THE ROLE OF ESWL IN THE TREATMENT OF LARGE KIDNEY STONES

A E Groeneveld

ABSTRACT

With extracorporeal shock wave lithotripsy firmly established as the treatment of choice for the majority of kidney stones, the management of large stone burdens and staghorn stones remains a point of discussion(1,2,3,4). Although with increasing experience the original limitations(5,6) posed by the size and the number of kidney stones have gradually become less important, most centres still approach large stones with a combination of percutaneous ultrasound lithotripsy and ESWL. This article reports on a personal series of 96 kidneys with an average stone burden of 51 mm treated by ESWL alone or in combination with indwelling ureteral drainage tubes, so called double J stents. Of these 96 kidneys, twelve were treated in one session, 74 in two, nine in three and one in four sessions. At six to twelve weeks after their last treatment session 42 were stonefree, 30 contained residual fragments smaller than 3 mm and four contained fragments larger than 3 mm. Complications were hematuria, pain, fever, encrustration of stone on the double J stent, spontaneous knotting of the double J stent and subcapsular hematoma. No kidneys were lost in this series and no deaths occurred. The results are comparable to those of combined PCN and ESWL(1). A case is made for ESWL with internal drainage by double J stent as the only auxiliary measure in kidneys with large stone burdens(7,8).

Key Words: - Kidneys with large stone burdens, Staghorn stones and ESWL, Double-J stents in ESWL, Extra corporeal shock wave lithotripsy (ESWL), Urolithiasis.

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INTRODUCTION

ESWL was started in Singapore in December 1985. Since then many patients with kidney stone disease have come forward who would not have consented to treatment, had open surgery been their only choice. Among them were a relatively large number with stone burdens greater than 30 mm, many of them recurrent stone formers who had been operated upon in the past.

The term stone burden is defined as the total added length in mm of all individual stones in a kidney as measured on a standard KUB(9,fig 1).

The main complication of ESWL for big stones is acute hydronephrosis caused by large amounts of fragments, travelling down the ureter and blocking the flow of urine. This phenomenon is know as stone street. The widely practised way to prevent or treat this complication is percutaneous drainage, either before or after the ESWL procedure(10). In many centres the standard therapeutic approach to these large stones is a combination of percutaneous ultrasound nephrolithotomy and ESWL(1,2). The former is used to remove the bulk of the stone, the latter to disintegrate remaining stone material located in calyces that are out of reach of the nephroscope.

Although PCN is a much smaller operation than a conventional open stone operation, it still has to be regarded as an invasive procedure, sometimes requiring bloodtransfusion and by no means guaranteed successful in one session. In an attempt to reduce the 'invasiveness' of the treatment for big stones even further, we have concentrated on ESWL in stages and with internal drainage as the only auxiliary measure(11,12).

MATERIAL AND METHODS

From July 1986 until November 1987, 83 patients who had between them 96 kidneys (Table 1) with stone burdens larger than 30 mm were treated in this manner with the Dornier HM3 lithotripter. The average stone burden per kidney was 51 mm, with a range of 31-114 mm. Twelve of these kidneys were treated with one ESWL session, 74 with two, nine with three and one with four sessions. The interim period between sessions depended on how quickly the passable stone fragments were discharged. Patients were followed by regular KUB's, either in Singapore or in their home town abroad. In 54 kidneys a double J stent was inserted immediately prior to ESWL. Later on in the series all patients with a stone burden larger than 30 were given a J stent. A double J stent is a ureteric catheter made of soft, inert silicone material. Spontaneous migration in either cranial or caudal direction is prevented by a retaining coil on each end (fig 2). These coils are easily straightened

Table 1

Number of Kidneys	Number of ESWL Treatments Needed
12	1
74	2
9	3
1	4
96	

Urology and Lithotripter Centre
The American Hospital of Singapore
321 Joo Chiat Place
Singapore 1542

AE Groeneveld, MD, PhD (Amsterdam),
Consultant Urologist

Fig 1.

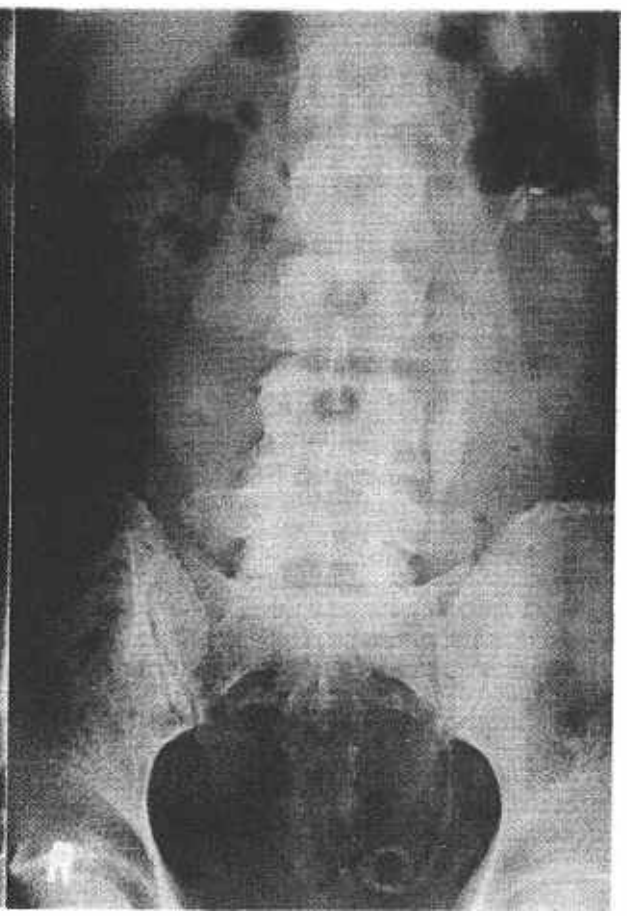


Fig 2.

Fig 1. Assessment of the stone burden.

Fig 2. Double J Stent in situ. Coils on either end prevent upward and downward migration. While the drainage of urine from kidney to bladder is secured, numerous stone fragments are travelling down in between ureteric wall and stent, forming a 'stone street'

by a guide wire when the stent is placed but on removal of the wire the coils form instantaneously in the renal pelvis and in the bladder. Placement of a double J stent is a simple cystoscopic procedure which is successful in almost 100% of cases, even when the pelvicalyceal system is completely filled with stone. Care was taken to fragment the pelvic and upper pole portions first. By leaving the lower pole stone intact, the fragments produced from the pelvis and upper calyces are forced to drain into the ureter rather than into the lower pole. Once the middle and upper portions of the kidney are stonefree, the lower pole stones are treated. Per session of 3000 shock waves, which is the maximum per treatment per kidney used in our series, about 12 cm3, or 25 to 30 mm in terms of stone burden, of calcium oxalate and calcium phosphate can be pulverized. Struvite stone, which is usually rather soft, is easier to break up. Two of the treatments were done under general anaesthesia, in the rest we used epidural anaesthesia with bupivacaine.

RESULTS

Postoperative check ups were done by standard KUB. In assessing the results we categorized the patients in 3 groups:

1. Stonefree
2. Residual fragments of 3 mm or smaller
3. Residual fragments bigger than 3 mm

Seventy six kidneys (Table 2) were available for follow up 6-12 weeks after their last treatment session. Of these,

Table 2

Results	Number of Kidneys	%
Stone free (group 1)	42	55
Fragments $\leq$3mm (group 2)	30	40
Fragments $>$3mm (group 3)	4	5
Total	76	100

42(55%) were stonefree, 30(40%) contained residual fragments smaller than 3 mm, and in 4(5%) the X-ray showed fragments larger than 3 mm. By offering another treatment session patients in group 3 could sometimes be converted to group 2 or even group 1. The patients in group 1 were discharged with dietary advice and medication, based on their underlying condition and stone analysis results. These patients are asked to take a yearly KUB in their home town in order to detect recurrence early. The patients in group 2 were given more time to expel their fragments with the advice to drink plenty, to take exercise and to use postural drainage. If there was a large amount of small fragments, trapped for instance in a lower pole with pyelonephritic scarring, clearance by percutaneous nephroscopy was offered. The patients of group 3 were advised to have more treatment, either by ESWL or PCN. Many patients however refused further treatment, mostly be cause they had no more symptoms or for financial reasons.

In this particular series percutaneous intervention was advised in three cases but refused by the patient in all three cases. If more patients with residual fragments larger than 3 mm would have consented to more ESWL treatment the eventual stonefree rate would probably have been higher. This shows that factors outside the technology of the method itself are playing their part in the ultimate success rate.

COMPLICATIONS

Macroscopic hematuria lasting from 6-36 hours occurred in all patients. The cause of this phenomenon is not completely understood but is thought to be a combination of micro-injury of the epithelium and bruising of renal tissue(13,14).

Of the 191 times a kidney was treated in this series, in 29 instances (approximately 15% of treatments; these numbers do not differentiate for one sided or bilateral treatment) did a patient develop colicy pains requiring stonger medicine than Buscopan, i.e. pethidine or diclofenac (Voltaren) i.m. Most patients feel no pain at all or just a dull ache which often is associated with the epidural anaesthesia. Fever with temperatures higher than 38°C has been uncommon since we started to use prophylactic Bactrim the evening before the treatment. In cases of urinary infection specific antibiotics are given.

Two cases of new stone formation on the J stent were recorded. One of these was diagnosed after 3 months. Upon removal of the stent an amount of soft struvite stone was peeled off the stent and left behind in the upper ureter, creating a whole new set of problems. This situation made further ESWL necessary. The second patient had gone to another hospital from where the complication was reported to us.

In one patient the J stent had spontaneously knotted inside the renal pelvis. It was removed in the normal fashion by gentle traction from below.

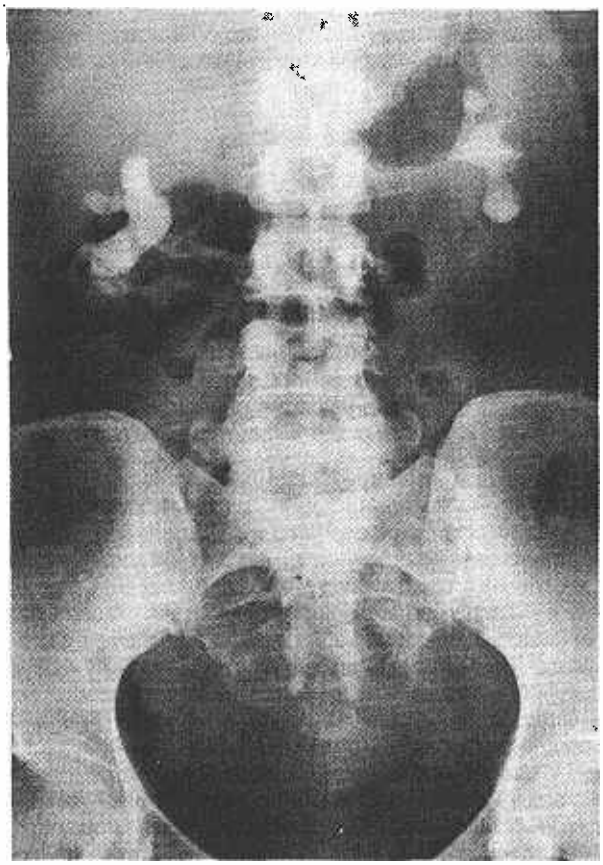
One patient developed a palpable mass in the area of the treated kidney. Ultrasound and CT scan showed a sizable subcapsular hematoma. The Hb dropped by 3 g/dl but the patient remained clinically well and was not given a blood transfusion. Late follow up of the kidney function and blood pressure in this patient is being arranged. No nephrectomies were necessary in this series and there were no deaths.

CASE HISTORIES

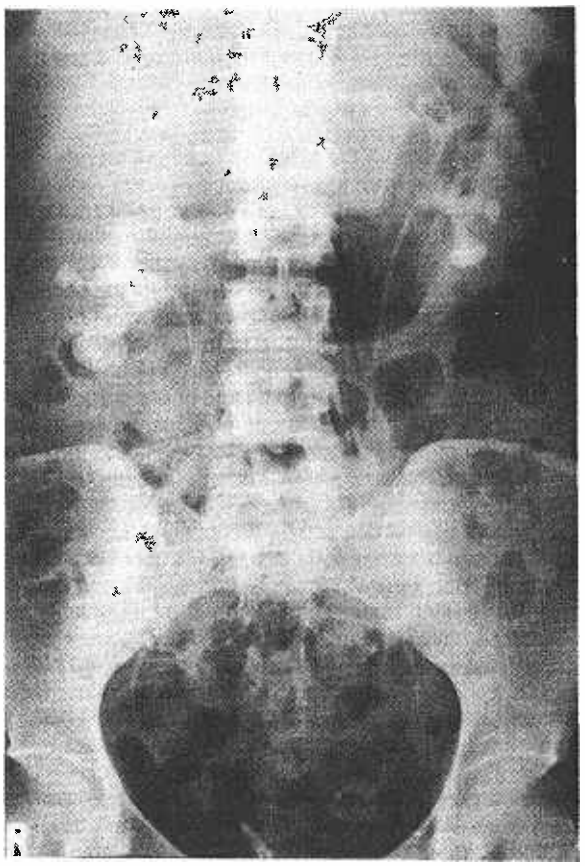
To illustrate the principles of staged ESWL and internal drainage of the kidney, two typical cases are presented.

Case 1. (fig 3). A 42 year-old lady presented with bilateral stone disease. The stone burden on the right was 57, on the left 53. The IVP showed clubbing throughout and hydronephrosis of the left upper pole. A double J stent was placed bilaterally and 3000 shocks were delivered to each kidney. Widespread disruption was seen on the right side and on the left there was complete pulverisation of the pelvic and upper pole portions of the stone. The patient started to pass large amounts of sand almost immediately and she was discharged home with low dose antibiotic cover (Bactrim Forte 1 tablet nocte). She was advised to drink plenty of fluids and to take exercise. Six weeks later the left side was treated with another 1000

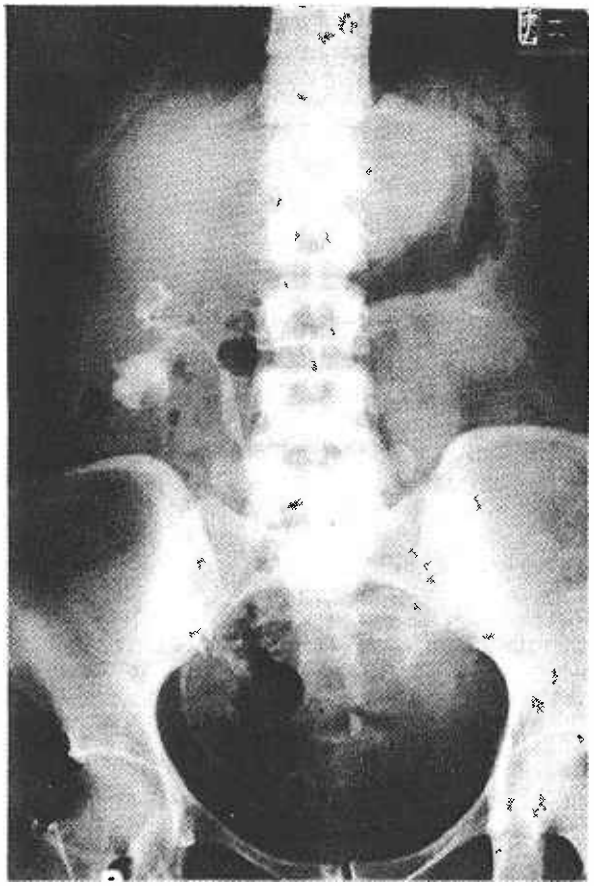
Fig 3. Case 1.



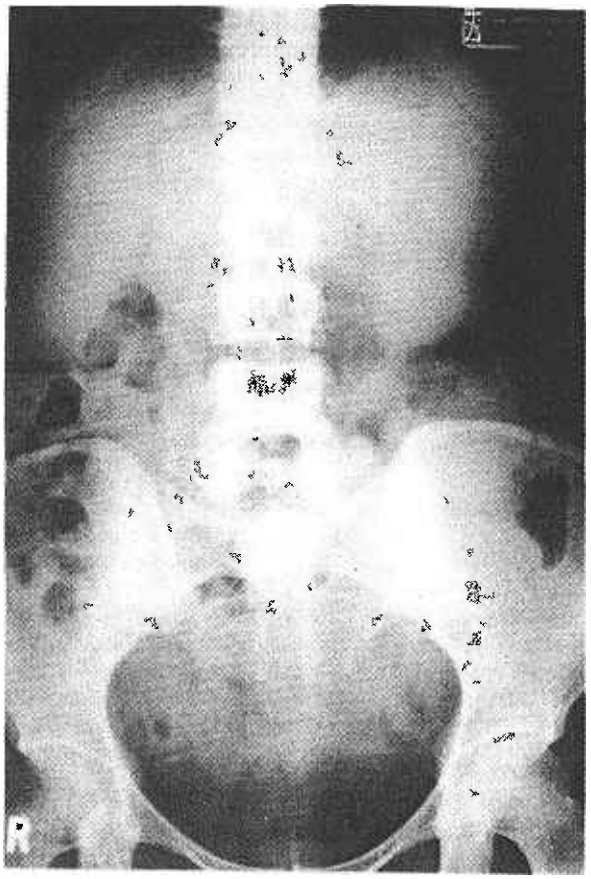
a. Preoperative KUB shows extensive bilateral kidney stone disease



b. One day after the first session: widespread disruption on both sides.



c. One day after the second session. There is a clear 'powder pyelogram' in the right lower pole and a stone street in the upper ureter. A few fragments remain in the left lower pole.



d. Two weeks after the third and last session: both kidneys are free of stone.

Fig 4. Case 2.

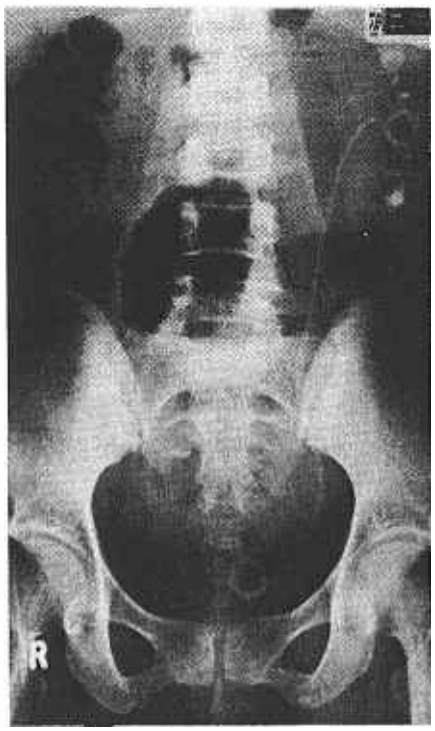
shocks and the left double J stent was removed. During the same session the right kidney received 3000 shock waves, reducing the size of the remaining stones considerably and causing discharge of many more fragments. Three months later there were residual fragments in the right lower pole and a bigger piece in the distal ureter. The left side had become stonefree. A third treatment was given, this time including the fragment in the distal ureter and two weeks later all stone material had been expelled. The patient spent 10 days in the hospital altogether over a period of 4.5 months. She never required more than an occasional Buscopan tablet.

Case 2. (fig 4). A 39 year-old woman had a solitary left kidney with a complete staghorn stone measuring 114 mm. The IVP showed compensatory hypertrophy and good function. A double J stent was placed and the first 3000 shocks were delivered on the pelvis and upper infundibulum, causing widespread disruption. She was discharged producing numerous stone fragments with the urine. A week after the second treatment, which took place 5 weeks after the first, there was good clearance of the middle portion but large fragments remained in both poles. She kept passing sand with the urine continuously and a third and fourth session were given. Check up 6 weeks after the final treatment showed no more stone and good function on the IVP, after removal of the double J stent.

DISCUSSION

Draining away the fragments rather than the fragmentation itself is the main problem in ESWL for large kidney stones.

a. Preoperative KUB after placement of double J stent. A complete staghorn stone in a solitairy left kidney with compensatory hypertrophy.



b. Two weeks after the third session. The bulk of the stone has cleared. Fragments in upper and lower poles require more treatment.

c. KUB three weeks after fourth and final session shows stone free kidney.

It appears that as long as the ureteric peristalsis remains intact, even very long stone streets will be cleared in time.

Peristalsis remains intact as long as urine can drain away from the kidney and hydronephrosis and hydroureter are avoided(10). Drainage of urine can be safeguarded by external means (percutaneous nephrostomy) or by internal means, namely the J stent. The ureter has a remarkable ability to distend and the stone fragments find their way down the ureter alongside the J stent (fig 2). The advantage of internal drainage is that patients can return to their daily occupation in between ESWL sessions completely normal and without a nephrostomy bag. They can also have a voice in the decision when to perform the next treatment. In the course of this series the impression existed that not only the ureteric peristalsis, but also the motility of the pelvicalyceal system is of utmost importance in the proces of clearing the kidney of stone dust. Those kidneys that were full of stone but whose calyceal system showed relatively little pyelonephritic scarring appeared more successful in expelling stone gravel than those that were badly scarred, particularly in their lower poles. If the assumption is correct that pyelonephritis with scarring can destroy the peristaltic pacemaker areas in the calyces, the above observation suggests that active peristaltic activity as well as passive factors (gravity) play a part in the clearance of stone debris from the kidney after ESWL. This could eventually help in selecting these patients for either internal or external drainage as the auxiliary measure of choice in the treatment of large kidney stones by ESWL.

d. IVP three weeks after fourth and final session shows good function and anatomy.

REFERENCES

1. Schulze H, Hertle L, Graff J, Funke P-J, Senge T: Combined Treatment of Branched Calculi by Percutaneous Nephrolithotomy and Extracorporeal Shock Wave Lithotripsy. J Urol 1986; 135: 1138-41

2. Kahnoski RJ, Lingeman JE. Coury TA, Steele RE, Mosbaugh PG: Combined Percutaneous and Extracorporeal Shock Wave Lithotripsy for Staghorn Calculi: An Alternative for Anatrophic Nephrolithotomy. J Urol 1986; 135: 679-81
3. Dickinson IK, Fletcher MS, Bailey MJ et al: Combination of Percutaneous Surgery Extracorporeal Shockware Lithotripsy for the Treatment of Large Renal Calculi. Br J Urol 1986; 58: 581-4.
4. Winfield HN, Clayman RV, Chaussy CG, Weyman PJ, Fuchs GJ, Lupu AN: Monotherapy of Staghorn Renal Calculi: Comparative Study Between Percutaneous Nephrolithotomy and Extracorporeal Shock Wave Lithotripsy. J Urol 1988; 139: 895-9
5. Chaussy C, Schmiedt E: Shockwave Treatment for Stones in the Upper Urinary Tract. Urol Clin N Am 1983; 10: 743-50
6. Chaussy C, Schmiedt E, Jocham D, Brendel W, Forssmann B, Walther V: First Clinical Experience With Extracorporeally Induced Destruction of Kidney Stones by Shock Waves. J Urol 1982; 127: 417-20
7. Groeneveld AE: ESWL Monotherapy in Large Stone Burdens. Paper presented at the Vth World Congress of Endourology and ESWL. Cairo, Nov 1987; 284
8. Abomelha MS, Said MT, Otaibi KE, Kourah MA: ESWL Monotherapy in Staghorn Calculi. Paper presented at the Vth World Congress of Endourology and ESWL. Cairo, Nov 1987. Abstract Book: 283
9. Griffith DP: ESWL, Urologists' Correspondence Club 1985; 66-7
10. Coptcoat MJ, Webb DR, Kellet MJ et al: The Complications of Extracorporeal Shockwave Lithotripsy: Management and Prevention. Br J Urol 1986; 58:578-80
11. Groeneveld AE: Extracorporeal Shock Wave Lithotripsy, Current Trends in Southeast Asia. Medical Progress. Jan 1988; 7-9 Guest Editorial
12. Groeneveld AE: Extracorporeal Shockwave Lithotripsy: A Revolutionary Development in Urolithiasis. JAMA South East Asia 1987: 3:5-6 Editorial
13. Fisher N, Muller HM, Gulhan A, Deutz FJ, Rubben H: Cavitation Effects: A Possible Cause of Tissue Injury During Extracorporeal Shockwave Lithotripsy. Paper presented at the Vth World Congress of Endourology and ESWL. Cairo, Nov 1987; Abstract Book: 238
14. Hegazy AR, Ishak AE, El-Kateb S: The Effect of ESWL on the Kidney: Histopathological Study. Paper presented at the Vth World Congress of Endourology and ESWL. Cairo, Nov 1987; Abstract Book: 250