NEPHROSTOMY

THESIS

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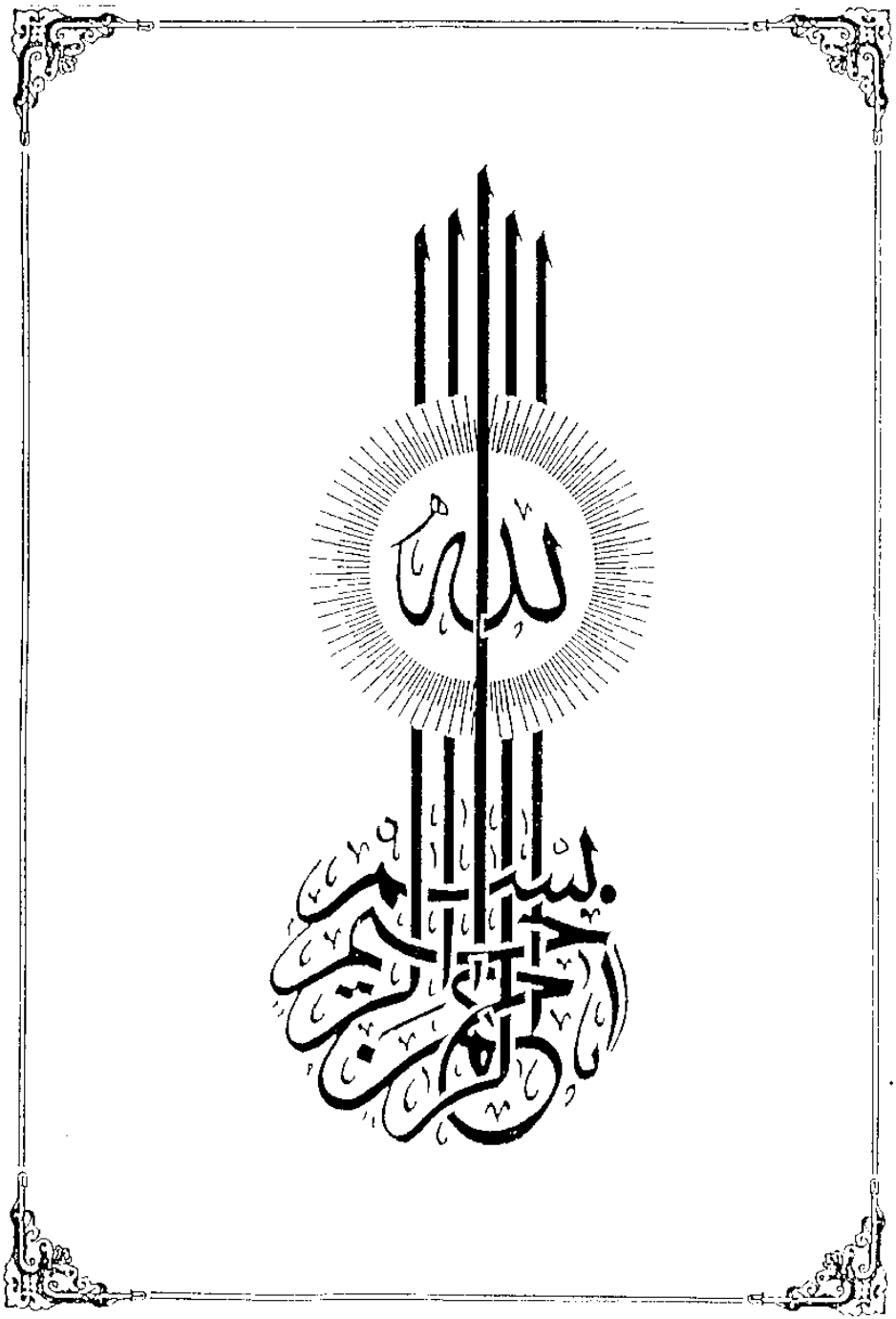

CONTENTS

INTRODUCTION

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Nephrostomy is one form of upper urinary tract diversion of urine. It may be used as temporary method for supravesical shunt or rarely as a permanent procedure. Because of the numerous problems associated with long term nephrostomy drainage it is best to use it as a temporary procedure.

Recently, the technique of percutaneous nephrostomy has now given the urologist a relatively straight forward method for the emergency drainage of the upper urinary tract. This technique has almost entirely replaced the formal nephrostomy.

The advantage of percutaneous nephrostomy is not only that it spares the patient an open operative procedure but also that radiologic and functional investigations can be carried out as soon as the drainage is established. Also percutaneous nephrolithotomy, lithotripsy and chemical dissolution of stones can be carried out through the nephrostomy tract. More recently operations on the ureter can be performed through the percutaneous nephrostomy.

Surgical and Radiological Anatomy of the Kidney

Surgical and radiological anatomy of the kidney

Introduction:

A sound knowledge of renal anatomy is an essential prelude to all percutaneous manoeuvres. There is imaging techniques which have provided the first chance to study the renal position relative to posture, movement and compression in vivo. Radiology remains paramount of these methods. Plain abdominal x-ray often indicates the position and size of the kidney, intravenous urography the structure and function , angiography the disposition of vessels, Co_2 insufflation the surface of kidney and x-ray screening the movements of the kidney in response to respiration and position. The advent of computerised axial tomography enabled the relationships of the kidney to be studied in a different dimension. Ultrasound also provides images of increasing clarity. Radio nucleotide investigations clearly outline the structure of the kidney and allow functional correlations to be made. All these methods have been exploited in order to demonstrate the relevant features of percutaneous anatomy.

The position of the kidneys:

The topographical position of the kidney depends on its embryological developments. Classically the pelvis lies opposite the lower border of the lst lumbar vertebra on the right and slightly higher on the left. Radiologically the pelvis lies opposite L. 2 on the right, 1-2 cms higher on the left.

Factors holding the kidney into position:

The enveloping renal fascia, vascular connections and intra abdominal pressure are probably paramount. Within the renal fascia the surrounding perirenal fat allows a considerable range of movement in most people . The vessels are relatively short and rigidly anchored to their mid-line origin. The intra abdominal pressure generated by the tone of the anterior abdominal wall may well be one of the most important stabilizing factors by virtue of the compressive forces applied to the surrounding viscera. Female patients are ten times more likely to have mobile kidneys.

Attitude of the kidneys: rotation.

The longitudinal axes of the kidneys are not straight. A degree of rotation is always seen. The upper poles of each kidney are more closely approximated than the lower poles. The kidney which lies on the psoas muscle has an anterior surface which is directed laterally and forward and a posterior surface which is directed medially and backwards. It therefore lies at approximately 25° to the coronal plane, lying in a posterior direction.

Position of kidney relative to respiration, patient position and compressive abdominal forces:

Movement of the diaphragm in respiration causes the kidney to move downwards in inspiration and upwards in expiration. The amplitude of movement is very variable but

it is in the order of 3 cm. The right kidney is more mobile than the left. Such movement is more pronounced in women than in men. A kidney transfixed by a percutaneous needle will convey this movement (in the vertical plane) to the needle which will clearly oscillate. Percutaneous operations are carried out through the loin. For the initial puncture the prone oblique position is optimal.

Surface anatomy:

The normal kidney is rarely palpable in the corpulent patient, in the child and thin female it can often be felt bimanually. Anteriorly , the kidneys may be localized as extending from the interchondral articulation of the sixth and seventh costal cartilages to approximately 2.5 cm above the umbilicus. The centre of the hilus is approximately on the transpyloric plane, about 5 cm from the median plane and slightly medial to the tip of the ninth costal cartilage. The hilus of the left kidney is just above the transpyloric plane and that of the right kidney is just below it.

Posteriorly the hilum of the left kidney is situated beneath the point where the lateral border of sacrospinalis meets the 12th rib. The lower border is 2 inches or less above the highest point of the iliac crest. The projection of the right kidney is on the whole ½ inch lower. Radiological confirmation is a prerequisite to any percutaneous manoeuvre.

The significance of the 12th rib:

On review normal intravenous urograms in order to determine the position of the calyces relative to the 12th rib we found if the calyces lie under cover or above the 12th rib, puncture is either very difficult or hazardous. Numerous factors determine the relationship of the 12th rib to the calyces namely: the angle, the length and width of the rib as well as the position, rotation and size of the kidney. The 5 minute film of intravenous urography taken in the supine position in full expiration used to evaluate this relationship. The male kidney is slightly larger than the female kidney and the left kidney is slightly larger than the right. One might therefore expect that the calyces of the right kidney should be easier to reach with a needle than the left and that the female kidney would be slightly more difficult to puncture than the corresponding male kidney. The position of the upper and middle calyces either above or under cover the 12th rib in majority of patients, demonstrated the inability of the radiologist to puncture these calyces in most cases, especially when the calyces are not dilated. The lower calyces must be regarded as the most common route of access to the collecting system.

The significance of the perirenal fascia of Gerota:

Gerota's fascia consists of an envelope of fibro-elastic connective tissue which completely surrounds both kidneys.

The thinner anterior leaf (fascia Toldt) merges imperceptibly with the prevascular tissues ventral to the great vessels medially, and fuses with the posterior layer laterally. A small partition extends from the anterior leaf to separate the kidney from the adrenal gland.

The tough posterior layer (the fascia of Zuckerkandl) fuses with the prelumbar fascia medially and with the anterior layer laterally. The cranial and caudal aspects are open ended, merging with the diaphragmatic and iliolumbar extraperitoneal tissues. It can thus be immediately appreciated that extravasating fluid (irrigant) in the so called perirenal space of Gerota can pass not only inferiorly to the pelvic extraperitoneal tissues, but also across the mid-line to the opposite side. This is easily demonstrated by pneumoradiography.

The perirenal fat itself consists of a variable amount of loose connective tissue which can become densely adherent to the true renal capsule when inflamed. On the whole it is slightly less viscid than normal fat in other locations in the body.

Topographical relations of the kidney:

The kidney is closely related to large blood vessels, highly vascular organs, the pleural cavity and the gut. Injudicious percutaneous manoeuvres with large calibre instruments are liable to result in dire consequence if not carried out with much care and a full understanding of the anatomical relationships.

Posterior relation of the kidney

The most important relation of the kidney is the pleura which is separated from the upper pole of the kidney by fat and a thin layer of diaphragm. The line of the pleura usually crosses the 12th rib at the lateral border of the erector spinae. The dorsal aspect of the 12th rib thus usually lies above the line of the pleura. It is not difficult to appreciate that supracostal punctures are liable to cause a pneumothorax. The right kidney is related to the 12th rib, the left kidney to both the 12th and 11th. A bed of muscles, the arcuate ligaments, psoas major, quadratus lumborum and the tendon of transversus abdominus complete the posterior relations. On these muscles run the subcostal vessels, the last thoracic nerve, the iliohypogastric and ilioinguinal nerves.

The lateral border of the kidney:

On the right the greater sac separates the kidney from the liver, on the left the spleen is similarly related to the kidney. The lower border of the left kidney is intimately related to the descending colon. If reteroperitoneal laparoscopy is performed in the convential renal position, the liver, spleen and colon are in great danger as there is a tendency to advance the instrument too far antro-laterally.

The anterior relations of the kidney:

On the left the suprarenal gland, spleen, stomach, pancreas, jejunum and descending colon form the anterior

relations. The suprarenal,pancreatic and colic areas are devoid of peritoneal coverings, the remaining viscera are separated from the renal surface by fat and a peritoneal layer.

On the right the suprarenal gland, liver, colon and duodenum form the anterior relations. The area in contact with the descendig part of the duodenum and hepatic flexture is devoid of the peritoneal covering which separates the other viscera from the renal surface.

Occasionally patients develop a fever and some an ileus following percutaneous puncture and dilatation. This is explained that the exploring percutaneous needle has passed too far in the ventral direction and has punctured one or other of the viscera. If this happen add Metronidazole prophylactically to the Gentamicin already given routinely.

The lateral limit of the hepato-renal recess of Rutherford Morrison is related to the kidney. This capacious potential reservoir may accommodate large volumes of fluid resulting from injudicious entery to the general peritoneal cavity.

The renal hilum:

The medial border of the kidney presents a concavity in which is centred a deep fissure, the renal hilum. It contains the expanded upper end of the ureter, the blood vessels, nerves and lymph channels.

The renal artery and its branches are related both to the anterior and posterior aspects of the pelvis. The vein is situated ventral to the artery.

The important aspects of the macroscopic and intrarenal anatomy:

The dimensions of the kidney are subject to considerable variation. The average kidney length is 11 cm, width 6 cm, breadth or thickness 3 cm and weight 140 grams. The left kidney is generally longer than the right. Radiographic measurements are misleading because of magnification, although often more useful (1-2 cm increase in all dimensions). The reddish brown colour of the kidney cannot be distinguished from the spleen or liver at reteroperitoneal laparoscopy. Lobulations and scarring however may help to identify the renal surface.

The kidney is covered by a true capsule which is composed mainly of fibrous tissue but contains both elastic tissue and nerves. Puncture of the capsule is always associated with some pain in the conscious individual. Dilatation of a transparenchymal track similarly may cause pain. The capsule should be preserved at open operations as closure of nephrotomies relies on this structure to hold the sutures.

The collecting system of the kidney can be divided into three divisions: