ORIGINAL ARTICLE

Evaluation the Results of Mini-Percutaneous Nephrolithotipsy (PCNL) in the Lateral Position to Treat Lower Pole Renal Stones

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ABSTRACT

Objective: **To evaluate the results of mini-percutaneous nephrolithotipsy (PCNL) in the lateral position to treat lower pole renal stones, performed at the Ha Noi Hospital of Post and Telecommunications in Viet Nam.**

Subjects and Methods: **This is a descriptive, retrospective, and prospective study which involves renal lower calyx stones patients treated by the mini-percutaneous nephrolithotipsy in the lateral position at the Hospital of Post and Telecommunications in Viet Nam, over the period from June 2019 to September 2020.**

Results: **For the 75 patients: the age was 53.7 ± 11.5 ; 49 male patients (65.3%) and 26 female patients (34.7%); There were 79.9% patients having clinical symptoms, pain in the back mostly. The size of stones was 22.5 ± 5.0 mm. The mean operative time was 46.6 ± 9.1 minutes; the average period of hospitalization was 5.2 ± 1.4 days. Early post-operative stone-free rate was 97.3%; after 01 month stone-free rate was 98.7%. The post-operative complication rate of our study group was 10.7%, all these are fever caused by infections after the surgery.**

Conclusions: **Mini-percutaneous nephrolithotipsy in the lateral position is a safe for patients and effective method to treat lower pole renal stones.**

KEY WORDS

mini-PCNL, renal lower calyx stones

INTRODUCTION

Kidney stone disease, which accounts for 70 - 75% of urinary stone disease, is common at the age group of 30 to 60[1)]. Among all kinds of kidney stones, calyceal - consists mostly of renal lower calyx, is a popular type. Most of the stones exist for a long time without causing any clinical symptoms. However, there are some cases in which renal lower calyx stones grow large in size or involve clinical symptoms that necessitate surgery intervention. In recent times, there are varieties of intervention methods being used in renal lower calyx stones treatment, namely open surgery, extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL) and mini percutaneous nephrolithotomy (mini PCNL). The PCNL method was first performed and introduced by Fernstrom and Johanson in 1976, and has since been further studied and developed. Standard-PCNL has steadily replaced other methods of treating renal stones, however, with big access tracts required, measuring from 24 to 30 Fr, it still causes many injuries to the kidneys and affects patients rehabilitation[2,3)]. From 2008, mini-PCNL has been performed worldwide with a smaller access tract to the kidney that measured only 12 - 20Fr, resulting in higher stone-free rates (SFR) and less complications than the standard PCNL[4,5)]. Also, a number of studies and reports about mini percutaneous nephrolithotomy method have been issued. Li reported that the stone - free rate after applying mini - PCNL to treat lower pole renal stones was 95.1% (2018). Similarly, 93.8% was the rate reported by Guler[6,7)].

In our hospital, the mini percutaneous nephrolithotomy method of treating renal lower calyx stones has been performed since 2017. We have conducted this study and reported the results of the mini-PCNL performed in a lateral position treatment renal lower calyx stones at the Ha Noi Hospital of Post and Telecommunications with a view to assess the efficiency and safety of the method.

OBJECTIVE AND METHOD

We conducted a prospective, cross-sectional study on 75 patients who were treated using the mini-PCNL in a lateral position treatment renal lower calyx stones, which took place at the Ha Noi Hospital of Post and Telecommunications in Viet Nam from June 2019 to September 2020.

The following criterias were used to select patients :

size of renal lower calyx stones > 20 mm ; multiple in stones located at lower pole calices; size of renal lower calyx stones 10 - 20 mm but has included clinical symptoms, patients who had undergone a prior

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Table 1: Patients' pre-operative indicators (n = 75)

Indicators		Number of patients	Rate (%)
Gender	Male	49	65.3
	Female	26	34.7
Mean age (years old)		53.7 ± 11.5 [27 - 83]	
Clinical symptoms	Symptomatic Stones	59	79.7
	No symptoms	16	21.3
Position of the stone	Right side	35	46.7
	Left side	40	53.3
Numbers of stone	Single stone	56	74.7
	Multiple stones	19	25.3
Mean size of stone (mm)		22.5 ± 5.0	
Hydronephrosis	Non-hydronephrosis	61	81.3
	Degree 1	11	14.7
	Degree 2	3	4.0
Total		75	100

Table 2: Surgery process (n = 75)

Indicators	Variables	Number of patients	Rate (%)
Puncture site	Upper calyx of kidney	0	0
	Middle calyx of kidney	10	13.3
	Lower calyx of kidney	65	86.7
Numbers of tunnels created/patients	One tunnel	74	98.7
	Two tunnels	1	1.3
Surgical accidents	No surgical accidents	74	98.7
	Failed to place double-J stent	1	1.3
Time	Mean operative time	46.6 ± 9.1[20-80] minutes	

Table 3: Post-operative care (n = 75)

Indicators		Number of patients	Rate (%)
Surgical complications	Fever, urinary infection	8	10.7
	Other complications	0	0
No surgical complications		67	89.3
Total		75	100
Time	Time for kidney drainage removal	4.2 ± 1.3[3-7] days	
	Mean period of hospitalisation	5.2 ± 1.4[3-8] days	

Table 4: Stone-free rate (n = 75)

Indicators		Number of patients	Rate (%)
Stone-free rate	Postoperative(third day)	73	97.3
	After the surgery 1 month	74	98.7
Other intervention (URS, ESWL or second PCNL)		0	0

failed ESWL or contraindications with ESWL, did not agree to be treated with ESWL. Patients with urinary tract infections (UTIs) being cured with antibiotics, and patients with serious illnesses were excluded before performing the procedure. All the patients were given clear information and agreed to participate in the study.

Operation techniques:

The procedure was performed under general anesthesia. The patient was placed in the obstetric position with a performed ureteroscopy and an intubated 7 Fr ureter catheters put into the renal pelvis. The patient was then turned 90° to the lateral position, and the stones location was identified under ultrasound guidance. A needle measuring 20 cm was punctured through the lower calyx of kidney or other positions. An incision of 6-7 mm in length was made, and then the tunnel was dilated by the access tracts from 8 to 18 Fr. An Amplatz sheath was introduced into the calyx of kidney - renal pelvis. We examined the calyx of kidney and renal pelvis via the Amplatz sheath to determine the location of the stone. The stone fragmentation was performed by laser, at an 80W power setting. The stone fragment removal was carried out via the Amplatz. Having been checked the calyx of kidney and renal pelvis, a double-J stent was placed between the renal pelvis - ureter. A plastic tract of 16 Fr was then inserted for kidney drainage.

Criteria for assessing stone-free status:

According to the 2015 Guidelines of the European Association of Urology (EAU), the stone-free status was defined when no residual stones were detected on plain X-ray photographs of the urinary system after the surgery, or there were residual stone fragments less than 4 mm in size. "Residue of stone" status refers to cases in which one or more stone fragments of more than 4mm in size were detected, and the patient continued to be treated in association with other methods[3]. In this study, we assessed the stone-free status based on the post - operative tests and one month after the surgery, including an ultrasound scan and radiography.

Data handling and collection:

The data was collected and processed by SPSS 20.0, using a statistical algorithm. The T-test and Fisher test were used to verify the difference. A comparative value was considered statistically different when $p < 0.05$.

STUDY RESULT

The results achieved by the study on 75 patients of lower pole renal stones treated with the mini-PCNL in the lateral position are stated below:

In our study, Male patients account for 65.3% and Female patients comprises of 34.7%. The mean age of the patients is 53.7 ± 11.5 [27 - 83], of whom the eldest patient is 83 years old. The right kidney accounts for 46.7% and left kidney for 53.3%. The stones are single stone in 56 patients (74.7%) and multiple in 19 patients (25.3%). The mean size of the stone is 22.5 ± 5.0 mm. We saw a large number of patients with non - hydronephrosis accounted for (81.3%).

The lower calyx of kidney was the most common renal puncture site, accounting for 86.7%; the middle calyx of kidney accounted for 13.3%; we didn't puncture site in upper calyx of kidney. Most of the patients needed only one tunnel for the procedure (98.7%). There were 1.3% patients who needed two tunnels for the procedure. In the study, there was no accident on surgery process. The mean operative time was 46.6 ± 9.1[20-80] minutes.

The post-operative complication rate of our study group was 10.7% and it was fever caused by infections after the surgery. The mean time for kidney drainage removal was 4.2 ± 1.3[3-7] days. The mean period of hospitalisation was 5.2 ± 1.4[3-8] days.

Assess the condition of stone-free rate postoperative : 97.3% stone-free rate and were re-examined one month after the surgery, increasing stone-free rate 98.7%.

DISCUSSION

Calyceal stones is a kind of common symptom in kidney stones. In which, renal lower calyx stones account for most of calyceal stones[1]. In our study, the mean age of patients was 53.7 ± 11.5 [27 - 83] years old, male rate accounted for 65.3% and female rate was 34.7%; the right kidney accounted for 46.7% and left kidney was 53.3% (Table 1). A couple of other studies have given the same results, for instance : Li studied 103 cases on the mean age of patients was 49.89 ± 13.09 year, male rate accounted for 72.8%; , the right kidney accounted for 47.5% and left

kidney was 52.5%[6]. The patients with clinical symptoms in our study accounted for 79.7% and 20.1 % patients who showed no symptoms on arrival at the hospital (Table 1). The renal lower calyx stones didn't often cause congestions or friction of urinary. Therefore, the patient rate has clinical symptoms such as backpain, dysuria, hamaturia and dribbling of urine often lower studies on renal stones in general. Darrad studied 1180 cases of renal lower calyx stones, 74.9% had clinical symptoms for which much of it was backpain[8].

The stone position of all patients was in lower calyx of kidney with the mean size of stone was 22.5 ± 5.0 mm. The stones were single in 74.7.2% patients and multiple in 25.3% patients. Dongol conducted a study in 2018, recording the mean size of stone was 17.6 mm (15 - 28 mm) in there group > 20 mm accounting for 61,5%[9]. According to the European Association of Urology (EAU, 2015), the mini-PCNL is recommended as a choice of treatment for big stones (> 20 mm) and smaller stones (10 - 20 mm), in which treatment failed in ESWL or ESWL was contraindicated[3].

We saw a large number of patients with non - hydronephrosis accounting for (81.3%). Hydronephrosis degrees 1, 2 for the patients in our study group were 14.7% and 4.0%, respectively (Table 1). In our opinion, the renal lower calyx stones often didn't cause congestions therefore causing little condition hydronephrosis. The cases hydronephrosis may be renal lower calyx stones big size, partial of stone into the renal pelvis, also be sequelae of previous surgery, the previous residual hydronephrosis or there were pathological stenosis of ureter, prostatic hypertrophy...

In the mini-PCNL procedure, we chose the lateral position under the ultrasound guidance, in accordance with clinical facts and previous studies. In our opinion, the lateral position has advantages of less effect on the respiration and circulation; which allows it to be carried out on kyphosis sufferers obese patients. Studies also show that mini PCNL with the lateral position has level of safety and high efficiency. Pan *et al* (2015) studied 100 patients divided into two groups, the prone and lateral positions. They concluded that both positions affected the circulation and arterial blood gas; however, the lateral position saw smaller changes in blood gas and haemodynamics[10]. Ultrasound has the advantage of determined none radiodensity stone; evaluated correlation of the kidney with organs and helped to avoid radiation when the X-ray exposure[11,12].

The localisation of the puncture site is important when performing the mini-PCNL procedure, as it ensures better control and stone clearance as well as a reducing risk of complications. The localisation of the puncture site depends on the location and size of stones and also the complexion of the urinary system. For simple stones, the puncture into the calyx of kidney, renal pelvis directly approaching the stones is the best way to the stone fragmentation, and to limit damage and complications. In our study, all patients' stones position are in lower calyx of kidney; we will prioritize puncture in lower calyx of kidney to directly approach the stone accounting for 86.7%. The PCNL of today have a tendency to puncture into location of stones. The renal lower calyx stones size is not large, it does not cause condition hydronephrosis or hydronephrosis mildly localisation of lower calyx. That might be difficult when puncture in calyx of kidney. In some cases, we can puncture into other positions. In this study, there were 13,3% cases of puncturing into middle calyx of kidney (Table 2). There were no cases for upper calyx of kidney puncture for this position are slightly hard to approach lower calyx of kidney and holds risk of pleural lesions. In 2012, Abdelhafez reported on 83 patients treated with the mini-PCNL, in which the upper calyx of kidney puncture accounted for 4.8%, the middle calyx of kidney puncture 10.8%, and the lower calyx of kidney puncture accounted for 84.4%[13]. According to several studies, the larger the stones are, the easier puncture in calyx of kidney is. Especially, the stones cause condition hydronephrosis of calyx of kidney. However, the larger the stones increases the risk of complications (bleeding, operating time is extended) and increases the rate of residual stones. Turna studied 234 patients, the stones dividied into groups according to complexity of stones provided with similar conclusions[14].

We apply the method of the mini-PCNL with size Amplatz 18Fr. The recent reports indicated that shrink the size of tunnels and endoscope (from standard - PCNL switch to mini - PCNL) often resulted in more efficiency and reducing risk of complications. Cheng conducted a comparative study divided into two groups: mini-PCNL and PCNL concluded that the mini-PCNL had a higher stone-free rate (85.2% compared with 70.0%, respectively) and a lower complication rate[4].

The amount of tunnel were created in performing the mini-PCNL, it relating to complexity of stones. For staghorn stones or multiple stones, in many cases, we needed to create more than one tunnel to approach the stones. Because, we study the renal lower calyx stones, most of the puncture into lower calyx of kidney to directly approach the stone, so there are 98.7% patients needed only one tunnel for the procedure. There was one patient who needed two tunnels for the procedure (1.3%).

The mean operative time was 46.6 ± 9.1[20 0] minutes: the shortest case was 20 minutes, and the longest was 80 minutes. In Guler's study on 96 patients, renal lower calyx stones with the mean size of the stone was bigger than ours (26.05 ± 3.30 mm) for mean operative time 57.54 ± 11.9 minutes[7].

In the study, there was no accident on surgery process as bleeding, pleural lesions or internal organs. The reason of limiting surgical accident may be due to the fact that the renal lower calyx stones size is not large, we will prioritize puncture in lower calyx of kidney to directly approach the stone to limit damage and surgical accidents.

There was a case who failed to place a double-J stent, may be because of the fold of ureteropelvic junction, we changed the patients position and successfully inserted the double-J stents by the RIRS procedure. All the patients were given kidney drainage after the surgery. In our opinion, placing kidney drainage may help the circulation of the urinary tract; limit complications if any, monitor and deal with them better.

The post-operative complication rate of our study group was 10.7%, which was fever caused by infections after the surgery (Table 3). No case is septicaemia or septic shock. In these cases, patients underwent tests for blood culture, urine culture, and were given antibiotics according to the treatment regimen, which showed all good results. The reason why complication after the surgery be limited, may be due to the renal lower calyx stones size, the operation time didn't last long. Antibiotics are used in post-operation time for all the patients. Regarding infection cases, we treated and waited till stable status for further surgery conduction. When studying 93 patients, Guler found that complications occurred in 10.4% of cases, including 1 case of pleural lesions (1%), 2 cases of need blood transfusion (2%) and the rests are cases with infections complications after the surgery[7].

We removed the kidney drainage based on the progress of the patient postoperation; the average-time of kidney drainage removal was 4.2 ± 1.3 days. The length of hospitalisation in the study was 5.2 ± 1.4 days. Dongol's study reported PCNL treatment renal lower calyx stones, the average period of hospitalisation 4.1 days[9].

The patients underwent rechecking on the third day after surgery and we assessed the stone-free status using radiography or ultrasound scan result. After surgery stone-free rate is 97.3%, residual stone rate is 2.7%. None of the patients administered a second mini-PCNL or other intervention (Table 4). Li studied 103 cases and after surgery stone-free rate is 93.2%[6].

All patients came back after one month for further re-checking examination after surgery. Nobody had clinical symptoms. The patients underwent a ultrasound scan, radiography and assessed the stone-free status. The stone-free rate 98.7%; 1.3% residual stone. The case residual stone in which stone size was size, it did not need to interfere additional tasks such as JJ removal and monitor periodically. Many studies have shown that the stone-free rate after the surgery a month is higher than the right after surgery stone-free rate. Li's study shows that right after surgery, stone-free rate is 93.2%; the stone-free rate at follow - up examination after the surgery a month is 95.1%[6]. Guler studying on 93 patients shows that right after surgery stone-free rate is 82.3% and increases 93.8% when re-examining after a month[7].

The stone-free rate in our study is relatively high, may due to the renal lower calyx stones simple stones and small/medium stone size. Zhu studied and indicated that there was a link between the stone-free rate and the complexity of stones[12]. According to Abdelhafez's report in 2013, the mini-PCNL seemed more effective for the treatment of smaller stones (< 20 mm) compared with bigger stones (> 20 mm), with the stone-free rates were 90.8% and 76.3%, respectively[15].

CONCLUSION

Through this study, we have noticed that the mini-percutaneous nephrolithotipsy in the lateral position is a safe method, to be high-effective in treatment lower pole renal stones. It is highly highly hoped that the mini-PCNL be treated renal lower calyx stones and improved as well as widely applied to bring benefits for patients.

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