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THE ROLE OF OPEN STONE SURGERY IN 2002

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ABSTRACT

Introduction: At one time, the standard treatment for patients with renal and ureteral calculi was open surgical lithotomy. Advances made in the past two decades have dramatically changed the way in which patients with urinary calculi are treated. In light of this present trend towards minimally invasive therapies, it is important to define which patients might be best served by undergoing an open surgical procedure for stone treatment.

Materials and Methods: The authors review the current indications for open surgical removal of urinary calculi. Particular attention is paid to developments described in recent literature.

Results: The development of percutaneous nephrostolithotomy, ureteroscopic stone removal, and extracorporeal shock wave lithotripsy has greatly diminished the role of open surgery in the treatment of urinary calculi. While most patients may be treated via these less invasive modalities, there are some patients to whom an open surgical procedure is the optimal therapy.

Conclusions: There remains a role, albeit small, for open surgical stone removal. The patients who benefit from these procedures generally have extremely complex calculous disease with associated anatomic and physiologic derangements.

Key words: kidney; kidney calculi; urolithiasis; treatment; surgery
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INTRODUCTION

Surgical treatment of patients with nephrolithiasis has seen unparalleled progress in the past two decades. The majority of patients with renal and ureteral calculi who have previously required open surgical lithotomy are now managed via less invasive therapy. The advent of percutaneous nephrostolithotomy (PNL), ureteroscopic stone removal (URS) and extracorporeal shock wave lithotripsy (SWL) created this therapeutic revolution (1). However, even with the introduction of these techniques, there still remains a role for open surgical stone removal. It is a small group of patients who have complex calculous disease and unique anatomic and physiologic anomalies that are candidates for this approach.

CURRENT TRENDS IN OPEN STONE SURGERY

Ostensibly, in the current age of minimally invasive surgery, open stone surgery is less commonplace than it once was. Following the introduction of SWL at a major stone treatment center, Assimos et al. (2) reported an open stone surgery rate of 4.1%. Nearly one-half of the patients requiring open surgery were deemed endoscopic treatment failures. Almost all of the patients who failed endoscopic management had complex calculous disease with anatomic and physiologic anomalies. Bichler et al. (3) from the University of Tubingen describe an open surgery rate of 2.7%. This included patients with large staghorn calculi, those with renal calculi and concomitant anatomic obstruction of the renal collecting sys-

tem, and those failing SWL and endoscopic therapy. Sy et al. (4) review the treatment of stone disease at Singapore General Hospital and describe an open stone surgery rate of 2%. Stone burden, failure of less invasive modalities, non-functioning kidney, concurrent open surgery, medical co-morbidities, patient preference, anatomic collecting system obstruction, and extreme morbid obesity were indications for open surgery in this series. Within the past two decades, a number of other investigators have reviewed what they perceived to be the role of open stone surgery. Their findings are consistent with the aforementioned study (5-11). Herein, we review the indications for open surgical stone removal.

SYMPTOMATIC CALCULI IN CALYCEAL DIVERTICULA

Calyceal diverticula are classified as type I, those communicating with a minor calyx or an infundibulum and typically located in a polar area, or type II, those emanating from the renal pelvis or a major calyx (12). Stones located in calyceal diverticula can usually be effectively removed with percutaneous or retrograde ureterorenoscopic techniques, and in select cases with SWL (13-15).

There are times, however, when it is either not possible or not safe to access the diverticular cavity with endourologic techniques. An example is an anterior calyceal cavity, as percutaneous access could result in excessive bleeding. As well, some centrally located type-II diverticula may be intimately associated with hilar vessels and have no overlying renal parenchyma. While some of the patients with anterior calyceal diverticula can be treated effectively with an ureteroscopic approach, others cannot. These individuals, as well as those with Type II anatomy, should be considered candidates for open surgery (16). There are two basic open surgical approaches one can pursue when treating these patients. The first approach involves unroofing the calyceal cavity. Following this, the calculus is removed, the diverticular epithelium is obliterated, and the calyceal ostium is closed. The second surgical approach is a partial nephrectomy, which is particularly appropriate for large polar diverticula associated with cortical scarring. Oftentimes in this situation, there is minimal functioning tissue surrounding the diverticular cavity.

CALCULI IN KIDNEYS WITH CONCOMITANT URETEROPELVIC JUNCTION OBSTRUCTION

The majority of patients with renal calculi and associated ureteropelvic junction obstruction can be treated effectively with PNL and antegrade endopyelotomy. However, there are certain patients who will not have good results with this approach. This includes patients with extremely large renal colleting systems, those with a long segment of strictured ureter, those with diminished renal function, and perhaps those with associated crossing vessels. Open surgery should be considered for these cases, as well as small children, for whom there is not adequate instrumentation available, and perhaps patients with solitary kidneys.

PATIENTS WITH ABNORMAL BODY HABITUS

Morbidly obese patients, especially when short, present unique management problems. Their posterior panniculus adiposus may put targeted calculi beyond the second focal point and surrounding blast path of the lithotripter. Furthermore, their weight may be beyond the capacity of the lithotripter table or gantry. The subcutaneous tissues of these individuals may engulf percutaneous access sheaths and instruments. Adequate fluoroscopic imaging and patient positioning may not be possible. Thus, PNL and URS may not be safe or viable treatment options for some of these patients, particularly those weighing in excess of 300 kg (17).

By default, then, open stone surgery may be the safest and most reasonable treatment for select morbidly obese patients (18). However, it must be recognized that this patient population is at a high risk of operative and post-operative complications. Surgical therapy should be reserved, then, for patients who have failed medical management and who are at risk of sepsis and permanent renal damage (19).

PATIENTS REFRACTORY TO SWL, PNL, OR URS

A small number of patients are refractory to SWL, PNL, or URS and may require open stone surgery as a salvage procedure (20,21). The introduction of better techniques of intracorporeal stone fragmentation such as the holmium laser and the pneumatic lithotriptor, as well as the development of better basket and grasping devices, better patient treatment selection, and increasing technical experience have made such salvage procedures very rare events.

PATIENTS WITH INFLAMMATORY RENAL CONDITIONS AND CALCULOUS DISEASE

Patients with xanthogranulomatous pyelonephritis associated with renal calculi are optimally treated with nephrectomy (22). On occasion, patients with renal calculi and perinephric abscesses or emphysematous pyelonephritis may be managed via a percutaneous approach. However, open surgical intervention may ultimately be required in this patient group (23). Patients with renal calculi located in non-functioning polar areas of the kidney may be candidates for open surgical partial nephrectomy.

PATIENTS WITH OTHER FORMS OF COLLECTING SYSTEM OBSTRUCTION

Patients with ureteral stones associated with ureteroceles, ectopic ureters, or obstructing congenital megaureter may benefit from open stone removal performed in conjunction with the correction of the underlying anomaly. Patients with renal stones and associated infundibular stenosis may require open surgical reconstruction of the collecting system using anatrophic techniques. Certain patients with less severe degrees of infundibular stenosis can be treated with percutaneous and ureteroscopic techniques (24,25). However, those patients with severe infundibular stenosis are optimally treated with well-established open surgical techniques, calicorraphy and calicoplasty (26). If this process is in a poorly functioning lower or upper pole, partial nephrectomy may again be a viable treatment option.

PATIENTS WITH STONES IN ECTOPIC KIDNEYS

The majority of patients harboring calculi in ectopic (horseshoe, renal transplant, and cross-fused) kidneys can be treated effectively with minimally invasive techniques. They may occasionally require open surgical stone removal for other reasons outlined in this manuscript. Patients with pelvic kidneys and large volume renal stones may require open surgical approach because percutaneous access may be dangerous due to the presence of surrounding structures, such as the bowel (27). However, a laparoscopic assisted PNL may be another viable approach (28).

IN CONJUNCTION WITH OTHER SURGERY

Open surgical removal may be undertaken in conjunction with other open surgical urologic procedures. An illustrative case would be a pyelolithotomy or proximal ureterolithotomy performed in conjunction with ipsilateral partial nephrectomy for removal of a solid parenchymal tumor. It is important that this does not adulterate or compromise the other procedure.

SELECT PATIENTS WITH STAGHORN CALCULI

The majority of patients with staghorn calculi can be effectively treated with PNL-based therapy. However, there are certain cases where open surgery should be considered. Nephrectomy should be considered if the affected kidney does not function or has negligible function. The functional integrity of the contralateral kidney should be determined before the latter approach is undertaken.

It is very difficult to attain a stone-free status with PNL in patients with giant staghorn calculi ($> 2500\ mm^2$) as demonstrated by the findings of Lam et al. (29). Unfavorable collecting system

anatomy in this setting further dilutes PNL results as reported by these investigations. We have not found this to be true with anatrophic nephrolithotomy, which should be considered for such patients (30). This latter approach has been found to be more cost-effective at our institution as well as in other regions of the world (31).

LAPAROSCOPY

Laparoscopic stone removal may be employed in select cases to circumvent open stone surgery. One must use the same criteria utilized for open surgery when selecting this approach. One must avoid selecting laparoscopic stone removal based on enchantment with this technique.

The feasibility of laparoscopic stone removal is well documented. Successful ureterolithotomy has been performed using both transperitoneal and retroperitoneal approaches by a number of investigators (32-34). Laparoscopic pyelolithotomy in both normal and ectopic kidneys has been performed (35). Laparoscopic nephrolithotomy has been described (36). While anatrophic nephrolithotomy has not yet been performed in humans, it has been accomplished in a porcine model. Laparoscopic removal of stones in complex calyceal diverticula using a marsupialization technique and partial nephrectomy has been reported (37,38). Laparoscopic pyelolithotomy may be performed in conjunction with pyeloplasty. When the renal pelvis is transected, a flexible cystoscope is passed through the laparoscopic port and the calculi are grasped and removed from the collecting system. The pyeloplasty then proceeds as usual. Results are reported to be similar to those achieved with open surgery (39).

Urinary calculi residing in ectopic kidneys may also be removed with laparoscopic techniques. In fact, one of the first reported laparoscopic pyelolithotomies was performed on a patient having a stone in a pelvic kidney (40). Laparoscopic removal of calyceal diverticular stones has been reported by a number of investigators (41,42). The utilization of laparoscopy to facilitate PNL in such patients was mentioned earlier in this manuscript.

Laparoscopic nephrectomy may be considered in patients with staghorn calculi and poorly functioning kidneys (43). However, this approach should be avoided if xanthogranulomatous pyelonephritis is suspected, as operating time has been reported to be significantly longer and morbidity significantly greater as compared to an open surgical approach (44).

CONCLUSIONS

In summary, there is still a role, albeit minimal, for open surgical stone removal. These patients typically have extremely complex calculous disease with associated anatomic and physiologic derangements. It is important to identify these patients early on so that less effective therapy is not chosen.

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