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"SANDWICH" THERAPY FOR THE TREATMENT OF COMPLEX RENAL STONES

LEE E. PONSKY, STEVAN B. STREEM

Department of Urology, Cleveland Clinic Foundation, Cleveland, Ohio, USA

ABSTRACT

Purpose: Shock wave lithotripsy (SWL) and percutaneous nephrolithotomy (PCNL) are well accepted, minimally invasive modalities available for the treatment of calculi. In this paper we review and discuss the technique of combination "sandwich therapy" for the treatment of select patients with large, extensively branched, or otherwise complex stones.

Materials and Methods: A review of the literature on combined percutaneous nephrolithotomy and shock wave lithotripsy for the management of "staghorn" calculi was performed and evaluated.

Results: Stone free rates after one month of follow up approach 70%, while the remaining patients are left with residual dust or gravel. Complications occur in less than 30% of patients, and no nephrectomies or mortality have been reported with this approach. The probability of new stone formation has been estimated to be 37% at five years, and renal function has been shown to remain stable or improve in 96% of patients.

Conclusion: The use of combination therapy for the treatment staghorn calculi is safe and effective and can limit much of the associated morbidity of SWL or PCNL monotherapy. We recommend this combined "sandwich" approach as the treatment of choice for select patients with large, extensively branched, or otherwise complex staghorn calculi.

Key words: kidney, calculi, shock wave lithotripsy, percutaneous nephrostolithotomy
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INTRODUCTION

"Sandwich therapy" provides a minimally invasive alternative endourologic approach for the management of large, extensively branched or otherwise complex calculi for patients with stones that might otherwise require operative intervention, or who would not likely benefit from percutaneous nephrolithotomy (PCNL) or shock wave lithotripsy (SWL) alone (1). In these patients, sandwich therapy minimizes the risk of bleeding and sepsis associated with PCNL monotherapy, and decreases the number of shock waves otherwise required for SWL alone. Furthermore, prolonged nephrostomy drainage, which had been a part of earlier approaches, can be avoided when utilizing this combined management.

Sandwich therapy involves the use of primary percutaneous debulking followed by SWL of residual "inaccessible" infundibulocalyceal stone extensions or fragments. Following SWL, a secondary percutaneous procedure is done through the mature tract to hasten clearance of fragments from SWL. Additional percutaneous or SWL treatments can be utilized as necessary to achieve a stone free state within a reasonable time period.

Use of this approach limits the number of punctures needed to manage large stones to one or two tracts. Limiting the number of access tracts can help avoid the bleeding complications that can be associated with the multiple percutaneous tracts that would be required for percutaneous monotherapy. Furthermore, the use of upper pole access is often not required, therefore avoiding the increased risk of pleural complications.

Utilizing percutaneous debulking prior to SWL also allows for a significantly reduced number of shock waves required compared to SWL monotherapy, and this reduces the potential toxicity of a large number of shock waves. Finally, having a large caliber nephrostomy tube indwelling at the time of SWL decreases the risk of sepsis by providing proximal diversion, especially in patients with infection-related (struvite) calculi.

This combination therapeutic approach has been proven to be safe and effective. It has also been demonstrated that immediate and long term results are at least comparable to other forms of management in this setting, specifically with respect to rates of recurrent stones, infection, and maintenance of renal function (2-4).

PATIENT SELECTION

Even patients with very large, extensively branched calculi can be managed with this protocol. Currently, open operative intervention is reserved only for patients in whom percutaneous techniques and SWL have failed or are contraindicated or for patients with associated anatomic abnormalities requiring open operative reconstruction. Occasionally, anatrophic nephrolithotomy is utilized for a stone burden so large and complex that open operative intervention more likely will render the patient stone free in a safer manner than would the multiple percutaneous procedures and SWL that would be otherwise be required.

In 1994 the AUA Nephrolithiasis Guidelines Panel on staghorn stones recommended percutaneous stone removal as the primary treatment modality, followed by shock wave lithotripsy and/or repeat percutaneous procedures as warranted. SWL monotherapy and percutaneous monotherapy were recommended as effective treatment choices only for small volume struvite staghorn calculi in collecting systems that were anatomically normal or nearly so (5).

POTENTIAL RISKS

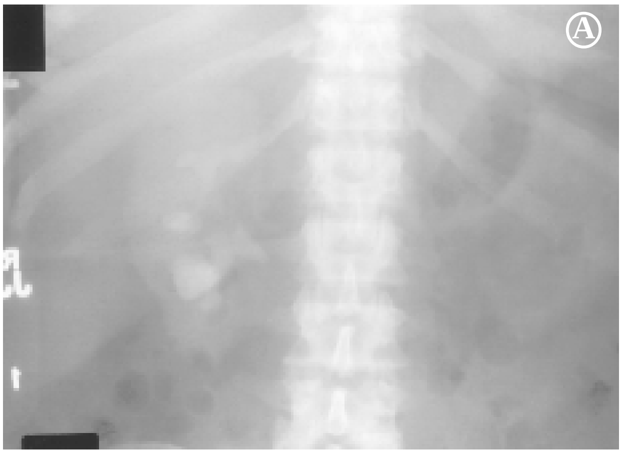
The potential risks are explained to the patient including the unlikely but potential need for emergent open operative intervention, and the need for secondary or even tertiary endourologic procedures that may be required to achieve a stone free result. Bleeding requiring transfusion has been reported in up to 14 % of patients, which compares favorably to percutaneous monotherapy for staghorn calculi with a reported transfusion rate of up to 53% (4,6), but this risk is also explained.

Fever and/or sepsis has been reported in 20% of patients undergoing sandwich therapy, and up to 27% being treated with percutaneous monotherapy (4,6). Many patients undergoing sandwich therapy have magnesium-ammonium-calcium phosphate stones associated with chronic bacterial infection. For these patients, sensitivity-specific oral antibiotic therapy is administered for at least 1 to 2 weeks prior to intervention, and broad-spectrum antibiotic therapy is given intravenously just prior to instrumentation.

TECHNIQUE

The technique is illustrated in the Figures. The site for the initial percutaneous puncture is chosen with the intention of providing access to the greatest stone burden. This usually allows for removal of the lower infundibulocalyceal and renal pelvic portions of the stone (Figures-1 and 2). Rarely, two or more tracts may be required to access particularly heavily involved collecting systems, especially those that are somewhat bifid. General anesthesia is used routinely. A Foley catheter is placed at the beginning of the procedure, and the patient is then positioned prone. Care is taken to ensure proper padding of the face, legs and arms, and two chest rolls are placed longitudinally under the chest.

Stone debulking then proceeds as a standard percutaneous nephrolithotomy. This initial percutaneous debulking is performed using a rigid 24.5 or 26F nephroscope and an ultrasonic lithotrite. For some especially hard non-struvite stones, electrohydraulic or Holmium laser lithotripsy is utilized as an adjunct. At this point, no attempt is made to reach calyceal extensions of the calculus that are located at acute angle to the existing tract and are therefore inaccessible to the rigid nephroscope. After extracting the entire accessible stone burden with this initial percutaneous debulking, a 24F nephrostomy tube



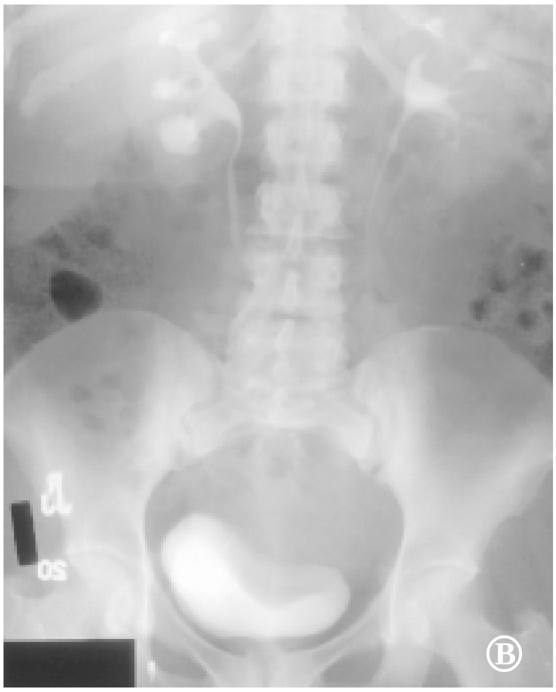


Figure 1 *– A) Plain film reveals completely branched "staghorn" calculus involving the right kidney. B) Intravenous pyelogram. Note relatively high location of the right kidney. Percutaneous monotherapy would require two or more tracts, including access via an upper pole infundibulocalix. However, upper pole access would require supra 11th rib puncture, placing the patient at significant risk for hydro, pneumo, or hemothorax.*

is left indwelling to gravity. The Foley catheter is removed within the next 12-24 hours, and ambulation is begun.

A nephrostogram, which includes oblique views before and after contrast is administered, is obtained 48 hours after the initial procedure. The nephrostogram is used to evaluate the extent and location of residual stones, and also to assess for urinary extravasation, as this would result in postponement of the subsequent SWL.

If the urine is relatively clear and there is no evidence of extravasation on the nephrostogram, SWL is performed for the "inaccessible" stones the following day. One to 2 days following the SWL, the previously "inaccessible" stones have migrated to an accessible location in the renal pelvis or lower calyces (Figure-3), and secondary rigid and/or flexible nephroscopy is then performed via the mature tract or tracts. If the entire stone burden has been cleared, the nephrostomy tube can be removed with the next 12-24 hours. However, for those patients with persistent calculi, additional treatment including secondary SWL or tertiary percutaneous extraction may be required.

One month following the final interventional procedure, a plain radiograph and renal ultrasound

Figure 2 *– Access via an involved lower lateral infundibulum allows "debulking" of the pelvic and lower infundibulocalyceal portions of the stone (inverted image).*

or alternatively an intravenous pyelogram is obtained (Figure-4). For those patients with infection related stones, chronic antibiotic prophylaxis is prescribed for the first 6-12 months of follow up. A metabolic evaluation can be completed at this time, and any associated problems also addressed.

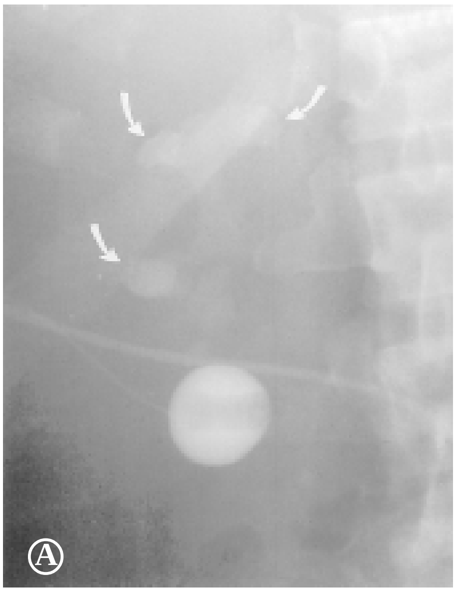


Figure 3 *– A) “Inaccessible” mid and upper pole stone extensions remain and will be treated with shock wave lithotripsy 48-72 hours later.*
B) Within 24 hours of shock wave lithotripsy, the post SWL fragments from the previously “inaccessible” stone extensions have migrated toward the renal pelvis. These residual fragments are now easily accessible with secondary rigid and/or flexible nephroscopy performed via the original access tract, which has now matured.

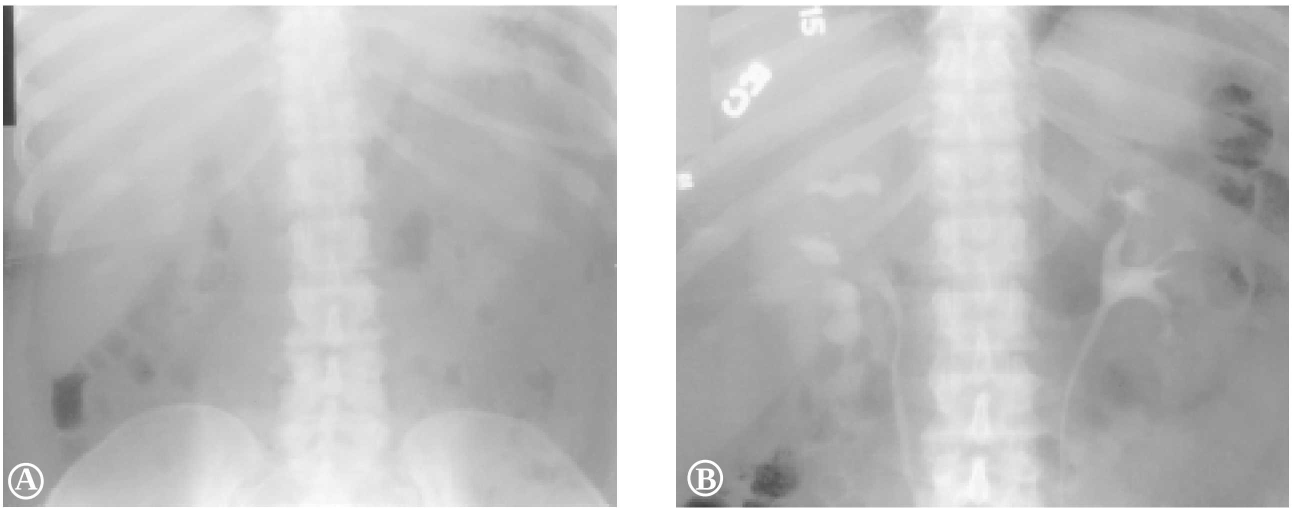


Figure 4 *– A) Follow-up scout film reveals a stone free system.*
B) Post “sandwich” therapy intravenous pyelogram confirms an excellent anatomic and physiology result.

RESULTS

We recently reviewed our results with 100 patients who underwent sandwich therapy for renal calculi. Magnesium-ammonium-calcium phosphate was the major component of the stone in 40.2% of patients. Calcium oxalate/phosphate was the major component in 37.1%, and uric acid combined with calcium oxalate/phosphate was the major component in 10.3%. Approximately 12% were primarily uric acid, cystine, or ammonium acid urate. The mean number of percutaneous procedures was just over 1.06 per patient, and fewer than 10% of patients required multiple access tracts, despite a mean stone burden of 20.8 cm^2. The mean number of shock waves to the involved renal unit was 3,100, divided over a mean 1.4 SWL treatments/patient (4).

Significant complications, which included bleeding requiring transfusion or fever delaying any planned treatment or hospital discharge, affected less than 30% of patients. No patients required a nephrectomy and there was no mortality. Early in our experience the average hospital stay approached 15 days. Over the past 10 years, the total length of hospitalization has decreased significantly and now averages less than 6 days. The stone free rate has also improved with experience. Of the first 25 patients in our series, 52% were stone free at one month follow up, while in comparison, 70% of the last 25 patients were rendered completely stone free, while the remainder had only residual calyceal dust or gravel.

There was a significantly higher rate of transfusion (20.5%) and fever or sepsis (33.3%) in patients with struvite stones. Of those patients with non-infection related stones, the rates of transfusion or fever/sepsis were significantly less at 10.3% and 12.1% respectively (4).

The long-term results of this sandwich approach have been evaluated, specifically for patients with infection related stones (3). With a mean follow up of 31 months, and as long as 5 years, the rate of new stone formation or stone growth has been 22%, while recurrent infection has developed in 30% of patients. In a more recent study using Kaplan-Meier estimates, the risk of new stone formation was estimated to be 36.8% over 5 years following combination therapy (7). Risk factors for recurrence have been evaluated and demonstrate that rates of recurrent stones are equivalent between patients undergoing percutaneous nephrolithotomy alone or percutaneous nephrolithotomy and SWL combined in a sandwich protocol. Finally, renal function has been shown to remain stable or improve in 96% of patients undergoing combination therapy (3), and this approach has also been shown to maintain or improve renal function even in patients with a solitary kidney (2).

CONCLUSIONS

The need for early and aggressive intervention for the treatment of staghorn calculi has been accepted practice for over 25 years (8). The goals of treatment of patients with complex stone disease include achieving a stone free renal unit, prevention of recurrent stones and infection, and preservation of renal function. Traditionally, the best therapeutic option for the treatment of staghorn calculi had been open operative intervention, as “medical” management of these complex stones has been shown to have a much higher renal related morbidity and mortality than operative stone extirpation (9,10).

Though some smaller staghorn calculi may be treated successfully with SWL or PCNL alone, there is a relatively high incidence of complications associated with either one of these treatment modalities as monotherapy for extensively branched or otherwise complex stones, and there are now several studies that have demonstrated that patients with this problem will benefit from a combined approach (4,11-13). For the most difficult patients, the immediate and long term results have been shown to be at least comparable to any other form of management currently available, and for almost 15 years, we have found this approach applicable to virtually any patient with large, extensively branched or otherwise complex renal calculi.

REFERENCES

1. Streem SB, Geisinger MA, Risius B: Endourologic “sandwich” therapy for extensive staghorn calculi. J Endourol, 1: 253, 1987.

2. Streem SB, Geisinger MA: Combination therapy for staghorn calculi in solitary kidneys: Functional results with long-term follow-up. J Urol, 149: 449, 1993.
3. Streem SB, Lammert G: Long-term efficacy of combination therapy for struvite staghorn calculi. J Urol, 147: 563, 1992.
4. Streem SB, Yost A, Dolmatch B: Combination "sandwich" therapy for extensive renal calculi in 100 consecutive patients: immediate, long-term and stratified results from a 10-year experience. J Urol, 158: 342, 1997.
5. Segura JW, Preminger GM, Assimos DG, Dretler SP, Kahn RI, Lingeman JE, Macaluso JN, Jr, and McCullough DL: Nephrolithiasis clinical guidelines panel summary report on the management of staghorn calculi. J Urol, 151: 1648, 1994.
6. Winfield, HN, Clayman RV, Chaussy CG, Weyman PJ, Fuchs GJ, Lupu AN: Monotherapy of staghorn renal calculi: a comparative study between percutaneous nephrolithotomy and extracorporeal shock wave lithotripsy. J Urol, 139: 895, 1988.
7. Streem SB: Long-term incidence and risk factors for recurrent stones following percutaneous nephrolithotomy or percutaneous nephrolithotomy/ESWL for infection-related calculi. J Urol, 153: 584, 1995.
8. Blandy JP, Singh M: The case for a more aggressive approach to staghorn stones. J Urol, 115: 505, 1976.
9. Teichman JMH, Long RD, Hulbert JC: Long-term renal fate and prognosis after staghorn calculus management. J Urol, 153: 1403, 1995.
10. Koga S, Arakaki Y, Matsuoka M, Ohyama C: Staghorn calculi—long-term results and management. Brit J Urol, 68: 122, 1991
11. Rassweiler J, Gumpinger R, Miller K, Holzermann F, Eisenberger F: Multimodal treatment (extracorporeal shock wave lithotripsy and endourology) of complicated renal stone disease. Eur Urol, 12: 294, 1986.
12. Fuchs G, Chaussy C: Extracorporeal shock wave lithotripsy for staghorn stones: reassessment of our treatment strategy. World J Urol, 5: 237, 1987.
13. Segura JW, Patterson DE, LeRoy AJ: Combined percutaneous ultrasonic lithotripsy and extracorporeal shock wave lithotripsy for struvite staghorn calculi. World J Urol, 5: 245, 1987

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Correspondence address:
Stevan B. Streem, M.D.
Head, Section of Stone Disease & Endourology
Department of Urology, Cleveland Clinic
9500 Euclid Avenue
Cleveland, Ohio, 44195, USA
Fax: (0021) 1 216 445-7031
E-mail: streems@ccf.org