

A Method for Teaching Junior Urologists How to Gain Access to the Pelvicalyceal System Under Fluoroscopy

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ABSTRACT

INTRODUCTION: The purpose of the study was to determine the success of a teaching method for junior urologists who were learning to puncture a calyx for percutaneous nephrolithotripsy (PCNL) under fluoroscopic guidance.

METHODS: The participants were 4 junior urologists who had never performed a complete PCNL puncture on their own. There were 22 patients with kidney stones, ranging in age from 28-52 years. The procedure was conducted by 1 junior urologist while being guided verbally by the senior physician. A needle was placed on the skin where its trajectory hit the desired calyx in the 0° and 30° planes under fluoroscopy. The needle was advanced in successive 1 cm increments. Its position was checked after each step. Any deviation from the correct path in either plane was detected early and corrected, until the desired calyx was reached in both planes simultaneously. Success of the teaching technique was determined by how often the senior physician needed to intervene. Success of the surgery was determined by its outcome, including the need for needle reinsertion and presence of complications.

RESULTS: Each surgery was performed independently by the junior urologist, with no senior physician intervention aside from verbal guidance. Successful puncture of the desired calyx was achieved during the first trial in 17 patients (77%); the needle had to be reinserted 1 or more times to attain proper direction in 5 patients (23%). Complications were blood transfusion (n = 1) and prolonged urine leakage after postoperative removal of the nephrostomy tube (n = 2).

CONCLUSION: Step-by-step advancement of the needle is a simple, accurate way to gain access to pelvicalyceal system. Junior urologists are spared the frustration that they might have after repeated failure to gain access to the kidney with other techniques.

INTRODUCTION

Percutaneous nephrolithotripsy (PCNL) for kidney stone removal is currently the most complicated surgery to teach. The steep learning curve is mainly related to obtaining renal access [1]. Successful PCNL relies on appropriate preoperative planning and optimal percutaneous access. The purpose of the present study was to determine the success of a teaching method for junior urologists who were learning to puncture a calyx for PCNL under fluoroscopic guidance.

KEYWORDS: Step-by-step instruction; Pelvicalyceal system puncture; Fluoroscopy

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METHOD

Participants

The participants were 4 junior urologists. They had been working in the Department of Urology in Adan Hospital for 5 to 12 years. They had received adequate training to do various endoscopic procedures such as rigid and flexible ureteroscopy as well as transurethral resection of the prostate. None of them had previously performed a complete PCNL puncture on

Abbreviations and Acronyms

PCNL, percutaneous nephrolithotripsy

his own.

There were 22 patients with kidney stones with a mean age of 37 years (range, 28-52 years). There were 16 males and 6 females.

Surgical Procedure

The PCNL procedure was undertaken by one of the 4 junior urologists while being watched by the other 3 juniors. The operating junior physician was supervised and guided verbally by the senior physician (Y.H.E.), who was ready to take over the surgery if needed. The patient was placed in the prone position with an open-tip ureteric catheter inserted into the collecting system. Contrast was injected through the catheter to display the pelvicalyceal system.

Figure 1 shows the skin markings and the insertion of needles at 3 points prior to surgery. Point A corresponded with the desired calyx in the 0° plane under fluoroscopy. Point B corresponded with the same calyx in the 30° plane. Both of these points were marked with regular intravenous needles. The tip of an 18-gauge needle (Cook Group, Inc; Bloomington, IN, USA) was placed at point C, which was positioned 3-4 cm laterally and caudally to point B. The angle between the needle and the

skin was adjusted so that the trajectory of the needle hit the desired calyx in both the 0° and 30° planes under fluoroscopy. The needle was then advanced 1 cm, and the new position was checked in both planes to confirm that the trajectory of the needle still hit the calyx (Figure 2). If the position was correct, the needle was advanced an additional 1 cm and the position was checked again (Figure 3). Any deviation from the correct path was detected early and easily corrected. The process was repeated in approximately 1 cm increments until the tip of the needle reached the desired calyx in both 0° and 30° planes (Figure 4). The meeting at the calyx from the 2 angles must occur at the same time; the tip of the needle should not reach the calyx in one plane before the other (Figure 5).

Once the calyx was reached, the trocar of the needle was withdrawn. Urine dripping was usually observed. If not, the trocar was reintroduced and the needle was advanced a short distance (usually a few millimeters) to puncture the mucosa of the calyx.

Analysis

Success of the teaching technique was determined by how often the senior physician needed to intervene. Success of the surgery was determined by its outcome, including the need for needle reinsertion and the presence of surgical complications.

Figure 1. Skin Markings and the Insertion of Needles at 3 Points Prior to Surgery. doi: 10.3834/uij.1944-5784.2010.08.04f1

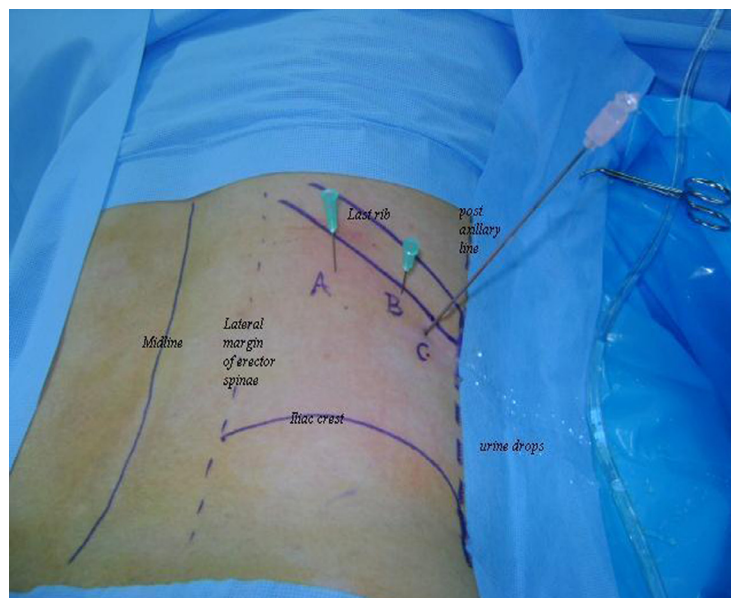


Figure 2. Fluoroscopic View of the Needles Showing Their Initial Trajectory in the 0° Plane (left) and 30° Plane (right).
doi: 10.3834/uij.1944-5784.2010.08.04f2

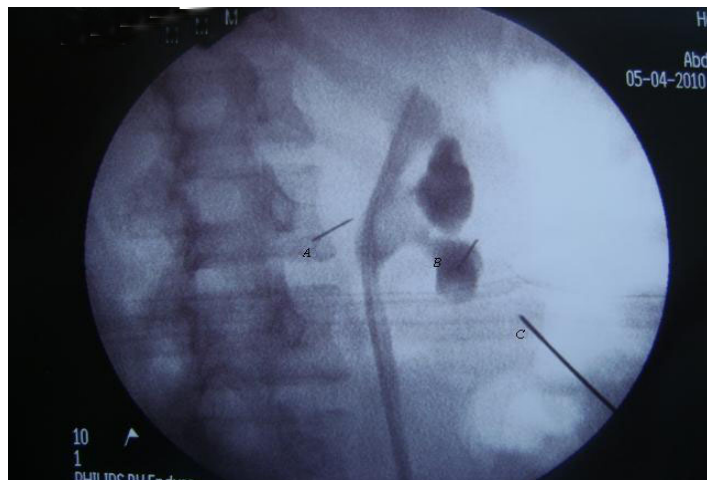


Figure 3. Fluoroscopic View of the Needles Showing a 1 cm Advancement in the 0° Plane (left) and 30° Plane (right).
doi: 10.3834/uij.1944-5784.2010.08.04f3

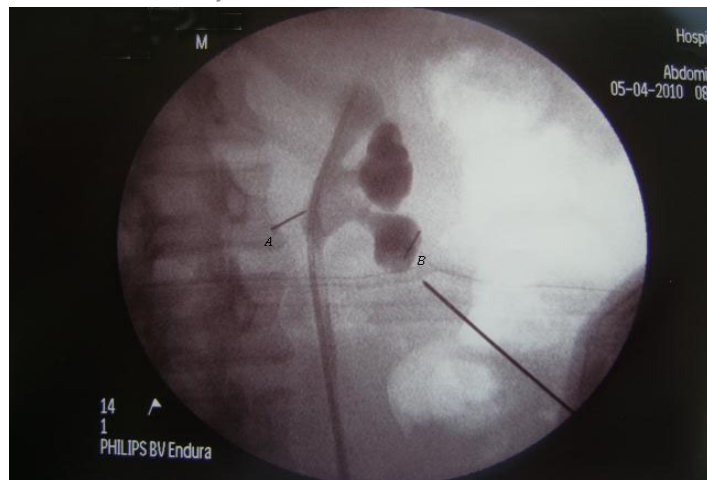
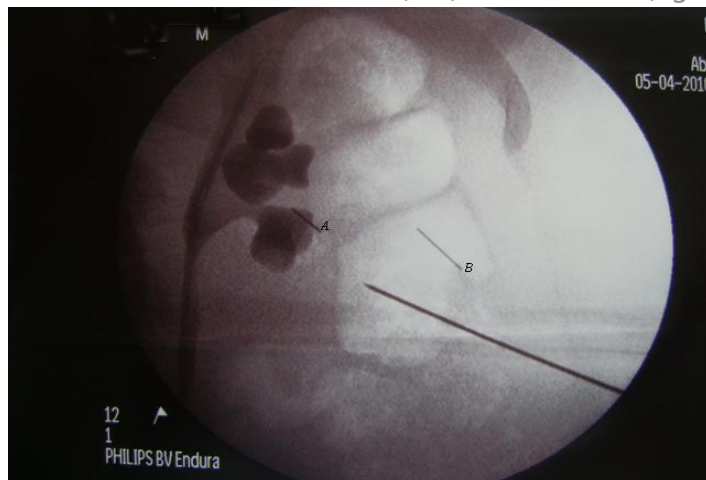


Figure 4. Fluoroscopic View of the Needles Showing Approach to the Calyx in the 0° Plane (left) and 30° Plane (right).
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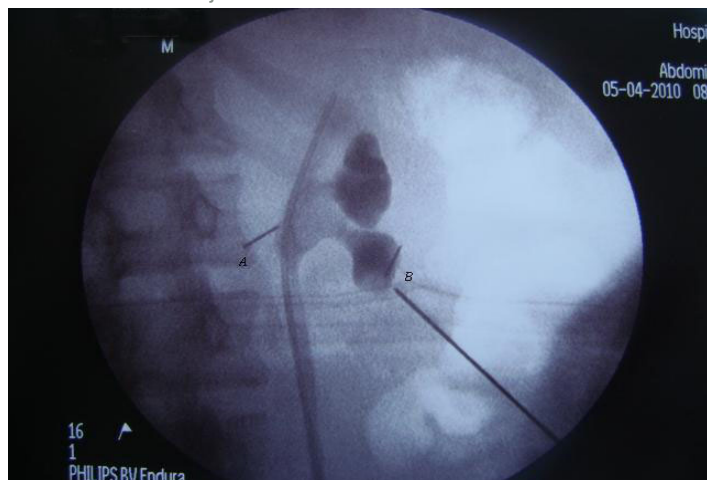
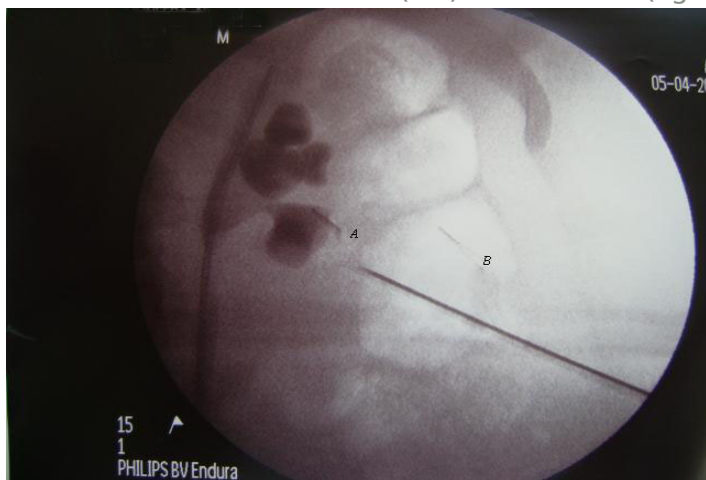
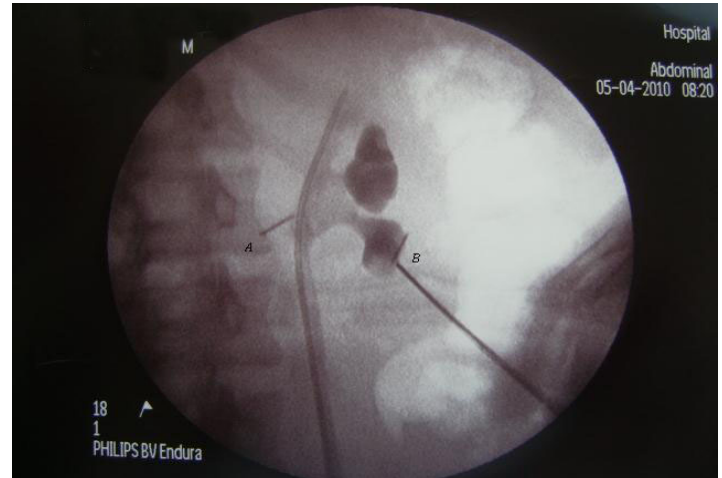
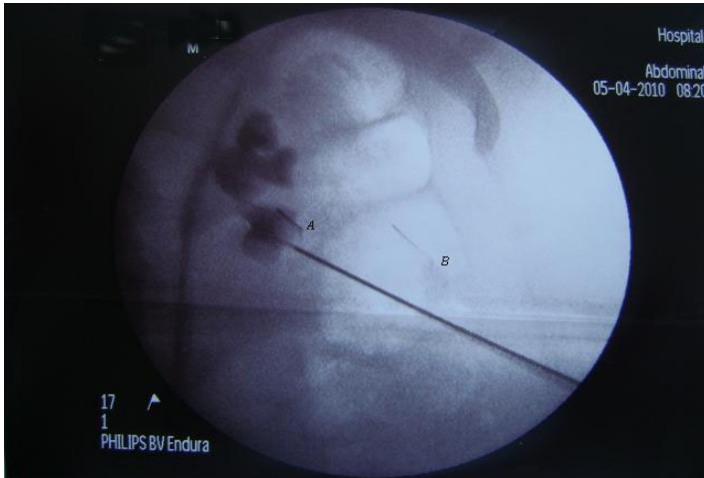


Figure 5. Fluoroscopic View of the Needles Reaching the Target Calyx in the 0° Plane (left) and 30° Plane (right) at the Same Time.

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The tip of the needle should not reach the calyx in one plane before the other.

RESULTS

Three of the 4 junior urologists performed 5 surgeries and 1 junior urologist performed 7. Each surgery was performed independently, with no senior physician intervention aside from verbal guidance.

Table 1 shows the location of the kidney stones, sites of the needle punctures, number of needle punctures, and surgical complications. Most of the surgeries were done on the left side, with puncture into the lower calyx. In 9 patients, fluoroscopy revealed that the desired calyx was covered by the last rib. In these cases, the initial skin puncture was chosen below the last rib. Successful puncture of the desired calyx was achieved during the first trial in 17 patients (77%); the path of the needle had to be adjusted 1 or more times to maintain proper direction in 5 patients (23%). Blood transfusion was required in 1 case, and 2 other patients had prolonged urine leakage after postoperative removal of the nephrostomy tube.

DISCUSSION

Percutaneous renal access in the context of PCNL is a difficult technique, requiring rapid and precise access to a particular calyx [2]. Obtaining renal access is one of the most important factors in training for PCNL [1]. Several methods have been introduced for training of junior surgeons. Bruyère et al [3] designed a rapid prototyping model to improve surgical technique and physician understanding of renal anatomy, which could decrease complications related to renal puncture.

Häcker and associates [4] described a biological model to teach the PCNL technique with ultrasound-guided and fluoroscopy-guided access. Other authors have described a technique for gaining access using computed tomography [5], or using a computerized system designed to improve percutaneous renal access by projecting the ultrasound puncture tract onto the

Table 1. The Location of the Stones, Sites of the Needle Punctures, Number of Needle Punctures, and Surgical Complications (N = 22). doi: 10.3834/uj.1944-5784.2010.08.04t1

Measure	n
Site of kidney stone	
Lower calyx	16
Middle calyx	6
Side of kidney stone	
Left	15
Right	7
Relation of stone to last rib	
Covered	9
Uncovered	13
Site of the needle puncture	
Above the last rib	2
Below the last rib	20
Number of needle punctures	
One (first trial)	17
Two or more	5
Surgical complications	
Blood transfusion	1
Postoperative urine leakage	2

fluoroscopic images [2].

When doing PCNL, many endourologists rely on trial and error to gain access to the pelvicalyceal system under fluoroscopy. Usually, the needle is advanced completely in 1 plane until it reaches the desired calyx; then, the needle tip position is checked in the other plane. If the position is not correct, the needle must be withdrawn and the procedure tried again (usually several times) until the calyx is reached. Repetition of trials can be frustrating and time-consuming, and it can increase the likelihood of patient complications.

In the present study, all punctures were successfully completed by the operating junior urologist with no more than verbal guidance from the supervisor when correction of the path of the needle was needed. The target was reached after the first trial in 77% of the cases. In the remaining cases (23%), the path of the needle had to be corrected 1 or more times, but all punctures ended successfully. Two of the patients had prolonged urine leakage after removal of the nephrostomy tube postoperatively, but this complication was not directly related to the puncture itself.

The bull's eye technique has been described by several authors to gain access to the calyx under fluoroscopy [6,7]. Despite the easiness of this approach, it might be difficult or impossible when the desired calyx is covered by a rib (as seen under fluoroscopy) and the path of the tract is hindered by that rib. In such a case, the puncture site into the skin has to be displaced to a point below (or possibly above) the rib, where the application of the bull's eye technique might not be possible. When this situation occurs, the step-by-step needle advancement technique described in the present study would be a simple and easy way to get access to the pelvicalyceal system, even in the more difficult cases where the desired calyx is not dilated or the patient is obese. In this study, puncture of the upper calyx was not tried because of the potential complication of injuring the pleura. It was thought that this surgery may be too challenging for a junior urologist just learning the technique. In addition to endangering the patient, such a complication could have a negative impact on the motivation of the junior urologist to continue to learn the procedure. If needed, access to the upper calyx could be achieved by flexible nephroscope after puncturing the lower or middle calices.

CONCLUSIONS

Step-by-step advancement of the needle is a simple, accurate way to gain access to the desired calyx during the PCNL procedure. The rapid, successful puncture of the pelvicalyceal system increases the self confidence of junior urologists as they

learn the procedure, sparing them the frustration that they might have after repeated failure to gain access to the kidney with other techniques.

Conflict of Interest: none declared

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