COMMON INVESTIGATIONS DONE FOR DISORDERS OF LIVER, PANCREAS & BILIARY TRACT
When a patient is suspected or diagnosed with a liver, gall bladder or pancreatic problem, a whole list of investigations are asked quite often, confusing the patient and the family regarding the reason behind so many expensive investigations, especially when it becomes difficult to give a certain answer after they are done or they are repeated at intervals or because the previous investigation was apparently suboptimal. This is a frequent scenario when a patient comes with a liver tumor of uncertain nature or patient with suspicious tumor in pancreas or chronic pancreatitis with cyst.

This list can go on but what is important is that patient and relatives should know why a particular test is asked, what is the nature of test and why more tests may be needed or tests may have to be repeated. The following information is aimed at solving this issue to a reasonable extent. However they do not include tests that are done for a very specific individual disease. The common tests include

**BLOOD TESTS**

**LIVER FUNCTION TESTS**

**TUMOR MARKERS**

**RADILOGICAL TESTS (IMAGING)**

**ULTRASONOGRAPHY OF ABDOMEN**

**CT SCAN OF ABDOMEN**

**MRI OF ABDOMEN & MRCP**
PTC & PTBD
MESENTERIC ANGIOGRAPHY, VENOGRAPHY, VENACAVOGRAPHY
PET SCAN OR PET CT STUDY

ENDOSCOPY
ERCP
EUS

BIOPSY

LIVER FUNCTION TESTS

These are simple blood tests done to assess whether the liver is functioning normally in any situation. These include level in the blood of bilirubin (total, direct & indirect), protein (total protein and fractions like albumin & globulin), liver enzymes (SGOT, SGPT, Alkaline Phosphatase, GGTP), & blood clotting (prothrombin time &INR).

In a patient with liver, biliary & pancreatic problem these tests develop changes depending on underlying disease. Most often they indicate the diagnosis before imaging changes take place. A careful assessment of these tests together with the clinical picture can give the possible diagnosis & help in treatment planning. These may be repeated frequently during the course of disease to follow the recovery. Therefore these tests are important part of your disease work up.

Preferably they should be performed on empty stomach, however when a patient comes with acute problem these tests may have to be done in emergency also.
TUMOR MARKERS

These are substances that show up in the blood when a particular tumor occurs in the body and are produced by the tumor cells. These indicate presence of tumor on simple blood test. The test very often but not always clinches the diagnoses because sometimes the levels can go up in noncancerous situations. Else the levels can remain normal in the presence of tumor. For liver, biliary & pancreatic cancers these include Alpha Fetoprotein (AFP), CA19.9, and CarcinoEmbryonic Antigen (CEA).

ULTRASONOGRAPHY
(USG OR ULTRASOUND STUDY)

This is a simple, painless and relatively quick investigation, which can be used to obtain a ‘picture’ of the inside of the abdomen. Pictures are made using harmless sound waves & are safe even in pregnant patient. These waves bounce off interfaces between dense and less dense structures. The sound waves will not cross solid areas (such as bone) or areas containing air or other gas. Usually only a fairly simple picture of the pancreas, liver, bile ducts and gallbladder can be obtained.

Avoid eating for 6-8 hours prior to the test, as any fluid or food, which is taken by mouth can obscure the pictures especially visualization of gall bladder & pancreas. The test is performed while you lie fully awake on a simple couch. A special jelly is used to enable the ‘probe’, which produces and collects the sound waves, to be moved over the skin of the abdomen. The radiologist moves the probe around
and simultaneously examines the images on a TV screen.

USG gives excellent information about gall bladder & liver pathologies. However, it has its own limitations in diagnosing intraabdominal problems of pancreas and lower portion of the bile duct because these structures are quite often hidden behind gas in the overlying intestine. It is also dependent on the person doing the examination. Hence one may need more sophisticated investigations even if USG is normal and certainly when USG shows pathology. However gall bladder problems like stones do not necessarily require more investigation. Sometimes USG itself is repeated and done on better machine with more experienced person given its lower cost compared to other investigations.

**COMPUTERISED TOMOGRAPHY (CT SCAN)**

A CT scan uses X-rays, which are emitted and collected through 360 degree. It produces excellent pictures of the liver, gall bladder, pancreas and other abdominal structures but not the bile duct.

A normal blood creatinin level is required to undergo a contrast CT scan study, so you would be asked to show this report at the time of CT scan.

You need to avoid eating for 6-8 hours beforehand and is performed while you are fully awake. You lie on a special couch attached to the CT scanner, which looks like a large ‘doughnut’. The couch is made to move through the doughnut as the X-rays are then put
together by a computer to produce the pictures at different levels of the abdomen. In order to make it easier to interpret the structures in the abdomen, you will be asked to swallow a liquid (‘contrast’). This fills the stomach and the intestines. Another injection of a different contrast (‘dye’) is given into a vein (usually in the arm) during the second half of the procedure. This helps to show up the blood vessels, nature of tissue and characterization of lesions. If you are allergic to iodine or have asthma you could have a serious reaction to the injection, so it's important to let your doctor know beforehand.

The results may be explained to you or a relative in the ward but the best time to discuss the findings is at the next outpatient visit or the next day in the ward.

It is vital that a triple phase study is performed when a CT scan is done for liver and pancreatic problem. A triple phase study provides information about these organs when no contrast is given, when contrast is flowing through the arteries and then veins of these organs and lastly when contrast has exited these organs altogether.

At many centers this protocol is not followed as they are not specialized units doing liver and pancreatic work and then it becomes difficult for your surgeon to come to a decision regarding diagnosis and treatment. In this situation a repeat study at the specialized center is asked for. Also often there is a significant time gap between the 1st study and the time when a specialist actually gets to see you. At such times repeating the CT scan is the only option to know the current status of the disease.
MAGNETIC RESONANCE IMAGING (MRI)

An MRI scan is similar to a CT scan but uses magnetic field to image the liver, pancreas & biliary tract instead of X-rays. Very powerful magnets are used to generate the pictures. For this reason, patients that have certain metal parts inside their bodies (that can respond to the magnet) must not have this procedure.

Most modern appliances introduced into patients, such as clips during open surgery or a heart valve with metal parts, are made of material which cannot respond to the magnet and are therefore safe. As a precaution you must tell your doctors if you have any such appliances in your body to let them decide.

MRI scans have the advantage that no X-rays are emitted and therefore are particularly suited to patients who need to have many such tests. The type of pictures produced by MRI however is not the same as CT and the decision of which to use and when to use them will rest with your doctor.

Some people are given an injection (gadolinium) of dye into a vein in the arm. This is called a contrast medium and can help the images from the scan to show up more clearly.

During the test you will be asked to lie very still on a couch inside a long cylinder (tube) for about 30 minutes. It's painless but can be slightly uncomfortable, and some people feel a bit claustrophobic during the scan. It's also noisy, but you'll be given earplugs or headphones. You will be
able to hear, and speak to, the person operating the scanner.

MRI can also be used to provide very good pictures of the bile ducts and pancreatic ducts. This procedure is called MRCP, which is short for Magnetic Resonance Cholangio-Pancreatography. MRCP has practically replaced ERCP as a diagnostic modality for pancreatobiliary problems.

**ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY (ERCP)**

This is a special investigation for taking pictures of the bile and pancreatic ducts and is mainly used for **treatment of bile duct and pancreatic duct problems**. It can also be used to unblock the bile duct if necessary.

Do not eat or drink anything for at least 8 hours before the test. Usually a plastic tube is put into a vein of the right forearm or the back of the hand before you go to the endoscopy department. You may need a drip of intravenous fluids and be given one or more antibiotics in the drip. You will be asked to sign a consent form after explaining the procedure & possible complications, agreeing to this procedure because complications can occur.

You are taken on a trolley to the endoscopy department and, after being checked by a nurse, asked to move onto the X-ray table. You will be asked to lie on your left side with your left arm behind your back and be given a throat spray of local anesthetic. This tastes awful but the feeling quickly goes and it will
stop any coughing during the procedure. A second spray may then be given under the tongue, which contains a substance to help the ampulla of Vater open up during the procedure. A strong sedative is now given by injection. This is enough to make most patients very sleepy but not fully unconscious. It is very important that you are as relaxed as possible before and during the procedure.

It involves inserting a flexible tube or endoscope (also called a duodenoscope) into the mouth. This is passed down the gullet and into the stomach and then into the initial part of small intestine called duodenum. There is then a strange sensation as air is introduced into the stomach. Belching should be avoided as the air helps the endoscopist to pass the tip of the telescope into the duodenum. Most patients usually do not remember anything of the procedure.

In duodenum endoscope is positioned opposite the opening of the bile duct and pancreatic duct (ampulla of Vater). A small tube (cannula) is then pushed into the opening of ampulla of Vater and contrast (‘dye’) is injected into the ducts. You lie on an X-ray table to enable pictures of the ducts to be taken while the contrast is injected.

To treat bile duct or pancreatic problems by this means, it is common to cut the sphincter of Oddi using a small electric current on the tip of the cannula. This procedure cutting the sphincter is called a sphincterotomy. Because it is performed using an endoscope its full name is endoscopic sphincterotomy. By cutting the sphincter it makes it easier to insert bigger instruments into the bile duct or
pancreatic duct to remove any gallstones or pancreatic stones.

Sometimes it is necessary to insert a temporary (plastic) or permanent (metal mesh) tube into the bile duct to keep a good flow of bile. These tubes are called stents – after Dr Stent who first used these small tubes. Stents or temporary tubes (also called a cannula) may also be inserted into the main pancreatic duct.

A small piece of tissue can be removed using minute tweezers (called forceps). This small piece of tissue is called a biopsy and is checked by histology. This procedure is therefore called endoscopic biopsy. A small brush may also be used to brush the sidewalls of the bile duct or pancreatic duct to obtain small cells that can be checked by cytology. This procedure is therefore called brush cytology.

Sometimes a small endoscope (baby) may be introduced through the main endoscope channels (mother scope). This baby scope can enter bile duct for spying on the pathologies, which are sometimes not visible (spy glass) or can enter pancreatic duct for a very close distance ultrasonography (IntraDuctal UltraSound -- IDUS)

The results may be explained to you or a relative on the ward but it can take time to receive the results of histology or biopsy. If you have been treated mainly as an outpatient, then the best time to discuss the findings and any procedures is at the next outpatient visit or the next day on the ward. The results are not
always easy to interpret and are usually combined with other tests to provide an overall diagnosis.

It is always necessary for a friend or relative to drive you home if you have had an ERCP as an out-patient because it takes several hours for the effects of the drugs to wear off.

**Is ERCP safe?**

ERCP is safe with no complications in about 95% of cases. There are occasionally complications from ERCP however even in experienced hands, the most common of which are acute pancreatitis, biliary infection, and bleeding & duodenal perforation.

If the procedure was planned as a day case procedure, it will be necessary to keep you in hospital overnight if there has been a complication. In most cases, the complications improve, and patients are soon discharged. Very occasionally the complication is serious and death may result in a very small proportion of cases.

For patients that are having ERCP for treatment (such as having a stent or having a gallstone removed) special precautions are taken to reduce the risk. These precautions usually include having a drip running in extra fluid into an arm or neck vein, antibiotics and a bladder tube (urinary catheter) and urinary collecting bag to make sure that the kidneys (which make the urine) are working properly.
For these reasons, an ERCP must be:
· **Performed by a specialist.**
· **Performed for a good reason preferably only therapeutic.**

**PERCUTANEOUS TRANS HEPATIC CHOLANGIOGRAPHY (PTHC)**
&
**PERCUTANEOUS TRANS HEPATIC BILIARY DRAINAGE (PTBD)**

Sometimes it is not possible to approach the bile duct or to enter the bile duct using an endoscope. In this situation it may be necessary to insert a very fine needle into the bile duct by going first through the skin on the right side and then finding a branch of the main bile duct within the liver. Therefore the full name of this procedure is Percutaneous Trans Hepatic Cholangiography and is always performed in the X-ray department. Pictures of the bile ducts are taken after injecting some ‘dye’ or contrast.

PTHC can be used to provide temporary or permanent (stent) drainage of bile, remove gallstones from the bile duct, perform brush cytology and insert a biliary stent, which may be either plastic or metal (PTBD).

Do not eat or drink anything for at least 6 hours before the test. Usually a plastic tube is put into a vein of the right forearm or the back of the hand before you go to the radiology department. You may need a drip of intravenous fluids and be given one or more antibiotics in the drip. You will be asked to sign a consent form after explaining the procedure &
possible complications, agreeing to this procedure because complications can occur.

PTHC is usually done under X ray guidance. You are made to lie on your back on a special x-ray compatible table. The procedure is done using sterile procedures, so the skin is cleaned with an antiseptic and special gown are used. Before the needle is passed local anesthetic is injected into the skin. The needle may need to be passed between the lower ribs on the right hand side but this is quite safe.

In difficult situations both PTHC and ERCP are performed together – one technique makes it easier for the other technique to be successful. When both techniques are used together it is known as a combined procedure or rendezvous procedure. PTHC requires additional informed, written consent.

Is PTHC safe?

PTHC is safe with no complications in about 95% of cases. There are occasionally complications from PTHC however, the most common of which are abdominal pain, biliary infection, bleeding and a bile collection or abscess. In most cases, the complications improve with medical management. But occasionally a surgery may be required to tackle the complication. Occasionally the complication is serious and death may result in a very small proportion of cases.

Special precautions are taken before the procedure is performed to reduce the risk. These include a drip of intravenous fluid, antibiotics and a urinary catheter.
This procedure is only performed if it is really necessary and is only performed in specialist centers.

ENDOLUMINAL ULTRASOUND (EUS)

This is a special investigation for taking ultrasound pictures of the pancreas, pancreatic and bile ducts, gall bladder and surrounding tissue such as blood vessels at close distance. A special probe inserted into the stomach and duodenum takes the pictures. Because the ultrasound probe is much closer to the pancreatobiliary tree, EUS can provide pictures that are much clearer than the usual percutaneous ultrasound scan.

EUS is performed using special flexible endoscope with an ultrasound probe at its tip. It is passed into the mouth, down the gullet and into the stomach. At this point the ultrasound probe is switched on and the pancreas can be seen through the stomach wall. The pictures are displayed on a television screen and copies of the images can be made. The telescope is then passed into the duodenum to obtain different views of the pancreas and also of the bile ducts, gallbladder and the liver.

You do not eat or drink anything for at least 8 hours before the test. The procedure is done on a flat couch under sedation. You will be asked to sign a consent form agreeing to this procedure because complications can occur. Normally you are taken on a trolley to the endoscopy department and, after being checked by a nurse, asked to move onto the flat couch. You will be asked to lie on your left side with your left arm behind your back and be given a throat
spray of local anesthetic. This tastes awful but the feeling quickly goes and it will stop any coughing during the procedure. At this stage you are given a strong sedative by injection. This is enough to make most patients very sleepy but not fully unconscious. It is very important that you are as relaxed as possible before and during the procedure.

The telescope is easily passed into the mouth and stomach. There is then a strange sensation as air is introduced into the stomach. Belching should be avoided as the air helps the endoscopist to pass the tip of the telescope into the duodenum. Most patients usually do not remember anything of the procedure.

EUS may be used to remove small cells using a small needle inserted into a suspicious area. Cells are drawn up a small tube (or cannula) using a small syringe. This procedure is therefore called EUS aspiration cytology. EUS is also used on occasions to guide therapeutic procedures like aspiration or drainage of cyst of pancreas or drainage of bile duct when a conventional sphincterotomy is not possible for various technical reasons.

A patient can have liquids immediately after a diagnostic EUS if no anesthetic is used, after 2 hours if an anesthetic is used. If a therapeutic procedure is done a minimum of starvation of 6 hours after the procedure is required, however the ideal time will depend on the procedure & post procedure recovery, and should be decided by the person who has done EUS. It is usually necessary to admit the patient if a therapeutic procedure is performed.
The results of EUS may be explained to you or a relative in the ward but the best time to discuss the findings is at the next outpatient visit or the next day in the ward. The results of cytology are often not easy to interpret and may take a while for them to become available. The results are usually combined with other tests to provide an overall diagnosis.

It is always necessary for a friend or relative to drive you home if you have had an EUS as an out-patient because it takes several hours for the effects of the drugs to wear off.

**POSITRON EMISSION TOMOGRAPHY (PET SCAN)**

This is a special scan performed in the Nuclear Medicine Department and is sometimes performed in certain centers if there is uncertainty as to the diagnosis. (Cancer versus inflammation).

Patients are fasted for 6 hours before going to the Nuclear Medicine Department. You are asked to lie down on a special couch underneath a special camera called a gamma camera. Fifteen minutes or so after the intravenous injection of a special chemical the camera will take images of your pancreas. The chemical contains a small amount of relatively harmless radioactivity. Your doctors will explain the results to you once they have put together the information from the PET scan as well as other tests such as results from the CT scan.
PET CT

In the newer generation machines CT & PET technology has been combined to give more specific information. Hence now clinicians ask for this whenever required.

ANGIOGRAM

This is a test to look at blood vessels. Diseases of liver, biliary tract & pancreas can involve the large blood vessels that carry blood to and from the liver. An angiogram may be used to check whether any of these blood vessels are affected by the cancer or sometimes in case of postoperative biliary injury.

Conventionally angiograms are carried out in the x-ray department. A fine tube is put into a blood vessel (artery) in your groin. A dye is then injected up the tube. The dye circulates in the arteries so that they show up on x-ray. Now the role for this conventional angiogram is reduced since very good angiograms are obtained during CT scan or MRI study and information regarding various arteries and veins can be achieved in minutes with much less discomfort.

Conventional Angiography is used now mainly for therapeutic purposes like control of bleeding vessels, inserting a stent in the blocked artery, portal vein or vena cava. Sometimes stent is inserted to relieve the blocked hepatic veins.
NEEDLE BIOPSY OR CYTOLOGY USING ULTRASOUND OR CT SCAN

A biopsy is obtaining a small piece of tissue from the organ concerned or mostly from a tumor for diagnosis. Occasionally a small piece of tissue from the pancreas or liver needs to be taken to help make a diagnosis. There are many ways that this can be done especially using an ultrasound scan or a CT scan to tell the doctor where to pass the needle. This procedure requires informed, written consent.

Biopsy or cytology is done taking sterile precaution. The skin is cleaned with an antiseptic. Local anesthetic is injected into the skin. A very fine needle is then introduced and its tip positioned using pictures from the scan before any tissue is taken.

If solid tissue is taken, however small this is called a biopsy and is examined by a pathologist using a microscope (called histology). Because a needle is used it is called a needle biopsy. If only some individual cells have been removed and examined by a special pathologist called the examination is called cytology. Because the cells are obtained by a sucking action (or aspiration) on the needle using a syringe, the procedure is called aspiration cytology.

Are needle biopsy and aspiration cytology safe?

These procedures are surprisingly safe in specialist centers. But complications such as bleeding can occur occasionally.
The results of biopsy or cytology are often not easy to interpret and may take a while for them to become available. The results are usually combined with other tests to provide an overall diagnosis.

**LAPAROSCOPY**

This is a small operation that allows the doctors to look at the gall bladder, the liver and other internal organs in the area around the gall bladder. This is usually done prior to the major surgery to confirm that patient will benefit by a major surgery. It is done under local or general anesthesia and will mean a short stay in hospital.

While you are under anesthesia the doctor makes a small cut (incision) in your abdomen and inserts a thin rigid tube containing a light and camera (laparoscope). The doctor looks at the internal organ and may take a small sample of tissue (biopsy) for examination under a microscope or collect fluid present within the abdominal cavity and send it for various tests in order to pick up the diseases like cirrhosis, tuberculosis or cancer.

After the laparoscopy you will have one or two stitches in your abdomen. You may have uncomfortable wind and/or shoulder pains for couple of days after the operation.

Laparoscopy is not without complications & requires informed consent. In experienced hands less than 1 % patients have complications & they include bleeding, bowel perforation & infection. Risk of death is less than 1 %.
Above information will help you to make an informed decision but it cannot replace the professional advice and expertise of a doctor who is familiar with your condition. You may have questions that are not covered; you should discuss these with your surgeon. You must remember every individual is different.