COMPLICATIONS OF RENAL STONE SURGERY

Essay

SUBMITTED IN PARTIAL FULFILMENT

FOR THE MASTER DEGREE IN

UROLOGY

By

AMGAD RAGHEB KOZMAN

M.B., B.Ch.

SUPERVISED BY

Dr. MAHMOUD EZZAT IBRAHIM

Assistant Professor of Urology

Faculty of Medicine

Ain Shams University

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

1987

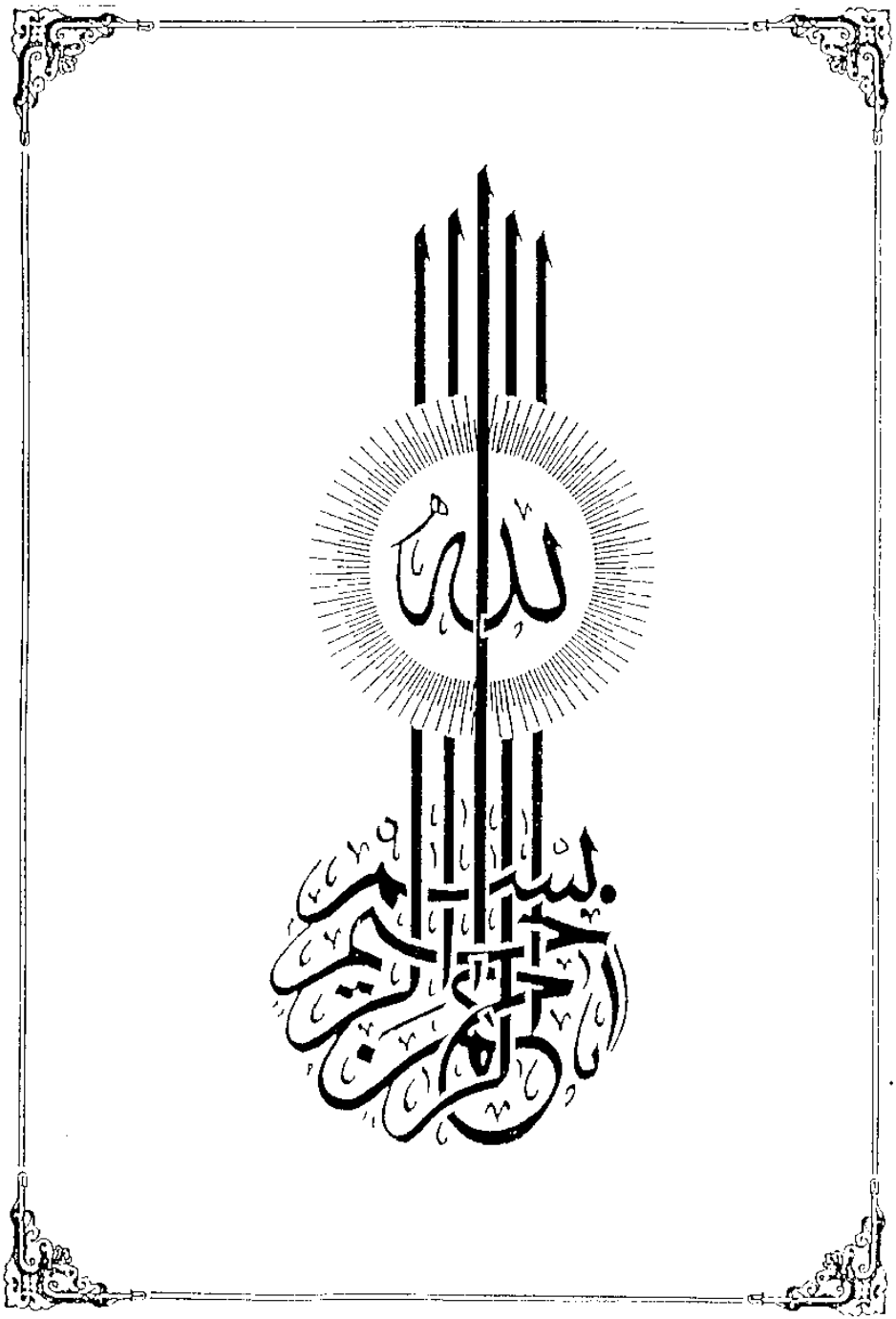
ACKNOWLEDGEMENT

I am deeply honoured to have the opportunity to express my great indebtedness and gratitude to **Dr. MAHMOUD EZZAT IBRAHIM**, Assistant Professor of Urology, Faculty of Medicine, Ain Shams University, for his great help, kind supervision, and continuous encouragement throughout the accomplishment of this work.

I would also like to take the opportunity to express my thanks to all the staff members of the Urology Department, Ain Shams University for their continuous help.

ANGAD R. KOZMAN

1987



CONTENTS

INTRODUCTION

INTRODUCTION

The morbidity following renal operations is higher than most surgeons realize. The intra-operative and post-operative complications of renal stone surgery depend on the pathology present, the procedure performed, and technique used.

Complications are inherent in every surgical procedure, successful surgery is the result of anticipating and avoiding them.

In this essay, the anatomical and physiological considerations of the kidney, and the surgery of renal stones and its various complications are discussed. The complications of endoscopic manipulations of renal stones are also mentioned. All of these considerations are essential for the surgeon in order to make every effort to save the maximum number of functional nephrons, remove all the calculi and minimize new stone formation.

ANATOMICAL AND PHYSIOLOGICAL

CONSIDERATIONS OF THE KIDNEY

I-ANATOMICAL CONSIDERATIONS

A sound knowledge of renal anatomy is an essential prelude to all surgical procedures for removal of renal stones. The surgeon's ability to move about inside the kidney with preservation of renal function is directly and proportionally related to the definition of the vascular segments and their relationship to other features of renal anatomy and to the pathologic process. This must be accomplisehd for each and every kidney at the time of surgery (Boyce, 1983).

GROSS ANATOMY

Anatomic Relations of the Kidney:

The renal fossa is bounded medially by the psoas muscle, posteriorly by the quadratus lumborum muscle, laterally by the broad abdominal muscles, and superiorly by the diaphragm. The diaphragm is attached to the 12th rib and arcuate ligament, which is a significant relationship to remember in order to avoid pleural

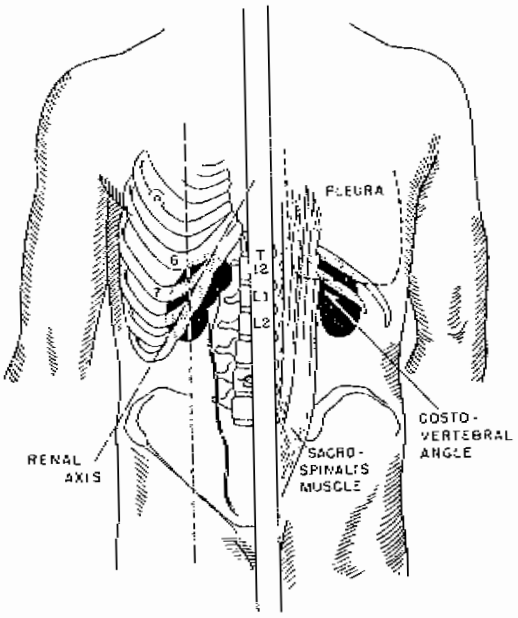


Fig. 1: The anterioposterior surface projection of the kidneys and ureters, emphasizing the medial position of the kidneys, the renal axis, and the pleural reflection (From: Lich et al., 1979).

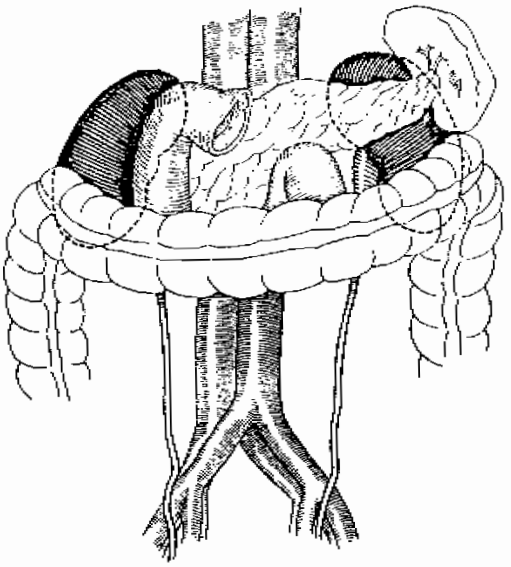


Fig. 2: The intraperitoneal relationships of the kidneys (From: Lich et al., 1979).

- Hepatic flexure of colon

- Splenic flexure of colon
- Tail of pancreas
- Beginning of jejunum

The immediate relationship between the right kidney and duodenum must be appreciated in placing the pedicle clamp during nephrectomy (Lich et al., 1979).

Renal Coverings:

The kidney has four coverings: the true capsule, the perirenal (or perinephric) fat and space, Gerota's fascia and the pararenal fat (Fig. 3).

The true capsule is a tough, fibrous membrane that is closely applied to the underlying parenchyma because of the penetrating nephrocapsular capillaries and lymphatics but it is not adherent and can be stripped off easily. The firmness of the true capsule can be appreciated when introducing a needle into the kidney.

Outside the true capsule, the kidney is surrounded by the perinephric fat, which shows special abundance posterolaterally; it is distinguishable from normal fat elsewhere in the body by its characteristic firmness and pale yellow colour (Lich et al., 1979).

Medially, the two layers pass in front and behind the renal vessels, aorta and inferior vena cava 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. Thus, there is no connection between the two perirenal spaces and blood, pus or urine rarely spread from one space to the opposite one.

The fourth covering of the kidney is the pararenal fat which is merely a continuation of the extraperitoneal fatty layer (Kaye and Goldberg, 1982).

Kaye and Goldberg (1982) concluded that, in performing a percutaneous nephrolithotomy, one traverses the four renal coverings: true capsule, perirenal space, Gerota's fascia and pararenal fat. The true capsule, Gerota's fascia and the lumbo-dorsal fascia provide the major resistance to track dilatation.

THE INTERNAL STRUCTURE OF THE KIDNEYS

Anatomic Relations of the Pelvis and Calyces:

Of all the parts of the kidney, the calyces and renal pelvis are the most varied in position, shape and number. Unfortunately, for the urologist dealing

with multiple stones, they are also the most important elements of the renal anatomy.

One of the best descriptions of the anatomic relations of the renal pelvis and calyces is that of Brödel (1901). He contends that, although considerable variation may be seen, from a surgical viewpoint, two principle types of pelvis and collecting systems exist: a true pelvis and a divided pelvis (Kaye and Goldberg, 1982).

True Pelvis: This is the classic type. Six to thirteen calyces (usually eight) are arranged in a uniform pattern that can best be understood in relation to the coronal plane of the isolated kidney (the plane of the surgically mobilized kidney assuming that it lies in the same coronal plane as the body) not the kidney in situ which normally lies at an angle of about 30° to the coronal plane of the body. In the upper and lower poles the calyces are compound and may have two or three papillae invaginating them. The upper and lower pole calyces tend to lie within the frontal plane at various angles facing the central region of the pole. The remaining six calyces are arranged in two distinct rows, one in the anterior half of the kidney, and one in the posterior half (Fig. 4). These pairs of calyces usually are not on the same level,

and thus, on a standard urogram, are generally not superimposed.

The anterior calyces usually lie at an angle of 70° from the coronal plane of the isolated kidney. Thus these anterior calyces are directed almost straight forward, facing the anterior surface of the kidney. The posterior calyces are more regular, and lie at an angle of about 20° from the coronal plane of the isolated kidney (Fig. 5). The minor calyces join to form the major calyces or infundibula, two or three major calyces may be present which join to form the renal pelvis. In most kidneys, the pelvis has a capacity of 3-10 mls. It may be completely within the renal sinus (intra-renal pelvis) or mostly outside it (extra-renal pelvis). The renal pelvis is roughly pyramidal, with the base facing the parenchyma and the apex funnelling down into the ureter (Kaye and Goldberg, 1983).

Divided Pelvis: The divided pelvis usually has a zone of cortical substance between the 2nd and 3rd and the 4th and 5th calyces that extends to the renal hilum. In most cases the lower portion has the larger number of calyces. In most divided pelvis, there are more than 8 calyces (Kaye and Goldberg, 1983).

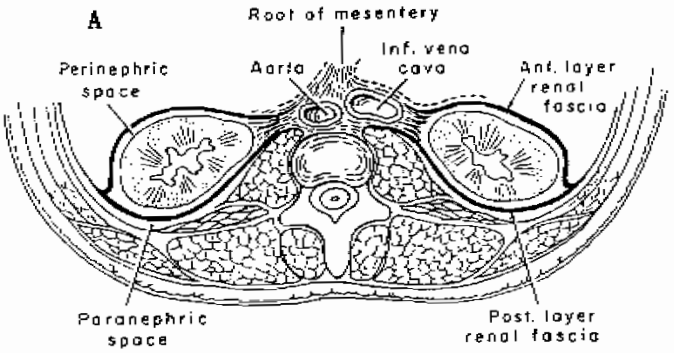
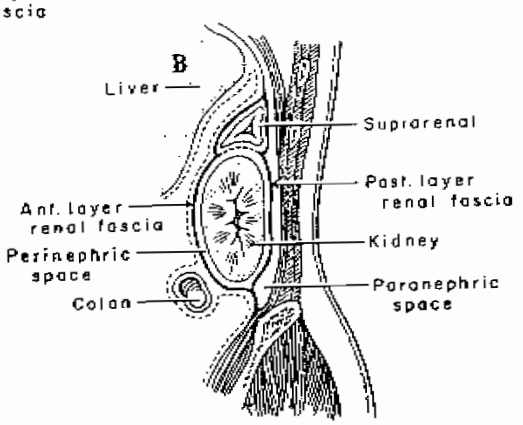


Fig. 3: The renal coverings. A, horizontal section. B, vertical section (From: Lich et al., 1979).



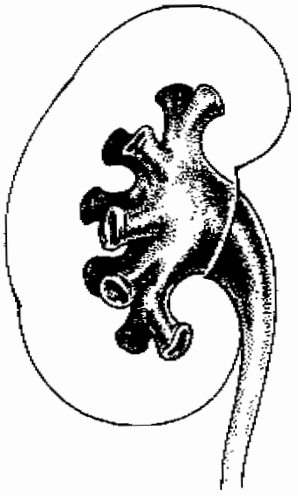


Fig. 4: Anatomic arrangement of the major calyces and their relationship to the segments of the kidney and to the renal pelvis (From: Straffon, 1982).

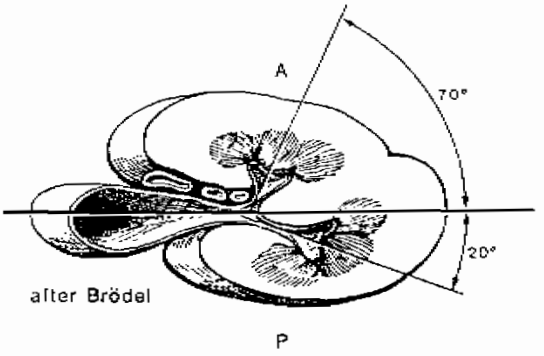


Fig. 5: Transverse section of the kidney shows arrangement of anterior (A) and posterior (P) rows of calyces (From: Kaye, 1983).

THE RENAL SINUS

The term sinus renalis was described as a rectangular cavity within the kidney. Its external edge borders on the medulla in the parenchyma and its internal edge on the hilus (Fig. 6). This sinusal cavity has two prolongations, one superior and one inferior, each containing the major infundibulum of the corresponding calyces. The hilus is lined by the internal sheet of fibrous capsule of the kidney, which melds with the pericalyceal connective tissue. The average dimensions of this sinus are 5 cm vertically, 3 cm from outside to inside, and 2 cm from front to back (Gil-Vernet, 1983, 1984).

Surgical access to hilar space is through the hilar recess, which has the shape of an oval fissure vertically elongated, (3.5 cm - 7 cm) in length and (1.5 cm - 2.5 cm) in width. The configuration of this opening or hilus may vary from angular to semicircular, with variations produced by the embryologic process of fusion. In surgically exposed kidney the anterior lip of the renal hilus appears retracted, the posterior protruding. In general, the more recessed the sinus the more open the hilus, the easier the intra-renal surgery (Gil-Vernet, 1983, 1984).

In the normal kidney, the sinus is occupied by