

# Results of combination of percutaneous nephrolithotomy and extracorporeal shock wave lithotripsy in treatment of staghorn calculi

Kieu Duc Vinh\*, Tran Cac\*,  
Nguyen Phu Viet\*\*

\*108 Military Central Hospital

\*\*103 Military Hospital

## Summary

**Objective:** To evaluate the outcomes of treatment of staghorn calculi by combination therapeutic approach of percutaneous nephrolithotomy (PCNL) and extracorporeal shock wave lithotripsy (ESWL).

**Subject and method:** A prospective study carried out from September 2014 to September 2017, 80 patients with staghorn calculus underwent combination therapeutic approach of PCNL and ESWL.

**Result:** Mean age was  $54 \pm 11$  years (27 - 78), size of stone was  $46 \pm 13$ mm, average operation time for PCNL was  $129 \pm 27$  minutes, the mean of the number of shock wave in the first time was  $2410 \pm 797$  and the second time was  $2614 \pm 561$ . Postoperative length of stay was  $7.3 \pm 2.2$  days. The number of tracts required per patient was 1 tract in 92.5% (74/80) and 2 tracts in 17.5% (6/80). The stone free rate after 3 months was 55.2%. Common complication rate was 27.5% (22/80), bleeding required transfusion was 6.2% (5/80), fever was 22.5% (18/80) and there were 1 case had ureter stone after removing double J stent (1.3%) that was required ureterorenoscopy. **Conclusion:** Combination therapeutic approach of percutaneous nephrolithotomy and extracorporeal shock wave lithotripsy is a good option, safety and effectiveness for treatment of staghorn calculi.

**Keywords:** Percutaneous nephrolithotomy, extracorporeal shock wave lithotripsy, staghorn calculi.

## 1. Background

Staghorn calculi are branched stones that occupy a large portion of the collecting system. Typically, they fill the renal pelvic and branch into several or all of the calices [1]. Staghorn calculi can damage the kidney that causes sepsis, renal failure and risk of death.

Treatment of staghorn calculi is a real challenge for many urologists. Open surgery has been used since the past but it was a much invasive surgery.

This therapy can damage to kidney tissue, increasing the risk of complications such as bleeding, urine leakage, infection... In addition, the patients were suffering from pain after surgery, the postoperative period is long. PCNL (percutaneous nephrolithotomy) monotherapy may require multiple tracts to increase the rate of stone clearance, therefore bleeding complication will increase with the number of tracts. On the other hand, ESWL (extracorporeal shock wave lithotripsy) is not recommended in the treatment of large size stones and kidney staghorn calculi. As a result, we decided to study the result of combination of PCNL and ESWL in treatment of staghorn calculi.

## 2. Subject and method

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**Correspondence to:** Kieu Duc Vinh - Department of Urologic Surgery, 108 Military Central Hospital

**Email:** kieuvinh2006@gmail.com

## **2.1. Subject**

A prospective study carried out for eighty kidneys that diagnosed with staghorn calculi and was underwent combination therapeutic approach of PCNL and ESWL from September 2014 to September 2017 in 108 Military Central Hospital. Kidney ureter and bladder (KUB) film, intravenous urography (IUV) or computed tomography (CT scan) were performed for diagnosis.

The selected patients criteria were staghorn calculus with had no history of use of antiplatelet and anticoagulant drugs such as aspirin within 2 weeks before treatment.

The exclusion criteria were as follows:

Patients with infections, renal tumor, renal atrophy, abnormal position of kidneys, transplanted kidney.

Basic diseases such as dysfunctions of heart, liver, lung.

Patients unable to complete the treatment process and without re-examination.

Patients with poor or non-contrasting stones.

## **2.2. Method**

### *Step 1: PCNL*

First of all, percutaneous access, puncture the needle into the renal calyx that was chosen with radiography guide, insert a guidewire into the kidney, tract dilation and percutaneous debulking with ultrasonic fragmentation are then performed in a single stage utilizing general or spinal anesthesia. The puncture site in to the collecting system is specifically choose how to get as much stone bulk as possible and generally allows removal of maximum stone in the lower infundibular and pelvic portion. In some cases, upper infundibular and several small middle caliceas extensions may also be extracted. In this step, no attempt need be made to reach the relatively inaccessible infundibulocaliceal extensions of the calculus located at acute angles to the tract and thus to the rigid nephroscope.

Remove of ureteral catheter and place a double J stent into the ureter. Place a 16/18F Foley neprostomy tube is left indwelling at the termination of the PCNL.

### *Step 2: ESWL*

ESWL was performed 4 days later depending on the condition of patients. This interval allows urine to clear and the tract to mature. Patients with conditions required for ESWL include size of recurrent stone is smaller than or equal 2cm; there were not any complications such as bleeding, collecting system perforation or laceration, peripheral organ impairment, infection. The other patients were going to be treated by ESWL one month later.

A electromagnetic extracorporeal lithotripsy machine (Modulith - SLX - F2) was used for ESWL and the energy of crushing stone was limited at 9.0 level, with beating time no more than 4000, the number of stone crushing times no more than 3, and the interval between two rounds of stone crushing was one month.

### *Observational indexes*

The kidneys, ureters and bladder were rechecked by radiography at 1 month and more than 3 months later to statistic stone free rate and complications. If the fragments of stones were smaller than or equal 4mm, the double J stent was removed in one month.

*Evaluating of results of study in our point of view:*

Very good: A very good result is stone free and without complication.

Good: A good result include no complications, still residual fragments that are smaller than or equal 4mm and clinically insignificant (clinically insignificant recurrent fragments - CIRFs).

Medium: A medium result is still residual stones that are larger than 4mm or may be occur some complications such as bleeding transfusion required, collecting system perforation or laceration,

steinstrasse that can be more procedure (ureteroscopy - URS).

Failure: A poor result include the failure in treatment, changed to open surgery, occurred serious complications such as sepsis, bleeding transfusion required embolism or nephrectomy.

### 3. Result

There were 46 (57.5%) renal patients of males and 34 (42.5%) renal patients of females. Mean age was  $54 \pm 11$  years. Mean largest diameter of the largest stone was  $46 \pm 13$ mm.

**Table 1. Technical features**

	PCNL	ESWL1	ESWL2
Single tract	74 (92.5%)	-	-
Two tracts	6 (7.5%)	-	-
Mean of shock	-	$2410 \pm 797$ (n = 80)	$2614 \pm 561$ (n = 14)
Frequency of shock (f)	-	1.5Hz (79/80) 2.0Hz (01/80)	1.5Hz (14/14)
Energy	-	$7.5 \pm 0.1$	$7.5 \pm 0.1$

**Table 2. Treatment results for 80 renal patients with staghorn calculi**

	One month later (n = 80)	$\geq 3$ months later (n = 58)	Lost follow up
Stone - free rate	24/80 (30%)	32/58 (55.2%)	22/80 (27.5%)
Remain stone	56/80 (70%)	26/58 (44.8%)	

**Table 3. Complications**

	PCNL	ESWL1	ESWL2	Combination
Bleeding transfusion required	5/80 (6.2%)	0	0	5/80 (6.2%)
Fever	18/80 (22.5%)	1/80 (1.3%)	0	18/80 (22.5%)
Urosepsis	0	0	0	0
Obstruction of ureter	-	-	-	6/80 (7.5%)

**Table 4. The results of research in our standard**

	Patients	Percentage (%)
Very good	32	40.0
Good	42	52.5
Medium	6	7.5
Failure	0	0
<b>Total</b>	<b>80</b>	<b>100.0</b>

### 4. Discussion

Complete removal of the stone is an important goal in order to eradicate any causative

organisms, relieve obstruction, prevent further stone growth and any associated infection, and preserve kidney function. In 2005, The American Urologic Association (AUA) recommended for

treating patients with staghorn calculi included Percutaneous Nephrolithotomy monotherapy, combinations of PCNL and ESWL, Extracorporeal Shock Wave Lithotripsy monotherapy and open surgery. PCNL is the first line for treatment of large stone, which does small wounds, has a high rate of stone free, allows for thorough treatment, and releases complications, allows for rapid recovery. Therefore, some of the small staghorn calculi may be treated successfully with PCNL or ESWL monotherapy. However, single use of PCNL or ESWL cannot completely remove stone of the complex staghorn calculi from the kidneys [2]. In the 90 decades, combined use of ESWL and PCNL to treat complex renal calculus can improve the stone-free rate and renal function, and does not increase the complication rate. Therefore, it is safe and effective [3].

In Viet Nam, open surgery is common for treatment of staghorn calculi. Some of hospitals have performed PCNL successfully for recently, however, large stones or staghorn calculi still remain a difficult challenge. There were not many reports of treatment of staghorn stones by PCNL in the past, most of reports of treatment general kidney stones with PCNL that was related to staghorn calculi. For example, Le Sy Trung et al (2012) [4] studied for 280 kidneys with staghorn calculi that were treated by PCNL in 10 years experiences. The rate of success was 75.36% (211/280) with PCNL monotherapy and increased to 90.36% (253/280) for combination of PCNL and ESWL. Thus, the successful rate of combination of PCNL and ESWL was 42/69 (60.87%). According to this author, combination therapy was only used for cases that were detected residual stones after PCNL. Similar to our research, this combination therapy the use of primary PCNL debulking followed by ESWL of residual inaccessible infundibulocalyceal stone extensions or fragments, ESWL can be repeated to maximum 3 produces. This therapy approach (generally a two-procedures sequence of PCNL-ESWL or three-procedures sequence of PCNL-ESWL-ESWL) was a chance from "sandwich" therapy of Streem B et al (1987)

procedures sequence of PCNL-ESWL-PCNL) because of terminal procedure. This change effected to results of study, the stones free rate was lower, but reduced PCNL procedures, shortening postoperative day, shortening remove nephroscope drainage time, and treatment costs was reduced. This is consistent with AUA definition in 2005 [1], the stone free rate of combination therapy was lower in the past (81% in 1994 versus 66% in 2004). According to AUA in 2005, in 1994, the majority of the cases analyzed were based on combination therapy approach where PCNL was the terminal procedure (PCNL-ESWL-PCNL). However, ESWL was the last procedure in a number of the cases in recently, and "second - look" nephroscopy was not performed to assure a stone free state. In comparison with previous research, the stone free rate in our study was lower (55.2% after 3 months), but the most of the goal of treatment were achieved, complications were not very high and could be accepted. In PCNL procedure step, single tract was 92,4% (74/80) and two tracts was 7.6% (6/80). The bleeding transfusion required was in 5/80 (6,2%), fever in 18/80 (22.5%), and there was not any serious complications. In the ESWL step, fever was only in 1/80 (1.3%), obstruction of ureter in 6/80 (6.5%), and most of them were solved by conservative treatment. One patient was treated successfully by ureteroscopy (URS). Evaluating of results of study in our point of view, the results of very good, good and medium were 40.0%, 52.5% and 7.5% respectively, and there was not any worse.

Multiple tracts PCNL was applied successfully for treatment of staghorn calculi. The stone free rate was 87.2% [5] - 88.9% [6], but we suppose that it is still a difficult challenge, because of establishing an tunnel is the hardest and the most important phase of the PCNL, most of the complication that happen relate to this technical such as bleeding, injury of surrounding organs (colon, lung and pleura, live and spleen...). In the reported of Chen J et al (2013) about multi tract PCNL with the number of tracts varied from 2 to 4 in a single renal unit. The complications included blood transfusion required in 9 patients (7.7%), fever > 38.5° in 12 (10.3%),

sepsis in 5 (4.3%), hydrothorax in 4 (3.4%) and pseudoaneurysm in 3 (2.6%). On the other hand, some of serious complications such as sepsis, hydrothorax and pseudoaneurysm did not occur in our research.

In 1997, Jacman et al [7] described a miniaturized PCNL technique for pediatric urinary stones using an introducer sheath 11F and then named miniPCNL (mPCNL). In fact, with the development of instruments and experience, this technique has been successfully applied in adults in many countries including Vietnam for several recently years. This change technical can reduce operative bleeding and tissue damage. It can accessible in infundibulocalyceal easier to improve the efficiency. The disadvantages of this technique are the prolonging operation time to dislodge stones and using high pressure of the water in the kidney, which increased risk of sepsis [8] and the operation may be have to repeat many time. Hence, cost of operation will be increased.

## 5. Conclusion

Combination therapeutic approach of percutaneous nephrolithotomy and extracorporeal shock wave lithotripsy is a good option for treatment of staghorn calculi. Though the rate of stone free was not only very high (55.2%), the complications could be accepted, there was not serious complication, most of kidney stone was removed, obstructions of urinary tract resolved and relived risk of infection. Therefore, it will be safe and effective.

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