Introduction

Percutaneous Nephrolithotomy (PNL) is a popular, minimally invasive surgical modality for management of most renal stones, Technologic advances and refinements have contributed to the high success rate and low morbidity of stone removal with PNL. **(Shah HN et al., 2006),** since its first description at 1976, PNL has become an integral part of renal stone management **(Anil Mandhani et al., 2007)**.

The placement of a percutaneous tube after the completion of the procedure has been considered standard practice to aid in haemostasis, to ensure proper drainage of urine and to facilitate easy access in case repeat PNL is required **(Anil Mandhani et al., 2007)**.

Despite these apparent advantages, the nephrostomy tube has been implicated in postoperative discomfort and morbidity. To reduce discomfort and tube related morbidity, modifications have been made like the use of smaller nephrostomy tube as mini-PNL **(Jackman Sv et al., 1998)**. It can be avoided completely after an uncomplicated procedure with complete stone clearance with or without leaving a Double-J stent **(Choi k et al., 2006)**.

Significantly less pain, lower analgesia requirement, and shorter hospital stay with early return to normal activities were observed in the tubeless PNL procedure vs the standard nephrostomy tube PNL procedure. Tubeless PNL in selected patients is a secure, effective, and less morbid procedure that does not compromise patient safety and concerns **(Iqbal singh 2008)**.

Aim of Work

To evaluate the safety & efficacy of "tubeless" PNL & its role in different situations as in multiple stones or intraoperative events as extravasation or bleeding & to compare it with PNL with nephrostomy tube regarding postoperative pain, hospital stay, the need for blood transfusion or further intervention

Historical Background

The comparable superiority of percutaneous renal Surgery has made it an effective alternative to open surgical Management of renal diseases. The morbidity of standard percutaneous nephrolithotomy (PCNL) has decreased in recent Years because of improvements in equipment, modification in Technique, and placement of a time bar on the operative period. The placement of a nephrostomy tube postoperatively has been an integral part of standard PCNL. The purpose of the Tube has been to ensure proper drainage of the pelvicaliceal system, Prevent extravasations and urinoma formation, assist hemostasis, and provide access for second-look PCNL **(Abdul Majid, 2007).**

Authors have recently challenged this practice through the introduction of the ‘tubeless’ modification to percutaneous renal surgery. The modifications has been Shown to offer numerous advantages over the placement of nephrostomy Tube, including a reduction in hospitalization and analgesia requirements and An earlier return to normal activities **(Jerry Limb, 2002).**

A chronological report can provide us with the most important events in the Evolution of percutaneous renal surgery:

1941, Rupel and Brown; removed a residual stone from a patient with solitary kidney who had recently undergone a formal open nephrostomy for calcular anuria. a general anaesthetics, panedoscope and utility forceps were used.

1955, Goodwin; first demonstrate the technique of percutaneous needle puncture and nephrostomy.

1976, fernstrom and johanssen; the first combined percutaneous nephrostomy tract and percutaneous extraction of renal stone under fluoroscopic control using a basket and stone grasping forceps.

1977, Kurth: described the disruption of a staghorn stone using the storz ultrasound Lithotriptor.

1978, smith,et al: used a combined antegrade and retrograde approach to extract ureteric Stones from a patient with ilieal conduit.

1980, Thuroff, et al: described ultrasonically guided percutaneous puncture and subsequent endoscopy with stone extraction using ziess loop cystoscope.

1984, Wickham, et al: first reported their experience of omitting the nephrostomy tube after percutaneous nephrolithotomy in selected patients.

1997, Bellman and colleagues: challenged the necessity of placing a nephrostomyTube after percutaneous renal surgery in 50 patients.

2001, Lojanapiwat, et al: reported the use of externalized ureteral stent, instead Of an internal ureteral stent for postoperative urinary drainage for patients Undergoing tubeless percutaneous nephrolithotomy.

2003, Mikhail, et al; used Tisseel vapour heated sealant in 20 consecutive patients undergoing tubeless percutaneous nephrolithotomy.

2004, Lee, et al: used a gelatine matrix haemostatic sealant in seven cases of tubeless percutaneous nephrolithotomy.

2004, Jou, et al: electrocauterized the bleeding points after stone extraction in 249 cases of tubeless percutaneous nephrolithotomy. In 84 patients it resulted in bloodless tract enable them to avoid nephrostomy tube.

Renal Anatomy

General Anatomy

The kidneys are paired organs lying retroperitoneally on the posterior abdominal wall. Each kidney is of a characteristic shape, having a superior and an inferior pole, a convex border placed laterally, and a concave medial border. The medial border has a marked depression the hilum containing the renal vessels and the renal pelvis.

Renal Morphometry

In adults, we found the left kidney larger than the right kidney, and this finding is in agreement with morphometric findings in fetal kidneys **(Sampaio FJB, 1992).**

The right kidney presented a mean length of 10.97 cm, while the left kidney presented mean length of 11.21 cm. The right kidney presented 3.21 cm of mean thickness at the hilum, and the left kidney presented mean thickness of 3.37 cm **(Fernstrom I, 1976).**

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).** Moreover, since the psoas major muscle has a shape of a cone, the kidneys also are dorsal and inclined on the longitudinal axis. Therefore, the superior poles are more medial and more posterior than the inferior poles. Because the hilar region is rotated anteriorly on the psoas muscle, the lateral borders of both kidneys are posteriorly positioned. It means that the kidneys are angled 30 to 50° behind the frontal (coronal) plane (**Ohlsen H, 1993) (figure 2).**

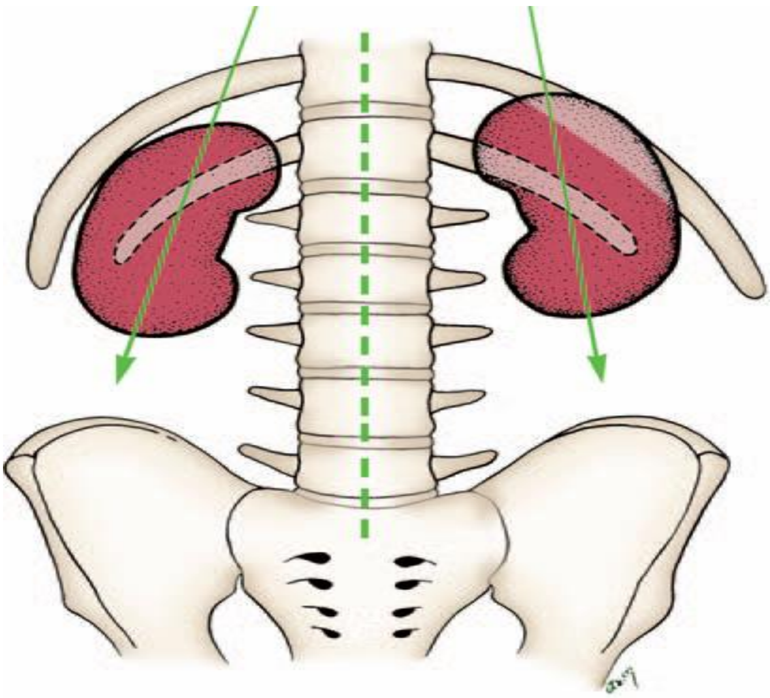


Figure (1): Anterior view of the kidneys in relation to the skeleton, shows that the longitudinal axes of the kidneys are oblique *(arrows),* being the superior poles more medial than the inferior poles. The dashed line marks the longitudinal axis of the body. This figure also shows that the posterior surface of the right kidney usually is crossed by the 12th rib and the left kidney by the 11th and 12th ribs.

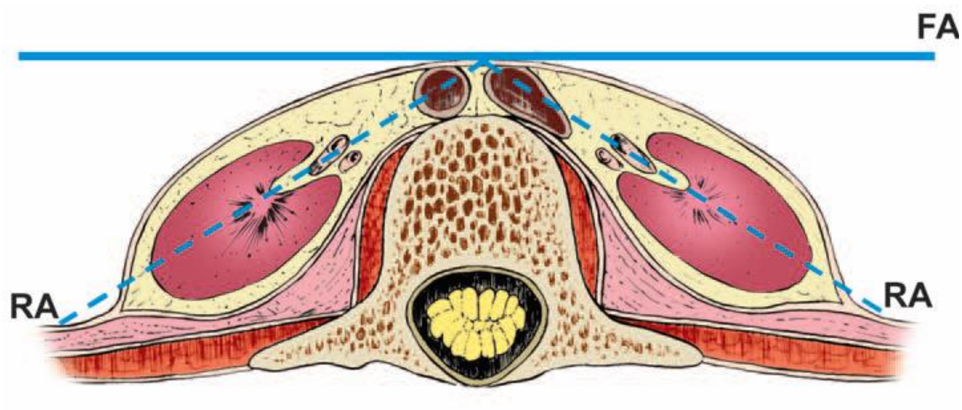


Figure (2): Superior view of a transverse section of the kidneys at the level of the 2nd lumbar vertebra shows that the kidneys are angled 30 to 50° behind the frontal (coronal) plane. *FA* = frontal plane of the body; *RA* = renal frontal (coronal) axis.

Kidney relationships with diaphragm, ribs, and pleura

The kidneys lie on the psoas and quadratus lumborum muscles. Usually, the left kidney is higher than the right kidney, being the posterior surface of the right kidney crossed by the 12th rib and the left kidney crossed by the 11th and 12th ribs. The posterior surface of the diaphragm attaches to the extremities of the 11th and 12th ribs. In this way, the posterior aspect of the diaphragm (Posterior leaves) arches as a dome above the superior pole of the kidneys, on each side. Therefore, when performing an intrarenal access by puncture, the endourologist may consider that the diaphragm is traversed by all intercostals punctures, and possibly by some punctures below the 12th rib **(figure 3).** Also, it can be expected that the pleura is transversed without symptoms in most intercostal approaches **(Segura JW, 1990).**

Generally, the posterior reflection of the pleura extends inferiorly to the 12th rib; nevertheless, the lowermost lung edge lies above the 11th rib (at the 10th intercostal space). Regardless of the degree of respiration (mid- or full expiration), the risk of injury to the lung from a 10th intercostal percutaneous approach to the kidney is prohibitive. any intercostals puncture should be made in the lower half of the intercostal space, in order to avoid injury to the intercostal vessels above **(Hopper KD, 1990).**

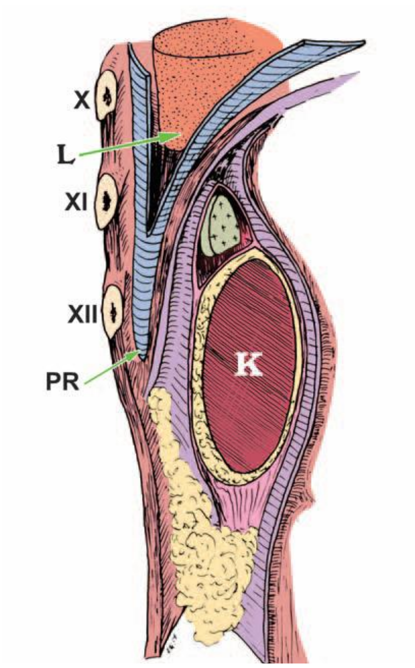
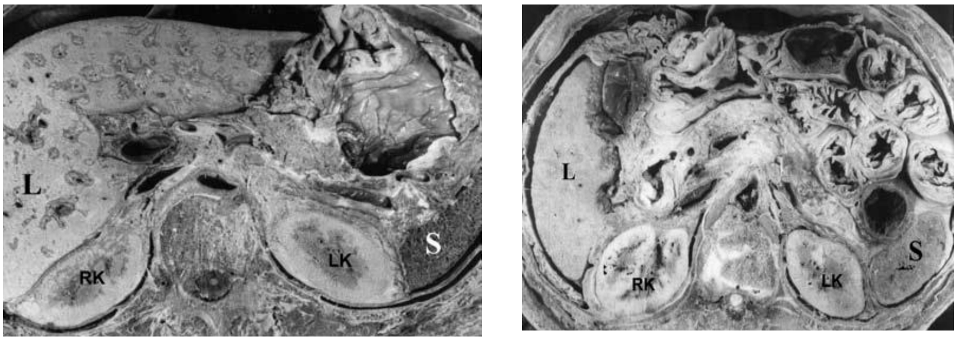


Figure (3): Schematic drawing from a lateral view of the kidney and its relationships with the diaphragm, ribs, pleura, and lung. *PR* = posterior reflection of the pleura,*L* = lower edge of the lung; *K* = kidney; *X* = 10th rib; *XI* = 11th rib; *XII* = 12th rib.

Kidney relationships with liver and spleen

The liver on the right side and the spleen in the left may be posterolaterally positioned at the level of the suprahilar region of the kidney, because at this point, these organs have their larger dimensions. Therefore, one may remember that a kidney puncture performed high in the abdomen has little space for the needle entrance **(Ohlsen H, 1993).**

If the percutaneous puncture is performed when the Patient is in mid- or full inspiration, the risk to the liver and spleen is increased. This knowledge is particularly important in patients with hepatomegaly or splenomegaly, on whom a computed tomography (CT) scan should be performed before puncturing the kidney **(Hopper KD, 1990) (Figure 4).**



(A) **(B)**

Figure (4): *A*, Inferior view of a transverse section through a cooled cadaver at the level of the suprahilar region of the kidney reveals that the liver *(L)* and the spleen *(S)* are posterolaterally positioned in relation to right *(RK)* and left *(LK)* kidneys. *B*, Similar section of that shown in *A*, performed at the level of the infrahilar region reveals that inferiorly, the liver *(L)* and the spleen *(S)* are more laterally positioned in relation to right *(RK)* and left *(LK)* kidneys.

Kidney relationships with ascending and descending colons

It was observed in the course of routine abdominal CT scan examinations, that the retroperitoneal colon is lying in a posterolateral or even a postrenal position. Hence, in these cases, it is at great risk of being injured during the intrarenal percutaneous approach **(Segura JW, 1990).**

In a controlled study, it was demonstrated by CT scan that, when the patient is in the supine position, the retrorenal colon was found in 1.9% of the cases **(Hopper KD et al., 1987).**

Nevertheless, when the patient assumes the prone position (the more frequent position used for percutaneous access to the kidney) the retrorenal colon was found in 10% of the cases. Therefore, special attention should be given, under fluoroscopy and with the patient in the prone position, to detecting patients with retrorenal colon prior any invasive percutaneous renal procedure. This examination is especially important in the area of the inferior poles of the kidneys **(Hopper KD et al., 1990) (figure 5).**

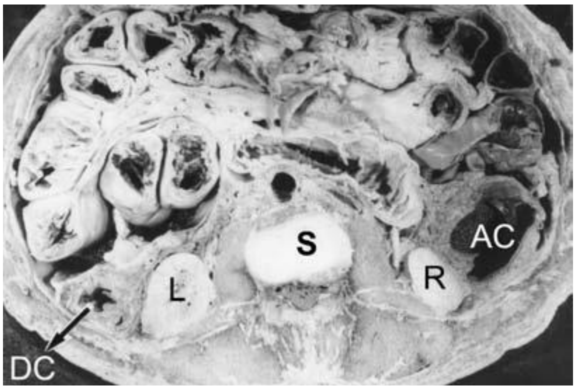


Figure (5): Superior view of a transverse section through a cooled cadaver at the level of the inferior poles of the kidney, reveals the ascending *(AC)* and descending *(DC)* colons lying in a posterolateral position in relation to right *(R)* and left *(L)* kidneys. *S* = spine.

Internal structure of the kidney

There are two distinct components within the renal parenchyma: the medulla and the cortex. The renal medulla is composed of multiple, distinct, conically shaped areas noticeably darker in color than the cortex called renal pyramid, The apex of the pyramid is the renal papilla, and each papilla is cupped by an individual minor calyx. While the renal cortex is lighter in color than the medulla and extends between the pyramids, the extensions of cortex between the renal pyramids are given a special name: the columns of Bertin. In which renal vessels traverse from the renal sinus to the peripheral cortex through it decreasing in diameter as the columns move peripherally. It is because of this anatomy that percutaneous access to the collecting system is made through a renal pyramid into a calyx, thus avoiding the columns of Bertin and the larger vessels present within them **(Drake et al., 2005) (figure 6).**

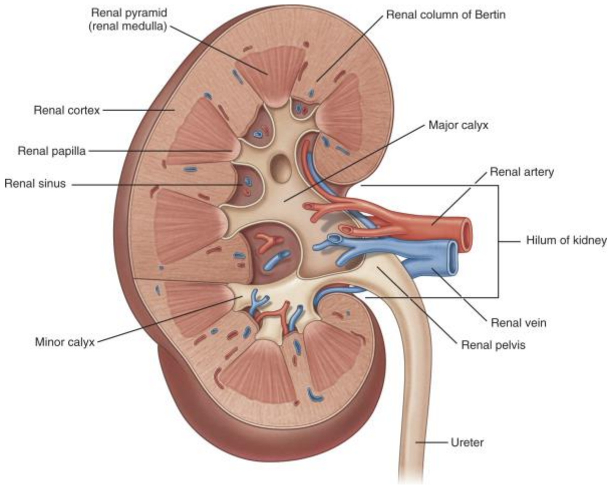


Figure (6): Internal structure of the kidney *(From Drake RL, Vogl W, and Mitchell AWM: Gray's Anatomy for Students. Philadelphia, Elsevier, 2005, p 323).*

Calyceal Arrangement

Recent advances in endourology have revived interest in collecting system anatomy, since a full understanding of such anatomy is necessary to perform reliable endourologic procedures as well as uroradiologic analysis **(Kaye KW, 1982).**

The classic human kidney contains 14 lobes each lobe consist of central core of medullary tissue surrounded by a cortical layer except in the region of the papilla. The papilla projects into the calyx and is the functional and anatomical connection between the renal parenchyma and the collecting system **(Hodson CJ, 1972).**

The renal lobes that form the kidney are arranged into anterior and posterior rows. In the Polar Regions the anterior lobes may fuse with one another as well as with the posterior lobes. In the mid zone of the kidney much less fusion occurs and the presence of the renal pelvis precludes fusion across the midline.hence the classic 14 lobed kidney usually has only 8 calyces **(Kaye KW,1982) (figure 7).**

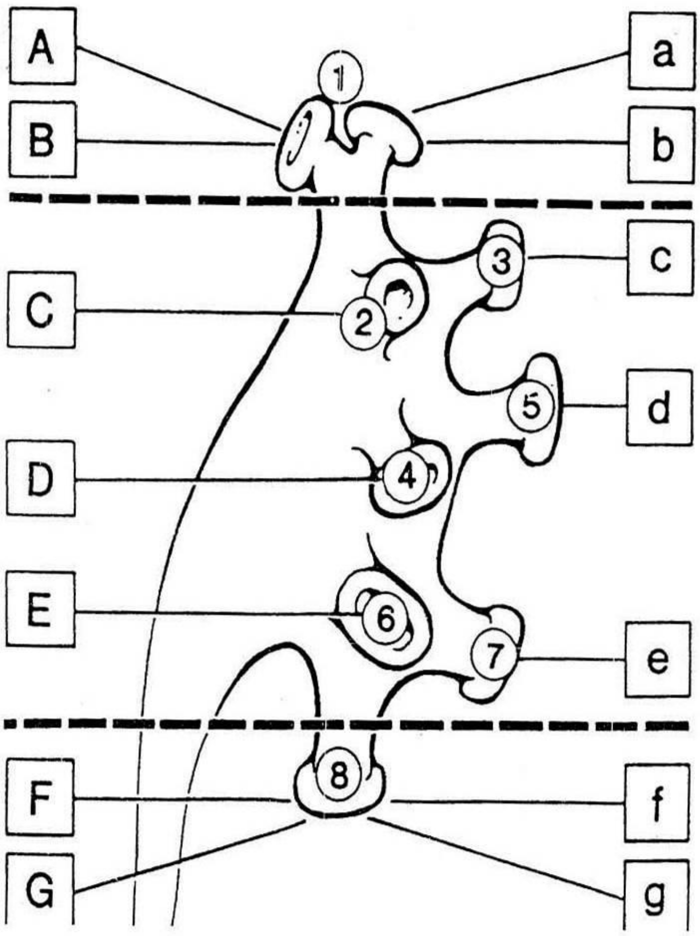


Figure (7): Classic Kidney shows how 14 primitive lobes, 7 anterior (A-G) and 7 posterior (a-g) fuse to drain into the 8 calyces of the. This figure is drawn from a more anterior view of the kidney and should not be mistaken for the pyelographic in situ appearance in which the kidney rotation throws the anterior calyx more laterally. **(From Clayman RV: Techniques n Endourology; A guide to the percutaneous renal surgery. Renal Anatomy, 1984)**.