

# Liver and liver function tests.

## **Functions of the liver.**

- Detoxification of endogenous and exogenous toxins
- Metabolism of carbohydrates, fats and proteins
- Bile production
- Blood filtration
- Blood glucose regulation and glycogen storage.
- Synthesis of plasma proteins etc

## **Liver function tests**

The various liver function tests can be classified broadly based on the major function of the liver including

### 1. Excretory function;

The liver is responsible for conjugating bilirubin a product formed from the catabolism of heme to diglucuronide which is readily excreted in the bile. Bilirubin and other bile pigments such as urobilinogen and stercobilinogen can be measured in blood serum and urine as an important test for liver function. Bilirubin is estimated by Van De Bergh reaction where diazotized sulphanilic acid is reacted with bilirubin to form a purple colored complex-azobilirubin. For the color change is produced immediately (direct bilirubin) while for unconjugated bilirubin the color is produced only after addition of alcohol (in direct bilirubin)

Only conjugated bilirubin is soluble in water and excretable in urine hence when there is obstructive jaundice urine contains bilirubin as a means of excreting it from the body.

### Bromsulthalein (BSP) test;

When this dye is injected into system the hepatic cells conjugate it with glutathione although a significant fraction is excreted unconjugated, when a single bolus dose of 50g/l is given, the retention of the dye after 45minutes in normal people is less than 5%.

Impairment of the liver cell function causes an increase in BSP retention.

Indocyanine green (ICG) is another dye also used also less frequently.

## 2. Metabolic functions

These liver functions tests are based on evaluation of substances that are selectively metabolized by the liver e.g galactose, half-life of galactose in blood is about 10-15 minutes, but in defective liver is prolonged. Antipyrine is rapidly and completely absorbed from the intestine and mostly metabolized by hepatic monooxygenase system, normal subjects excrete 5-8% of this compound in their breathe in 2 hours while patients with cirrhosis excrete 2-3% and hepatitis 2-4%.

## 3. Synthetic function of the liver

The liver functions in synthesis of almost all plasma proteins except Igs and so levels of plasma proteins may be assessed to determine the condition of the liver. Serum albumin is appreciably reduced in all chronic liver diseases but is not a good indicator of acute liver damage because of its long half-life. Haptoglobin and transferrin are better indicators of acute liver changes.

Prothrombin time is used as an indicator of poor prognosis in chronic liver diseases.

Others are alpha-fetoprotein which is a tumor marker whose level is markedly increased in blood during hepatocellular damage.

## 4. Serum enzymes.

Aminotransferases levels in serum are used to indicate liver disease as they are elevated usually in almost all liver disease .alkaline phosphatase (ALP) whose synthesis is induced by bile duct obstruction have elevated levels in serum in cholestasis and hepatic carcinomas as compared to parenchyma liver disease. Gamma glut amyl transferase levels are also used and are sensitive to biliary tract disease.

5'-nucleotidase, leucine amino peptidase and in special circumstances glutathione -S-transferase are also used.

## **Kidney and kidney functions tests**

The basic units of the kidneys are microscopically thin structures called nephrons, which filter the blood and cause wastes to be removed in the form of urine.

The major function of the kidney is to excrete metabolic waste products and to maintain water, pH and electrolyte balance. It also has endocrine functions of producing rennin, erythropoietin (influences the production of red blood cells in the bone marrow) and calcitriol. An additional function of the kidney is the processing of vitamin D; the kidney converts this vitamin to an active form that stimulates bone development.

### **Kidney functions test**

Kidney functions tests can be broadly classified into;

1. Tests for glomerula filtration rate and
2. Tests for tubular functions.

Renal threshold is the concentration of a substance in plasma above which it is excreted in urine with both glomerular and tubular functions presumed normal. E.g renal threshold of glucose can be affected by physiological and pathological changes in renal blood flow, glomerular permeability or the absorptive capacity of the tubules.

Clearance tests.

Measurement of GFR is a useful index for assessment of severity of renal damage. Clearance is defined as the quantity of blood or plasma completely cleared of a substance per unit time and is expressed as milliliter per minute. It estimates the amount of plasma that must have passed through the glomeruli per minute with complete removal of that substance to account for its appearing in urine.

Clearance =  $\frac{\text{mg of substance excreted per minute}}{\text{Mg of substance per ml of plasma or serum}}$

Mg of substance per ml of plasma or serum.

$$C = \frac{U \times V}{P}$$

P

U = Concentration of substance in urine

P = Concentration of substance in plasma

V = ml of urine excreted per minute

Inulin; It is neither absorbed nor secreted by the tubules; therefore its clearance is a good measure of GFR.

Diodrast – di-iodo- pyridine acetic acid , it is used in urinary tract x-ray, because it filtered and excreted

Para amino hippurate (PAH), is also filtered and excreted hence it a good measure of renal plasma flow.

It is however difficult to determine the plasma concentration of inulin and others above since it is and exogenous substance infused into the blood stream. So endogenously present substances like creatinine and urea are used.

Creatinine is a waste product formed from creatinine phosphate it has a continuous production pattern which hardly fluctuates, hence its excretion is a good measure of GFR.

Urea , a breakdown product of dietary and endogenous catabolism of protein, although is partially reabsorbed , is used and GFR is slightly more than urea clearance.

### **Tubular functions assessment.**

Measuring specific gravity (SG)- indicating osmolality

-concentration test

-ADH tests

-Dilution test

Useful adjunct to kidney function tests is urinalysis, which are basic test carried out on urine to determine the functional status of the kidney and as a whole. Tests carried out on the urine include broadly

- a. Physical tests including evaluation of volume, appearance, odor, color and specific gravity etc
- b. Chemical: pH, protein blood glucose ketone bodies. Bile salts etc

## **Imagery**

plain x-rays and ultrasound are useful tools for visualizing aberrations in the number, size and texture and position of the kidneys and its related structure. It is also useful in detecting mineralized densities i.e kidney stones etc.

## **Cytology and histology**

Tissue biopsy or cytology may also be employed to determine cause and extent of damage to the kidney.