ORIGINAL ARTICLE

A Decade-Long Experience of Open Anatrophic Nephrolithotomyn for Staghorn Renal Calculi

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Abstract

Introduction: Staghorn stones of the kidney represent complex stone configuration. Monotherapy with Percutaneous Nephrolithotomy (PCNL), Extracorporeal shock wave lithotripsy (ESWL) and Retrograde intrarenal surgery (RIRS) does not give complete stone clearance. Anatrophic nephrolithotomy (AN) is one of those modalities that can give complete stone clearance. Stone-free rates achieved with AN are 80-100% and is better or comparable with other modalities. We share our experience of complex surgery in the last one decade.

Materials and methods: We did a retrospective descriptive study from January 1st 2013 to December 31st 2022. 174 patients underwent AN for staghorn calculi. All the patients were assessed and relevant blood, urine, and radiological investigations were done. We used descriptive statistical analysis.

Results: We performed 1428 procedures for renal staghorn calculi in last 10 years. Anatrophic nephrolithotomy was performed in 174 cases. The mean age of the patients was 42.16 years with a male-to-female ratio of 1.21. The size of the staghorn stone ranged from 40 to 76 mm. The mean surgical time was 178 minutes with wara m ischemia time of 27.5 minutes. We had intra-operative complications in 6.32% of the cases. 39 patients developed complications with majority being the wound infection. 22 patients had residual stones, which needed an ancillary procedure. Nephrectomy was not needed in any patient.

Conclusion: Anatrophic nephrolithotomy is a reasonably good approach to staghorn renal calculi in selected cases. The stone-free rate is comparable with other approaches. Cases with multiple previous endourological failures and complete staghorn calculi benefit the most by the standard open approach.

Keywords: Anatrophic nephrolithotomy, Anatrophic pyelolithotomy, Staghorn calculi, Open renal stone surgery, Large renal calculi.

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Introduction

Renal calculus disease is among one of the three most common diseases in genito-urinary system. Renal calculi make upto 90% of the stone burden in the world. Staghorn stones of the kidney represent complex stone configuration, where the stone occupies renal pelvis and two or more calyces. The staghorn stones are very challenging to the urologists in terms of complete removal, recurrent urinary tract infection (UTI), modality of surgery to be used, financial issues and concurrent morbidities. Maximum clearance with minimum morbidity with minimum financial losses to the patient are the goals of the urologist in developing countries like India. With the advent of percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy (ESWL) and retrograde intra-renal surgery (RIRS), the need of open surgery for staghorn calculi is reduced and looks old fashioned. Still, monotherapy with any of the above modality does not give complete stone clearance. Anatrophic nephrolithotomy (AN) is one of those modalities that can give complete stone clearance. The open surgery is challenging to the urologists of current era who mostly practice endourological management of the stone. Therefore, open surgery should be done by a urologist who is experienced in doing complex open urological procedures. AN was introduced in 1968 by Smith and Boyce[1]. Stone free rate achieved with AN is 80-100% and is better or comparable with PCNL or ESWL. Another good thing about the AN is that the success of stone clearance does not depend upon the nephrolithometric measurements of the stone burden. Therefore, AN is still preferred approach in many centres for treatment of staghorn calculi.[2-4] We, here share our experience of the complex surgery in the last one decade. To the best of our knowledge, this is the first largest study with 174 cases of staghorn renal calculi.

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Methods and material

Study Design

This is a retrospective descriptive study done at SMBT IMS & RC, Nashik, Maharashtra, India from 1st January 2013 to 31st December 2022.

Inclusion Criteria:

1. Age ≥ 18 years
2. Complete staghorn stone on imaging
3. Written and informed consent for open surgery

Exclusion Criteria:

1. Active UTI (urinary tract infection)
2. Solitary kidney
3. Uncorrectable coagulopathy
4. Patient or relatives not willing for open surgery

Study population

1428 patients underwent surgery for renal stones. Among these only 174 patients underwent AN for staghorn calculi and included as per the criteria. All the patients were assessed and the demographic information was collected. In all the patients, complete hemogram, serum creatinine levels, complete urine examination and urine culture and sensitivity, x-ray of the kidney, ureter and bladder (KUB) region (Figure 1 and 2), ultrasonography of the KUB region, intravenous pyelography (IVP) and/or computed tomography of the KUB region.

Surgical technique

The surgery was done under general anaesthesia supported by regional epidural analgesia. Culture specific antibiotics were started 7 days prior in all the patients. We used retroperitoneal approach and 12th rib cutting incision. The kidney was dissected clearly as in a renal transplant. Hilar vessels were also identified clearly and Satinsky clamp was used to cross-clamp the vascular pedicle. The kidney was incised and split open laterally along the avascular plane of Brodel. All the stones were taken out (Figures 1 and 2). Kidney was sutures back with vicryl 2-0 mattress sutures without separately closing the collecting system and hemostasis was achieved. Operative time, intra-operative blood loss, intra-op and post-op complications, length of hospital stay, residual stones and other important data were collected. All patients underwent post-operative x-ray KUB (Figure 2), and USG KUB to look for the residual stones. We followed up patients in the post-operative period at 7 days, one month and three months. The minimum duration of follow-up in the study is 3 months.

Statistical analysis

We used SPSS software version 20 for data analysis. We used descriptive statistical analysis.

Results

We performed 1428 procedures for renal staghorn (partial and complete) calculi in last 10 years. Anatrophic nephrolithotomy was performed in 174 cases. The mean age of the patients was 42.16 years with a male to female ratio of 1.21. The size of the staghorn stone ranged from 40 to 76 mm. 26.42 % cases had positive urine culture (Table 1). The mean operative time was 178 minutes with warm ischemia time of 27.5 minutes. Overall, 18 patients required blood transfusion during intra-operative and post-operative periods. Eleven patients had intra-operative complications with pleural injury being the commonest and one renal vein injury, which was repaired at the same time. All pleural injuries were repaired intra-operatively and post-operative chest x-ray was to done to

Figure 1 – showing single side

Figure 2 – Showing bilateral large Renal Staghorn calculi Staghorn Renal Stones

Table 1: Showing pre-operative variables

	Mean	**SD**
Age (years)	42.16	11.02
Gender (M/F)	92/82	Ratio = 1.21
Laterality (L/R)	103/71	
Size (Mean/Range)	54 mm/40-76 mm	10.26
Co-morbidity	**Number**	**Percentage (%)**
DM	45	25.86
HTN	38	21.83
CAD	29	16.66
Hypothyroidism	12	6.89
Neurological disorder	8	4.59
CRF	5	2.8
Tuberculosis	4	2.29
Pancreatitis	2	1.14
Urine C/S	**Number**	**Percentage**
Positive	46	26.43
Negative	128	73.56

confirm pleural complication. In the post-operative period, 39 patients developed complications with majority being the wound infection. 22 patients had residual stones, which needed an ancillary procedure later (Table 2). Nephrectomy was not needed in any patient. Stones of size ≥ 4 mm in the post-operative USG were considered as residual stones. The success defined by the stone free rate was 87.36%. All surgeries were performed by the one surgeon.

Table 2: Showing intra-operative and post-operative variables

	Mean	**Range**
Duration of surgery (minutes)	178	140–240
Warm ischemia time (minutes)	27.5	20–37
Blood loss (ml)	214.4	100–540
	Number	**Percentage**
Transfusion (No of patients)	18	10.34
Intra-op complications		
	5	2.8
	3	1.72
	2	1.14
	1	0.57
Post-op complications		
Wound infection	19	10.91
Haematuria	12	6.89
Urinary leak	5	2.8
Sepsis	3	1.72
Residual stones	22	12.64
Duration of hospitalisation (Days)	**Mean**	**SD**
	7.5	1.98

Discussion

Staghorn renal calculi are very challenging. None of the open or endourological method ensure 100% clearance. ESWL, the advanced endoscopic procedures for renal stone treatment like mini PCNL, standard PCNL and RIRS and the advanced laproscopic procedures are enough to deal with most of the renal calculi. Though, PCNL is the prime line of treatment, open nephrolithotomy has its own place for managing the large staghorn renal calculi. Open surgery for large renal stones is done in only 1–5.4% of the cases.[5] European Association of Urology 2023 guidelines suggest open or laproscopic surgery for stone when percutaneous approaches are likely to be unsuccessful or multiple previous failed endourological operations.[6] Smith and Boyce introduced AN in 1968 to reduce the renal parenchymal damage. Since then, many urologists are selectively using this approach.

Several studies have reported a good clearance rate with Anatrophic pyelolithotomy. Matlaga *et al.*[7] had 100%, El Nahas AR had 92%[8] and Sayed MAN *et al.* reported 91.6% stone clearance with open AN, while Zhou *et al.*[9] had 90.9% with laproscopic AN surgery. We achieved complete stone clearance in 87.36% cases. Urine culture was positive in 26.43% of the cases in our study. Sayed MAN *et al.*[4] reported positive urine culture in 10.4% of the cases in their study. Patients with co-morbidities like diabetes mellitus, hypertension, heart disease, hypothyroidism, chronic renal failure, etc were also included in our study and were successfully managed without any major complications except wound infection. The mean surgical time of 178 minutes, the mean ischaemia time of 27.5 minutes and the mean blood loss of 214.4 mL in our study was comparable with other studies for open, laproscopic, and robotic anatrophic pyelolithotomy.[5,10-13]

We had intra-operative complications in 6.32% of the cases, with pleural breach contributing the majority. Sayed *et al* reported pleural injury in 12% of the cases.[4] None of our patient needed nephrectomy, like Dongol *et al.* in their study.[5] Jaffery *et al.* have reported nephrectomy as a complication due to severe bleeding[11]. Deger *et al.* also needed nephrectomy in one patient in their study.[14] We closed the nephrolithotomy incision by horizontal mattress sutures in single layer. Collecting system and parenchyma were not closed separately. Same approach was used by Dongol and Weight *et al.* in their studies.[5,15] We do had urinary leak in 2.8% of the cases, but there were no pseudoaneurysms or arterio-venous fistula.

The mean duration of hospitalisation in our study was 7.5 days and was comparable with other studies.[5,10,16]

The limitations of our study are that it is not a randomised study, only simple variables are analysed and there is no comparison with other techniques of dealing the staghorn calculi. However, our study is the largest study done till now for renal staghorn stones and results are quite impressive to impact the clinical practice.

Conclusion

Anatrophic nephrolithotomy is a reasonably good approach to staghorn renal calculi in selected cases. The stone free rate is comparable with other approaches. Cases with multiple previous endourological failures and complete staghorn calculi benefit the most by the standard open approach. AN gives better outcome when compared to other modalities in terms of number of surgeries, financial loss, co-morbidities and stone clearance.

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