

# Safety of Supracostal Percutaneous Nephrolithotomy in Paediatric Population: A Single Centre Experience

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## Author's Contribution

<sup>1</sup> Conception of study

<sup>1,2,3,4,5</sup> Experimentation/Study conduction

<sup>2,3</sup> Analysis/Interpretation/Discussion

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## Abstract

**Objective:** The objective of this study is the assessment of the safety and efficacy of supracostal mini percutaneous nephrolithotomy in pediatric patients.

**Materials and Methods:** This is a prospective study of patients whose kidney stones were treated with mini percutaneous nephrolithotomy through a supracostal approach between February 2019 and Dec 2020. These patients were selected for supracostal puncture based on preoperative ultrasound, CT KUB findings, and peroperative assessment of stone burden, stone location, and anatomy of the pelvicalyceal system.

**Results:** Of 80 patients 72(90%) were treated with only one supracostal puncture while an additional 2nd puncture was used for 8(10%) patients. Overall stone clearance is 85% only with percutaneous nephrolithotomy and the stone clearance has reached 95% with ancillary procedures. 13% of patients had hydrothorax, 3.75% had urosepsis, 2.75% had bleeding and 1.25 % had a perinephric fluid collection.

**Conclusion:** This study concludes that the safety and efficacy of supracostal percutaneous nephrolithotomy is the same as subcostal PCNL if surgical boundaries are not violated.

**Keywords:** Supracostal, Percutaneous Nephrolithotomy, Hydrothorax, Bleeding.

## Introduction

Urinary calculi are the 3rd most common affliction of the urinary tract after urinary infection and pathologic condition of the prostate.<sup>1</sup> In the modern era of kidney stones management percutaneous nephrolithotomy (PCNL) is the gold standard as it is less invasive, less painful, less traumatic to the kidney, less chance of post-procedure bleeding, and early return to work.<sup>2</sup> Access to the kidney for stone retrieval depends upon the site of stone, stone burden, anatomy of the pelvicalyceal system, and rarely location of the kidney.<sup>3</sup> While getting access to a kidney the gold standard calyx is the one with a wide, straight, and short infundibulum.<sup>4</sup> Puncturing through the upper pole of the kidney is good for managing stones in the renal pelvis, proximal ureter, lower and upper pole, even staghorn stones can be easily and safely managed with upper pole access. The upper renal pole is anatomically more posteromedial than a lower pole, so access via the upper pole is more straight as compared to the middle and lower poles.<sup>5</sup> With this approach access to the lower calyx, renal pelvis, and upper ureter can be easily achieved if the initial puncture is appropriate.<sup>6</sup> Careful preoperative assessment of pelvicalyceal system anatomy with the help of renal ultrasound or intravenous urography or CT KUB and intraoperative retrograde pyelography (RPG) can help to select the site of percutaneous puncture for kidney stone retrieval, most stones can be approached subcostally but sometimes if the subcostal approach is not appropriate then the supracostal approach can also be utilized.<sup>7</sup> Supracostal approach is considered to have worse complications like a hydrothorax, hemothorax, and lung parenchymal injury.<sup>8</sup>

Lange et al in their retrospective study conducted in tertiary care hospitals out of 642 patients, 127 had supracostal access to the kidney while 515 had subcostal access, they had 88.3% of stone clearance with supracostal PCNL and complications rate of 11%. They have concluded that supracostal PCNL is a safe and effective way of treating patients with various sizes of kidney stones. The purpose of this study is to know the outcome of supracostal mini PCNL in terms of overall stone clearance, chest complications, bleeding, perinephric fluid collection, and urinary tract infection or sepsis.<sup>9</sup>

## Materials and Methods

After approval from the institutional ethical committee (NO102/PEADS URO/IKD), this prospective study

was conducted in the Department of Paediatric Urology Institute of Kidney Diseases Hayatabad from February 2019 to December 2020 on kidney stone patients. Detailed assessment of patients complaining of kidney stone symptoms was done with pertinent history, thorough physical and relevant genitourinary examination, after that baseline urological investigations i.e. urine routine examination, complete blood count, Creatinine, ultrasound kidney, ureter and bladder (KUB), intravenous pyelography or computed tomography of kidney, ureter, and bladder (KUB) performed and the indications for supracostal approach were assessed, and before surgery urine culture should be sterile and after all these steps all patient or relatives were given written form of proper informed consent with all complications explained.

Postoperatively patients were called for follow-up at 1 week for a general checkup and after a month for DJS removal. Meanwhile, all patients were assessed for any kind of complications like bleeding, hydrothorax, injury to surrounding structures, urosepsis, and residual stones during surgery and post-operatively with well-defined proforma.

### **Surgical Technique**

Under general anaesthesia, patients were put in lithotomy position under fluoroscopic guidance open-ended ureteric catheter passed, reached up to the proximal ureter, and secured with a Foley catheter. The prone position was made with all necessary precautions and the site of puncture was properly draped with opsite, PCS visualized with urografin 10 ml diluted with 10 ml normal saline, and the site of puncture marked. 5mm skin incision given before needle puncture, the author mostly uses 22 G needle and under fluoroscopic guidance with gradual descent technique access to PCS obtained and dilation of the track done with facial and Alken metallic dilators over the guidewire and finally, plastic amplatz sheath was used. Stone fragmentation was done with pneumatic lithoclast, stones were retrieved with wash and bifrong forceps. At the end of the procedure, all calyces were inspected with a nephroscope and fluoroscope for any residual stones. And under fluoroscopic guidance through antegrade approach DJS put in, nephrostomy tube was only put in cases of residual stones, bleeding, injury to PCS or extravasation of irrigation fluid.

## Results

During the period of study 80 patients were operated on with supracostal mini PCNL age ranging from 3 months to 16 years, male to female ratio is 48:32, 38

were right side and 42 were left side kidney stones. For 72(90%) patients single upper pole access through the supracostal route was used and in 8(10%) patients additional 2<sup>nd</sup> subcostal tract through middle and lower calyx access was used due to large stone burden. Stone clearance was 85% with PCNL only and clearance reached 95% with ancillary procedures like ESWL, Ureteroscopy, and re PCNL as shown in Table 1. Hydrothorax developed in 11(13%) patients who were all managed in the Paediatric Urology Ward, 2(2.5%) of patients having significant intraoperative bleeding in which procedures were abandoned none of them required angioembolization and conservatively managed with blood transfusions, 1(1.25%) had a perinephric fluid collection which resolved conservatively, 3(3.75%) patients having urinary tract infection and sepsis as shown in Table 2.

**Table 1: Demographic features of patients for supracostal mini PCNL**

Characteristics	No of patients (%)
Age	3 to 11 months 17(21.25%)
	1 to 5 years 28(35%)
	Above 5 years 35(43.7%)
Gender	
Male	48(60%)
Female	32 (40%)
Side of kidney stone	
Right	38 (47.5%)
Left	42(52.5%)
Stone clearance only with PCNL	68(85 %)
Ancillary procedures for stone clearance	6(7.5%)
ESWL	1(1.25%)
Re mini PCNL	1(1.25%)
URS	
Hospital stay	
One night stay	74(92.5%)
More than one night's stay	6 (7.5%)

**Table 2: Complications of supracostal mini PCNL**

S.No	Complications	No of patients (%)
1	Hydrothorax	11(13%)
2	Bleeding	2(2.5%)
3	Perinephric fluid collection	1(1.25%)
4	Sepsis	3(3.75%)

## Discussion

Before the era of modern minimally invasive urological procedures in the old days, while treating the patient for stones and other urological diseases with open surgery they had to be admitted to hospitals for many days, they have the chance of wound infection, incisional hernia, and many other morbidities, so doctor starts thinking about new ideas in which procedures are devised in such a way so that patients have to stay for a short time in hospital and return to work quickly with fewer morbidities, in the same path of evolution of modern urology instruments it has been modified from rigid to semi-rigid and finally flexible with miniaturization of diameter.<sup>10,11</sup> Same is true for PCNL instruments in which the diameter of the nephroscope is reduced to 7.5Fr from 30Fr, fiber optics, lighting systems, irrigation systems, stone fragmentation, stone retrieval mechanisms, and most importantly puncture techniques and fluoroscopy are much refined over the last decade. The most important step in the PCNL procedure is tract formation, the ideal tract is the one in which the infundibulum is short, wide, and straight so that surgeon can easily manipulate the nephroscope and other instruments for stones clearance.<sup>12,13</sup> In the beginning days of PCNL most urologists hesitate for doing PCNL through the supracostal route so the majority of urologists used a subcostal approach which mostly leads to a large bulk of residual stones as stones were not properly approached and bleeding due to extra torque applied over nephroscope in the kidney.<sup>14</sup> Nowadays supracostal PCNL is considered as safe as subcostal in terms of hydrothorax, bleeding, perinephric fluid collection, injury to adjacent viscera, and stone clearance.<sup>15</sup> We had treated stones which were staghorn, in the upper calyx, lower calyx, kidney pelvis, and proximal ureter with 12Fr semi-rigid nephroscope, and upon pre-op CT scan and per Op retrograde contrast studies of PCS the surgeon has decided to used supracostal route for PCS access, for 8 patients we used additional 2<sup>nd</sup> puncture for access to PCS due to large stone burden and anatomy of PCS which helped in stone clearance, our overall stone clearance rate is 85% only with PCNL and increased to 95% with ancillary procedures i.e. ESWL, Ureteroscopy and re PCNL.<sup>16</sup> We used fluoroscopy and nephroscopy for residual stone during surgery, and x rays KUB and ultrasound for stone follow-up after surgery.<sup>17</sup> Six patients had residual stones which were treated with ESWL, one patient required 2<sup>nd</sup> PCNL in which procedure was abandoned due to

bleeding and a single patient needed Ureteroscopy as stone migrated into the ureter during the procedure and the nephroscope was unable to reach the stone. Our main concern was hydrothorax which was drained with a 20 cc syringe in 3 patients, 2 patients needed chest tube drainage and 6 patients were treated conservatively with a urethral catheter and DJS.<sup>18,19</sup> All patients were discharged home on self-medication on 1st post-operative day and called for follow-up after 4 weeks. 6 patients were remain admitted for 2 days due to chest tube and 1 with urosepsis.<sup>20</sup> El Karamany et al in their prospective study of 40 patients with 16 complete staghorn stones while 24 patients had partial staghorn stone, 78% of patients were stone free with PCNL only and it increased to 88% with ancillary procedures. They had a complications rate of 38% according to the modified clavien system.<sup>21</sup> Nitin S kekre et al in their series of 102 cases of supracostal PCNL which they have used for various sizes of kidney stones with complete clearance of 78.9% and 9.8% of patients has chest complications hydrothorax or hemothorax which were all managed with intercostal chest intubation. Lange et al in their large retrospective study of 642 patients 127 had supracostal access to the kidney while 515 had subcostal access, they had 88.3% of stone clearance with supracostal PCNL and a complications rate of 11%. They have concluded that supracostal PCNL is a safe and effective way of treating patients with various sizes of kidney stones.

## Conclusion

This study concludes that supracostal mini PCNL is a safe and effective procedure for treating kidney stones if a urologist adheres closely to the anatomical landmarks of the pleura and follows the basic principles of PCNL.

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