



**A THESIS RESEARCH OF
MASTER DEGREE of UROLOGY IN
Comparison between OPEN STONE SURGERY vs
PERCUTENOUS NEPHROLITHOTOMY in
Managment of Renal Stones By Using S.T.O.N.E
Nephrolithometry Scoring System**

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SYMBOLS AND ABBREVIATIONS

>	more than
<	less than
≥	equal to or greater than
≤	equal to or less than
%	percent
AUA	American Urological Association
BMI	body mass index
cm	centimeter
CROES	Clinical Research Office of the Endourological Society
CTUT	computed tomography urinary tract
EHL	Electrohydraulic lithotripsy
ESWL	extracorporeal shock wave therapy
GSS	Guy's Stone Score
HoL	holmium laser
KUB	Kidneys, ureter and bladder (X-ray)
NLSS	Nephrolithometry Scoring system
NCCT	Non-Contrast Computed Tomography
OSS	Open Stone Surgery
PCNL	Percutaneous Nephrolithotomy
RIRS	Retrodrage Intra-Renal Surgery
S-ReSC	Seoul National University Renal Stone Complexity
SFR	Stone Free rate
SS	Scoring Systems (SS)
SSD	Skin-Stone Distance
URS	Ureteroscopy
YAG	yttrium-aluminium-garnet (laser)

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INTRODUCTION

INTRODUCTION

- Urinary tract stone diseases are considered common medical condition, with high recurrence rate and, one of the most common diseases of the urinary tract all over the world[1]. This affect about 5% to 15% of the general world population[2] with a high incidence in young adults between the third and fourth decade of life[3]. About 15% to 20% of all patients with renal stones need invasive intervention[4]. Large renal stones that causes pain, hematuria, recurrent infections, renal function deterioration and increases mortality[5] should be actively treated .

- Before the endo-urology era, the main treatment has relied on conservative surveillance or open stone removal surgery. Ancient Egyptian surgeons were the first to be credited with removal of bladder stone by urethral dilatation and sucking out the stones[6]. William Ingalls of the Boston City Hospital was the first one to perform a planned nephrolithotomy in 1872[7].

- Nowadays, Open surgery for most urinary stones currently holds only a historical importance and its use had been reduced for only 1% to 5.4% of the cases. However, in developing countries, the rate of open stone surgery amounts to up to 14%[8-9] of all cases.

- In the past two decades, advances in the endoscopic management of nephrolithiasis, in the form of newer refined endoscopes and stone fragmentation techniques, have resulted in a strong shift toward minimally invasive procedures[10]. Among these several treatment options, Percutaneous Nephrolithotomy (PCNL) is now the treatment of choice for large and complex renal stones[11].

- However, in spite of these technical advances in the endourological interventions , there is still a need for open surgical approach as a second- or third-line of treatment option in many cases[\[12\]](#).

- Due to the availability of the equipment, present facilities in each countries, expertise and experience in surgical treatment of urinary stones, most urological centers worldwide report a need for peri-operative risk assessment and estimation of treatment success rates especially in older and more ill patients[\[13\]](#).

- The success of procedure is measured by a stone-free rate(SFR). The SFR was defined as the absence of residual stone or the presence of asymptomatic clinically insignificant residual fragment of < 4 mm on the non-contrast computed tomography(NCCT) in the next 30 days postoperatively.

- In urology practice, nephrolithometry scoring system(NLSS) has enabled extensive patient orientation, more effective surgical planning and better evaluation of outcomes .

- Recently, three different Scoring Systems (SS) were used to predict outcomes. The Guy's Stone Score (GSS) , the Clinical Research Office of the Endourological Society (CROES) nomogram and S.T.O.N.E. (Stone size, Tract length, Obstruction, Number of involved calices, and Essence/stone density) nephrolithometry Score allow for objective assessment of kidney stones and predict outcomes[\[14-16\]](#).

- This study will talk about S.T.O.N.E. nephrolithometry Score, identifying it, how to use and its quality in the prediction of the stone free rate and complications following the PCNL and OSS in patients. we will prospectively apply this system on the preoperative non-contrast CT (NCCT) and collect data in the same cohort to determine the STONE score for every case and use it clinically in both PCNL and OSS. We then will use the results of each case to compare it with the post-operative outcome (SFR and complications) between these both procedures to determine which is the best procedure can be used in treating same renal stones situations according to the results that we will get by the score.

- We chose the STONE nephrolithometry scoring system to use it in the study as it provides more accurate data than the Guy's Stone score and offers an easier application than the CROES nomogram according to Labadie et al.[\[17\]](#). Furthermore, a multicenter study including 850 patients suggested that the STONE score predicts accurately surgical outcomes after procedures, including the SFR and overall complications[\[18\]](#).

- Understanding the relative predictive value of a universal tool for multiple treatment modalities will broaden its applicability to stone disease and allow for effective comparison between treatment options, informing clinical decision making.

AIM / OBJECTIVES

- The primary aim of my research is to evaluate and compare between Open Stone Surgery (OSS) and Percutaneous Nephrolithotomy (PCNL) in the management of renal stones by using the S.T.O.N.E. nephrolithometry scoring system to predict and assess the stone free rate and the correlation with peri-operative complications in that two procedures.
- Additionally, we propose future directions for the development and analysis of surgical treatment for stone disease, namely, the importance of assessing radiation exposure and patient quality of life when counseling patients on treatment options.
- The potential benefits of preoperative scoring systems that can aid the urologist and his/her patient in the preoperative discussions about the risks and benefits of surgery and can decide which is the best procedure for that case .

REVIEW

RENAL ANATOMY

General anatomy :

- kidneys are paired organs lying in the retro-peritoneal space on the posterior abdominal wall. Each kidney has a characteristic shape, with a superior and an inferior poles, a convex border placed laterally and a concave medial border. The medial border has a marked depression, called the Hilum, containing the renal vessels and renal pelvis (Fig. 1.0)[19].
- The level of the liver makes the right kidney to be lower than the left.

Position of the kidneys

- Because the kidneys lie on the posterior abdominal wall, against the psoas major muscles, their longitudinal axis parallels the oblique course of the psoas (Figure 1.1). Because the hilar region is rotated anteriorly on the psoas muscle, the lateral borders of both kidneys are posteriorly positioned. This means the kidneys are angled 30–50° behind the frontal (coronal) plane (Fig. 1.2)[20].

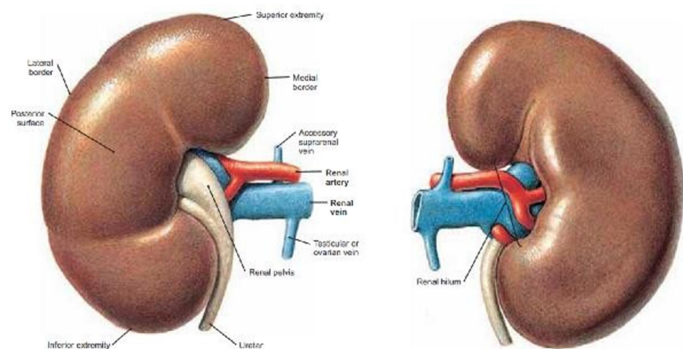
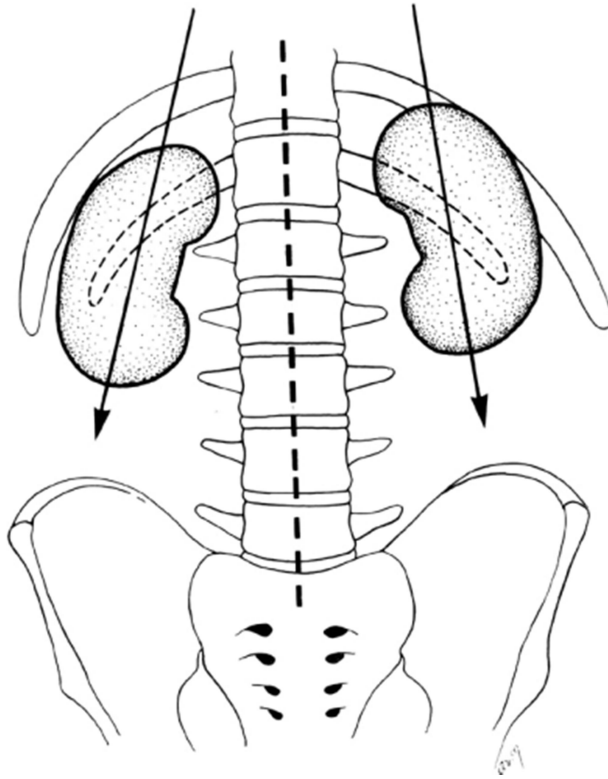


Figure 1.0

- (1) The kidneys are paired, bean-shaped organs, and normally weigh about 125 to 150 g each.
- (2) The **ureter** is the most posterior structure at the hilum. The **renal vein** is the most anterior structure at the hilum, but the **renal artery** frequently divides into anterior and posterior branches (or divisions), and the anterior branch often enters the kidney ventral to the renal vein.

**Figure 1.1**

Schematic of an anterior view of the kidneys in relation to the skeleton showing that the longitudinal axes of the kidneys are oblique (arrows), with the superior poles more medial than the inferior poles. The dashed lines mark the longitudinal axis of the body. It can also be seen that usually the posterior surface of the right kidney is crossed by the 12th rib and the left kidney by the 11th and 12th ribs.

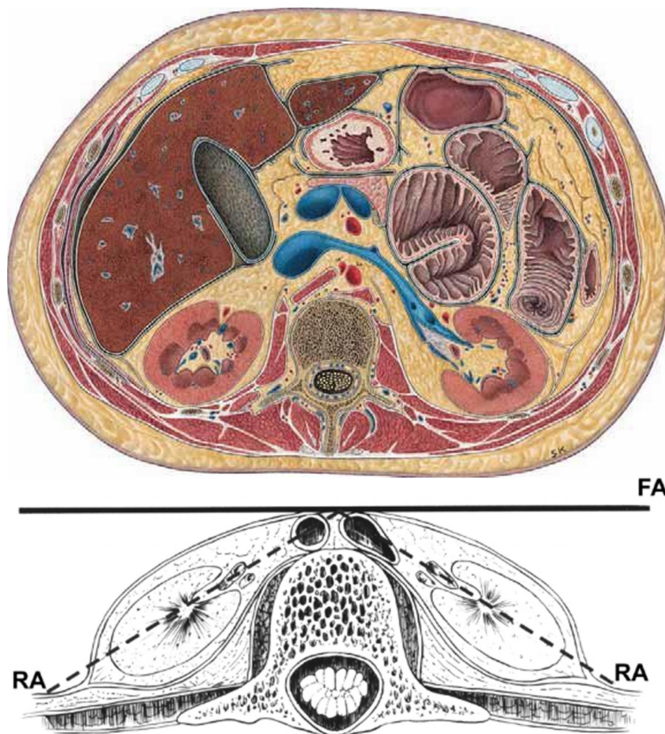


Figure 1.2 Schematic of a superior view of a transverse section of the kidneys at the level of the second lumbar vertebra showing that the kidneys are angled 30–50° behind the frontal (coronal) plane of the body (FA). RA, renal frontal (coronal) axis.

Peri-renal coverings

- kidney surface is enclosed in a continuous covering of fibrous tissue, the renal capsule (“true renal capsule”).
- Each kidney with its capsule is surrounded by a mass of adipose tissue, lying between the peritoneum and the posterior abdominal wall (Fig. 1.2). This peri-renal fat is enclosed by the renal fascia (the so-called fibrous renal fascia of Gerota). The renal fascia is enclosed anteriorly and posteriorly by another layer of adipose tissue, the para-renal fat, varies in thickness [19].
- The renal fascia is made up of a posterior layer and an anterior layer .

These layers of the renal fascia (fascia of Gerota) subdivide the retroperitoneal space into three potential compartments :

(1) the posterior para-renal space, which contains only fat.

(2) the intermediate peri-renal space, which contains the suprarenal glands, kidneys, and proximal ureters, together with the peri-renal fat.

(3) the anterior para-renal space, which unlike the posterior and intermediate spaces, extends across the midline from one side of the abdomen to the other. This latter space contains the ascending and descending colon, the duodenal loop, and the pancreas[20] (Fig. 1.3).

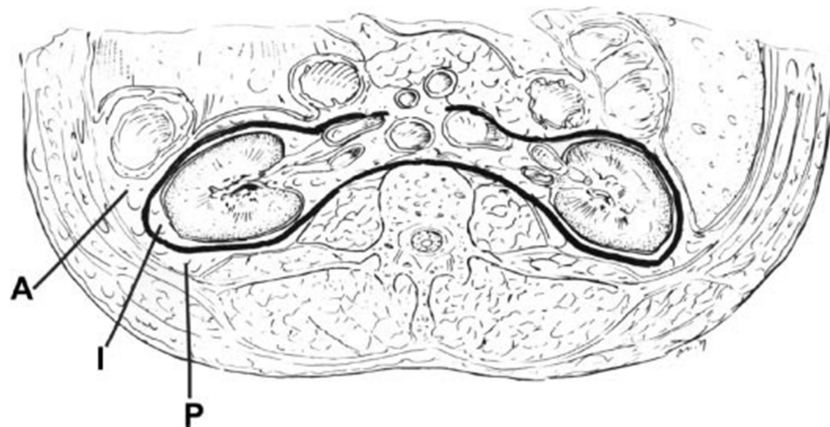


Figure 1.3 Schematic of a superior view of a transverse section of the kidneys at the level of the second lumbar vertebra showing the three compartments of the retroperitoneal space. **P**, posterior pararenal space, which contains only fat; **I**, intermediate perirenal space, which contains the suprarenal glands, kidneys, and proximal ureters, together with the perirenal fat; and **A**, anterior pararenal space, which unlike the posterior and intermediate spaces, extends across the midline from one side of the abdomen to the other, and contains the ascending and descending colons, duodenal loop, and pancreas.

➤ **Relationship of kidneys to the diaphragm, ribs, and pleura**

Usually, the left kidney is higher than the right kidney, with the posterior surface of the right kidney crossed by the 12th rib and the left kidney crossed by the 11th and 12th ribs (Fig. 1.1).

The posterior aspect of the diaphragm arches in a dome above the superior pole of the kidneys on each side.

Generally, the posterior reflection of the pleura extends inferiorly to the 12th rib; nevertheless, the lowermost lung edge lies above the 11th rib[21].

➤ **Relationship of kidneys to the liver and spleen**

The liver on the right side and the spleen on the left may be posterolaterally positioned at the level of the supra-hilar region of the kidney, because at this point these organs have their largest dimensions (Fig. 1.4)[21].

➤ **Relationship of kidneys to the ascending and descending colons**

The ascending colon runs from the ileo-colic valve to the right colic flexure (hepatic flexure), where it passes into the transverse colon. The hepatic colic flexure (hepatic angle) lies anteriorly to the inferior portion of the right kidney. The descending colon extends inferiorly from the left colic flexure (splenic flexure) to the level of the iliac crest. The left colic flexure lies anterolateral to the left kidney (Fig. 1.5).

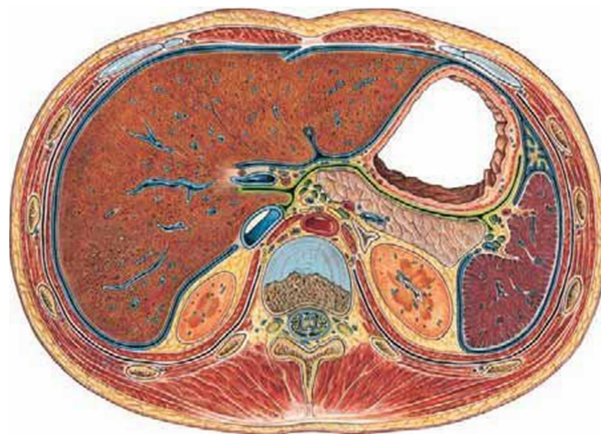


Figure 1.4 Inferior view of a transverse section through a cooled cadaver at the level of the supra-hilar region of the kidney. This shows that the liver (L) and spleen (S) are postero-laterally positioned in relation to the right (RK) and left (LK) kidneys.

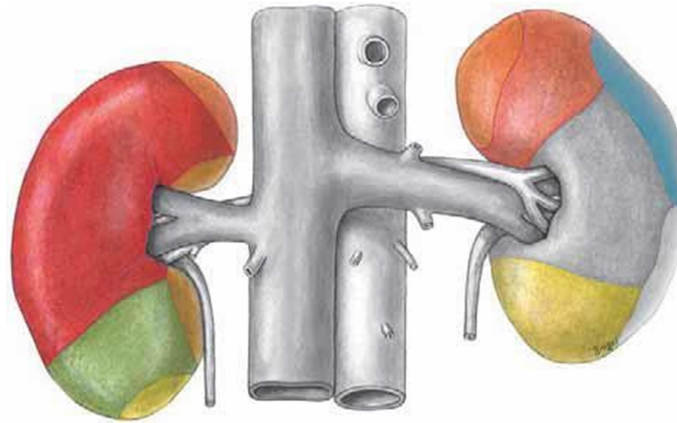


Figure 1.5 The relationships of abdominal organs to the anterior surface of the kidneys are : (1) The structures in contact with the anterior surface of the **right kidney** are the right suprarenal gland, hepato-renal ligament, duodenum (second part), liver, right colic flexure and transverse colon, and a small area of the jejunum. (2) The structures in contact with the anterior surface of the **left kidney** are the left suprarenal gland, stomach, spleen, pancreas, jejunum, and left colic flexure. (See **Color Code** below.)



Pelvi-calyceal system:

Basic intra-renal anatomy[22-25]

- The renal parenchyma basically consists of two kinds of tissue, the cortex and the medulla. On a longitudinal section(Fig. 1.6), the cortex forms the external layer of renal parenchyma. In the other hand, the renal medulla is formed by several inverted cones, surrounded by a layer of cortical tissue on all sides, called renal pyramid; the apex of this pyramid is termed the renal papilla. The layers of cortical tissue between adjacent pyramids are termed renal columns (cortical columns of Bertin; Fig. 1.6)[22-24]. A minor calyx is defined as the calyx that is in immediate opposition to a papilla(Figs. 1.7 and 1.8). The renal minor calyces drain the renal papillae and range in number from 5 to 14 (mean, 8)[25]. The minor calyces may drain straight into an infundibulum or join to form major calyces, which subsequently will drain into an infundibulum(Figs. 1.7 and 1.8). Finally, the infundibula drain into the renal pelvis[22].