PCNL Puncture Technique.

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***Abstract**: Percutaneous nephrolithotomy remains an important technique for managing nephrolithiasis. With increasing awareness of the limitations of ESWL, the role of percutaneous stone surgery has now become better defined. Optimal renal access is the most critical factor influencing surgical success and minimizing complications. To achieve the proper access various imaging modalities and techniques are available. Endourologist experience, familiarity with imaging modality and knowledge of intrarenal anatomy are the key factors for the safety and success of the initial access.*

Percutaneous approach to the kidney was first used by Goodwin and colleagues in 1955 for the drainage of obstructed kidney[1]. Fernstrom and Johansson in 1976 reported first percutaneous removal of renal stone[2]. With the constant evolution of operative technique and instruments by early to mid 1980 s, it developed more widespread use.

Percutaneous entry is the initial and most important part of percutaneous renal surgery. The ideal tract is the shortest, straight, direct path along the axis of calyx through papilla into the desired calyx. The calyx of entry should be chosen carefully so that all / maximal possible stone bearing calyces can be inspected facili-tabing stone removel[3]. A posterior calyx is the preferred site of entry since it is usually easier to negotiate a wire out of the calyx and into the ureter when the site of puncture is through a posterior rather than an anterior calyx.

Despite the increasing use of PCNL, Lee et al reported that only 27% of urologists who were trained in percutaneous access, gain their own access for PCNL[4]. Watterson et al studied access related complications during PCNL when access was obtained by a urologist vs an interventional radiologist and found that, despite similar access difficulties between the groups, access related complications were less and stone-free rates were higher during urologist acquired percutaneous access[5].

Obtaining precise access to a predetermined renal calyx is the most critical part of PCNL and sub-optimal access leads to increased operative time and decreased stone-free rates[3].

Currently available techniques for obtaining percutaneous access to the renal collecting system include the antegrade puncture and retrograde percutaneous access[6]. Despite the feasibility of retrograde access, it offers no advantage over antegrade percutaneous access and is not commonly utilized.

The optimum route for PCNL should be decided after a careful study of the pre-procedure imaging. The knowledge of intra-renal anatomy is crucial to successful PCNL planning. A good quality IVU supplemented by CT (with three-dimensional volume rendering). if feasible is required.

Fluoroscopy remains the mainstay of intraoperative imaging, although ultrasound is a useful alternative. Selection and application of appropriate imaging modalities for patients undergoing percutaneous nephrolithotomy enhances the safety and success of the procedure

PCNL is routinely performed in prone position. Recently supine and lateral positions are also described[7]. Routine approach for accessing the pelvicalyiceal system is the placement of a ureteral catheter, injection of contrast media or air, and puncturing the calyceal system using fluoroscopy. There are few studies reporting blind access for drainage of the obstructed kidneys in emergency cases or when catheter placement for retrograde injection of a contrast medium for PCNL is not possible[8]. Blind approach first reported by Chien and Bellmanin 2002[9]. for access to the system in PCNL, especially in severely hydronephrotic kidneys, is a potential alternative for experienced surgeons for reducing radiation exposure. However, it is reasonable to guide access using fluoroscopy or ultrasonography to avoid complications related to inappropriate puncture site. Ultrasonography has gained popularity amongst endourologist and is being used at many centers. Other imaging modalities used for caliceal access are intravenous contrast injection and computed tomography-guided (CT-guided)., MRI guided and retrograde endoscopy (Flexible ureteroscopy) assisted.

Flouroscopy guided puncture for renal access should be medial to the posterior axillary line to avoid injury to the colon because the position of the colon is usually anterior or anterolateral to the most lateral part of the kidney. The two techniques of fluoroscopic puncture best described are “eye of the needle” (Bullseye) and “triangulation”. Both consist of several steps where C-arm fluoroscopy is rotated into different positions relative to the needle and the target (contrast-filled). Calyx[3]. The needle is advanced until the calyx is punctured in a controlled and predictable fashion.

For ultrasonography-guided access, location of the target calyx is identified in the transverse and sagittal planes by real-time ultrasonography. Puncture of the target calyx is attempted with a puncture needle attached to the side of the ultrasound probe. If access to the collecting system was achieved, further dilatation is done under fluoroscopy. Aggrawal M et al in their study showed that USG guidance took less time, attempts and radiation to successful puncture than fluoroscopic puncture[10]. Whereas Basiri et al in their comparative randomized study found that duration for access was more with USG guided puncture but radiation exposure was significantly less[11]. Kukreja M et al showed less bleeding with Ultrasound guided puncture than fluoroscopic puncture[12]. Recently Negele et al described the Minimally invasive nephrolithaloplaxy (MIP). with specially designed nephroscope and used ultrasonographic puncture for the access[13]. Ultrasonography is particularly useful in ectopic , malrotated kidneys and in children[14]. Mozer P et al presented a computerized system consisting of a computer and a localizer allowing spatial localization of the position of the various instruments designed to improve percutaneous renal access by projecting the ultrasound puncture tract onto fluoroscopic images[15].

Heyns and Van Gelderen (1990) were the first to propose computed

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tomography imaging of the pelvicalyceal system with 3-dimensional reconstruction as an aid in selecting the appropriate calyx for PCNL[16]. CT guided percutaneous access has been reported to be feasible alone or with fluoroscopy[17]. Matlaga et al described its use in cases with an unfavorable body habitus or known retrorenal posterior organs[18]. The technique requires a suitable setup in the radiology suite and/or specialized equipment, which may not be available at all institutions. It also requires that access be performed with the patient awake and as a procedure separate from actual percutaneous nephrolithotomy . Khan et al, [19] reported use of ureteroscopic-guided percutaneous renal access. The technique consists in gaining access under ureteroscopic vision with the use of the flexible ureteroscope. In this approach, the patient is in the prone position since the beginning of the procedure, precluding positioning changes. The desired calyx is chosen under ureteroscopic vision .Puncture to the calyx is done under fluoroscopic guidance until the tip of the needle is seen by the ureteroscope, The authors suggest it may be advantageous for nondilated caliceal systems, complex stone burdens, ectopic or malrotated kidneys, and for morbidly obese patients, where the traditional puncture is almost always difficult.

The robotic system to access the renal collecting system for PCNL was first described by Potamianos et al. in 1995 and consisted of a manually positioned robotic arm mounted on the operating table, guided by C-arm fluoroscopy. Cadeddu et al. designed a fully automated robot that managed all aspects of percutaneouus access[20]. In the PAKY (percutaneous access to the kidney). system and PAKY-RCM (remote center of motion). the passive robotic arm was improved by adding an electronic needle insertion device and the ability to position the needle by remote control[21]. The "robotic arms" mainly serve to stabilize and in some cases advance the needle, and reduce radiation exposure. However, the urologist still needs to calculate and plan the needle trajectory to the desired renal calyx[22].

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