EXTRACORPOREAL RENAL SURGERY AND AUTOTRANSPLANTATION

An Essay

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of the Master Degree in

Urology

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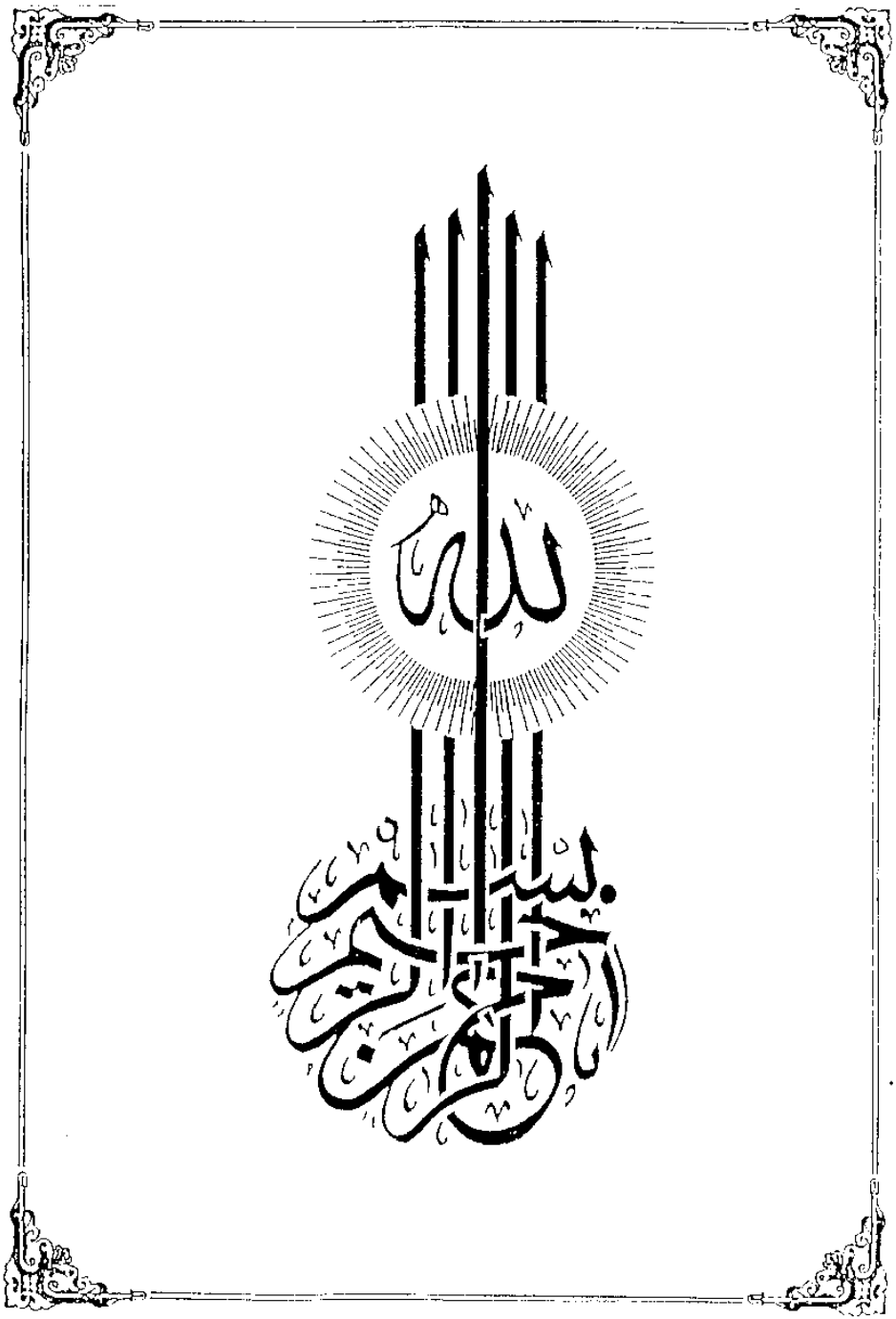

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CONTENTS

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INTRODUCTION

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INTRODUCTION

Bilateral renal diseases and renal diseases in a solitary kidney, constituted a problem that embarrased the urologic surgeons in the past. Extracorporeal renal surgery and/or autotransplantation arouse as an excellent solution for these problems.

With the advent in the procedures used for kidney preservation and for employement of the microvascular techniques, extracorporeal renal surgery offers the treatment of choice for some properly selected cases

The advantages of the procedure include a bloodless surgical field, optimum magnification and illumination, optimum exposure, proper preservation of the kidney against ischemia and prevention of spillage of tumour cells in cancer surgery.

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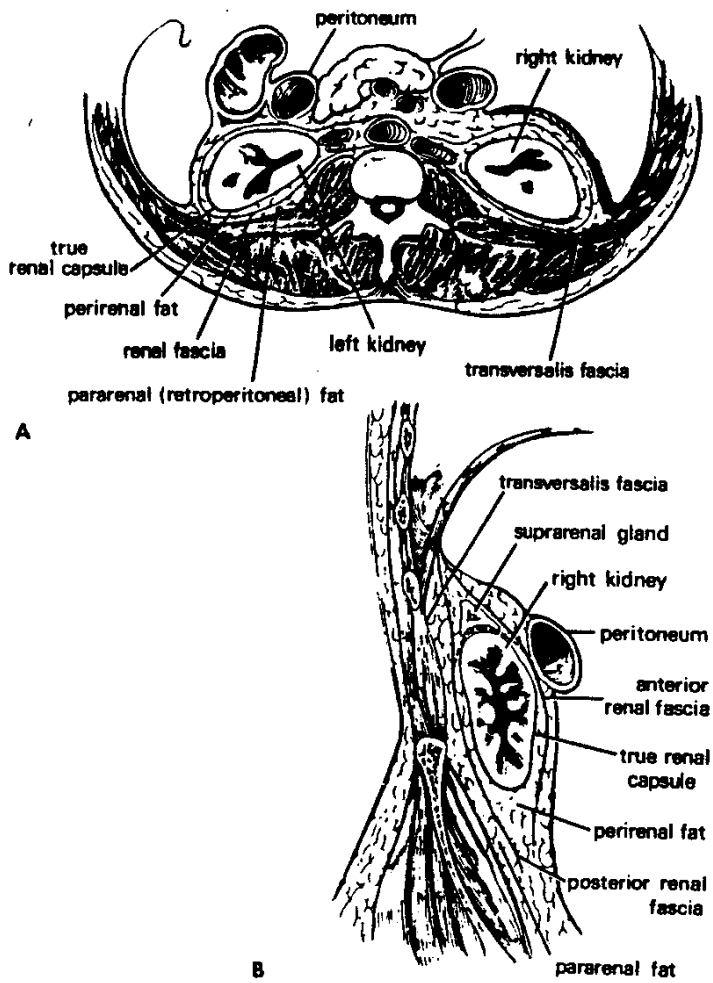

Fig. 1: The renal coverings.

A. Transverse Section.

B. Sagittal Section.

(After Keith, W.K. et al Applied anatomy of the Kidney and ureter).

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ANATOMY

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**ANATOMY OF THE KIDNEY,
URETER AND RENAL VESSELS**

The kidneys lie on each side of the spinal column, usually beside the bodies of the 12th thoracic through the 3rd lumbar vertebrae, the right being 1 to 2 cms lower than the left due to the right lobe of the liver. They are not situated parallel and vertical, rather their upper poles are tilted slightly towards one another, probably because of the kidney's position in relation to the muscles of the posterior abdominal wall and also because they are situated in a shallow trough (the renal niche) just lateral to the vertebral column and it's enclosing muscles, their medial borders are tilted forwards on the edges of the psoas muscles.

Therefore, each kidney is rotated so that the medial border faces slightly anterior and the lateral border slightly posterior. It also must be remembered that the kidneys do not lie in the coronal plane of the body but rather at an angle of approximately 30° posterior to it (Bulmer, 1974).

The average dimensions of an adult kidney are approximately 11 cm long, 6 cm wide and 3 cms thick.

The posterior renal surface is flatter than the rounded, convex, anterior surface. In approximately 10% of the left kidneys, there is a bulge of renal parenchyma on the lateral

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aspect. This is the splenic, or dromedary hump which is due to compression by the spleen during development (Frimann-Dahl, 1961).

In the middle of the concave medial border of the kidney is the "hilum", a slit approximately 3 cms long through which passes the renal pelvis, nerves, blood vessels and lymphatics. Here (from anterior to posterior) the renal vein leaves the kidney to join the inferior vena cave, the renal artery brings blood from the aorta and the renal pelvis tapers into the ureter. In the hilum the medial aspect of the kidney, is hollowed out to form the renal sinus which accommodates the renal pelvis, blood vessels and the peripelvic fat.

Anatomic Relations of the Kidneys

The posterior relations of both kidneys are the same except that the right kidney being lower has less relations to the diaphragm and pleura. The renal bed is bounded medially by the psoas major muscle, posteriorly by the quadratus lumborum muscle, laterally by the aponeurosis of the transversus abdominis muscle and superiorly by the diaphragm. Thus the posterior relations compromise these four muscles, three nerves (the subcostal, iliohypogastric and ilioinguinal) and 2 vessels (the subcostal vein and artery which pass with the nerve across the quadratus lumborum muscle (Tobias, and Arnold, 1963). The diaphragm is attached to the inner aspect of the 12th rib thus separating the

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kidney from the rib and the pleural cavity. On the left side the upper half of the posterior surface is related to the pleural cavity, whereas on the right side, only the upper 1/3 is so related, if the 12th rib is very short, the pleural cavity may extend 2 or 3 cms below the rib (Bulmer, 1974).

The principal anterior relation of both kidneys is the peritoneum, however 3 structures on each side are related to the kidneys with no intervening peritoneum. On the right side, there is the triangular adrenal gland, overlying the upper renal pole, the descending part of the duodenum which overlies the front of the medial border and the hepatic flexure of the colon which is in contact with the lower lateral part of the anterior surface. The 2 areas of the right kidney that are covered by peritoneum are related to the liver above the colon and the small intestine below the colon. On the left side, the 3 structures in contact with the kidney are the adrenal gland above, the pancreas and the splenic flexure of the colon, while the areas of the left kidney that are covered by peritoneum are related to the spleen above, the stomach laterally and the jejunum, below the pancreas.

Renal Coverings (Fig. 1)

The kidney has 4 coverings that need to be considered. The true capsule, the perirenal space and fat, Gerota's fascia, and the pararenal fat.

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The true capsule is a tough, fibrous membrane that is closely applied to the underlying parenchyma. Capillaries and lymphatics extend from the capsule into the renal substance, but despite this, the normal capsule can be easily stripped off the kidney.

Outside the true capsule, the kidney is surrounded by the perirenal fat which has a characteristic firmness and a pale yellow color which distinguish it from other fat in the body. Multiple fibrous strands traverse this fat between Gerota's fascia and the capsule.

Surrounding the perirenal fat is Gerota's fascia which is a loose envelope of collagenous, elastic and connective tissue surrounding the perirenal fat, the kidneys and the adrenal gland. Thus, it separates the perirenal fat from the extraperitoneal (pararenal) fat. Two layers are present, the posterior layer (Zuckerkandl) which is more distinct than the anterior layer (Toldt) which is thin and attached to the peritoneum. Laterally, the two layers fuse together while superiorly the envelope is closed above the kidney and adrenal gland, where it fuses imperceptibly with the diaphragmatic fascia. A thin partial septum separates the adrenal gland from the kidney allowing separation of the kidney without interference with the adrenal gland, yet allowing gas or contrast medium to pass from the perirenal space into the periadrenal space. Inferiorly, the fascia extends around the ureter for a distance terminating as an

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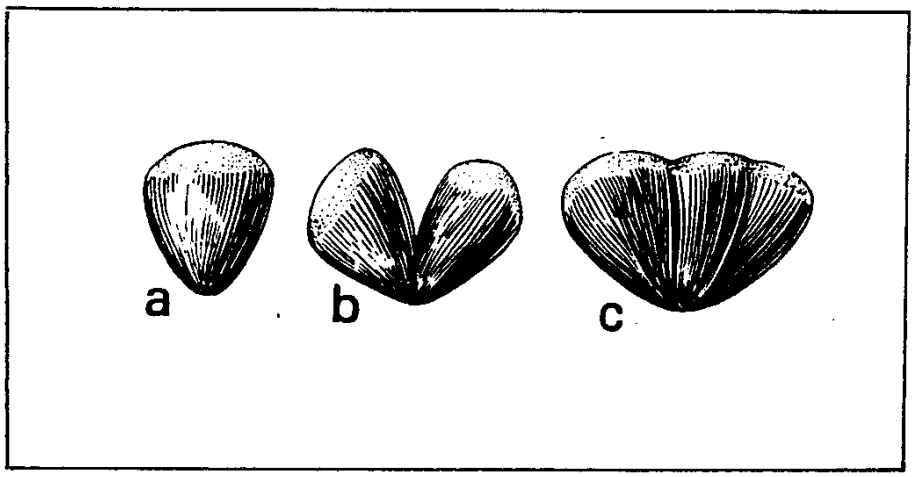

Fig. 2: The degrees of lobar fusion.

A. No fusion: Simple pyramid and simple papilla.
B. Simple pyramid and compound papilla.
C. Compound pyramid with compound papilla.

(After Keith, W.K. et al Applied anatomy of the Kidney and ureter).

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open ended cone. Medially the two layers pass in front of and behind the renal vessels, aorta and I.V.C. and fade away by fusing with the adventitia of these vessels. The posterior layer also fuses with the connective tissue in front of the vertebral column. The 4th covering is the pararenal fat which is a continuation of the extraperitoneal fatty layer (Tobin, 1944).

Internal Structure of the Kidney

Each kidney consists of 4 to 28 (usually approximately, 14 lobes) (Witten, et al., 1977). According to Hodson, each lobe consists of a central cone of medullary tissue surrounded by a cortical layer, except in the region of the papilla (Hodson, 1972). Thus, the lobe can be thought of as a sugar cone (the medulla) with a hefty helping of dripping ice cream (the cortex) covering all but the bottom of the cone where it is being held (the papilla) when several such cones are collected with their apices towards the center, the "ice cream" melts in one structure, the renal cortex (Fig. 2). On longitudinal section, the cortex forms the outer 1/3 of the renal parenchyma. The portion covering the sides of the cone is known as the cortical columns of Bertin. Because a longitudinal section of a cone is pyramid-shaped, the accepted term for the medulla is the renal pyramid (Keith and Marvin, 1982).

The cortex which has a granular appearance consists primarily of the glomeruli and the proximal and distal

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convoluted tubules. The darker medulla has a more striated appearance because of the presence of the loops of Henle and the collecting ducts. The ducts join to form the papillary ducts of Bellini, 20 or more of which open onto the surface of the papilla (area cribrosa), draining urine from the parenchyma into the collecting system. Thus the renal papilla is the anatomic and functional boundary between the kidney and it's drainage conduit.

As Hodson and Ransley have demonstrated the renal lobes may fuse, especially in the renal poles (Hodson, 1972). Depending on the degree of fusion, one of three types of renal lobes may be seen. First, if there is no fusion, the result is a simple pyramid and a simple papilla. These simple-shaped papillae occur primarily in the central zone of the kidney. Second, two or more cones may fuse only at the papillae. Third whole cones may fuse, in which case one finds compound pyramids with compound papillae. Compound papillae drain more than one renal lobe.

The papillae invaginate into the minor calices. Different and often strangely shaped, compound minor calices may be present, depending on the degree of fusion and the shape of the papillae.

The pyramids of the renal medulla are arranged in anterior and posterior rows every where except in the polar regions. Between the rows is a column of cortical tissue. The base of this tissue is marked on the surface of the kidney by

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