Rapid Evaluation of Creatinine Clearance

Thesis

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للأستاذة الدكتورة
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مع شكري وامتناني
وتقديري
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بسم الله الرحمن الرحيم

Table of Abbrevasion

Crt. = Creatinine.

Crt. cl.= Creatinine Clearance.

S. = Serum.

Ys. = Years.

Ht. = Hight.

Cm. = Centimeter.

Wt. = Weight.

Kg. = Kilogram.

min. = minute.

F. = Formula.

GFR. = Glomerular Filtration Rate.

Fig. = Figuer.

Hrs. = Hours.

Meas. = Measured.

Cal. = Calculated.

>. = More Than.

<. = Less Than.

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INTRODUCTION
and
AIM of the WORK

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The endogenous creatinine clearance (crt. cl.) has been employed as a basic determination of glomerular filtration for assessment of the renal function in routine practice (Effrose, 1957). There is linear decrease of creatinine clearance over time as the kidney fails (Rock *et al.*, 1987). But there are many difficulties met in collecting 24 hours urine sample for measurment of creatinine clearance, and there are many emergency conditions which require a very rapid estimation of creatinine clearnace to access the renal function (Kampmann and Molhom, 1981).

So, it is preferable to predict crt. cl. without collecting 24 hours urine by certain simple mathematical equations, which depend on serum crt. level, body weight, age and sex (Cockroft and Grault, 1976 and Durakovic, 1986).

The aim of this work is to measure creatinine clearance by biochemical method and calculate it by different formulas in normal and diseased subjects. Comparison of the different results will be performed to reach the best formula to overcome the difficulties and errors in collecting the 24 hours, urine samples.

REVIEW OF LITERATURE

Anatomy of the Kidney

Kidneys are retroperitoneal organs lying on the posterior abdominal wall in close proximity to the spinal cord at either side from last thoracic to third lumbar vertebra (lich *et al.*, 1978).

They are been shaped, paired structures the right is slightly lower than the left due to the size of the right lobe of the liver. The hilum of the kidney is at its middle and transmits the ureter, vessels, renal sympathetic nerves and lymphatics (Romanes, 1975).

Figure (1) represents a diagram of a vertical section through the kidney, where the cortex, the medulla and the hilum of the kidney are shown. Blood vessels and nerves pass into and out of the kidney at the hilum (Churg, 1979).

Structures of the Kidney:

The Excretory channels: are the minor, major calyces and renal pelvis which are continous with the ureter (Hamburger *et al*, 1969).

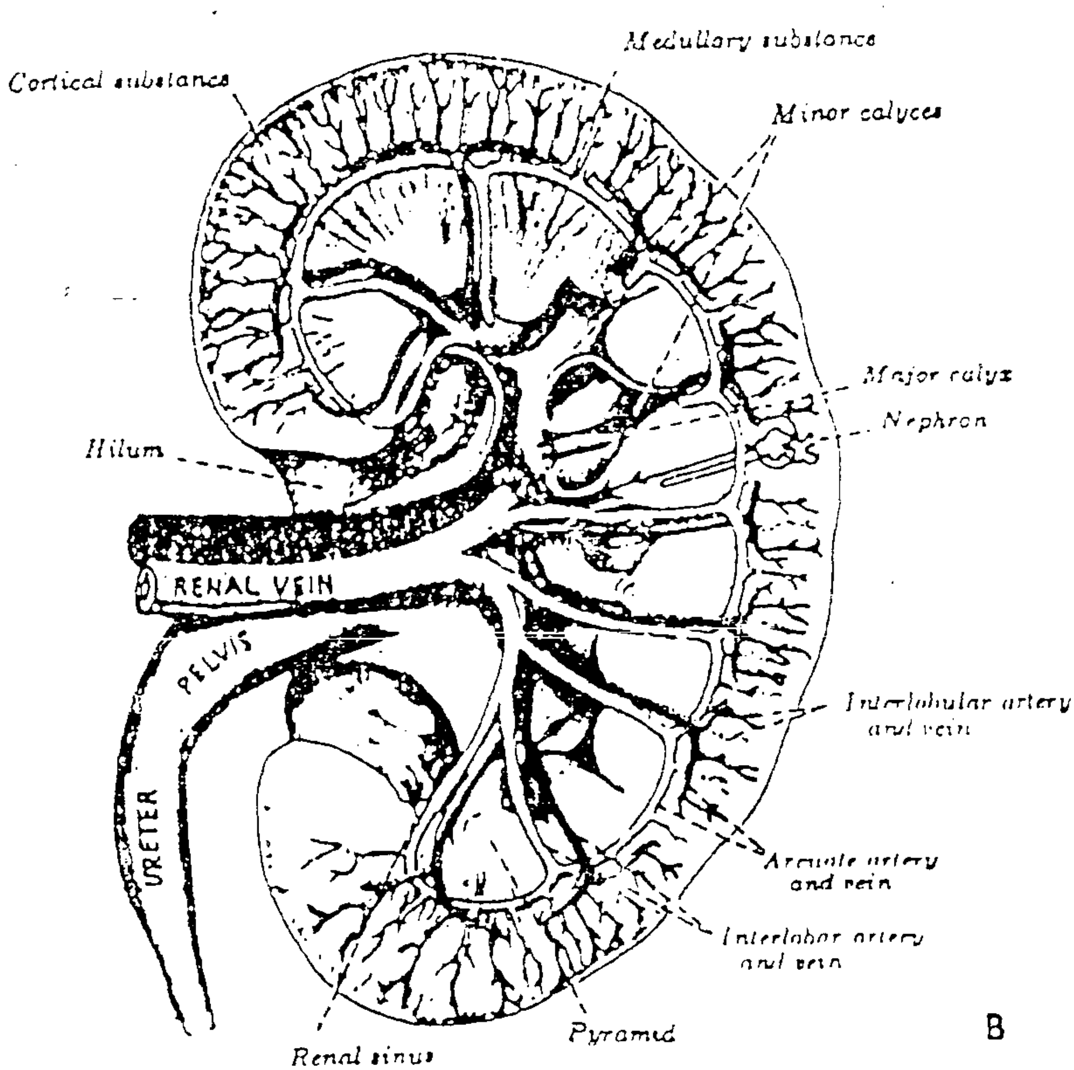

Fig (1):

Digram of a vertical section through the kidney (Mcass lea and Febiger, 1966)

The minor calyces are short and funnel like tubes (6-10) in each kidney, each embraces renal papilla, receving urine from collecting tubules. They unite to form major calyces which open into and form the base of renal pelvis (Romanes, 1975).

The calyces drain into the infundibula, which are the primary divisions of the renal pelvis and are usually two or three in number (Spinack and Resnick, 1983).

Renal Parenchyma:

It is formed of outer pale cortex adjacent to the capsule and dark red medulla which includes a series of triangular radially striated medullary rays, these are Malpighian pyramids (6-10) in number and correspond to the number of minor calyces, (Bulger, 1979).

The nephron is the structural and functional unit of the renal parenchyma. The number of nephrons in each kidney is about 12 million. Not all of them are working at the same time (Guyton 1981).

Each Nephron consists of a glomerulas and renal tubules

(a) Glomerulus

It is compossed of capillary tuft surrounded by Bowman's capsule. Blood enters the glomerulus from afferent arteriole, and leaves it by the efferent arteriole.

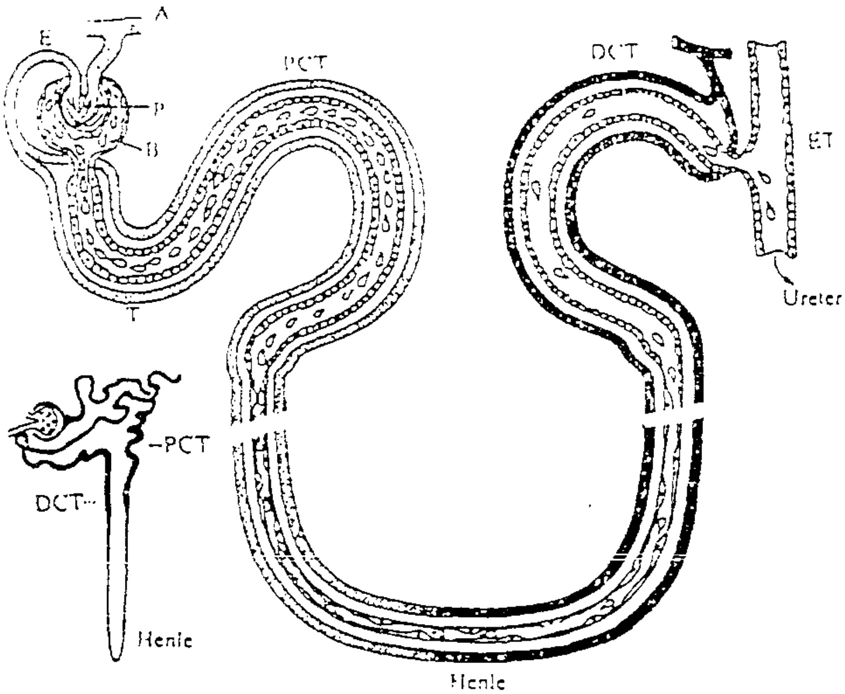

Fig (2):

Schematic drawing of the glomerulus and tubular system:

A, afferent arteriole; E, efferent arteriole; P, plexus of capillaries (glomerular tuft); B, Bowman's capsule; T, tubular blood supply; PCT, proximal convoluted tubule; Henle, loop of Henle; DCT, distal convoluted tubule; ET, excretory tubule; or duct. The blood capillaries, shown also along the tubular system (T). (Willard *et al.*, 1982).

(b) Renal tubule:

It consists of:

(a) Proximal convoluted tubules.

(b) Loop of Henle.

(c) Distal convoluted tubules.

Each of the distal tubules open into a collecting tubule which will join together and open into the minor calyces (Bulger, 1979).

As shown in Fig (2), Each nephron is supplied by a small blood vessel, the afferent arteriole. It carries blood from a branch of the renal artery into the nephron at a rate of about 1200 ml / min. which is the total renal blood flow.

The arteriole enters into an expanded portion of the renal tubule called Bowman's capsule. Within the capsule, the vessel breaks up into a plexus of capillaries, which recombine to form an efferent arteriole. The efferent arterioles join each other to carry blood from the nephron to the renal tubular area (Aukland, 1976).

Physiology of the Kidney

The kidneys are the excretory organs of the body, but they also perform metabolic activities as conversion of 25 hydroxycholecalciferal to the active 1,25 dihydrocholecalciferol, and have endocrinal functions as production of renin and erythropoietin. So kidney requires a high blood supply. The main renal function is the maintainenance of the internal environment by controlling the quality of the extracellular fluid.

The kidney must act first as a selective filter to remove water and filterable solutes from the plasma. This process occurs in the glomerular filtrate (Brenner and Deen, 1979). Large volume of the filtrate is formed which is then modified as it passes through the nephron.

Glomerular filtration is approximately 125 ml/min. 95% or more of it is reabsorbed (Ganong, 1981).

Filtration is accomplished through the thin walls of the capillaries that make up the plexus. The blood flows into the plexus from the relatively large afferent arterioles and leaves the plexus through the smaller efferent arterioles. This difference in size of the two vessels produces an increase in hydrostatic pressure within the capillaries that is to be "75 mm Hg". This pressure is almost twice that of the other capillaries in the body. The filtrate is therefore forced through the thin capillary epithelium and is caught in Bowman's capsule, which envelopes the glomerular tuft and is connected with the tubules (Lassiter, 1975).

About 200 litres enters the tubular lumina each day mainly by glomerular filtration. The filtrate contains diffusible constituents at almost the same concentrations as plasma. For example, at normal plasma concentrations about 30,000 mmol of sodium, 800 mmol of potassium, 500 mmol of free ionized calcium, 1000 mmol (180g) of glucose and 800 mmol (48g) of urea would be filtered daily in 200 litres.

Although 200 litres of plasma is filtered, only about 2 litres of urine is formed each day. The reabsorption of about 99% of the filtered volume and adjustment of individual solutes, indicates that tubular cells have carried out selective active transport against physicochemical gradients.

Among the components of the glomerular filtrate are many substances that are necessary for the body to prevent their loss, the kidney tubules are designed to reabsorb water and useful solutes selectively. So glomerular filtrate is converted to urine, which contains end products of metabolism their accumulation in the body is injurious (Anderson, 1971).