

# Anatrophic Nephrolithotomy: Preservation of Renal Function and Stone Clearance Rate

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## ABSTRACT

**Aim:** To assess the outcomes of anatrophic nephrolithotomy in terms of stone clearance and change in renal function.

**Study design:** Observational study

**Place and duration of study:** Department of Urology Sindh Institute of Urology & Transplantation, Karachi from 1<sup>st</sup> January 2016 to 31<sup>st</sup> December 2021.

**Methodology:** Fifty patients who underwent anatrophic nephrolithotomy from were enrolled. Outcomes were measured in terms of stone clearance, change in pre and post procedure eGFR, serum creatinine and differential renal function on renal scan (MAG-3 scan).

**Results:** There were 30 (60%) males and 20 (40%) females with mean age was 5.96±13.09 years. Post-operative serum creatinine and eGFR were compared with pre-operative values and no statistically significant difference observed. Comparison of pre-operative and post-operative 99mTc-mercaptoacetyltriglycine (MAG3) scans revealed statistically significant mild loss of renal function with p-value of 0.376.

**Conclusion:** Anatrophic nephrolithotomy can be an alternative for multi tract PCNL when there is huge stone burden as it yields excellent stone clearance, and it can be practiced fearlessly for large staghorn stones because they can become the frequent cause of infections and mortality. Although parenchymal damage after anatrophic nephrolithotomy is of concern, renal dysfunction is usually clinically insignificant.

**Key words:** Anatrophic nephrolithotomy, Staghorn stone, Renal calculi

## INTRODUCTION

Salts and minerals are aggregate within the kidneys to develop kidney stones, which then can migrate down the urinary system. The stones originate in the kidney's pelvicalyceal system and can range in size from a few millimetres to the size of the renal pelvicalyceal system itself the staghorn stones<sup>1</sup>. Symptoms and signs of kidney stones include hematuria and abdominal or flank discomfort. Approximately 5% of persons will get kidney stones throughout their lifetime. The majority of individuals with kidney stones are able to pass them on their own between 48 hours and six weeks after drinking plenty of water. Analgesics can alleviate pain<sup>2</sup>. The smaller the stone, the greater the likelihood that it will pass unimpeded. Stones measuring 5mm have an 80% probability of passing on their own, but stones measuring 4mm or smaller have a 100% chance of passing without intervention. The stone clearing rate is dependent on the stone's type, size, and number.

Patients might present with a single stone in a single calyx or pelvis, several stones in multiple calyces, or a staghorn stone<sup>3</sup>.

Calculus that fills at least one calyceal group and the pelvis is the definition of "staghorn calculus." If the calculus covers the renal pelvis and one or two calyceal groups, but not all of them, it is considered a "partial staghorn calculus". If this kidney stone occupies the renal pelvis and at least three-quarters of the pelvicalyceal system, however, it is referred to as a "total staghorn stone." Morphometric studies based on computed tomography may assist categorize and predict treatment results for staghorn calculus. Staghorn calculi are associated with renal failure, infections, and mortality<sup>3,4</sup>.

Surgical removal through fragmentation of the stone or open, laparoscopic, or robotic-assisted surgery is the treatment modalities for staghorn stones. A percutaneous nephrolithotomy is a minimally invasive treatment option<sup>5</sup>.

Due to advancements in endourological surgery, indications for open stone surgery have dropped significantly. Due to the infectious process and inadequate clearance, PCNL and retrograde intrarenal surgery (RIRS) have a significant risk of sepsis.

Open stone surgery accounts for 1% to 5.4% of cases in the contemporary age. Complex staghorn stones that cannot be removed by a reasonable number of PCNL attempts, abnormal anatomy of the collecting system, multiple obstructive stones in different calyces, and large staghorn calculi with co-morbidities such as chronic obstructive pulmonary disease are indications for open stone surgery<sup>6</sup>. Smith and Boyce advocated anatrophic nephrolithotomy in 1968 as the procedure of choice for such stones. Compared to ESWL or PCNL, a stone-free rate of 80 to 100% can be attained with intact renal function<sup>6,7</sup>.

As a tertiary care unit and region's high volume centre for stone disease we at our institution performs anatrophic nephrolithotomy, hence we wanted to assess our results in terms of clearance rate morbidity, healing, and return of renal function.

## MATERIALS AND METHODS

This retrospective observational study was conducted in Department of Urology, Sindh Institute of Urology and Transplantation (SIUT) after getting approval from Ethics Review Committee (ERC). All the patients who underwent anatrophic nephrolithotomy from 1<sup>st</sup> January 2016 to 31<sup>st</sup> December 2021 were reviewed. Data regarding age, stone size, serum creatinine, blood transfusion, eGFR, operative time and ischemia time was recorded and analyzed using SPSS-20. Serum creatinine, pre and postoperative eGFR and pre and post-operative MAG3 were evaluated using paired t-test. P value <0.05 was considered as significant.

## RESULTS

(MAG3) scans were compared by t-test with 95% confidence interval it reveals statistically significant mild loss of renal function with p-value of 0.376 (Figs. 1-2).

There were 30(60%) males and 20(40%) females. The mean age of these patients were 35.96±13.098 years. Majority 34(68%) of patients were having complete staghorn stone involving all of calyces while 16(32%) of them were having partial staghorn type of stone. The 88% patient had stone clearance of 90-100%. Ischemia time was zero in 84% of patients with mean value 2.28±5.60 minutes.

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Table 1: Demographic information of the patients (n=100)

Variable	No.	%
<b>Gender</b>		
Male	30	60.0
Female	20	40.0
<b>Blood transfusion</b>		
Yes	9	18.0
No	41	82.0
<b>DJ-Nephrostomy placement</b>		
Nephrostomy placed	24	48.0
Both of them	6	12.0
None of them	20	40.0

Only 9(18%) patients required intraoperative blood products transfusion. Both DJ stent and nephrostomy tube were inserted in 20(40%) patients, in 24(48%) patients only nephrostomy tube was inserted and in 6(12%) patients no tube was inserted (Table 1). Post-operative serum creatinine was compared using paired sample t-test having 95% confidence interval level with p-value 0.03 (Table 2). Pre-operative and post-operative estimated GFR was measured by using t-test and have p-value of 0.00 after using 95% confidence interval (Table 3). Pre-operative and post-operative 99mTc-mercaptoacetyltriglycine

Table 2: Comparison between pre-operative and post-operative serum creatinine by using paired sample t-test

	Mean	Standard deviation	Standard error of mean	95% confidence interval of the difference		t	Df	Sig. (2tailed)
				Lower	Upper			
Pre-op creatinine & post-op creatinine	.13920	.31610	0.04470	-0.22903	-0.4937	-3.114	49	0.003

Table 2: Comparison between pre-operative and post-operative estimated glomerular filtration rate (GFR) by using paired sample t-test

	Mean	Standard deviation	Standard error of mean	95% confidence interval of the difference		t	Df	Sig. (2tailed)
				Lower	Upper			
Pre-op GFR & post-op GFR	20.680	31.058	4.392	11.853	29.507	4.708	49	0.000

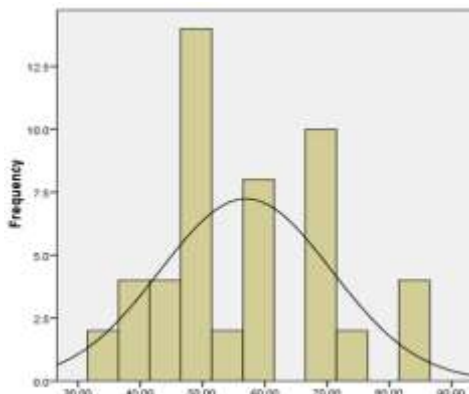


Fig.1 Preoperative MAG3 scan which indicates the normal renal function of patients

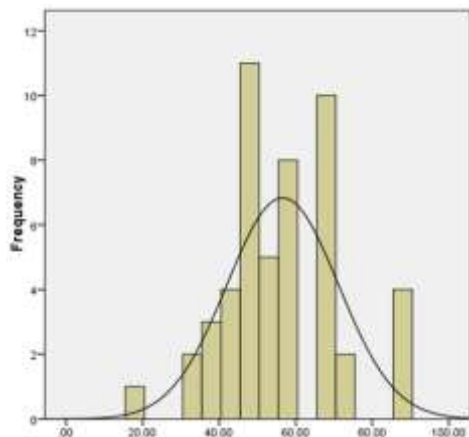


Fig. 2: Post-operative MAG3 Scan which indicates that most of the values lie closer to normal distribution

## DISCUSSION

Staghorn stones are a problematic issue in urology because they can cause mortality and severe morbidity, such as renal failure, pyonephrosis, and other infectious diseases<sup>8,9</sup>. Although endourological methods are supplanting open surgical approaches, they are still advancing and have limitations<sup>10-12</sup>.

Percutaneous nephrolithotomy is the standard and most recommended procedure for the treatment of stones, but for patients with complex stones or large staghorn stones that require multiple tracts for stone clearance, kidney function will deteriorate, particularly in patients with a single kidney and complex stones.<sup>13-16</sup> The section of endourology has documented the effectiveness of PNL in treating patients with staghorn stones<sup>17,18</sup>.

The Clinical Research Office of the Endourological Society (CROES) study group compared the results of 1466 patients receiving PNL with staghorn calculi to those of 3869 patients with nonstaghorn calculi. Patients with staghorn stones had multiple punctures more frequently (16.9% vs. 5.0%) and had poorer stone-free rates (56.9% vs. 82.5%)<sup>17</sup>. The United Kingdom research group on 299 patients who had PNL for staghorn calculi found an intraoperative stone-free rate of 59% and a formal postoperative stone-free rate of 47%.<sup>18</sup> When the number of minimally invasive procedures surpasses what is regarded appropriate, traditional treatments should be utilized. Anatomic nephrolithotomy is the optimal approach in such circumstances when there are more complicated staghorn stones involving all calyces, and if the patient has intrarenal pelvis or atypical architecture.<sup>19</sup> Al- Kohlany et al<sup>20</sup> presented a well-designed research comparing PNL with open surgery. 88 renal units were evaluated, 43 received PNL and 45 underwent standard operation including modified anatomic nephrolithotomy (ANL), extended pyelolithotomy, and simultaneous pyelolithotomy and nephrolithotomy. Using 99mTc-mercaptoacetyltriglycine (MAG3) scans, renal function was evaluated and no significant deterioration in the operated renal unit was found, however data were not segregated by technique.<sup>20</sup>

As a result of the Pakistani society's disregard for stone symptoms and the large burden of stone, open operations are critical in removing the stone more efficiently in our scenario. Usually people ignore symptoms until the stone disease progresses to involve all calyces, then only available treatment option is conventional therapy by open approach via flank incision. By making the incision on a relatively avascular plane, the clearance rate in our study is 88% and there is low or negligible loss of renal function, as the bar graph of 99mTc-mercaptoacetyltriglycine (MAG3) indicates values that are near to the normal range. The blood creatinine levels before and after surgery were compared using a paired sample t-test with a 95% confidence interval and no statistically significant difference was found (p-value 0.03). Using the t-test, the pre-operative and post-operative estimated GFR values were found to have insignificant difference (p-value of 0.00) after calculating the 95% confidence interval. Pre-operative and Post-operative renal scans 99mTc-mercaptoacetyltriglycine (MAG3) were also compared using a t-test with a 95% confidence interval,

and we found mild loss of renal function p-value 0.376. In developing countries such as Pakistan, where there are a large number of patients reporting staghorn stones advancing into pyonephrosis and other infectious kidneys and where there are fewer resources and advancement in PNL techniques, anatrophic nephrolithotomy can play a greater role in enhancing the quality of life of suffering patients by achieving maximum stone clearance with minimal renal dysfunction.

## CONCLUSION

Anatrophic nephrolithotomy should be performed without reluctance for large staghorn stones, as they are a common cause of infection and mortality. The clearance rate of the stone is 88%, and it provides less renal function loss compared to multiple tract PNL.

**Conflict of interest:** Nil

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