

CHAPTER 14

Kidney function test

Kidney functions in the elimination of waste products and toxic substances from the body. It regulates water balance and maintains normal crystalloid and colloid osmotic equilibrium between plasma and tissues. It also maintains normal acid base equilibrium of the body.

The following tests are required to be done to assess the kidney function under diseased conditions

1 Concentration test: This is based on the determination of the concentrating power of the kidney

The patient is given high protein content meal with 200 ml of fluids at 6 P.M. in the previous day. No food or drink is allowed till the test is completed. Empty the bladder at the bed time. Discard this urine and any other sample passed in the night. Collect the urine sample at 8 a.m. and 10 a.m. separately. Determine the specific gravity of each sample.

In case, the kidneys are normal, at least one specimen shows a sp. gr. above 1022 often reaching 1032. In hypofunction, the sp. gr. is nearer 1010.

2 Dilution test (Water test): In presence of edema this test should not be done.

The bladder is emptied early in the morning and urine discarded and breakfast not allowed. The patient is advised to drink 1200 ml of water in 20 to 30 minutes (at 8 a.m.). The hourly urine samples are collected from 9 a.m. to 12 noon. Measure the sp. gr. of each sample.

In normal persons, the water elimination is 1200 ml in 4 hours. The sp. gr. of at least one sample is 1002 to 1003. Water elimination is significantly decreased and the sp. gr. falls below 1010 in unpaired state of kidney. Renal or extra renal (edema or cardiac failure) may be the cause of the decreased output. If the concentrating power is normal, the cause must be extra renal.

3 Urea clearance test: This test is a sensitive index of renal function in children as well as in adults. Under normal conditions urea excretion is constant and the blood cleared of urea per minute serves as a measure of the kidney function.

In the normal adult, the urea excretion is directly proportional to the level of urea in blood when 2 ml or more is excreted per minute. This is called maximum clearance (C_m). If the urine output is less than 2 ml per minute, it is clear that reabsorption of urea by the tubules is increased. When the urea excretion is diminished and varies with the square root of output of urine per minute, it is called standard clearance (C_s).

Procedure: A light breakfast without tea or coffee is given on the day of test. Drug therapy is stopped a day before. The patient is advised to empty his bladder. Note the time. Allow him to drink 500 ml of water to have free flow of urine. Collect blood for urea estimation at about 50 minutes. At 60 minutes collect all the urine. Measure the volume. Ask him to drink about 500 ml of water more to drink. At 120 minutes collect separately all the urine and measure the volume. Estimate the blood urea nitrogen (urea) and urine urea nitrogen (urea) of the two urine samples.

Calculation

$$C_m = \frac{U \times V}{B} \text{ ml}$$

$$C_s = \frac{U \times \sqrt{V}}{B} \text{ ml}$$

whereas, U = mg. of urine urea nitrogen Per 100 ml.

V = urine volume per minute in ml.

B = Mg. of blood urea nitrogen per 100 ml.

The clearance may be expressed in ml. but generally it is expressed in percentage of the normal clearance. The values for average normal C_{in} is 75 ml. (100%) and for C_s is 54 ml. (100%).

$$\therefore \text{Percent of } C_{in} = \frac{U \times V}{B} \times \frac{100}{75} = \frac{1.33UV}{B}$$

$$\therefore \text{Percent of } C_s = \frac{U \times \sqrt{V}}{B} \times \frac{100}{54} = \frac{1.85U \sqrt{V}}{B}$$

If the surface area of the patient varies widely from the normal (1.73 sq m.), then the true ' V ' is obtained by multiplying the observed ' V ' by 1.73/A. Where A is the surface area in sq. m. This correction is necessary particularly in case of children.

Discussion: The clearance test is of great help in following the progress of advanced cases. The elimination or deposition of edema fluid does not affect the test, so it is done in such cases.

Normal clearance in unimpaired kidney function is 75% or above (in Indians 40–70%). If all extra renal causes are excluded, a clearance of 10% or less indicates severe kidney damage.

The urea clearance test serves as an indicator of glomerular function. If the clearance value falls, it is the indication that the glomeruli is destroyed. The concentration tests are very sensitive to slight degree of renal damage but they fail to show differences between moderate and severe renal impairment. If the concentration test is normal, further studies are not necessary. Urea clearance test assures whether the decreased excreting power is serious or not. Excretory power and clinical condition follow the clearance test but not the specific gravity.