Symposium

Open surgical management of pediatric urolithiasis: A developing country perspective

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ABSTRACT

Objectives: To describe decision factors and outcome of open surgical procedures in the management of children with stone.
Materials and Methods: Between January 2004 and December 2008, 3969 surgical procedures were performed in 3053 children with stone disease. Procedures employed included minimally invasive techniques shockwave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), ureterorenoscopy (URS), perurethral cystolithotripsy (PUCL), percutaneous cystolithotripsy (PCCL), and open surgery. From sociomedical records demographics, clinical history, operative procedures, complications, and outcome were recorded for all patients.
Results: Of 3969 surgeries, 2794 (70%) were minimally invasive surgery (MIS) techniques to include SWL 19%, PCNL 16%, URS 18.9%, and PUCL+PCCL 16% and 1175 (30%) were open surgeries. The main factors necessitating open surgery were large stone burden 37%, anatomical abnormalities 16%, stones with renal failure 34%, gross hydronephrosis with thin cortex 58%, urinary tract infection (UTI) 25%, and failed MIS 18%. Nearly 50% of the surgeries were necessitated by economic constraints and long distance from center where one-time treatment was preferred by the patient. Stone-free rates by open surgeries were pyelolithotomy 91%, ureterolithotomy 100%, and cystolithotomy 100% with complication rate of upto 3%.
Conclusions: In developing countries, large stone burden, neglected stones with renal failure, paucity of urological facilities, residence of poor patients away from tertiary centers necessitate open surgical procedures as the therapy of choice in about 1/3rd of the patients. Open surgery provides comparable success rates to MIS although the burden and nature of disease is more complex. The scope of open surgery will remain much wide for a large population for considered time in developing countries.

Key words: Open surgery, pediatric, urolithiasis.

INTRODUCTION

Urolithiasis in children remains endemic in our region afflicting children of <1 year to 15 years of age.[1,2] In fact stone disease comprises more than 60% of the urological disease burden in a urology center.[1] Many children present late with large stone burden associated with varying degree of renal failure.[2] In developed countries, management of pediatric stone disease has shifted from the historic open surgical procedures to newer minimally invasive techniques (MIS), e.g., shockwave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), ureterorenoscopy (URS) utilizing ultrasound and laser as a source of intracorporeal lithotripsy.[3-5] Although our experience is similar where MIS techniques constitute the mainstay of treatment of patients with stones,[6] large number of stone formers presenting with complex and neglected stones and their geographic/demographic variables still necessitate treatment by open surgery. In this paper, we describe the need and outcome of open surgical procedures in the era of MIS from the perspective of a developing country.

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MATERIALS AND METHODS

This is a retrospective analysis of 3969 pediatric stone surgeries performed in 3053 patients between January 2004 and December 2008 at a tertiary care urology center. The whole treatment was offered free to all patients on a model

based on community government partnership where the infrastructure is provided by the government and funds by the community. This allows our center to provide free comprehensive treatment with the lifelong follow-up. Hospital records were reviewed for demographics, area of residence, travel distance, and socioeconomic factors from the medical social department. Clinical history, operation notes, pertinent radiographic, and laboratory findings and procedures undertaken were recorded from the patient's records. Apart from the type of surgery performed, other factors analyzed included stone bulk and complexity, blood transfusions, hospital stay, stone free rates, and intra- and postoperative complications.

MANAGEMENT

Renal stone

Renal stones were managed by SWL, PCNL, and open surgical methods. SWL was advised for stone size up to 1.5 cm, preferable with normal renal functions, good cortical thickness, no or minimal hydronephrosis, and without urinary tract infection (UTI). Ultrasound combined with x-ray was used for stone imaging. SWL in majority of the children were performed under general anesthesia; however, in selected older children intravenous sedation has been used.

PCNL was performed in patient with stones greater than 1.0 cm, favorable pelvicalyceal anatomy, age more than 1 year, preferably good cortical thickness, and no UTI. Pneumatic lithoclast and ultrasound burr were used for intracorporeal lithotripsy.

Open surgery was performed in children with large bulk of stones, anatomical abnormalities, marked obstructive cortical atrophy and scarring, gross hydronephrosis, or UTI. Nephrectomy was performed in end-stage kidneys with stones including pyonephrosis/xanthogranulomatous pyelonephritis.

Ureteric Stones: Ureterorenoscopy using Holmium: YAG (Ho:YAG) laser or pneumatic lithoclast was used to fragment ureteric stones upto 1.5 cm, preferably in lower and midureter. Lager stones greater than 1.5 cm, and impacted stones with UTI, or with anatomical abnormalities wanting open surgical correction (ureteroneocystostomy) were managed by ureterolithotomy.

Vesical Stones: Perurethral cystolithotripsy (PUCL) was performed in stones upto 2.5 cm using pneumatic lithoclast or Ho:YAG laser. Large size stones with UTI and lower urinary tract abnormalities were managed by percutaneous cystolithotripsy (PCCL) and cystolithotomy. Failed MIS techniques were converted to open surgery procedures. Furthermore open surgery was undertaken where logistic and economic factors made this modality the preferred choice for the patients.

RESULTS

In the last two decades, over 7235 patients presented with urolithiasis in our outpatient department (OPD) and emergency room. Establishment of a dedicated pediatric stone clinic increased the number of patients many fold as a result about 42% (3053) presented within the last 5 years. Between January 2004 and December 2008, 3969 surgeries were performed in 3053 patients by minimally invasive methods and/or open surgery [Table 1]. The mean age of the patients was 6.35 ± 3.7 with a male-to-female ratio of 2.8:1 and a range of 25 days (<1 month) to 15 years. Of the 3053 patients, 519 (17%) presented in renal failure. These patients required initial management in the form of hemodialysis in 210 (40.5%), peritoneal dialysis in 30 (5.7%), percutaneous nephrostomy (PCN) in 163 (31.4%), and Double J stent placement in 114 (22%). Frequencies of factors that necessitated open surgical procedures are listed in Table 2. Anatomical abnormalities included complex pelvicalyceal anatomy in 98, pelviureteric junction obstruction (PUJO) in 35, ectopic, horseshoe, cross-fused ectopic kidneys in 40, and duplex system with nonfunctioning upper or lower moiety in 14 patients. Many of the factors were prevalent in combination and about one-third of the open surgeries were performed due to inability to visit the center on multiple occasions either for economic or logistic reasons, i.e., place of residence several hundred kilometers from the center. Of the 3053 patients, 1404 (46%) were from rural areas with a mean travel distance of 175 ± 145 km (even upto 1000 km) and a mean travel time of 13 ± 8 h by road transport. Of the 1404 patients from rural area, 547 (39%) were managed by open surgery as compared to 362 (22%) of the patients from urban areas. One of the reasons of necessitating open surgery is the large stone burden and this includes partial staghorn and staghorn stones. The mean size of the kidney stone was 5.05 ± 5.88 cm, ureter 1.95 ± 1.33 cm, and bladder 7.6 ± 3.2 cm. Stones at multiple sites in 305 (26%) and large stone burden in 440 (37.4%) [Figure 1] were other important factors. Gross hydronephrosis and thin cortex with thickness in the range 0.3–0.6 cm were the other factors. UTI were found in a quarter of the procedures. Major contributing

Table 1: Surgical modalities in pediatric stone formers

	No	%
Minimally invasive	2794	70.3
SWL	757	19.0
PCNL	625	15.7
URS	751	18.9
PUCL + PCCL	661	16.7
Open surgery	1175	29.6
Pyelolithotomy	846	21.3
Nephrectomy	88	2.2
Ureterolithotomy	148	3.7
Cystolithotomy	93	2.3

Table 2: Frequencies of factors necessitating open surgery

	No	% Frequency
A. Clinical		
Anatomical abnormalities	187	15.9
Large stone burden	440	37.4
Impacted ureteric stones	86	7.3
Stones with renal failure	400	34.0
Stones at multiple sites	305	25.9
Gross hydronephrosis with thin renal cortex	681	58.0
Stone with recurrent UTI	293	24.9
Children <1 year	42	3.6
Others	35	3.0
Failed MIS	213	18.1
B. Logistics		
Long distance to center	275	23.4
Economic constraints	357	30.4

Table 3: Outcome measures in minimally invasive surgery and open surgery

Minimally invasive	Stone free		
	No	No	%
SWL	757	613	81
PCNL	625	563	90
URS	751	720	96
PUCL + PCCL	661	661	100
Open surgery			
Pyelolithotomy	846	768	91
Ureterolithotomy	148	148	100
Cystolithotomy	93	93	100

factors were obstruction and large stone burden. Children <1 year and majority of infants, those with large burden were treated by open surgery. The other group included coagulation disorders, hemoglobinopathies, and comorbids where open surgery was undertaken after corrective measures to avoid similar treatment on repeated occasions for MIS. Finally failed MIS was the other indication for undertaking open surgical procedures. Outcome measures of different modalities are given in Table 3. Overall success rate was 90% in PCNL, 96% in URS, 100% in cystolithotripsy, and 81% in SWL. Open surgical methods had success rate in excess of 90%. Complications encountered in the management of kidney stones are listed in Table 4. Mean hospital stay, blood requirement, and stone-free rates were similar in pyelolithotomy and PCNL. All the patients who had excessive bleeding required blood transfusion in both the groups.

DISCUSSION

Advances in technology have changed the management of stone disease. There has been a paradigm shift from open surgical procedures to the era of MIS. In developed countries, more than 95% of patients are now treated by MIS.[4,5,7] The few that still require open surgery are the patients with anatomical abnormalities and complex large stone burden.[7] In fact open surgery is now a last resort when all else fails with MIS.[8,9] However there is a contrast when it comes to developing countries where open surgery still retains its importance in the armamentarium for the management of stone disease.[2,3,10] Indications for open surgery from our experience can be divided into two groups – first technical which are more or less prevalent in every part of the world. These include anatomical abnormalities, complex and large stones, neglected stones with renal failure, and failed MIS[2,6]; and second socioeconomic which are generally specific to developing countries.[10]

Considering the first criteria, the disease is endemic with large number of patients and a significant proportion of present with complex and large stone burden and many in renal failure.[4] Almost 1/5th of our population present in renal failure and other reports from the region give a similar picture with a range of 5–15%.[2,11] This is in contrast to developed countries where the overall burden is small and patients present early due to high degree of awareness, screening, and availability of urological services.[7,12] In our population, open surgery therefore remains the preferred approach for patients with complex stone burden, specially

Table 4: Comparison of outcome and complications in various modalities for treatment of renal stones

Parameter	Pyelolithotomy n=846	PCNL n=625	SWL n=757
Mean hospital stay days	4.32 ± 2.8	4.51 ± 3.0	N.A.
Blood transfusion	89 (10.5)	75 (12)	N.A.
% Stone free	768 (91)	563 (90)	613 (81)
Excessive bleeding	16 (1.9)	19 (3.0)	N.A.
Prolong urine leak/ Extravasation	21 (2.5)	16 (2.5)	N.A.
Sepsis	18 (2.1)	13 (2.0)	N.A.
Wound infection	15 (1.8)	2 (0.3)	N.A.
Stein strasse	N.A.	N.A.	18 (2.3)

N.A., Not applicable., Values in parenthesis are in percentage

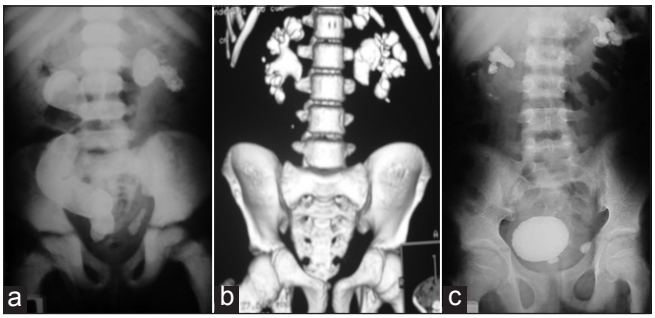

Figure 1: Complex large stone burden. (a) Large stones at multiple sites specially in right ureter. (b) Bilateral staghorn stones. (c) Bilateral renal, large bladder, left ureteric stone.

where these are associated with anatomical abnormalities, e.g., pelvic uretro junction obstruction (PUJO), horseshoe kidneys, pelvic kidney, malrotated kidney, severe obstruction, cortical atrophy and scarring, and with UTI or sepsis.

Socioeconomic factors that necessitate open surgical procedures include poor infrastructure, paucity of urological facilities, and residence of poor patients in the rural areas. Considering Pakistan as an example of a developing country, the per capita income is $1,000 and 33% of the population lives below the poverty line mostly in rural areas and the government expenditure on health is 1.3% of GDP.[13] There is paucity of urological facilities and specially pediatric services are nonexistent. Facilities where available are offered at a cost which is beyond majority of the patients. They therefore seek alternate therapies and only present at tertiary centers when the stone burden has become too large, patients are in sepsis, and/or varying degree of renal failure. These factors combined with poverty, malnutrition, and logistic problems all contribute to the "neglected stone disease." Therefore when patients travel long distances to the tertiary care centers, they prefer open surgery as one-time treatment because repeated visits are economically not feasible. Almost a third of our patients from rural areas preferred open surgery to avoid costs of travel, board and lodge in the city, even though all treatment is offered free at our center. Our policy of free treatment, therefore, brings patients to us from far and wide as reflected by the large number of surgeries performed at our center.

Management of stone disease, therefore, has to be viewed in the context of the technical aspects related to disease pattern and burden and the socio-economic conditions of the patients. Presently, at our center 70% of the surgeries are by MIS where the number of patients is very large as compared to that which is seen in centers in developed countries with low incidence of stone disease.[14] Although MIS has enabled us to treat large number of patients with excellent stone-free rates, SWL 81%, PCNL 90%, URS 96%, and Cystolithotripsy 100% which are comparable to other centers in the world,[15,16] for the large stone burden with prevalence rate of 10–15% MIS will have little impact.[17] We therefore have to invest in preventative and awareness strategies to reduce the stone burden.

Economic forecasts for the region predict that the two reasons that necessitate open surgery are likely to persist in the foreseeable future. Therefore MIS and open surgery will be required side by side and will remain important components for the management of stone disease. Training of urologists in open surgical techniques is therefore necessary to provide core urology.

CONCLUSION

Minimally invasive surgery is the way forward; however the pattern of stone disease, patient volume, and overall economy still gives open surgery the "therapy of choice" status in many situations. Therefore the scope of open surgery will remain much wider for a large population of patients for considerable time in developing countries.

REFERENCES

1. Rizvi SAH, Naqvi SAA, Hussain Z, Hashmi A, Hussain M, Zafar MN, *et al*. Pediatric urolithiasis in Pakistan: Developing nation perspectives. J Urol 2002;168:1522-5.
2. Rizvi SAH, Naqvi SAA, Hussain Z, Hashmi A, Hussain M, Zafar MN, *et al*. Management of pediatric urolithiasis in Pakistan: Experience with 1,440 children. J Urol 2003;169:634-7.
3. Buchholz NNP, Hitchings A, Albanis S. The (soon forgotten) art of open surgery: to train or not to train? Ann R Coll Surg Engl 2006;88:214-7.
4. Kerbl K, Rehman J, Landman J, Lee D, Sundaram C, Clayman RV. Current management of urolithiasis progress or regress? J Endourol 2002;16:281-8.
5. Matlaga B, Assimos DG. Changing indications of open stone surgery. Urology 2002;59:490-3.
6. Rizvi SAH, Sultan S, Zafar MN, Ahmed B, Faiq SM, Hossain KZ, *et al*. Evaluation of children with urolithiasis. In J Urol 2007;23:420-7.
7. Honeck P, Wendt-Nordahi G, Krombach P, Bach T, Hacker A, Alken P, *et al*. Does open stone surgery still play a role in the treatment of urolithiasis? Data of a primary urolithiasis center. J Endourol 2009;23:1209-12.
8. Alivizatos G, Skolarikos A. Is there still a role for open surgery in the management of renal stones? Curr Opin Urol 2006;16:106-11.
9. Paik ML, Resnick MI. Is there a role for open stone surgery? Urol Clin North Am 2000;27:323-31.
10. Zargooshi J. Open stone surgery in children. Is it justified in the era of minimally invasive therapies? BJU Int 2001;88:928-31.
11. Gopalakrishnan G, Prasad GS. Management of urolithiasis with chronic renal failure.
12. Wadhwa P, Aron M, Seth A, Dogra PN, Hemal AK, Gupta NP. Pediatric shockwave lithotripsy: Size matters. J Endourol 2007;21:141-4.
13. Human Development Report 2009. Pakistan HDI 141. Available at: http://hdr.undp.org/en/media/HDR_2009_EN_Complete.pdf
14. Charalambous S, Printza N, Papathanasiou A, Rombis V, Coga Ch, Papachristou F. Shockwave lithotripsy and endourological management of urinary calculi in children: a single center 20-year experience. J Endourol 2008;22:2169-74.
15. Smaldone MC, Corcoran AT, Docimo SG, Ost MC. Endourologic management of pediatric stone disease: present status. J Urol 2009;181:17-28.
16. Mishra SK, Ganpule A, Manohar T, Desai MR. Surgical management of pediatric urolithiasis. In J Urol 2007;23:428-34.
17. Hussain M, Rizvi SAH, Askari SH, Sultan G, Lal M, Ali B, *et al*. Management of stone disease: 17 years experience of a stone clinic in a developing country. J Pak Med Assoc 2009;59:843-6.

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