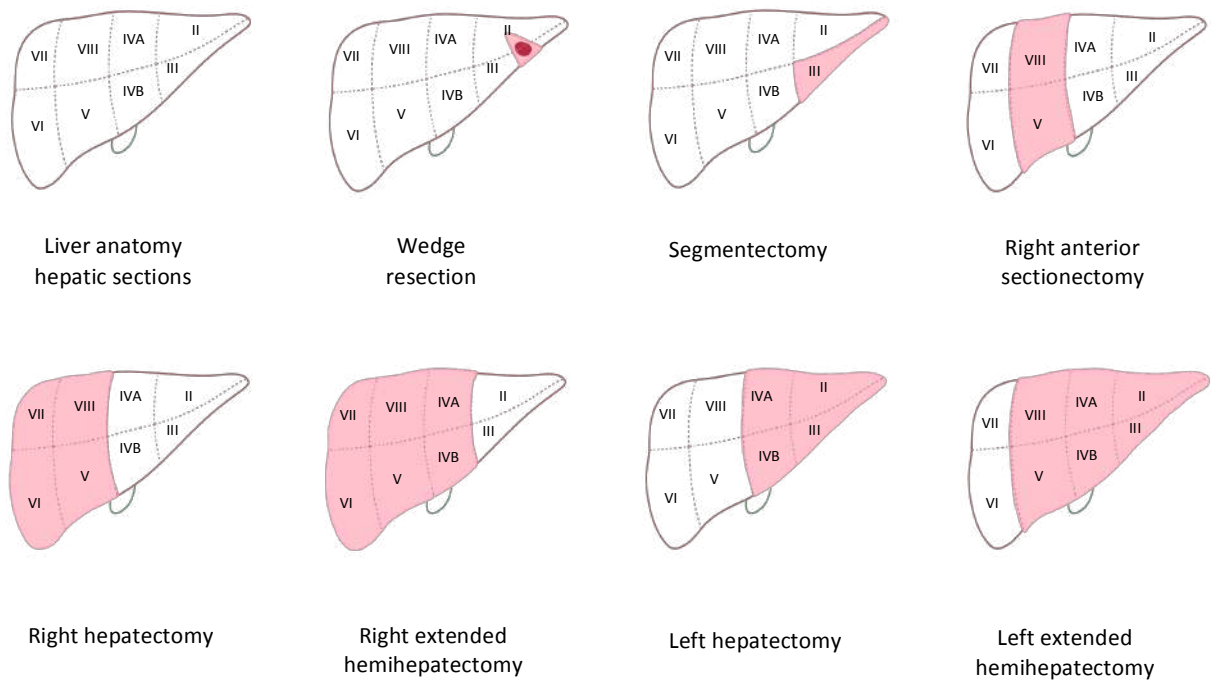
**Figure 13** – Liver lesion involving all three branches of the hepatic vein.  
 RHV – Right hepatic vein, MHV – Middle hepatic vein, LHV – Left hepatic vein, GB – Gallbladder, IVC – Inferior vena cava.

- 3) There should be no residual tumors in the liver or elsewhere in the body after surgery.
- 4) The patient should have adequate residual liver volume after surgery.

For the patient to survive after surgery, the liver should maintain minimal function during the postoperative period but, after a few weeks the liver will regenerate and stabilize.

The residual liver function and the capacity to recover is dependent on the quality of the liver parenchyma.

E.g. – If two patients are taken, one with a normal liver and another with a cirrhotic liver, the cirrhotic liver will require a larger volume to produce the same function.



**Figure 14** – Types of Liver Resections.



- Find out the hematological investigations and other special tests that can be done to assess the functional status of the liver.



## Hepatocellular carcinoma

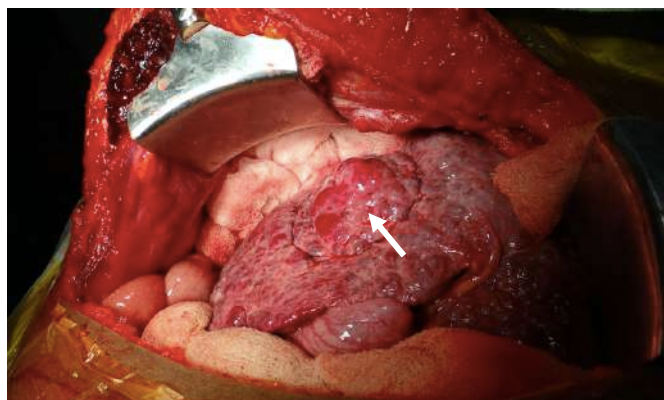


Figure 15 – Operative picture of a hepatoma in a cirrhotic liver

- *Hepatocellular carcinoma* (HCC) is the most common primary liver malignancy.
- Most of the HCCs arise in patients with a background cirrhotic liver.
- The degree of background cirrhosis is highly variable among patients with HCC.
- In patients with advanced cirrhosis, the patient outcome is mostly dependent on the stage of cirrhosis.

A patient with child C cirrhosis is more likely to die from liver failure rather than from a 2 cm hepatoma in the liver.

- In patients with early cirrhosis, the surgical treatment will follow the same principles as in the treatment of other liver tumors.



- Read about screening for HCC in cirrhotic patients.

### *Liver transplant for HCC*

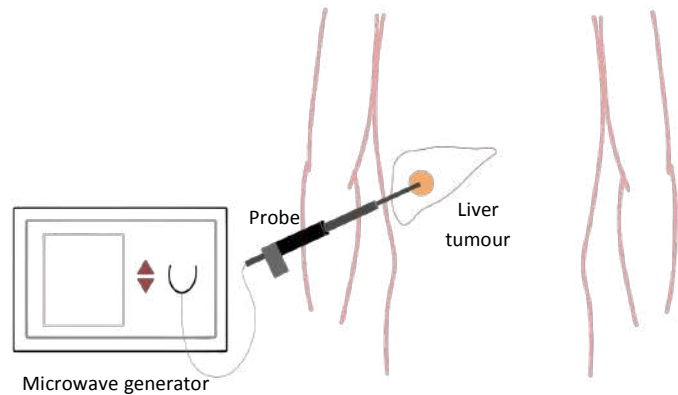
- For patients with cirrhosis and HCC, liver transplant offers the most effective chance of cure, addressing both the underlying liver disease and the tumor.
- However, not all patients with HCC are suitable candidates for liver transplant.
- Patients are given immunosuppression following a transplant which increases the risk of recurrence.
- Patients with large tumors and multiple nodules have a higher tendency of recurrence after a liver transplant and so are usually considered to be outside the criteria for transplant.



- Read about the criteria used for the selection of HCC patients for liver transplant.

### Ablation of liver tumors/HCC

- Different energy devices or chemicals can be used to ablate liver tumours.
- Microwave or radiofrequency waves produce heat, cryo-probes freeze the tissues, and chemicals such as alcohol can also be used.
- The energy is applied into the tumor via image guidance.
- Hence, the effectiveness of the ablation is dependent on multiple factors such as the location, size, equipment quality, and the skill of the operator.
- There is a maximum size up to which energy delivery is effective.
- Hence, large lesions cannot be treated with ablation.



**Figure 16** – Resection of a liver tumor using microwave ablation.

### Trans arterial treatment for liver tumors (TACE)

- HCC has a predominant blood supply arising from the hepatic arteries.
- This is the reason why HCCs are enhanced in the arterial phase.
- A catheter can be passed from a peripheral artery to the aorta, through the coeliac axis into the hepatic artery, and eventually into the feeding arterial branch to the tumour.
- Then a chemotherapeutic agent is injected directly into the tumor and subsequently, the artery is blocked with an embolic agent to cut-down the blood supply to the tumour.



- Read about the clinical outcome of TACE and the novel modifications of TACE that gives better results.

### Reference

- 7) <https://youtu.be/wT4ECqvotuk?si=f0stWDUYC9nzzq5l8>

### *Management of secondary liver deposits*

Tumors arising from other parts of the body can metastasize to the liver. In the process of metastasis, millions of cells leave the original tumor site and start circulating in the blood stream. Of these circulating cells, one cell clump can lodge in the liver to survive and grow as a metastatic deposit. In other words, the tumor has started to disseminate. When a metastasis is detected in the liver, it is considered to be disseminated and inoperable.

However, there are exceptions, and some tumours behave differently. These exceptional tumours have a favorable biology for resection. Colorectal cancer, neuroendocrine cancer, and small bowel cancer are still considered curable even in the presence of liver metastasis and the same principles of treating a cancer is applicable.



- Why are colorectal cancer metastases different from other metastases when it comes to curative resection?

## Learn solid organ transplantation - Liver transplant (LT)

- An organ is transplanted when there is an irreversible failure of its function.
- Transplantation is a complex procedure. It carries a significant risk to the patient and needs long-term follow-up. It also incurs an enormous cost to the health system.
- However, it is lifesaving and at present, kidneys, liver, heart, lungs, pancreas, and small bowel are the solid organs that are transplanted.

### *In order to transplant an organ,*

- 1) The degree of organ failure should be clearly assessed to decide when the patient benefits from the transplant, or if the benefit of transplanting outweighs the risk associated with it.
- 2) There should be organs available for transplant.
- 3) The organ should be compatible with the recipient.
- 4) A patient's physiological reserves should be able to tolerate a transplant surgery and to make a successful recovery.
- 5) Recipient immunity should be manipulated to prevent rejection of the transplanted organ.

### **1. Organ failure should be clearly identified at the point where the patient benefits from transplant.**

- When the liver is irreversibly damaged, we call it cirrhosis. However, not all cirrhotic patients require liver transplant. For instance, Child A cirrhotic patients can have a longer life expectancy with medical care as their liver functions are relatively adequate for the demands.
- When cirrhosis is severe, overweigh the risk of transplant, it is indicated. The presence of acute decompensation and life-threatening complications are some of the indications for transplant.

The MELD score assesses the degree of liver dysfunction and is used as an objective tool to assess the need for a transplant.



- Read on how the MELD score is calculated.

## 2. Availability of organs for transplant.

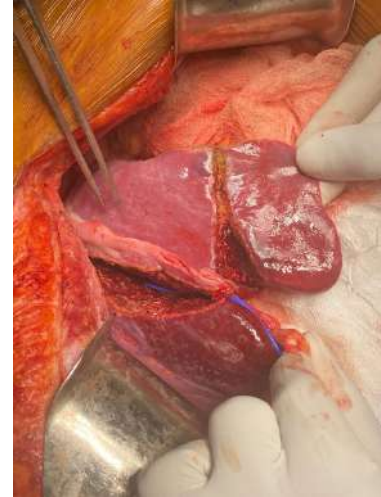
- There are two main sources of organs.

### A. *Living donors/Altruistic donors*

A part of the liver can be harvested from a healthy living person, but there is a small risk to the donor.

Similarly, in a paired organ such as the kidney, one can be safely harvested for transplantation. Living donors can be related or unrelated to the patient.

However, financial dealings between these parties are prohibited by law and ethical code.



**Figure 17** – A liver monosegment harvested from a mother for transplant



- Read about absolute contraindications for organ donation.
- If you are pressed for money, is it all right for you to give an organ in return for money?
- What if your brother is sick and you do not have a suitable donor in the family. Will you pay money for a donor?
- Will you take a risk on your life and donate for someone whom you do not know?

### B. *Deceased donors*

#### I. Brain dead donors

- Sometimes the brain stem can be irreversibly damaged following a major brain insult.
- In these patients, there is a small-time interval from the time of brain death till the cessation of other organ functions.
- With the consent of the family, organs can be harvested for transplant.



- Read about the criteria required to diagnose brain death.

## II. Cardiac dead donors

- There are instances where patients are known to have terminal medical conditions and are being treated in the ICU with organ support, but not meeting brain death criteria.
- Sometimes, with the consent of the family, life support is withdrawn, and the organs are harvested immediately after circulatory arrest.



- Read about the organ preservation methods outside the body after harvesting from the donor.

### 3. Compatibility of organs for transplant

- Different organs have different immunogenicity and immune tolerance.
- Hence, the degree of immune compatibility between the donor and recipient is different from organ to organ.
- In liver transplant, blood group compatibility is adequate.
- However, there are many other anatomical factors that needs to be matched before a transplant.
- In the presence of some of these variations, surgery can become technically difficult.
- For example, if there are three or four small arteries instead of one left hepatic artery, surgery becomes complicated.

### 4. Patients should be fit to undergo transplant

- Liver transplant is a complex surgery, and the patient should be able to withstand the physical and psychological stress of the transplant.
- Furthermore, the patient should also have the ability to commit for lifelong follow up after the transplant.



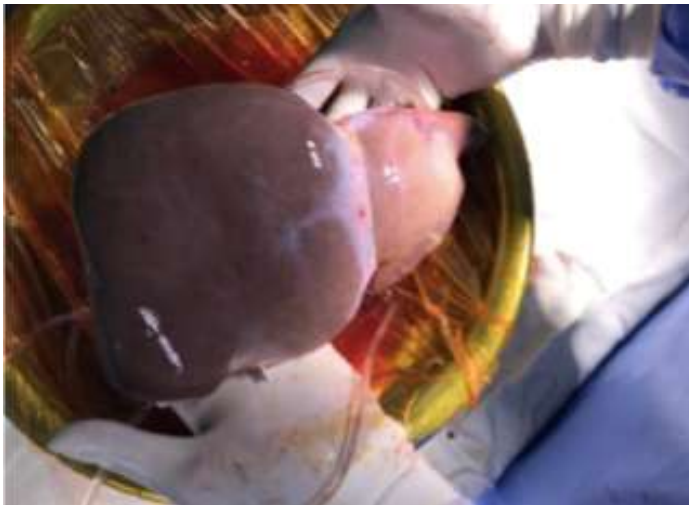
- Learn how a patient is assessed for liver transplant.

## 5. Manipulation of the immune system

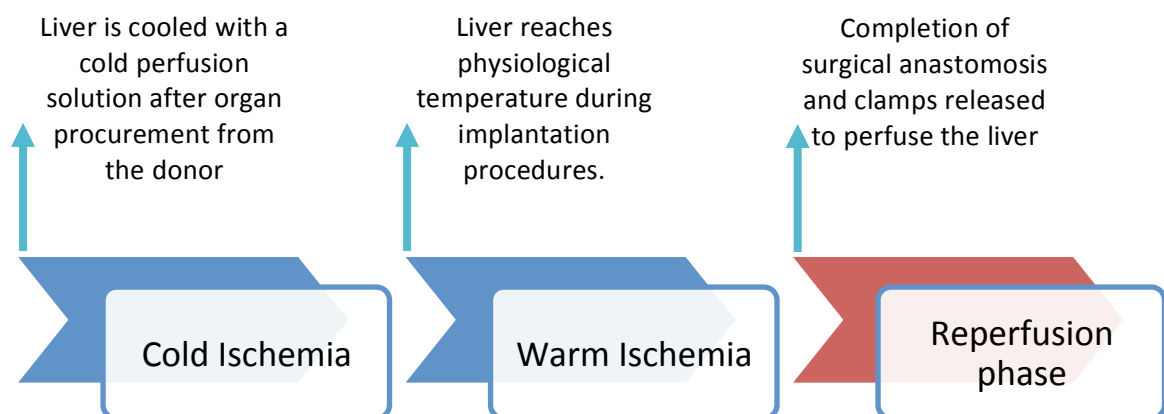
- The organ that is transplanted is foreign to the native immune system.
- The body tries to reject the graft and it is a major challenge that needs to be addressed.
- There are many groups of drugs that are used in immunosuppression.
- Induction is the initial immune suppression given at the time of surgery and usually it is a potent drug such as methylprednisolone.
- Later, the patient is started on maintenance immunosuppression drugs such as, tacrolimus, mycophenolate mofetil (MMF) and Azathioprine.
- Over treatment will lead to multiple complications such as infection and development of malignancies and under treatment will lead to rejection.



- Read about complications of immunosuppression.



**Figure 18** – A cadaveric liver taken out from cold preservation prior to implantation

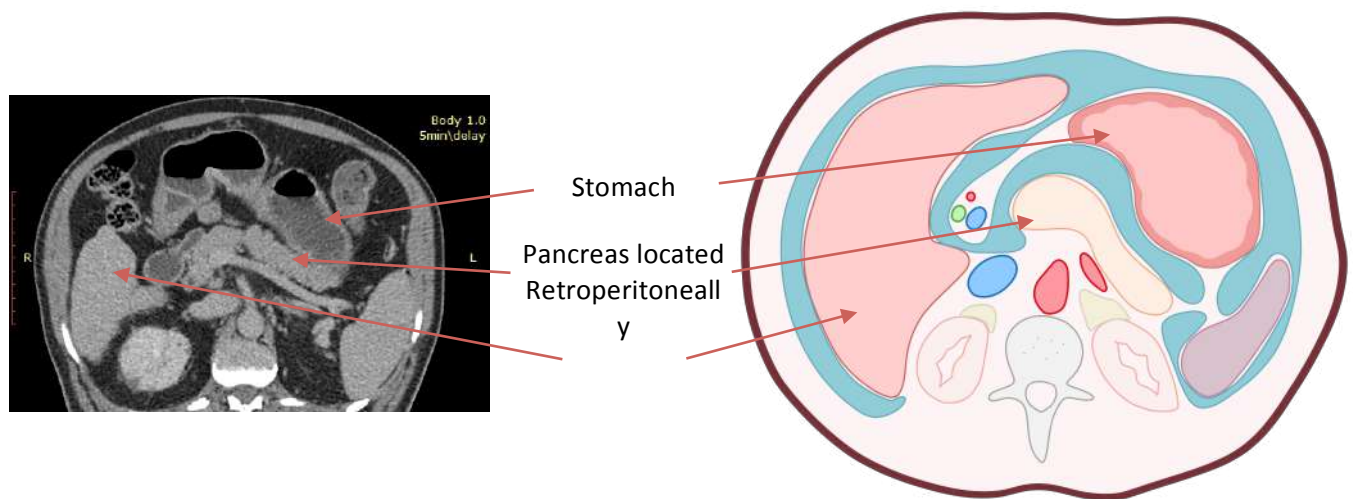


## Pancreatic diseases

There are surgeons of different surgical specialties. If you look carefully, this division is based on the anatomical system. For example, neurosurgeons operate the nervous system, and orthopaedic surgeons operate the skeletal system. So, the type of training that they should undergo is unique to the system that they operate on. If one uses the approach in handling bone while handling the brain, results may not be favourable.

### Pancreas to a surgeon

- Pancreas is a feared organ to a surgeon.
- If you revise your cross-sectional anatomy, you will realize that it is in the retroperitoneum and access is difficult as it is covered by structures anterior to it.
- Many important vessels are closely related to the pancreas like the superior mesenteric artery, splenic artery, splenic vein, and the superior mesenteric vein. When operating on the pancreas, all these structures have to be handled and preserved.
- The organ contains digestive enzymes in the parenchyma.
- If a surgeon traumatizes the organ excessively during surgery, it will activate enzymes leading to pancreatitis and digest even the sutures placed in the gland.



**Figure 19** – CT image and Schematic diagram of the abdomen showing the pancreas located retroperitoneally in the posterior abdomen, making it difficult to access during surgery.



## Acute pancreatitis

- Pancreatic enzymes are stored in pancreatic acini in their inactive form.
- Multiple injurious agents and factors can damage the acini, extravasate, and trigger the activation of these enzymes.
- This leads to further cell destruction and extravasation of enzymes.
- This acts like a vicious cycle eventually causing cell injury leading to an inflammatory response.
- The body has natural mechanisms against the activation of enzymes, but protective mechanisms of each person are different. So, the degree of destruction and the inflammatory response ultimately depends on,
  - The extent of the primary injurious agent
  - Patients' susceptibility to the injurious agent
  - Patients' protective mechanisms
- The initial clinical manifestation of acute pancreatitis is related to the inflammatory response generated by the injury. The inflammatory response may be of different degrees,
  - Mild localized pancreatic injury and localized inflammation.
  - Spillage of inflammation into locoregional tissues.
  - Major spillage of inflammation and its mediators leading to systemic inflammation.
- In the management of acute pancreatitis, we manage the impact of inflammatory responses. Grading systems or scoring systems in acute pancreatitis gives an objective measure for this inflammatory response.



- Read and try to find out the different injurious agents and their prevalences.
- Try to work out the different signs and symptoms described in pancreatitis based on the pathophysiology of cell injury and inflammation.

### *The diagnosis of acute pancreatitis*

The diagnostic parameters are aimed at identifying pancreatic cell destruction and pancreatic inflammation.

Cell destruction leads to spillage of amylase and lipase to blood; However, the elevation is dependent upon the rate of release, the extent of release, and half-life of these enzymes.

Physically, cross sectional imaging, USS, CT, and MRI may be used to demonstrate cell destruction and inflammation.



- Read more about pancreatic amylase and lipase assessments.
- Look at CT images and try to identify changes in acute pancreatitis.
- How is each organ affected by Systemic inflammatory Response Syndrome (SIRS) and what are their manifestations?

### ***Impact of acute pancreatitis***

- In acute pancreatitis, morbidity and mortality is related to the severity of the inflammatory response. The massive spillage of inflammatory mediators to blood is carried throughout the body. Implications start with endothelial damage and fluid extravasation.
- All organs like the lungs, kidneys, Intestines, liver, heart, and vascular system are affected, eventually leading to multi organ dysfunction and organ failure.
- There are no drugs to stop pancreatic injury, hence the treatment of acute severe pancreatitis is organ support and helping the body to recover on its own.

### ***Management of acute severe pancreatitis***

Management of acute pancreatitis revolves around the management of the impact of SIRS and monitoring the progression of system dysfunction.

- 1) *Resuscitation* – helps the vital organ functions to recover as much as possible. e.g., a drop in the blood pressure is treated with aggressively with fluids.
- 2) *Invasive monitoring* - such as central venous pressure monitoring. Precise monitoring is important when the patient is deteriorating.
- 3) *Maintaining vital organ functions as normal as possible* – whenever the organ function starts dropping, it is supported so that it remains as normal as possible.
- 4) *Nutrition support*
- 5) *Assessing and treating secondary complications.*

### ***Secondary complications of acute pancreatitis***

- Pancreatitis leads to severe tissue necrosis in and around the pancreas.
- If a cross-sectional imaging is performed after an adequate time, macroscopic changes may be detected in the imaging.
  - 1) *Peri pancreatic fluid collection* – inflammatory exudative fluid gets collected around the pancreas and collections can track in the retroperitoneum.
  - 2) *Pancreatic necrosis* – pancreatic tissues and soft tissues around it can necrose. The degree of necrosis is variable.

- 3) Eventually there will be different degrees of combinations of necrosis and fluid collection.
- These collections and the necrotic tissues induce an acute and later, a chronic inflammatory process around it.
  - Thus, the body tries to localize these damaged areas by forming a fibro inflammatory wall.
  - When this necrotic fluid collection is localized by such a wall it is called a **pseudocyst**, and when the same happens in necrosis, it becomes a walled off necrosis.
  - This protein rich fluid and dead tissues are a good culture medium for organisms.
  - Organisms originating from the GI system can lodge and proliferate in these collections, leading to infections.



**Figure 20** – CECT of a patient eight weeks after an attack of acute pancreatitis showing a large pseudocyst



- Look at different images and try to identify the necrosis and collections.
- Try to identify the important anatomical relations of these collections by looking at the CT scans.

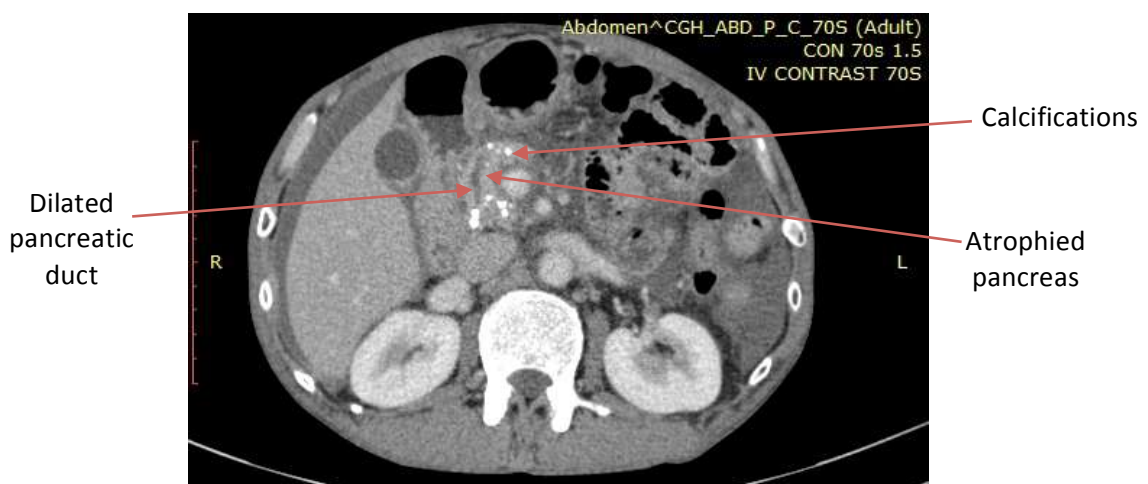
### Treatment of late complications

- 1) Walled off collections and necrosis can be observed as the body has already started to localize the injury. However, large collections due to mass effects may need treatment.
- 2) Infected collections and necrosis need active and aggressive treatment with,
  - a. antibiotics
  - b. drainage of fluid or removal of dead tissue



- Read about open drainage and minimally invasive drainage options.

### Chronic pancreatitis



**Figure 21** – CECT image of a patient with chronic pancreatitis showing calcifications, pancreatic duct dilatation and pancreatic atrophy

- As a result of clinically evident or subclinical recurrent injurious factors, the pancreas can get permanently damaged.
- Chronic injury leads to replacement of normal gland with fibrosis, atrophy, and calcification.



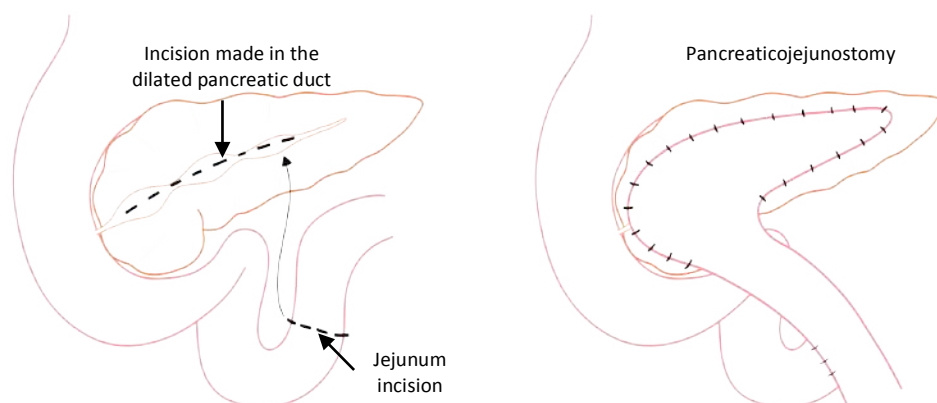
- Go through a CT image of chronic pancreatitis and try to identify chronic changes.

### *Pain in chronic pancreatitis*

- Pancreatic pain nerve fibers arise from the ducts and the parenchyma, and travels along the sympathetic nervous system.
- Parenchymal pain endings become trapped in this fibro calcific tissue, leading to pain.
- When the ducts are obstructed, ductal hypertension also leads to pain.
- The treatment of pain depends on the origin and severity of the pain.
- Most aggressive treatment is for the most severe resistant pain.

### *Treatment options based on severity*

- Analgesics according to the pain ladder.
- Minimally invasive measures for pain relief (endoscopic stenting, coeliac plexus block).
- Surgical resection / surgical drainage procedures.



**Figure 22 – Surgical drainage**

- Total pancreatectomy



- Try to work out what treatment modality can be offered to patients based on the pathology and clinical symptoms.

### *Nutrition in chronic pancreatitis*

- Progressive destruction of pancreatic parenchyma leads to loss of pancreatic acini.
- These patients' digestion is impaired, and it is predominantly the fat digestion that is affected.
- Depending on the clinical symptoms and nutritional depletion, they will require enzyme supplements.

### *Glucose intolerance*

- Loss of islets cells leads to diabetes and should be treated accordingly.

## **Pancreatic neoplasms**

- Patients can present with solid or cystic pancreatic lesions.
- Usually, pancreatic solid lesions need surgical intervention.
- Pancreatic adenocarcinoma has an aggressive tumour biology.
- Other solid lesions such as neuroendocrine tumors are low grade cancers.

### *Cystic neoplasms*

#### **A. Cystic lesions with a benign course**

- Some cystic lesions carry no risk of cancer.
- These include simple cysts and serous cystic neoplasms.
- However, these can be located in a critical location in the pancreas and cause symptoms.
- For example, a lesion in the head may cause obstruction of the common bile duct and as a result, jaundice. These patients may need surgical intervention.



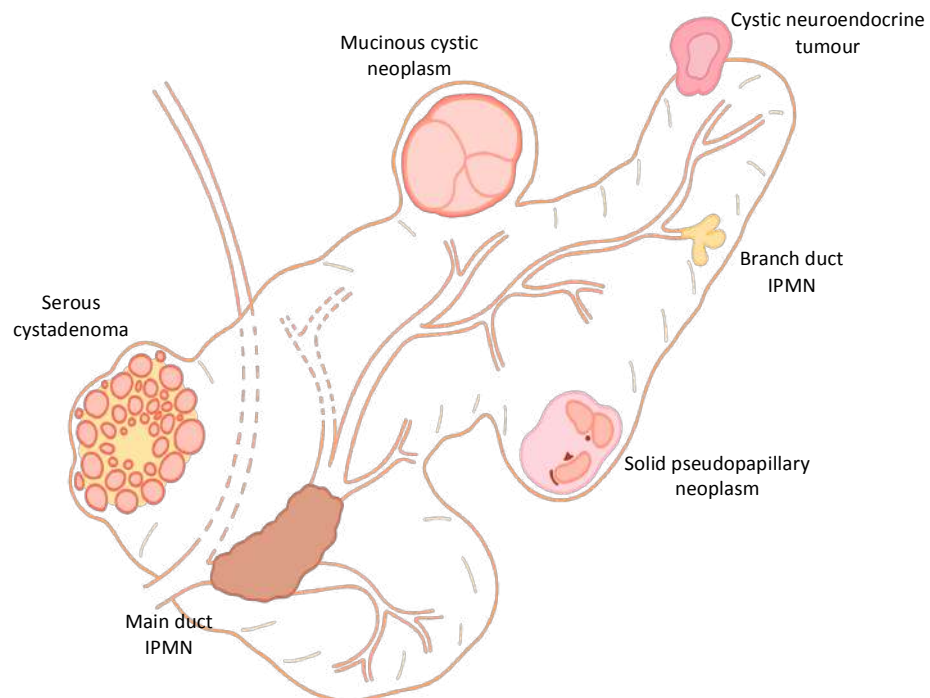
- Look at a CT scan of a pancreatic cystic neoplasm and try to identify its characteristics.

### B. Cystic lesions with a malignant potential

- Intra ductal papillary mucinous neoplasms – these are cystic lesions arising from pancreatic ductal system.
- These carry the highest risk of developing into a cancer.
- Mucinous cystic neoplasms also carry the risk of cancer.



- Read and find out the observations in a cystic lesion that predicts the risk of developing cancer.



**Figure 23** – Cystic neoplasms of the pancreas

## Surgery in the pancreas

- If a lesion in the pancreas is a known invasive cancer, radical surgery is offered (e.g., Whipple surgery, distal pancreatectomy with splenectomy).
- If a lesion is noninvasive or low grade, limited resections can be performed (enucleation, local resection).

### Whipple surgery

- Whipple surgery is one of the most commonly performed and complex HPB surgeries. The surgery comprises of two parts.
  - Resection – during this phase, pancreatic head together with the duodenum is separated from other structures.
  - Reconstruction – using a small bowel loop, continuity is restored to drain the pancreatic juice, bile, and gastric contents.

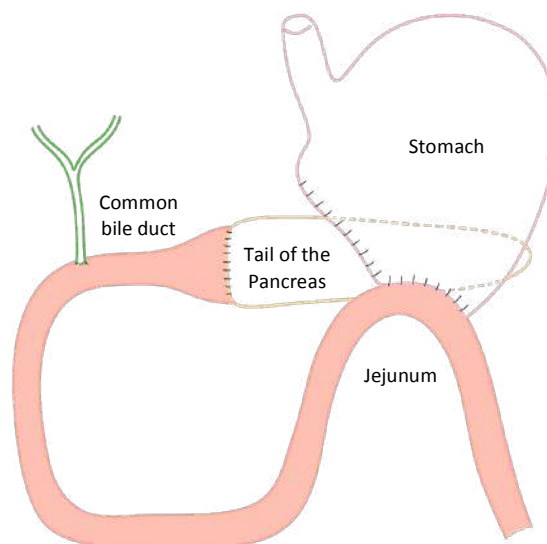


Figure 24 – Whipple surgery



- Observe an anatomy diagram and try to identify the structures that has to be divided to remove the Whipple specimen out of the body.



## Transition from medical student to the next level



We were all once medical students before becoming doctors, consultants, or scientists. Being a medical student is the most difficult time in life, and often this time is wasted. Life becomes difficult when we do not understand our objectives. The five long years you spend in the medical school is expected to transform you from an advanced level school student to a doctor. The advanced level exam is a highly competitive selection exam. After facing this hurdle of advanced level, when the students enter into the university, they enter with minds that are molded to be competitive by collecting as many facts as possible and reproducing them better than others.

When it comes to medicine the amount of facts you can gather are limitless. Students try to collect everything that is available, and it is too much of an influx. Sometimes, we as teachers also try to give everything that we know and try to test all that is taught during exams. We all need to understand that there is nothing called learning everything in medicine and that there are no fixed end points. What we learnt today will change tomorrow. There is no competition in university.

First, it is important to explore how our profession differs from other professions such as, accountants, bankers, or engineers. Doctors deal with the sick and the helpless. Human behavior is highly complex. For practical purposes, all of us are made up of complex chemical molecules. As we know, the outcome of a chemical reaction is predictable. Let us imagine a certain complex chemical reaction that results in fever. Hundred patients develop a fever of 102 °F as a result of this chemical change. But the physical manifestation of this fever in each person is different. One patient might be doing his normal job despite his fever, while another might fall seriously ill and may be admitted to the hospital. There is always the “human component”. Human behavior and manifestations are unpredictable. The challenge of practicing clinical medicine is understanding this “humanness”.

Second, it is important to understand what is to be a university student, a future intellectual. To understand this, let us take an example of a fisherman. A traditional fisherman learns how to fish from his friends, family, and seniors by following them. However, a fisherman with a fisheries degree has learnt how things work and its basis, what other fishermen in the world are doing, what is to come in the future. He also has gained practical experience. Most importantly, he has the ability to think and apply what he learnt. It is this free thinking and the ability to use what you learnt that makes you an intellectual.

Most of the time we grasp these two qualities many years after we become practitioners. The time in the university is spent and lost as an extension of advanced level exams, memorizing, and reproducing while it should have been used in, understanding, thinking,

seeing, and learning to apply. When something is taught, read or observed, first try to think whether you have understood it. Remembering is different to understanding. Take your room for example. How many sentences are needed to explain about your room accurately? If you write it down and give it to your friend, how hard will it be for him to remember it? But you remember your room because you have been there. It is your room. Understanding is something similar. You need time to reflect and understand what you have gathered, to make it your own.

Most of you are going to be clinicians. As we discussed earlier, we interact with humans. In order to give answers to human problems, first you need to understand its complexity. So be there and know it like your room!

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