Original Article

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Anatrophic nephrolithotomy for the management of large complete staghorn calculi

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Abstract

Background: Complete staghorn calculus is a challenging issue in urological practice. Anatrophic nephrolithotomy is a major surgery frequently performed for a large complete staghorn calculus. Current endourological procedures like percutaneous nephrolithotomy or extracorporeal lithotripsy or retrograde intra renal surgery are less effective in the management of complete large staghorn calculi.

Objectives: The objective of this study is to assess the safety and efficacy of anatrophic nephrolithotomy in the management of complete large staghorn calculus diseases.

Methodology: Total 25 adult patients with complete staghorn calculi from March 2012 to the first week of Sept 2017 were included in the study and were evaluated for patient demography, operating time, blood transfusion rate, cold ischemia time, hospitalization duration, stone clearance rate and the complications.

Results: Twenty five adult patients with the mean age of 36 years (26-73years) and the mean stone size of 50 mm (40-65mm) underwent anatrophic nephrolithotomy. Fifteen were male patients and 10 female patients. The mean operating time was 156 minutes (130—210 minutes) and the cold ischemia time was 41 minutes (33-54 minutes). Six patients (24%) needed blood transfusion. The duration of hospital stay was 7.2 days (6–11 days). The stone clearance rate was 88 % at the time of discharge and 96 % at three month follow up.

Conclusion: Anatrophic nephrolithotomy is a valid and useful approach and is a reasonable alternative in selected patients with complete large staghorn calculi. It can achieve high stone free rate with very low morbidity and low cost.

Key words: Anatrophic nephrolithotomy, Cold ischaemia, Percutaneous nephrolithotomy, Staghorn

INTRODUCTION

The common presentations of patients with staghorn calculus of the kidney are loin pain, haematuria, fever or in some cases may be asymptomatic. Chronic urinary tract infection is common in these patients. Proteus, klebsiella, providencia and pseudomonas are the typical urea splitting organisms responsible. Plain and contrast radiography is done to establish the diagnosis. In case of large complete but radiolucent staghorn calculi, a spiral non contrast computerized tomography (CT) scan may be needed for the diagnosis[1].

Staghorn renal stones are challenging issues in urological practice. These stones can destroy not only renal function but also general health. At present it is not clear whether a staghorn calculus is amenable to open surgery or to minimally invasive techniques[2]. Minimal invasive methods eg Percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS) are less effective in the management of complete staghorn calculi in certain circumstances[3-8]. Current endourological procedures achieve a lower stone free rate and frequently require multiple operative sessions[5].

Complete removal of stone along with the least morbidity and cost is the ultimate goal in the management of renal stone diseases including the large complete staghorn calculus. It may not be achieved even after several attempts of PCNL[9]. Monotherapy with PCNL for staghorn calculi is reported to have a residual stone rate of 28% while ESWL monotherapy resulted in residual stones in 50% of cases[10,11]. The more invasive a modality is, the higher the stone free rate adhieved. The adjuvant procedures after PCNL might increase the complication rate thereby increasing the overall morbidity and costs[12].

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Therefore many urologists prefer open surgery for managing large complete staghorn calculus so that the secondary interventions can be decreased[7]. Anatrophic nephrolithotomy was first performed by Smith and Boyce in 1968 and is the most preferred technique for the large complete staghorn calculus[13]. Stone free rate of 80%-100% can be achieved as compared with extracorporeal lithotripsy (ESWL) or percutaneous nephrolithotomy (PCNL) [14]. The stone free rate for anatrophic nephrolithotomy does not depend on the nephrolitometric measurements as the PCNL does with the success rate of 75-95% in a single procedure. Thus in many centres, anatrophic nephrolithotomy is a valid and useful approach for the complete large staghorn calculi[5,15].

METHODOLOGY

Twenty five adult patients with large complete staghorn renal calculi from March 2012 to the first week of Sept 2017 were included in the study. It was the prospective observational study conducted in the department of surgery Kathmandu Medical College and Teaching Hospital. Ethical approval was taken from the ethical committee of Kathmandu Medical College and informed written consent was taken from the patients.

Data were statistically analyzed using Statistical Package for the Social Sciences, SPSS version 20. Descriptive statistics were used.

There was no history of previous renal surgery in these patients. All the patients underwent complete radiological evaluation including ultrasonography of abdomen and pelvis and intravenous urography (IVU) to map out renal anatomy, location and size of stone, degree of hydronephrosis with involvement of calyces. All the baseline preoperative investigations were done. The patients were admitted two days before surgery and received intravenous antibiotics according to the urine culture report.

With the patients under general anaesthesia and on full flank position, extraperitoneal flank incision was made thereby cutting the underlying muscles and exposing the kidney. Hilar dissection was done meticulously. The main renal artery and posterior segmental artery was identified and dissected. Brodel's line was identified and marked after temporarily clamping the posterior segmental artery. Twenty five grams of mannitol was infused and cold ischemia achieved with ice slushes for 15 minutes. Nephrotomy incision was made at Brodel's line being careful to avoid extension into the upper and the lower poles. The pelvicalyceal system was then entered taking control of small bleeders with 4-0 chromic catgut. The staghorn calculus was then removed completely along with its ramifications. The renal pelvis and calyces were copiously washed with cold saline. A 6 Fr double J ureteral stent was passed from renal pelvis to the urinary bladder. After adequate haemostasis, renal pelvis and renal capsule was closed with 2/0 polygalactin (vicryl) suture. Ice slushes which were continuously reapplied throught the procedure were removed and renal artery declamped. The kidney was observed for good haemostasis and return of pink colour and good turgor.

All the patients received intravenous antibiotics for 72 hours and remained on complete bed rest for 48 hours. Renal function was assessed daily and Foley's catheter removed after 48 hours. Surgical details like stone size (largest diameter), duration of operation, cold ischemia time were recorded. Residual stone if any was documented by taking X-ray KUB and ultrasonography of abdomen before discharge from hospital. Postoperatively the duration of hospital stay, complications were also noted. The renal function and collecting system was assessed at three month follow up by intravenous urography.

RESULTS

Twenty five patients (15 male and 10 female) underwent anatrophic nephrolithotomy. The mean age of the patients was 36 years. Sixteen operations were done on right side and nine operations on left side. All the patients had complete staghorn calculi with mean size of 50 mm (40-65mm). There was no significant hemoglobin drop and increase of creatinine level measured after 12 hours.

The mean operating time duration from skin incision to closure was 156 minutes and the cold ischemia time was 41 minutes. Six (24%) patients needed blood transfusion. Preoperatively the average haemoglobin level of these six patients was around 10.3 gram% which dropped to 8.4 gm%. However the mean haemoglobin level did not drop significantly. The mean hospital stay was 7.2 days. There was no need of nephrectomy. No urinary leakage was seen after surgery and the retroperitoneal drainage tube was removed in all patients before discharge from the hospital. X-ray KUB and abdominal ultrasonography was done in all patients before discharge from the hospital. Patients with residual stones < 4 mm were considered stone free. The stone free rate was 88% on discharge and 96% after one session of extracorporeal shock wave lithotripsy at three month. Intravenous urography done after three month of surgery showed good functioning kidneys with significant improvement in obstruction in all patients.

Table 1: Different variables of patients who underwent anatrophic nephrolithotomy

Mean age of the patients	36 yrs (26-73 yrs)
Sex distribution	15 male 10 female
Side	16 on right side, 9 on left side
Size of stone (mean mm)	50 mm (40-65mm)
Before/12 hours after surgery	Haemoglobin--------14.2/11.8 gms Creatinine ----------1.1/1.3 mg%

Table 2: Intraoperative and post operative variables

Operating time (mins)	156 (130-210)
Cold ischemia (mins)	41 (33-54)
Blood transfusion (n %)	6 (24)
Hospitalization (days)	7.2 (6-11)
Nephrectomy	0
Residual stones (n%)	3 (12)

Table 3: Comparison of variables between different series of anatrophic nephrolithotomy.

Different Series	No of patients	Operation time (minutes)	Blood loss (ml)	Transfusion %	Hospital stay(days)	Stone free rate %
Meglissourgos et al	24	180	500	0	8.2	83.3
Keshavamurthy et al	13 (14 renal units)	163.3	130 ml	78.5	15.44	95
Jaffery AH et al	100	76.93	Not mentioned	12	Not mentioned	93
Our study	25	156	658 ml	24	7.2 days	88

Figure 1: Large Complete staghorn calculus in a patient undergoing anatrophic nephrolithotomy

Figure 2: X-ray KUB of the same patient after operation (after drain is taken out)

DISCUSSION

Even with the introduction of endourological methods and ESWL, the management of patients with complete staghorn calculi remains among the most complex and challenging problems in urology[7]. In the modern era of stone management, though methods like percutaneous nephrolithotomy (PCNL) and extracorporeal shockwave lithotripsy (ESWL) are good and is the first line of treatment in majority of these patients, there are some limitations to these procedures. The patients may require several sessions of PCNL and ESWL to achieve the stone clearance[16]. Open stone surgery in the modern era constitutes about 1%-5.4%[13]. The indications for open stone surgery include complete large staghorn stones not amenable to a reasonable attempts of PCNL and large complete staghorn stones with co-morbidities like chronic obstructive airway diseases[17]. The other indications are failed endourological procedures, anatomical variations of the collecting system causing difficult access to PCNL, necessity of anatomical reconstruction of pelvi-ureteric junction and skeletal abnormalities like severe kyphoscoliosis[18,19]. Anatrophic nephrolithotomy is a valid and useful alternative for large complete staghorn calculi excision[20]. It was first described by Smith and Byoce in 1968 with the nephrotomy incision being placed in the Brodel's line- the plane that is relatively less vascular[13]. Anatrophic nephrolithotomy for staghorn calculus diseases has a superior stone free rate of 80-100% and is cost effective alternative to multiple endourological treatment sessions. Due to the high incidences of recurrences of these staghorn calculi, increased potential of infection and renal functional impairment, the significance of complete stone removal cannot be overemphasized. The incidence of recurrence being high even up to 30% over six years, the goal of treatment is thus the complete stone clearance[8]. Thus open surgery is the preferred route by many urologists for managing the large complete staghorn stones to minimize the need for secondary procedures[5]. Although PCNL and ESWL is minimizing the role of open stone surgery (OSS), several series have shown better stone free rate with anatrophic nephrolithotomy. In a study by Matlaga et al, the stone free rate was 100% in staghorn renal stone by open stone surgery[3]. Esen et al also reported a better stone free rate with open stone surgery [4].

In the present study the stone free rate was 88% at the time of discharge and 96% after one session of ESWL at three month which is comparable to other series. The operative time (mean) was 156 minutes, cold ischemia time 41 minutes and the estimated blood loss of 658 ml. In a study by Melissourgos et al, the mean operating time was 180 minutes, blood loss 500ml and transfusion rate 8.3% (2 patients). He also reported mean hospital stay of 8.2 days and the stone free rate of 83.3%[7]. Similarly in a series of 13 patients (14 renal units) by Keshavamurthy et al, the mean operating time was 163.3 minutes, cold ischaemia time 47.64 minutes, stone clearance of 95% and blood loss 130 ml. However the haemoglobin drop being 1.5 gm% and the mean haemoglobin being 10.89 gm, 11 patients (78.5%) needed blood transfusion in their series[21]. Jaffery AH et al reported the series of 100 cases of open anatrophic nephrolithotomy with mean operative time of 76.93(45-190) minutes and cold ischaemia time of 22.24(15-25) minutes. One patient needed nephrectomy for uncontrolled haemorrhage and 12 (12%) patients needed blood transfusion[22].

Closing the collecting system and cortex in one single layer had been applied by Weight et al after laparoscopic partial nephrectomy and shown to be safe and effective[23]. In the present study both collecting system and cortex was also closed in single layer. No urinary leak was observed. The complications like pseudoaneurysm, arterio-venous fistula were also not seen. No patient needed nephrectomy. Six patients (24%) needed blood transfusion and the mean period of hospital stay was 7.2 days.

CONCLUSION

Anatrophic nephrolithotomy thus is a valid and useful approach and is a reasonable alternative in few selected patients with large complete staghorn calculi. It can achieve a high stone free rate with very low morbidity and low cost. The little morbidity of a loin incision must be compared with the need of several sessions of surgery if endourological methods and ESWL are done.

REFERENCES

1. Smith MJ, Boyce WH. Anatrophic nephrolithotomy and plastic calyrrhaphy. J Urol. 1968;99(5):521-7. https://doi.org/10.1016/S0022-5347(17)62743-5
2. Linyu Zhou, Qiang Xuan, Bin wu, Jun xiao, Xiaocheng Dong, Tao Huang et al. Retroperitoneal laparoscopic anatrophic nephrolithotomy for large staghorn calculi. 2011;18(2);126-29.
3. Matlaga BR, Assimos DG. Changing indications of open stone surgery. Urology.2002;59:490-93. https://doi.org/10.1016/S0090-4295(01)01670-3
4. Essen AA, Kirkali Z, Guler C. Open stone surgery; is it still preferable procedure in the management of

staghorn calculi? Int Urol.Neprol.1994;26:247-53. https://doi.org/10.1007/BF02768205

5. Assimos DG. Anatrophic nephrolithotomy. Urology.2001;57:161-5. https://doi.org/10.1016/S0090-4295(00)00920-1
6. Paik ML, Wainstein MA, Spirnak JP,Hampel N, Resnick MI. Current indications for open stone surgery in the treatment of renal and ureteral calculi.J Urol.1998;159:374-8. https://doi.org/10.1016/S0022-5347(01)63922-3
7. Melissourgos ND, Davilas EN, Fragoulis A, Kiminas E,Farmakis A. Modifi ed anatrophic nephrolithotomy for complete staghorn calculus diseases: Does it still have a place? Scand J Urol Nephrol. 2002;36;426-30. https://doi.org/10.1080/003655902762467576
8. Lingerman JE, Matlaga BR, Evan AP. Surgical management of upper urinary tract calculi. Campellwalsh urology. 8th edn. Philadelphia; Saunders Elsevier,2007:1431-507.
9. Simfaroosh N, Radfar MH, Nouralizadeh A, Tabibi A, Basiri A, Ziaee SAM et al. Laparoscopic anatrophic nephrolithotomy for management of staghorn renal calculi. J laparoendoscopic and advanced surgical techniques.2013;23(40):306-10. https://doi.org/10.1089/lap.2012.0275
10. Synder JA, Smith AD. Staghorn calculi; Percutaneous extraction versus anatrophic nephrolithotomy. J Urol.1986;136:351-53. https://doi.org/10.1016/S0022-5347(17)44864-6
11. Constantinides C, Recker F, Jaeger P. Extracorporeal shockwave lithotripsy as monotherapy of staghorn renal calculi: 3 years of experience. J Urol.1989;14(21)415-17.
12. Preminger GM, Assimos DG, Lingerman JE.Nephrolithiasis Guidelines Panel Chapter 1: AUA guidelines on management of staghorn calculi. Diagnosis and treatment recommendations. J Urol. 2005;173;1991-2000. https://doi.org/10.1097/01.ju.0000161171.67806.2a
13. Unsal A, Cimentepe E, Saglam R, Balbay MD. Pneumatic lithotripsy through pyelotomy incision during open surgery for staghorn calculi: an alternative method to anatrophic nephrolithotomy. Urologiainternationalis. 2003;72(2):140-44. https://doi.org/10.1159/000075968
14. Deger S, Tuellmann M, Schoenberger B, Winkelmann B, Peters R, Loeining SA. Laparoscopic anatrophic nephrolithotomy. Scand J Urol Nephrol.2004;38(3):263-5. https://doi.org/10.1080/00365590410028719
15. Aminsharifi A, Irani D, Masoumi M, Goshtasbi B et al. The management of large staghorn renal stones by percutaneous versus laparoscopic versus open nephrolithotomy: a comparative analysis of clinical effi cacy and functional outcome. Urolihtiasis.2016; 44(6):551-7. https://doi.org/10.1007/s00240-016-0877-6
16. Assimos DG, Boyce WH, Harrison LH, McCullough DL, Kroovand RL et al. The role of open surgery since extracorporeal shock wave lithotripsy. J Urol.1989;142(2):263-7. https://doi.org/10.1016/S0022-5347(17)38725-6
17. Simforoosh N, Aminsharifi A, Tabibi A, Noor- Alizadeh A, Zand S, Radfar MH et al. Laparoscopic anatrophic nephrolithotomy for managing large staghorn calculi. BJU Int. 2008;101(10): 1293-6. https://doi.org/10.1111/j.1464-410X.2008.07516.x
18. Swearingen R, Sood A, Madi R, Klaassen Z, Badani K. Zero fragment nephrolithotomy: A multi center Evaluation of Robotic pyelolithotomy and nephrolithotomy for treating renal stones.Euro urol Pii.2016;S0302-2838(16)30724-28
19. Kijvikai K. The role of laparoscopic surgery for renal calculi management. Ther Adv Urol.2011;3(1):13-8. https://doi.org/10.1177/1756287211398254
20. Leonardo de, Albuquerque dos santos Abreu, Douglas Gregorio Camilo-silva et al.Reviews on renal recovery after anatrophic nephrolithotomy: Are we really healing our patients? World J Nephrol. 2015;4(1):105-10.
21. Keshavamurthy R, Karthikeyan VS, Mallya A, Sreenivas J, Nelivigi GG, Kamath AJ et al. Anatrophic nephrolithotomy in the management of large staghorn calculi-A Single center experience. Journal of clinical and diagnostic research.2017;11(5):pc01-pc04.
22. Jaffery AH, Zubair M, Abdullah A. Anatrophic nephrolithotomy in the management of large staghorn renal calculi. Pak J Surg. 2008;24(2):110-2.
23. Weight CJ, Lane BR, Gill IS : Laparoscopic partial nephrectomy for selected central tumours;Omittingthe bolster. BJU Int. 2007;375-8. https://doi.org/10.1111/j.1464-410X.2007.06928.x