

Liver disease tests explained



BRITISH
LIVER
TRUST

Fighting liver disease

Liver disease tests explained

The British Liver Trust works to:

- support people with all kinds of liver disease
- improve knowledge and understanding of the liver and related health issues
- encourage and fund research into new treatments
- lobby for better services.

All our publications are reviewed by medical specialists and people living with liver disease. Our website provides information on all forms of adult liver disease and our Helpline gives advice and support on general and medical enquiries. Call us on **0800 652 7330** or visit **www.britishlivertrust.org.uk**

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The liver

Your liver is your body's 'factory' carrying out hundreds of jobs that are vital to life. It is very tough and able to continue to function when most of it is damaged. It can also repair itself – even renewing large sections.

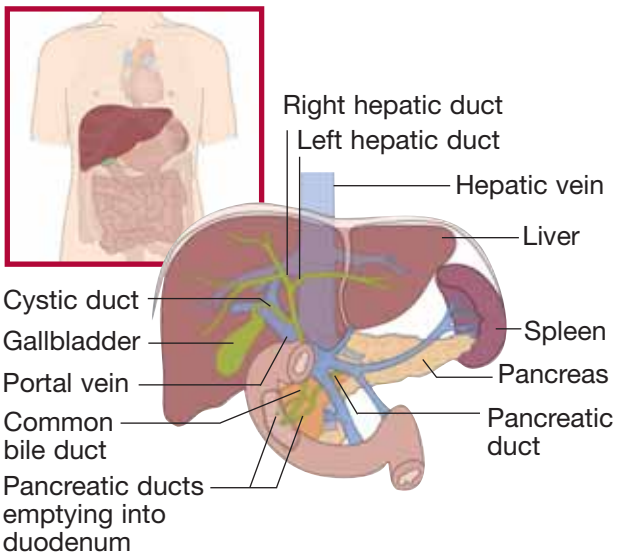
Your liver has around 500 different functions. Importantly it:

- fights infections and disease
- destroys and deals with poisons and drugs
- filters and cleans the blood
- controls the amount of cholesterol
- produces and maintains the balance of hormones
- produces chemicals – enzymes and other proteins – responsible for most of the chemical reactions in the body, for example, blood clotting and repairing tissue
- processes food once it has been digested
- produces bile to help break down food in the gut
- stores energy that can be used rapidly when the body needs it most
- stores sugars, vitamins and minerals, including iron
- repairs damage and renews itself.

How liver disease develops

Liver damage develops over time. Any inflammation of the liver is known as hepatitis, whether its cause is viral or not. A sudden inflammation of the liver is known as acute hepatitis. Where inflammation of the liver lasts longer than six months the condition is known as chronic hepatitis.

Fibrosis is where scar tissue is formed in the inflamed liver. Fibrosis can take a variable time to develop. Although scar tissue is present the liver keeps on functioning quite well. Treating the cause of the inflammation may prevent the formation of further liver damage and may reverse some or all of the scarring.



Cirrhosis is where inflammation and fibrosis has spread throughout the liver and disrupts the shape and function of the liver. With cirrhosis, the scarring is more widespread and can show up on an ultrasound scan. Even at this stage, people can have no signs or symptoms of liver disease. Where the working capacity of liver cells has been badly impaired and they are unable to repair or renew the liver, permanent damage occurs.

This permanent cell damage can lead to liver failure or liver cancer. All the chemicals and waste products that the liver has to deal with build up in the body. The liver is now so damaged that the whole body becomes poisoned by the waste products and this stage is known as end stage liver disease. In the final stages of liver disease the building up of waste products affects many organs. This is known as multiple organ failure. Where many organs are affected, death is likely to follow.

Liver disease tests

There are over one hundred types of liver disease. They affect two million people in the UK. This figure may only be the tip of an iceberg as many cases of liver disease remain undiagnosed.

Your liver is very resourceful and able to work well enough even when it may be damaged. This means that you may often not 'present' with clear symptoms, or show obvious sign of liver disease or illness, when you see the doctor. However, if your GP suspects that you have a liver problem you will be asked to take a number of tests which will provide complex information about your condition.

To help you understand this information and manage your disease this leaflet will look at the different tests you may encounter and explains how they are used in the diagnosis and treatment of liver disease. It describes the various health professionals that you will come into contact with and what kind of information you can expect from them, with explanations of some of the medical terms used most frequently by hospital staff in relation to the tests themselves.

Following your diagnosis the GP may suggest a full screen of bloods to get an overview of your general physical health. The results of these blood tests may take a little time and often you will only be contacted sooner if your blood test shows up a 'value', or number measurement, which gives concern. If your condition requires further testing you will be

referred to a local hospital, liver specialist centre or clinic. Here, more specific blood samples may be taken for tests involving liver function, virology (viruses) and immunology (antibodies). Sometimes genetic studies are also requested to check for hereditary diseases.

To get a fuller picture of your diagnosis you may need a scan of your tummy. This is usually an ultrasound scan in the first instance.

You will be booked in for testing under the name of a consultant. Although the consultant has the overall responsibility for your treatment, you may be seen by members of their medical team. These doctors practice at different levels of experience and responsibility. It is useful to write down the names of the consultant as well as the doctor you saw on the day of your visit.

Doctors may also refer to a radiologist to help them confirm your diagnosis. Other tests include ultrasound, CT (cat) scan, MRI scan and liver biopsy. When there are problems with the blood flow to your liver, an angiogram may be performed. An explanation of these tests, and what to expect while you are undergoing them, will be discussed in later sections of this leaflet.

Consent

Before you have any medical treatment you must give your 'consent' (permission). For certain liver test procedures you may be asked for your written consent. The consent process is to ensure that you understand the nature and purpose of providing a sample or undergoing a particular treatment. This cannot go ahead without your consent. Before giving consent you should understand:

- why you need the treatment or test
- what will happen during the treatment or test
- the advantages and disadvantages of the treatment or test
- any risks or side effects
- what the alternatives are
- what would happen if you did not have the treatment or test

Categories of liver disease

Below is a broad introduction to the types of liver disease or conditions.

1. **Cholestasis** is the result of damage to the bile ducts caused by diseases such as primary biliary cirrhosis (PBC), obstetric cholestasis (OC) and primary sclerosing cholangitis (PSC). Obstruction of the common bile duct (the main duct from the liver) may result in jaundice, caused by conditions such as gallstones or a tumour.

2. **Infective** damage such as hepatitis A, B, C, D and E.
3. **Chemical** damage such as poisoning and substance abuse – paracetamol overdose, recreational drugs and alcohol.
4. **Genetic** or **hereditary** damage such as Crigler-Najar syndrome, Dubin-Johnson syndrome, haemochromatosis and Wilson's disease.
5. **Vascular** damage such as Budd-Chiari syndrome.
6. **Autoimmune** damage such as PBC, PSC and autoimmune hepatitis (AIH).
7. **Congenital** damage such as choledochal cyst, Caroli's syndrome and Gilbert's syndrome.
8. **Metabolic** damage such as galactosaemia, fatty liver disease, non alcoholic fatty liver disease (NAFLD) and non alcoholic steatohepatitis (NASH).

When diagnosing liver disease the most useful test in each disease is often (but not always)

Disease	Test or procedure
Alcohol-related liver disease	History/liver function tests (blood sample)
Autoimmune hepatitis	Autoantibodies such as anti-nuclear antibody and anti-smooth muscle antibody (blood sample)

Haemochromatosis	HFE Gene analysis for C282Y or H63D mutation (blood sample)
Hepatitis A	Antibody test (blood sample)
Hepatitis B	Antibody, antigen tests/hepatitis B DNA (blood sample)
Hepatitis C	Antibody test/ hepatitis C RNA (blood sample)
Fatty liver disease, non alcoholic fatty liver disease (NAFLD), non alcoholic steatohepatitis (NASH)	History/liver function tests (blood sample)/ BMI/ultrasound scan appearance and liver biopsy
Primary biliary cirrhosis	Anti-mitochondrial antibody (blood sample)
Primary sclerosing cholangitis	Biopsy/bile duct imaging – ERCP
Wilson’s disease	Genetic analysis/ copper studies (blood and urine samples), slit lamp examination of the eyes.

Often a liver biopsy is required to confirm the diagnosis. The need for this will be guided by your doctor or liver specialist.

A guide to understanding liver tests

Generally blood test results cannot be seen in isolation. To get a fuller picture of your liver problem various things need to be considered together. These might include the severity of your physical symptoms, how long you have had your illness, your age, the influence of any medication and your lifestyle as well as the results of supporting tests that have been performed.

For example, liver cancer cannot be confirmed on a blood test alone. You will also need specialised scans (such as CT, MRI or contrast-enhanced ultrasound) and, in some instances, a biopsy. It is important to remember that these liver blood test values are like a snapshot of your blood structure at one given time. They will be monitored, or checked, over a period of time. These values may differ across the UK as different hospitals use the services of different laboratories and 'normal' ranges may vary from lab to lab.

It is in your best interest that you always discuss your personal blood result values with the medical officer who is in charge of your care. Always try to keep a copy of these with you when talking to them.

Liver function tests

For blood testing a syringe with a fine needle is used to remove a small amount of blood from a vein in your arm. You should only feel a tiny pin-prick as this done. The sample can be taken by your GP or a nurse at your local clinic, or by hospital staff. It will then be sent to a laboratory to be tested.

The most common sections of the test are:

- Alanine aminotransferase (ALT)
- Aspartate aminotransferase (AST)
- Alkaline phosphatase (ALP)
- Gamma glutamyl transferase (GGT or 'Gamma GT')
- Bilirubin
- Albumin
- Clotting studies, i.e. prothrombin time (PT) or international normalised ratio (INR)

Each of these has results given to them in numbers and values. The laboratory provides a 'normal value' or 'reference value' to the test, which shows the doctor, nurse or specialist whether your test is within the normal range. Abnormal functions are shown by how much they are below or above the normal range.

Usually the liver function test gives an indication of how much your liver is inflamed and possibly either damaged or changed in its ability to work properly. The test does this by measuring the following.

- **ALT** and **AST** levels, which indicate the degree of inflammation. The aminotransferases are enzymes that are present in the liver cells (hepatocytes). They leak into the blood stream when the liver cells are damaged. These values are usually high in hepatitis – possibly twenty to fifty times higher than normal. The ALT value is more specific to the liver than the AST value. The AST value may also give an indication of muscle damage elsewhere in the body. Ratios of these enzymes can be helpful in NASH and alcohol-related liver disease.
- **Alkaline phosphatase (ALP)**, an enzyme found mainly in the bile ducts of the liver. Increases in ALP and another liver enzyme called **Gamma GT (GGT)** can indicate obstructive or cholestatic liver disease, where bile is not properly transported from the liver because of obstruction (blockage) of the bile duct. GGT is tested with ALP to make sure that ALP increases are coming from your liver. The GGT is also a potential indicator of your alcohol usage.
- **Bilirubin**, formed from haemoglobin and the main pigment in bile (a yellow/green substance made by your liver). An increase of bilirubin causes jaundice, a yellowing of the eyes and skin in liver disease.
- **Albumin**, a very important protein that helps keep fluid pressures in the body stable and carries many substances in the body. Albumin may decrease in chronic liver disease, particularly if the disease is getting worse, but may be decreased for other reasons such as a lack (deficiency) of protein, for example malnutrition.

- **Clotting studies**, which may indicate liver disease, especially worsening chronic liver disease if the prothrombin time (clotting ability) is prolonged. Clotting is the thickening of blood, known as coagulation. Your liver has a big role in the normal clotting of blood. When your liver is damaged your blood becomes too 'thin' and takes longer to clot. This may lead you to bruise more easily.

All of the above can be affected by disorders and diseases that do not affect your liver directly. As strange as it sounds, 'abnormal' liver function test results are not uncommon. However, further investigation should be considered if any of your results are found to be outside of the normal range in a liver function test.

Differences in normal range for different laboratories can make it difficult to compare or comment on individual test results specifically. This is due to the different brand of tests that are used and how these are interpreted. There are, however, international normal ranges that all doctors, nurses and health care professionals use as an approximate guide. Interestingly the normal values for liver function tests can vary between men and women, at different times of the day and as you get older.

Different diseases of the liver will cause different types of damage and will affect liver function tests accordingly. It is possible to suggest which disease may be present from a liver function test but these tests are not the conclusive way of

diagnosing liver disease. They are helpful, but only part of the picture. They are also useful for monitoring someone with liver disease, but are not always accurate.

It is well accepted that in certain liver diseases (hepatitis C, for example) the liver function test may not accurately show the extent of inflammation or fibrosis (formation of scar tissue), although this does not apply to the majority of people who have liver disease.

Biochemistry

Biochemistry values usually are to do with the fluid balance in your body and its ability to use electrolytes (substances that provide cells with energy) such as sodium, potassium, calcium, phosphate, magnesium and glucose.

Kidney function is also represented in this test. In advanced liver failure the kidney function can be badly affected. Urea is the end product of protein usage by the body. Creatinine is the end product of metabolism in the body. Both of these values will rise with worsening kidney function.

Clotting

As the liver is involved in clotting, it is standard procedure to have clotting studies done when any 'invasive' procedure is planned such as biopsy, surgical procedures and operations. A clotting profile is made to assess your risk of bleeding.

If your risk for bleeding is very high, your procedure/surgery may be postponed until a later date.

Values and substances involved in clotting include:

Prothrombin time (PT): This test measures the time taken for a clot to form in a blood sample. This is compared against values in healthy people and is an important value for indicating the clotting ability of your blood, as influenced by the presence or lack of vitamin K. The prothrombin time will take longer as a result of deficiencies in vitamin K.

INR (international normalised ratio): As the chemicals used to perform the PT test may vary between laboratories, the INR is a calculation the doctors use to allow for any changes when results from different laboratories are compared. This is an important consideration when you have been prescribed blood-thinning products such as warfarin.

APTR (activated partial thromboplastin time ratio): The APTR is the time taken for thromboplastin to convert into thrombin.

Fibrinogen: This is another substance in the blood that helps clotting by producing fibrin strands. Platelets stick to the fibrin strands to form a plug that prevents bleeding.

The presence of drugs and poisons in your body can also alter the clotting pathway (normal course of coagulation) of the liver. This may be the case if you are receiving medications such as aspirin, clopidogrel or warfarin.

Full blood count

This blood test gives an indication of the quality of your blood cells. If there is a rise in **white cell** count it can indicate an infection. The white cell count can further be broken down into different subtypes. This is called a differential count. Types of cells looked at here are neutrophils, lymphocytes, basophils and eosinophils. These types of white blood cells help your immune system (your body's defence) to fight off the infections.

If the **red blood** cells and **haemoglobin** are too low it may indicate bleeding somewhere in the body. The amount of haemoglobin, which is carried in red blood cells, is an indication of your blood's ability to carry oxygen to the cells. A low red blood cell count is referred to as anaemia and can explain why you may be feeling excessively tired. Liver disease may be suspected when your platelets are low. Platelets are cell fragments that play an important part in clotting by plugging or covering a broken blood vessel.

Haematocrit indicates the amount of red blood cells you have suspended in the plasma (the sticky, clear fluid in your blood). It is important to look at all the blood tests as so many values are dependent on each other.

Microbiology

Microbiology tests are used to find out what type of bacteria or fungus is causing an infection. When the type of bacteria has been cultured (grown), it is checked to see how it reacts against the presence of various antibiotics. If certain antibiotics slow down the growth or kill most of the bacteria then it is likely that this type will be selected to fight your infection. If the bacterial growth is unchanged then another more sensitive antibiotic will be selected. This explains why doctors will change some antibiotic treatments.

All human secretions such as blood, urine, stools, phlegm, ooze from wounds, etc. can be cultured. Some bacteria can take up to a week to be cultured for identification. This is why the test results may not be immediately available.

Virology and antibodies

The terminology associated with viral hepatitis is complex, but understanding some of the main terms used and the meaning of key test results will help to keep you informed about your condition.

Understanding the significance of antibodies and antigens is a good place to start.

An antigen is a foreign or invading protein substance that enters the body. Your body's immune system defends against antigens by producing its own special proteins that bind to

the invader to destroy them. These are antibodies, also known as immunoglobulin.

The production of antibodies against antigens is known as your 'immune response'. Many of the following tests are used to measure your immune response.

Acute or chronic?

An acute illness means a short, sharp illness of sudden onset that may be severe, but most people recover within a few weeks without lasting effects. A chronic illness is one that lasts a long time (more than six months), possibly for the rest of a person's life.

Hepatitis A (HAV)

This is a test to detect whether you have produced antibodies known as immunoglobulin M and immunoglobulin G against the hepatitis A virus (HAV). A total antibody test is able to indicate both current and previous infection with hepatitis A. It will also read positive after you have received the hepatitis A vaccination. It is presumed that one infection with hepatitis A produces lasting immunity (protection) against further infection.

Hepatitis B (HBV) – Antibody and antigen tests

Most people who come into contact with hepatitis B (HBV) will rid themselves or 'clear' the virus during the first six months of their infection. The

disease is known during this phase as acute hepatitis B. People who do not clear the virus after six months will be diagnosed as having chronic hepatitis B.

Tests are carried out to look for antigens and antibodies in your blood. These are a sign or indication that:

- you have been infected by the virus in the past
- you have a new infection
- your infection is likely to go away by itself
- your infection has become chronic.

These antigens and antibodies are known as serological or viral 'markers'. Medical staff will look for markers in your blood over the course of your infection to see how the virus is progressing and/or responding to treatment. In particular, finding the 'surface' and 'e' antigens known as HBsAg and HBeAg and their corresponding antibodies will be very important in establishing the pattern of your disease.

Hepatitis B surface antigen (HBsAg)

This is a test to find out if you have a current infection. HBsAg is the earliest sign of the virus and disappears from your blood as the infection clears. A positive result indicates infection. If the antigen is not found (negative result), this shows that either you have never been exposed to hepatitis B or that you have recovered from infection and rid yourself of the virus. The term 'surface' refers to the outer surface of the virus itself.

Hepatitis B surface antibody (Anti-HBs)

This is to detect the protective antibody in your blood that reveals whether you have had previous exposure to hepatitis B. The presence of the antibody anti-HBs (positive result) indicates that you are immune to hepatitis B due to vaccination or recovery from past infection, and are no longer infectious to others.

Hepatitis B e-antigen (HBeAg)

This test is used to confirm the presence of HBeAg, which only appears in the blood when the virus is present and is a sign that you are a 'carrier' (able to infect others). What happens after this antigen is found will depend on how quickly your immune system produces antibodies called anti-HBe. The appearance of an antibody and subsequent elimination of the virus to a very low level is known as 'seroconversion'. The rate at which this occurs will vary from person to person and can take months or years. Although you remain infected, the virus is inactive and your liver is able to repair itself. This is known as an 'inactive carrier state'.

Anti-HBe

This is the test that looks for the anti-HBe antibody produced in response to the hepatitis B e antigen (although anti-HBe is also present in people recovering from acute hepatitis B infection). In chronic hepatitis B, a positive result suggests that only low levels of the virus are likely to be present in your blood.

Anti-hepatitis B core antigen (anti-HBc)

The anti-hepatitis B core antigen is an antibody to the 'core' part of the hepatitis B virus, the hepatitis B core antigen. However, this antibody does not provide the protection usually associated with antibodies and is found in people with acute infection, in chronic carriers and in people who have cleared the infection. Doctors will use the results of other tests to interpret the presence of anti-HBc in your blood.

HBV DNA

This important test does not look for antigens or antibodies but monitors the success of antiviral medication. It shows the amount of virus in your blood, known as your 'viral load'. The higher your viral load, the more active your infection will be. Active virus replication, where the virus is making lots of copies of itself, is known as positive HBV DNA. Doctors will be looking for a very low amount or no trace of the virus as a marker of your response to antiviral medication.

Hepatitis C (HCV)

As with hepatitis B, a number of tests will be carried out when you are suspected of having hepatitis C (HCV) or after the virus has been diagnosed. They will be used to follow its progression and to check on your response to treatment.

Anti-HCV

An anti-HCV test looks for any trace of antibodies in your blood. If they are found, this shows that

you have been exposed to the hepatitis C virus. This test is unable to reveal whether you have an active viral infection.

HCV-RNA

An HCV-RNA test detects the hepatitis C virus in your blood and indicates whether this is an active infection. Evidence of HCV viral RNA is a 'positive' result while no sign will be 'negative'. This test may also be used as a follow-up to your treatment to see if you have eliminated the virus from your body.

HCV Viral load (quantitative HCV)/PCR (polymerase chain reaction)

This test measures the number of viral RNA particles in your blood. Doctors will usually perform these tests over the course of your treatment. Measuring your viral load before and after treatment will show whether or not this therapy is working.

Viral genotyping

Viral genotyping is carried out to identify the types of hepatitis C virus. There are six major types, known as 'genotypes'. The most common is genotype 1. Treatment time for genotype 1 is also the longest (48 weeks). Genotypes 2 and 3 have better success response rates to treatment (24 weeks therapy). Genotype tests are ordered before treatment is started to give doctors an idea of the length of time and the likely success of your therapy.

Some issues about testing

When testing for hepatitis B or C, there are some issues you may like to think about. Public knowledge about hepatitis is slowly improving but widespread ignorance about who gets hepatitis and how it is transmitted remains. It is a good idea to discuss your concerns with a health professional or counsellor who is trained to help you cope with hepatitis and any social difficulties that come with it, such as:

- **Insurance and mortgages**

Most insurance companies will ask applicants if they have been tested for HIV, hepatitis B and hepatitis C. A positive test result may mean a life insurance policy or a mortgage linked to a life policy could be refused or the premium raised. If this happens, it is worth talking to your doctor as many consultants are willing to write to a mortgage or insurance company stating your health and life expectancy.

- **Who to tell**

This is often a difficult decision but consider that a positive result may affect your family and sexual partner(s) and whether these people should also think about testing. If you are HBsAg positive your partner will need vaccinating if they are negative.

- **Confidentiality**

You may want only certain people to know about your test and results. Certain agencies such as GUM (genito-urinary medicine) clinics offer a confidential testing service, although in the case of a positive result your GP will become involved when you are referred to a specialist for on-going care.

Immunology/Autoimmune profile tests

AMA (antimitochondrial antibody)

This test is used when doctors are looking for evidence of primary biliary cirrhosis (PBC). This is because antimitochondrial antibodies are found in more than 90% of patients with this disease.

SMA (smooth muscle antibody)

This is a test that is used to detect autoimmune diseases such as autoimmune hepatitis (AIH). A liver biopsy is usually necessary to confirm the diagnosis and stage of the disease.

LKM (liver/kidney/microsomal antibody)

This test can be positive in a subtype of autoimmune hepatitis.

Imaging tests

Imaging tests allow doctors to examine you by looking at still and moving images of your internal organs and tissue. The consultant who will arrange and supervise your test is a radiologist. The medical staff that operate the imaging equipment are called radiographers.

Ultrasound

If you are required to undergo a liver biopsy (see page 32) you may need to have an ultrasound scan first.

Ultrasound is a routine procedure which can provide very useful information. It is usually

performed in the X-ray department of the hospital or in an outpatient's clinic, day care department or on a ward. Unlike an X-ray (see 'X-rays' page 31) ultrasound does not use radioactive waves. The procedure is very safe and should not be painful, but it may take 10 to 15 minutes to complete.

Before the scan you will be asked to uncover the top of the right half of your abdomen (below your ribs) and lie on your back. Gel will be applied to your skin which may feel slightly cold. A probe, like a microphone, will be moved across the surface of your skin. The gel helps to make this movement easier and makes sure that sound waves can be directed through your skin as the probe passes over your liver area. Anything solid will bounce back as a reflected sound wave via the probe and will be turned into an image that can be seen on a screen.

Once the procedure is finished and the probe removed, the gel is wiped off your skin. You will then be able to go home or on to an appointment if one is scheduled. If you are a hospital patient you will be advised whether you are to stay or go home.

The ultrasound machine will have recorded the pictures of your liver. A report will be made by the radiologist, who is trained to examine the images. This report may be ready soon after your ultrasound or may take one to two weeks. You should have an appointment arranged to discuss the result with your specialist or medical advisor. Sometimes the specialist will describe the type of picture received from your liver ultrasound as

being 'echogenic'. This means how clearly or 'bright' your liver can be seen on the ultrasound. The report will provide you and your specialist with information about the surface and the general shape of your liver, as well as any significant changes from its normal appearance. While ultrasound is able to highlight unexpected changes or anything that is not normal, it cannot show these in detail.

If you have any concerns about your liver ultrasound, discuss these with your doctor or nursing staff. Do this either when they are arranging your appointment or while you are having the ultrasound, to make sure you have the answers you need.

CT scan (computed tomography)

This test uses special X-ray equipment to demonstrate the density (thickness) of your body tissues. It can obtain pictures, called tomograms, from different angles around your body using computer processing and can show cross sections or 'slices' of your tissue and organs. This scan is useful for showing several types of tissue very clearly. The types of tissue investigated are the lungs, bones, soft tissues and blood vessels. The CT scan is one of the best tools for studying your chest and abdomen. It can be used to find out whether you have excess fat in your liver (fatty liver). Sometimes CT scans are also used by doctors to help guide entrance sites for biopsies. To prepare for the test you should wear comfortable clothing. You will be asked to remove all metal objects including hairpins, jewellery,

hearing aids, removable dental work and glasses. CT scanning is not painful. An iodine dye, usually given as a fluid to swallow, is used to show up the gullet (oesophagus), stomach and intestines (small bowel and colon). Alternatively, a dye may be injected into a vein to make your blood vessels and kidneys easier to see and to highlight the appearance of normal and abnormal tissue in organs such as the liver and spleen.

The CT scanner itself is a large machine into which you will be moved backwards and forwards. This is to allow the scanner to send a number of narrow beams across your body in a circular motion to provide very detailed images of the area under examination.

It is possible for the scan to take only several minutes unless many pictures are required (perhaps 20 to 30 minutes). There is a slight exposure to radiation, but for the time this test takes the risk is considered minimal. You are unlikely to have this scan if you are pregnant. The risk of allergic reactions to iodine dye material is rare and radiology departments are well equipped to deal with them should they occur.

MRI (magnetic resonance imaging)

MRI uses a type of tube scanner to provide a more detailed view of your organs than a CT scan. It is a relatively new kind of technology that creates powerful magnetic fields by releasing radio frequency energy to act on water molecules in your body. These emissions are a type of radio signal that can be picked up by the MRI equipment and

relayed to a computer that is able to generate very detailed views of tissues within your body. For this reason MRI is a very useful tool for investigating tumours both before and after treatment.

You will be required to remain very still. The scan is painless although some people may find being inside the scanner claustrophobic. It can take up to one hour but the majority of scans will take between 20 and 30 minutes.

Preparation and guidelines for the scan are similar to those for the CT scan. Although most people with metal in their bodies will be able to have MRI, people with certain implants may not. Your radiologist will advise.

MRCP (magnetic resonance cholangiopancreatography)

MRCP is a test using specialised magnetic resonance imaging (MRI, above) to provide doctors with a picture of your biliary (bile carrying) and pancreatic ducts. In this scan, the fluid in your biliary ducts appears brighter while the surrounding organs and tissues will appear darker.

The procedure can be used to find out whether gallstones are lodged in any of the ducts surrounding your gallbladder.

The scan is painless and takes about ten minutes unless combined with a normal MRI scan (an extra 20 to 30 minutes) and is normally performed as an outpatient. Again, you will be asked to prepare for this examination in very much the same way as for a CT or MRI scan.

X-rays

An X-ray is a common and painless examination in which invisible radioactive waves are passed through your body to record an image of your body organs.

A special X-ray that studies the veins and arteries that supply blood to the liver is known as hepatic angiography. This X-ray may be needed if your diagnosis is still doubtful after a CT and MRI scan. The procedure uses a catheter (a thin, flexible tube) that is placed into a blood vessel through a small cut in your groin. A dye, referred to as a 'contrast dye' or 'contrast medium', is then injected through the catheter to light up the blood vessels to make them easier to see.

A hepatic angiogram is usually done under local anaesthetic and you are also likely to be given sedation. Because of this, you may be asked to stay in hospital overnight (the minimum stay is six hours). The test is usually uncomfortable, rather than painful. You should be able to drive the next day.

Other diagnostic procedures

Laparoscopy

A laparoscopy is a procedure using a flexible (bendy) fibre optic tube with a tiny camera and a light on the end. This is called a laparoscope. It is inserted into your tummy through a small cut in your skin ('keyhole') to take pictures of your liver. If needed, a biopsy (see below) of your liver can be taken at the same time. A laparoscopy may also be used to follow up something seen on an X-ray or used alongside certain surgical procedures such as removal of the gallbladder (cholecystectomy) for gallstones.

A laparoscopy is performed under a general anaesthetic. Afterwards it can be painful (you may have a stitch or two), but tablet painkillers are usually enough to dull the pain. It is a good idea to have someone keeping an eye on you for 24 hours afterwards and you should not drive a vehicle during this time.

Liver biopsy

There are many causes of liver disease and it is sometimes difficult to diagnose a condition based on symptoms and simple blood tests such as liver function tests. Often a liver biopsy is the only way to diagnose your liver disease and identify how advanced it has become.

The first liver biopsy was performed in 1922 and since then it has become a standard procedure. It is considered routine by most specialists, but for a patient about to experience their first liver

biopsy it can be an anxious and worrying time. A discussion with your specialist or medical advisor prior to the liver biopsy is useful to help you deal with any unnecessary fears.

A liver biopsy is usually performed in one day and only occasionally requires an overnight stay. Usually you can expect to go home later the same day or in the evening. You must, however, make sure that you receive further information about this when talking to the specialist prior to the procedure.

Your liver biopsy will be performed by a doctor who may be a gastroenterologist, hepatologist or a radiologist. There may also be some difference between individual biopsies other than those described here.

You will need to give your consent (permission) to the medical staff to carry out the biopsy.

A blood sample will be taken to check your blood's ability to clot. This is a routine precaution to ensure the liver biopsy can be performed as safely as possible.

A local anaesthetic is given to you prior to the liver biopsy procedure. This may be above the liver area on the right side of your abdomen and below the ribs, or more likely between the lower ribs on your right side. In some cases a light sedative can be given if you require it, but discuss this with your doctor.

Sometimes the liver biopsy will be done under ultrasound guidance so that the liver can be seen and the biopsy directed by the imaging. You may already have had an ultrasound performed prior to the biopsy.

When the local anaesthetic has started to work (the area will feel numb), you will be asked to lie on your back or on your side, depending on where the doctors decide to insert the biopsy needle. This is a long thin tube that is inserted through your anaesthetised skin. You may be asked to take a few deep breaths before the needle or biopsy device is inserted and to hold your breath. Once the needle is inserted it is withdrawn quickly to remove a very small sample of liver tissue.

The term 'biopsy' actually refers to the sample of tissue taken even though you will hear it being used for the procedure itself.

You will then be asked to lie on your right side so that the weight of your body presses on the wound. This is to make sure the wound clots and then heals. It also means that you will need to remain in bed on your side or on your back for up to six or eight hours so you are advised to go to the toilet before the liver biopsy. It may be an idea to take a book to read or a personal music player to listen to. While you are lying in this way you will be regularly checked for pulse and blood pressure to detect any complications early.

There is a very small risk of either internal bleeding or bile leaking from the liver, but this is very uncommon. You may experience pain or discomfort during or after the liver biopsy. Not all

people do, but if you experience it there can be varying degrees. You should be provided with enough pain relief after your biopsy, but discuss this with your doctor and nursing staff.

Once you have completed the recovery stage after the liver biopsy you can usually go home. You should arrange to have someone to accompany you because you should not drive or travel on your own. If you have received sedation during your biopsy you should not drive for 12 to 24 hours. If you have any worries after your return home, contact the hospital or your GP.

Your liver biopsy sample is sent to a pathologist (a doctor who identifies diseases by studying cells and tissues) who will examine it under a microscope and produce a report. This is usually in the form of a description and a number that is a measure of any inflammation and/or fibrosis seen in the sample. This may take about two weeks, but it could be longer as services will vary across the country. You will have an appointment to discuss your results with your specialist or medical advisor who will explain the findings and any possible consequences they may have on your health and possible treatment.

Occasionally if the blood clotting is too prolonged or in the presence of ascites it may not be possible to perform a liver biopsy by the conventional route. In these circumstances the liver biopsy may have to be performed via a vein in the neck. This is called a Transjugular liver biopsy. This procedure is usually limited to specialist centres

and details would be discussed with you by your consultant or his team.

Liver biopsy is considered the best way for diagnosing liver disease. Other tests that are non-invasive and therefore less uncomfortable are beginning to emerge. These include the use of blood markers to detect or predict the amount of fibrosis and a technique similar to ultrasound known as elastography (FibroScan). This test measures the stiffness of your liver. The more stiffness it finds, the more fibrosis there may be.

However such tests do not differentiate between liver diseases i.e. they are not diagnostic tests but markers of the severity of liver injury.

For further information about these tests talk to your specialist or your medical team.

Pathology or histology

Pathology is the study of diseased tissues.

Histology looks at the detailed structure of cells and tissues under the microscope and this is what is studied on a biopsy. The histology is helpful in working out the cause of the liver disease and the stage (how advanced the liver disease is) such as whether there are changes such as cirrhosis.

Percutaneous transhepatic cholangiography (PTC) and biliary drainage

This is a procedure that allows the radiologist to examine the bile duct system of your liver. The procedure is done under local anaesthetic and will require a short stay in hospital.

'Percutaneous' means through the skin. In this case a thin needle is passed through your skin and through the liver into a bile duct. A dye is injected so that the bile duct system becomes outlined on X-ray. This picture will show any narrowing or blockages. If the duct is blocked, a flexible tube is inserted and remains in the duct. This will also allow your bile to be drained into a collection bag. Usually, either at the time of the procedure or within a few days, a small wire-mesh or plastic tube called a stent will be placed across the blockage to allow the drain to be removed.

Endoscopy

Endoscopic retrograde cholangio-pancreatography (ERCP)

Endoscopy is an established and reliable method of investigating the body's internal organs. An endoscope is a long, flexible fibre optic tube with a tiny camera and a light on the end. ERCP is an endoscopic procedure that is valuable in both examining your biliary and pancreatic structures. It can identify problems with the biliary tree, cystic duct obstruction, gallstones, narrowings and tumours. As a treatment ERCP can drain pus as well as dislodge, break down and remove gallstones.

You should get instructions from the hospital where your ERCP has been scheduled. These will provide you with guidelines on what preparations you need to make before the procedure. It is important for you to know how long before the procedure you will need to stop eating and drinking and about any possible changes in your medication.

At the beginning of the procedure, the doctor will spray the back of your throat with a local anaesthetic to make it feel numb. Sometimes a local anaesthetic lozenge is used, or you will be given a sedative injection through the drip (venflon) in your hand or arm. This will make you drowsy so that you can put up with the discomfort of having a tube passed into your gullet. You will be positioned on your side to follow the curvature of your gut.

The doctor will ask you to swallow the first section of the endoscope. After this the doctor will push it further down your gullet into your stomach and duodenum. The doctor will look at images on a TV monitor which come from the endoscope's camera which is filming the procedure.

Air is also passed into the tube into your gut to make it easier to see the lining of the gut. This may make you feel bloated.

The endoscope has a side attachment down which small instruments and tubes can pass. It has many uses:

- Contrast dye can be placed into the bile and pancreatic ducts. X-ray pictures are taken immediately after the dye has been given. This may show narrowings (strictures), any gallstones that might be stuck, tumours pressing on the ducts etc.
- A small tissue sample (biopsy) from the lining of the gut can be taken to check for abnormal tissue or cells. The sample is used for two types of test, histology and pathology (see page 36).

- If the X-rays show a gallstone obstructing the bile duct the doctor can widen the duct by making a cut to let the stone into the duodenum. This is called a sphincterotomy.
- If there is a narrowing in the bile duct the doctor can place a stent to open it up and keep it from collapsing. The stent can remain in place to help to drain away bile into the duodenum.

The endoscope is gently pulled out when the procedure is completed. It takes around 30 minutes to one hour, depending on what is done.

Your aftercare will depend on the findings of the ERCP. You might be booked in for an overnight stay if you have received a stent or had gallstones removed. You should not drive for 24 hours after receiving a sedative. Ask a friend or relative to drive you home from hospital. Also make sure that someone can stay with you for the first 24 hours after discharge from hospital. The hospital will also provide you with information when you are discharged that will help with any problems that might arise after an ERCP procedure.

Endoscopic techniques are also used to treat bleeding varices (small, protruding veins in the stomach and gullet). These techniques are called **injection sclerotherapy** and **banding**.

Injection sclerotherapy

In this technique a special chemical material called a sclerosant is injected into the veins of the gullet. This is done after you have been given some sedation

and an endoscope has been passed into your gullet. A very fine flexible needle is passed through the endoscope to inject the sclerosant material into the oesophageal veins or the tissue nearby.

This kind of injection causes the blood within the varix to clot and will also encourage some scarring to reduce the likelihood of varices returning. Side effects are rare in elective sclerotherapy. In emergency situations some pain and ulceration may occur.

Banding

After you have been sedated a single vein (varix) is sucked into a small chamber attached at the end of the endoscope. A small band is then placed around the base of the varix (ligation).

Like injection sclerotherapy, banding is usually performed as day surgery. The procedure may cause some mild pain and discomfort.

Injection sclerotherapy and banding are complementary procedures and both may be used if necessary. They each have advantages and disadvantages which you might discuss with your endoscopist.

Transjugular intrahepatic portosystemic shunts (TIPSS)

This technique, which connects two veins to change the direction of blood flow in the liver, is usually done by a radiologist with the help of ultrasound and other imaging technology to guide them. It is not classed as surgery and is commonly used for complications of portal hypertension. Portal hypertension is a complication of cirrhosis where

you have too high a pressure in your portal vein which normally carries blood from your bowel and spleen to your liver.

To lower the pressure in your portal vein a stent is passed across your liver to make a shunt, or bypass, causing blood to travel straight into the hepatic vein which carries the blood from your liver. This is done using a needle guided by a catheter inserted through a tiny puncture in your neck. This is not painful in itself and will be performed under a general or local anaesthetic.

The hospital will advise you on how to prepare for this procedure. This will include requiring you not to eat on the day before, what to bring with you etc. You can expect to stay in hospital overnight or perhaps two or three days. You will be given a sedative (in some cases this may be a general anaesthetic) for your discomfort and monitored closely. Possible complications include internal bleeding and later encephalopathy (mental confusion and memory loss) resulting from the blood flow to the liver being bypassed. This usually responds to laxatives (such as lactulose) but your liver specialist will discuss this with you before the procedure.

This procedure is usually indicated when bleeding from varices is uncontrolled. It may also be used when ascites does not respond to treatment with diuretics.

In the following weeks you will be required to have further imaging tests so that doctors can be sure the shunt is working properly.

Emergency procedures

Sengstaken Blakemore tube (aka Linton tube)

This is an emergency procedure used to stop active bleeding from both the stomach and gullet in which a tube will be passed through your mouth (or nose) into your gullet and stomach. It is limited to uncontrolled bleeding for those with varices where other medications do not have an effect.

You may be given deep sedation to put up with the tube before being admitted to a high dependency unit (HDU) or an intensive care unit (ITU) where you may be placed on a breathing machine. The breathing machine allows you to remain deeply sedated and prevents your lungs from being filled up with blood. The bleeding is caused by ruptured gastric or oesophageal varices. The tube contains two balloons that are filled with air to compress the bleeding. You will receive blood transfusions and clotting products to control the bleeding as well as drugs to keep your blood pressure within a safe limit.

This procedure has a good success rate but is a temporary procedure until more permanent treatment can be determined for you. This may be endoscopic or radiological (TIPSS) or, rarely, surgery (including transplantation).

Hemodialysis and haemofiltration

If you suffer from liver failure your kidneys may shut down. This means your body will need help to clear your blood of waste products and extra fluid. This is carried out by using a kidney-dialysis machine. Should this become necessary you will be referred to a specialist unit, either renal or

intensive therapy (ITU) who will keep a close eye on you, supported by your liver doctors.

Keeping up to date with your tests

During diagnosis, try to learn as much as you can about liver disease so you can ask questions and express any concerns you have.

In liver disease doctors may often have to consider a number of conditions that could be affecting you. They often have to ask very personal questions to exclude possible causes of your disease or reasons for changes in your liver tests.

It will be useful for you to understand why you are taking a particular test and to be aware of any possible side effects from them. Listen carefully to what the doctors say and do not be afraid to ask again if you do not follow an explanation. The need to reduce unnecessary testing for people at low risk of disease does not mean that you should not ask further questions of medical staff if you feel there is no follow-up to an abnormal test result.

Keep a diary or logbook to jot down the names of medical staff and record details of your lab results where they are known. Some understanding of your blood tests and keeping copies of them will help both you and the medical staff when discussing your results.

An active involvement in your own care is important.

Useful words

AFP – alpha-fetoprotein, a protein produced by liver cells normally found only in tiny traces in your body. The AFP blood test is a common test for liver cancer.

Antigen – a foreign, invading protein. When recognised by the body as foreign, the body's immune defence will react to the antigen by producing antibodies.

Antibody – a specific immunoglobulin (protein) produced by your body as part of a defence reaction against an invading substance (antigen).

Autoantibodies – abnormal antibodies that attack your own body tissues because it has mistaken them as foreign.

Blood markers – substances measured in blood which may increase if infection or disease is present or suspected.

Blood serum – the clear, liquid part of your blood. Serum will separate from blood during clotting.

Cholestasis – a condition where the flow of bile from the liver is reduced.

DNA – deoxyribonucleic acid, the genetic material of cells carrying the instructions for making up our bodies.

ELISA – enzyme linked immunosorbent assay, a biochemical test used to detect the presence of an antibody or an antigen in a sample.

Enzyme – a substance, usually a protein, produced by the body to help speed up a chemical reaction (which can be measured with liver function tests).

GGT – gamma-glutamyl transferase, a liver enzyme in your blood that is measured to check for liver damage.

Hepatic – anything relating to the liver.

Hepatitis – any inflammation of the liver is known as hepatitis, whether it is caused by a virus or not. A sudden inflammation of the liver is known as acute hepatitis. Where inflammation of the liver lasts longer than six months the condition is known as chronic hepatitis.

Hepatocyte – a liver cell.

Hepatologist – a doctor who specialises in liver disease.

Immunoglobulins – also known as Ig, these are large proteins that act as antibodies found in body fluids and cell tissues. They will bind to invading organisms, such as bacteria or viruses, to destroy them.

Inflammation – the first response of your immune system to infection or injury, usually noticeable by pain, swelling or tenderness.

Metabolic – relating to the break down and processing of substances in your body for growth and vitality.

Pathogenesis – the development of a disease or illness.

Pathological – relating to or caused by a disease.

Protein – a large molecule made from amino acids (peptides) required for the structure and working of your body's cells, tissues, and organs. Most proteins are made in the liver.

RIBA – recombinant immunoblot assay, a sensitive test used to detect the presence of anti-HCV antibodies in your blood.

RNA – Ribonucleic acid plays an important role in translating the genetic information (DNA) into protein production (synthesis)

Seroconversion – a change in your blood test so that something related to the virus appears. This may be an antigen, an antibody or the virus itself.

Stent – a small, thin wire-mesh or plastic tube used when treating obstructions in the bile ducts. Where there is a narrowing (stricture) in the bile duct the doctor will insert a stent to open up the duct to keep it from collapsing.

Tumour markers – substances found in blood, urine or body tissues which may increase if cancer is present or suspected. Alpha-fetoprotein (AFP), for example, is a protein that is a tumour marker for liver cancer.

Viral load – the amount of virus in your blood.

Virus – a microscopic particle that infects living cells by getting inside them and reproducing (replicating). Viruses cannot reproduce by themselves and can only multiply from within the cells of their living host.

Useful websites

www.nhsdirect.nhs.uk

Government site providing information and self-help advice about tests, treatments, operations and local services.

www.patient.co.uk

Register of health information provided by GPs to patients during consultations. Also contains a directory of patient support information and patient feedback.

www.labtestsonline.co.uk

Information to help the patients understand the way laboratory tests are used to diagnose, monitor and screen for a broad range of conditions and diseases.

www.rcr.ac.uk

The Royal College of Radiologists is a charity which aims to advance the science and practice of radiology and oncology, further public education and promote study and research through setting professional standards of practice.

www.radiologyinfo.org

A US site providing information about common radiological procedures and answers to frequently asked questions.

Further information

The British Liver Trust publishes a large range of leaflets about the liver and liver problems written for the general public.

Leaflets that you may find particularly helpful include:

- *Alcohol and liver disease*
- *Diet and liver disease*
- *Fatty liver and NASH*
- *First steps – a guide to your liver*
- *Getting the best from your doctor*
- *Hepatitis A*
- *Hepatitis B*
- *Hepatitis C*
- *Liver cancer*
- *Liver transplantation*

Special thanks

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This leaflet is for information only. Professional, medical or other advice should be obtained before acting on anything contained in the leaflet as no responsibility can be accepted by the British Liver Trust as a result of action taken or not taken because of the contents.

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For the British Liver Trust to continue its support, information and research programme, we need your help. We raise funds from many sources and a large proportion is donated by voluntary contributions. If you would like to send a donation it will enable us to continue providing the services that people need.

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