Changing Trends in the Management of Urolithiasis and the Current Role of Open Surgery in Our Context

Binod Shrestha, FCPS, MRCS; Jagdish L Baidya, FRCS, FCPS
Department of General Surgery, B & B Hospital, Gwarko, Lalitpur, Nepal

Address for Correspondence:
Binod Shrestha, FCPS, MRCS
Department of General Surgery, B & B Hospital, Gwarko, Lalitpur, Nepal
Email: drbinshrestha@googlemail.com

Received, 12 September, 2017
Accepted, 10 October, 2017

Rapid development of minimally invasive modalities has drastically diminished the need for open intervention in the management of urolithiasis. We reviewed our last six years experience with the management of urolithiasis and evaluated the current indications for open surgery in our tertiary care centre.

We reviewed all patients who underwent either endoscopic and extracorporeal shock wave lithotripsy (ESWL) or open intervention for the management of urolithiasis from January 2006 till December 2012. A retrospective analysis was performed to identify factors for gradual decline in the rate of open surgeries and to evaluate the indications for open surgery in our centre.

In the last six years, we had 4176 patients who underwent intervention for stone diseases and 702(16%) underwent open interventions. In the year 2006, the rate of open surgery was 23.4% and the rate has drastically gone down to 4.6% by the year 2012. Open nephrectomy was performed in 9 patients. Anatrophic nephrolithotomy was performed in one patient and 3 patients underwent pyelolithotomy.

Drastic improvement in minimally invasive techniques over the last few years has diminished the need for open intervention. However, open surgical removal of stone is still a viable option in many circumstances.

Keywords: anatrophic nephrolithotomy, Extracorporeal Shock Wave Lithotripsy (ESWL), Percutancous Nephrolithotomy (PCNL), pyelolithotomy, urolithiasis.

The term "lithotomy" was first used by a Greek Surgeon, Ammonious, in late 276 BC. However, The Roman Physician Celcius over a period of 25 BC – 25AD properly described the lithotomy procedure for bladder stone.[1] The first planned "Nephrolithotomy" was performed by Ingalls in 1872 in the United states. Later nephrolithotomy was performed by Morris in an uninfected kidney in England in 1880.[2] Over the last one and half century, open surgical intervention remained a gold standard for management of all forms of urolithiasis. However, minimally invasive techniques have revolutionized stone management in the last three decades.

The management of urolithiasis has changed drastically over a decade. Advances in various endoscopic techniques in the form of Percutaneous Nephrolithotomy (PCNL), Ureterorenoscopy (URS) with laser and pneumatic lithotripsy have reduced the rate of open surgery. Moreover, introduction of ESWL has further reduced the rate.

We reviewed our last seven years experience with all modalities of stone management available in our institute. We have tried to determine the factors responsible for the changing trend in the management of urolithiasis and to evaluate the situations in which open surgery be a reasonable option and might even represent the preferred treatment approach.

Materials and Methods

We conducted a retrospective evaluation of all patients who underwent procedures for the purpose of removal of stone or fragmentation of stone at B and B Teaching Hospital from January 2006 till October 2012. All the interventions were identified and were documented. The medical records including indications of intervention, radiographic studies and operative notes of patients who underwent open surgical intervention, were reviewed.

UROLITHIASIS	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
PCNL	9	14	20	95	111	121	143	513
URS	168	142	139	125	162	135	168	1039
PYELOLITHOTOMY	69	78	81	84	61	31	9	413
NEPHROLITHOTOMY	17	29	26	12	24	8	2	118
URETEROLITHOTOMY	27	19	24	10	11	5	3	99
ESWL	205	232	244	287	354	246	237	1805
CYSTOLOTHOTOMY	2	2	3	6	3	3	2	22
CYSTOLITHOLAPEXY	16	24	18	17	22	8	13	117
NEPHRECTOMY	7	5	4	9	3	13	9	50
TOTAL	**520**	**545**	**535**	**645**	**751**	**570**	**586**	**4176**

Table 1: Urological intervention at B and B Hospital from Jan 2006 – Dec 2012

Results

During the period of seven years 4176 patients were intervened for stone retrieval. There were 1808(43%) patients who underwent fragmentation of stone with ESWL. Out of 4176 stone units, 702(16%) underwent open interventions which include, Pyelolithotomy, Nephrolithotomy, Ureterolithotomy, Cystolithotomy and Nephrectomy for non functioning kidney due to stone diseases. Over the last seven years, the number of stone units tackled remained more or less the similar.

As shown in **Table 1**, there was a gradual decline in the rate of open interventions. In the year 2006, the rate of open surgery was 23.4% and the rate has drastically gone down to 4.6% by the year 2012. The number of PCNL per year was gradually picking up to 143 in the year 2012 from 9 in the year 2006. PCNL was introduced in the year 2005 in our institute. The number of URS seems pretty stable over the last six years. The rate of renal loss due to stone seems unchanged over the last seven years and out of all stone units overall renal loss was about 1% due to stone diseases.

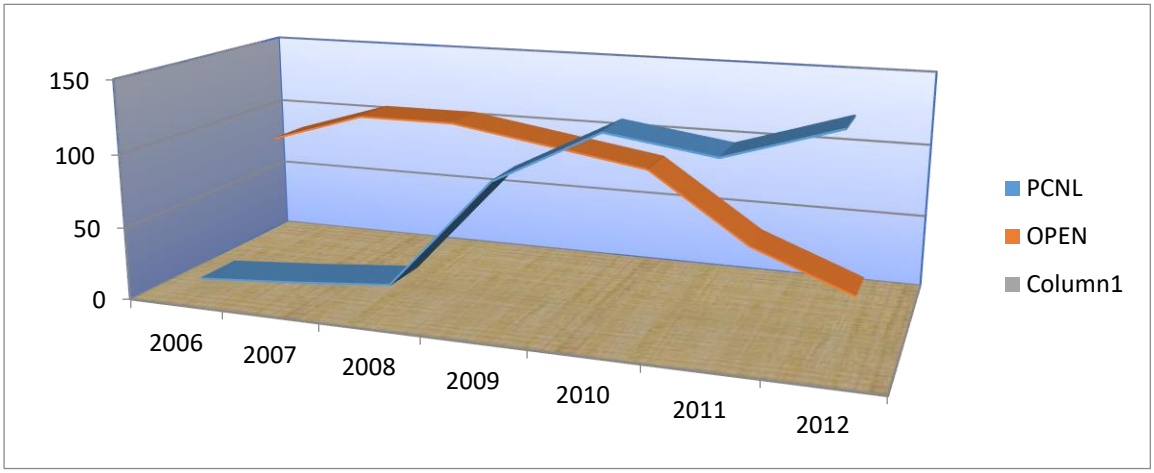

Figure 1: Trend of PCNL over 7 years

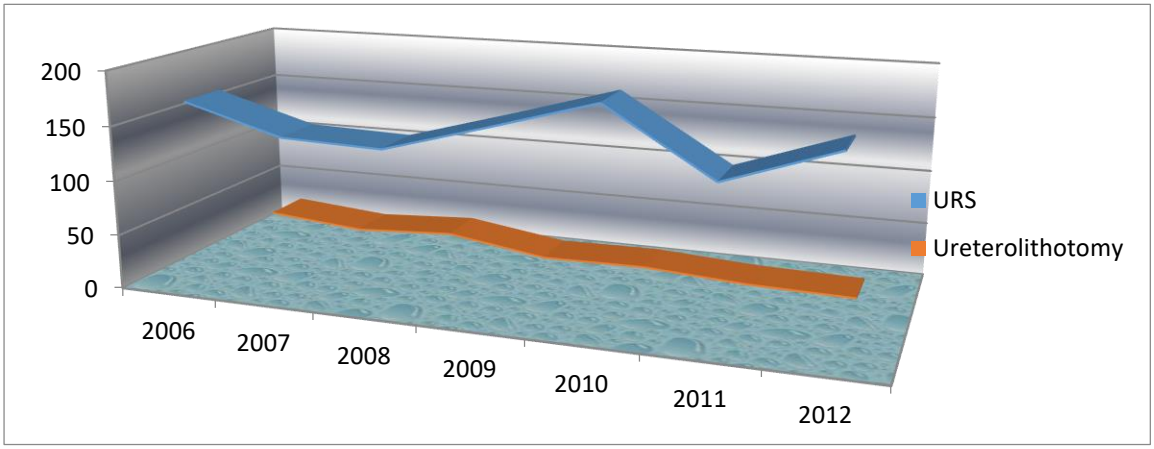

Figure 2: Trends in the management of Ureteric stones

As shown in **Figure 1**, there was a sharp inclination of PCNL from the year 2008 and it reached the peak in the year 2012. The rate of Open surgery for renal stone gradually declined till mid 2009 and then sharply declined in the year 2012.

As shown in the **Figure 2**, the rate of open ureterolithotomy has more or less remained stable over the last seven years. Total 27 ureterolithotomy were performed in the year 2006 which went down to 3 in the year 2012.

Indications	**Number of patients**
Open nephrectomy due to non-functioning kidney	9
Complex staghorn renal stones	4
Renal stone with severe uretero pelvic junction obstruction	1
Open surgery for renal stones as demanded by patient	2
Multiple diverticular stones in the kidney	2
Failed URS for ureteric stones	2
Multiple giant ureteric stones	1
Giant bladder stones	2

Table 2: Summary of indications for open surgeries in 2012 in our series

As shown in **Table 2**, open nephrectomy was performed in 9 patients due to non functioning status of kidney in IVU and Renogram due to stone diseases. Anatrophic nephrolithotomy was performed in one patient and 3 patients underwent pyelolithotomy. One had severe uretero pelvic junction obstruction (UPJO) along with stone and hence, he under went Pyeloplasty and Pyelolithotomy at the same sitting. Two patients demanded for open surgery for simple pelvic stone due to economic constraints. Two patients decided to have open nephrolithotomy for stone in the diverticulum. They were given the option of PCNL and possible conversion to open surgery. We had two patients who had complicated URS. There was gross ureteric abrasion and a small breach in the ureter. Moreover the stone could not be pushed back into the kidney for PCNL hence, patient underwent open ureterolithotomy. Another case was a stone in the ureter with tight ureteric stricture beneath the stone and the patient underwent stone removal by open means. One patient who had multiple ureteric stones, each measuring more than two centimeters, in the distal ureter underwent ureterolithotomy. We had two patients with bladder stone in whom the size of the stone was more than five centimeters and was very hard stone. Hence, they underwent open cystolithotomy for removal of entire stone in few minutes.

Discussion

The annual incidence of urolithiasis is 7-21 cases per 10,000 persons, with the peak at 20-30 years of age.[3] Since the insurgence of minimally invasive armamentarium in the form of endoscopic techniques and ESWL, the rate of open surgery for stone

management has sharply gone down worldwide. The need for open surgery for stone diseases was about 4.6% this year 2012 although it used to be about 23% in the year 2006 in our institute. This clearly illustrates the degree to which minimally invasive techniques have superseded even in our place. The indications for open surgery have definitely been reduced to a great extent in our context too. There are a number of reasons behind this. First, the introduction of PCNL in early 2006 has promoted gradual success in removing renal stones. Second the use of semi rigid small caliber ureteroscope helped in dealing with most of the ureteric stones. Third the introduction of more effective intracorporeal pneumatic lithoclast and later holmium laser in our institute has further expedited stone removal. Improvement in the technical expertise of endourologic surgeons has also promoted a decrease in the trend of open surgery. There is a learning curve in the endoscopic treatment hence in early 2006; we used to have significant numbers of open surgery for stone diseases, which has gradually been replaced by minimally invasive methods.

Developing countries of South East Asia like Nepal, India, Pakistan and African nations like Egypt, Sudan are found to have high incidence of stone diseases. High population density and low socioeconomic status are their peculiar features and majority of them are living below the poverty line. More than half of them live in rural areas with hot and temperate climate where access to sophisticated treatment modalities is extremely low. Against this scenario, urolithiasis constitute 40-50% of the urological workload in hospitals.[4] Similarly, in our institute, stone work constitute about 51% of all urological cases. The rate of open surgery used to be 26% and 3-5% in tertiary centres in Pakistan and in the US respectively a decade ago.[5,6] More recently, this has gone down to 8% in Pakistan and 0.7-2% in the industrialized countries respectively. In our institute, open surgery for stone diseases, has drastically gone down to 4.6% in 2012 from 23.4% in 2006 as shown in the **Figure 2**.

In general, indications for open stone surgery may be complex stone diseases, concomitant anatomical abnormalities, failure of minimally invasive treatments, morbid obesity, concomitant co-morbidities, concurrent open surgery, severe limb contractures and patient's preference.[2] However, this narrow spectrum of indications widely vary from place to place depending upon the armamentarium, expertise and experience available.

Non-industrialized countries have about 8-14% open surgery rate[2,7] which is remarkably high in comparison with the industrialized world. Unavailability of less invasive techniques, cost factors, consequent desire for a single procedure and later presentation are the factors responsible for the open surgery.[2]

A retrospective analysis done by Rizvi et al[8] in 2010 stated that the rate of open surgery at tertiary care centre in paediatric age group was as high as 30%. A large stone burden, neglected stones with renal failure, paucity of urological facilities and

residence of poor patients away from tertiary centers are the factors attributed to open surgical procedures as a therapy of choice in nearly one third of the study subjects. Moreover, due to financial issues in the developing world, open surgery remains an economically viable option in patients with staghorn stone with comparable efficacy, favorable morbidity and hospital stay when compared to PCNL and ESWL.[9]

Since the 1980s, the rate of open surgery for stone diseases was gradually declining. A study conducted by Snyder and Smith had the rate of retained stone after PCNL and anatrophic nephrolithotomy for the staghorn calculi were 13% and 0% respectively but had shortned operation time and convalescent times for the percutaneous procedure.[10] A similar study conducted by Assimos had stone-free rate of 89-100% with anatrophic nephrolithotomy whereas only 12-25% with PCNL.[11] Esen and coworkers demonstrated stone free rate of 80%, 50% and 25% for open stone surgery, PCNL plus ESWL and ESWL monotherapy respectively.[12]Many studies have demonstrated the improved results of PCNL though. Falahatkar and co workers reported stone-free rates of 88% with tubeless PCNL for staghorn calculi.[13] Sukumar and co workers reported a stone-free rate of 86.4% with PCNL monotherapy and 97.3% after secondary procedures.[14] The stone-free rate increased up to 95% with the use of flexible nephroscope.[15]

Open surgery in those previously operated with open techniques is often challenging and time consuming due to excessive perirenal fibrosis and anatomic changes because of displacement of bowel. However, PCNL in the previously operated kidney seems much safer instead. Various authors have compared PCNL in patients with a history of open renal surgery.[16,17] All of them concluded that PCNL in previous open stone surgery does not adversely affect the efficacy or morbidity.

With respect to cost effectiveness, Sinha M[18] and coworkers had reported that open stone surgery is less costly that PCNL in large staghorn calculi with the latter having almost double the cost in achieving complete stone clearance. Preminger et al[19] found that percutaneous approach was slightly more expensive than open surgery with significantly shorter convalescent times. We believe that less invasive therapy for complex stone burden requiring multiple procedures is probably more expensive that a single definitive open procedure. Also, after explaining all the risks and benefits of each of every possible treatment modalities for stone disease, the patients' preference should always be considered.

The main concern is regarding which patient is treated best with open surgery. There are various indications stated by different guidelines however, many more factors may have to be considered according to availability of manpower, economic status, access to the equipped centers and so on. In well set up centers, if a reasonable number of PCNL is unlikely to be successful or multiple sessions have to be performed, then open surgery may be a

primary viable option.

The indications for open surgical stone removal according to the most recent EUA guidelines (2012) are: [20]

- Complex stone burden
- Treatment failure of SWL and/or PNL, or failed ureteroscopic procedure
- Intrarenal anatomical abnormalities: infundibular stenosis, stone in the calyceal diverticulum (particularly in an anterior calyx), obstruction of the ureteropelvic junction, stricture if endourologic procedures have failed or are not promising
- Morbid obesity
- Skeletal deformity, contractures and fixed deformities of hips and legs
- Co morbidity
- Concomitant open surgery
- Non-functioning lower pole (partial nephrectomy), non-functioning kidney (nephrectomy)
- Patient choice following failed minimally invasive procedures; the patient may prefer a single procedure and avoid the risk of needing more than one PNL procedure
- Stone in an ectopic kidney where percutaneous access and SWL may be difficult or impossible
- For the paediatric population, the same considerations apply as for adults

In our context, there are many factors which have to be considered before performing the proper procedure apart from characteristics of stone diseases, failure of minimally invasive procedures or any anatomical difficulties in the subject. In a country like ours, where minimally invasive facilities are concentrated only in a few urban areas and on top of that, these procedures are expensive. Most of the people in our country live in remote hilly and mountainous areas hence they have very tough access to these tertiary centers. Owing to ignorance and poor health education system, negligence and late presentation is the usual scenario. Even the tertiary centers, there is a paucity of paediatric minimally invasive armamentarium hence open surgical procedures for stone diseases in these age groups are done even more than in adults. In a place like ours, where people are not medically insured, they have to bear all the expenses on their own and these minimally invasive procedures are far more expensive then open procedures. Last but not the least, the paucity of trained minimally invasive manpower to deal with all varieties of stone diseases in the country is also a very crucial reason for still high rate of open surgery in our place.

Open surgery for stone disease has become a rare event in many western countries due to advancement of endourological practices. The question often arises whether the currently trained endourologist will be able to manage all of these cases in the future in a minimally invasive fashion. The literature suggests that open surgery still retains a place in selected cases. Currently trained urologists in the western world are having nominal exposure to open stone surgery and there has been constant discussion whether open surgery should be incorporated in the urology trainee curriculum. Buchholz N et al[1] stated the

pros and cons of incorporating open stone surgical skills in the urological training program in their settings. Although a relatively small and decreasing number of patients require open surgical procedures in developed countries, it is at present unclear whether this proportion will eventually disappear. In contrast, in the developing world where significant number of cases requires open surgery for stone diseases, it is almost mandatory to acquire open surgical skills by the trainee urologists. In view of very nominal volume of open urological procedures for stone diseases in the western world, it may be a good idea for trainees from the west to have some exposure of open stone surgery from places where open stone surgeries often take place. We believe that urologists practicing in underdeveloped or developing places like ours are not as comfortable as it might be thought of. In spite of knowing the fact about the choice of options available in the management of stone diseases, many other confounding factors have to be practically considered. Hence, it is a very crucial responsibility of the treating surgeon to recognize those cases in which open surgery may represent a viable option to minimally invasive therapeutic modalities even though it may not be a primary treatment option.

Conclusion

Despite rapid advancement of minimally invasive techniques, open surgery maintains its pertinent role as a therapeutic option in many instances. Acquiring open surgical skills in the management of stone diseases even in this minimally invasive era is equally important to be prepared for any unforeseen encounter. Although the trend towards minimally invasive and endourological procedures is expected to continue with further improvements in technologies and expertise the role of open surgery will remain for some more time with its own significance. Moreover, it is a critical responsibility of the urologist treating stone diseases to be able to recognize those clinical situations in which open stone surgery may represent at least a viable and reasonable alternative to less-invasive modalities.

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