# EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY MONOTHERAPY FOR SELECTED STAGHORN STONES

P K Tan, E C Tan, K H Tung, K T Foo

*ABSTRACT*

***Objective:*** ***To define a subgroup of staghorn stones that is amenable to extracorporeal shockwave lithotripsy (ESWL) monotherapy and review the need for prophylactic ureteric stents.***

***Methods:*** ***Fifty-eight renal units with staghorn calculi in 56 patients (30 males and 26 females) were treated by ESWL monotherapy on the EDAP LT-01 lithotripter. The stones were grouped as complete staghorn (11, 19%), partial staghorn (34, 59%) and borderline staghorn (13, 22%). Results of treatment were analysed in relation to subgroups and calyceal dilatation. Post-treatment complications were studied and the influence of prophylactic ureteric stents examined.***

***Results:*** ***The average number of ESWL sessions was 3.1 (range: 1 to 8). The mean follow-up period was 13 months. Stone-free rate at 10 months was 52%. When clinically insignificant residual fragments less than 4mm were included, the overall clearance rate was 75%. Favourable factors influencing treatment outcome included smaller stone burden, peripheral distribution of stone mass and absence of pelvicalyceal dilatation.***

***The overall complication rate was 39% with urosepsis being the commonest. Complications were related to stone burden. More than half of the renal units with complete staghorn stones developed one or more complications. Auxiliary procedures were required in 18% of the renal units. Twenty of 39 renal units with a stone burden (sum of length and width) greater than 50mm had pre-treatment ureteric stenting using the double-J (DJ) siliastic stent. A urosepsis rate of 50% was noted in those with ureteric stents compared to 26% in those not stented. The stents did not offer any advantage in preventing post-treatment obstruction by fragments. Six of 7 renal units with post-treatment obstruction had in-situ stents.***

***Conclusions:*** ***ESWL monotherapy is suitable for selected staghorn stones. Prophylactic ureteric stents do not offer any advantage and may predispose to urosepsis.***

***Keywords:*** *Extracorporeal shockwave lithotripsy, staghorn calculus, ureteric stents*

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## INTRODUCTION

The results of ESWL monotherapy for staghorn stones have been thought to be unsatisfactory because of the high incidence of complications requiring auxiliary procedures[1-4]. Percutaneous nephrolithotripsy has been advocated as the treatment of choice for this form of renal calculus[2,4]. However, favourable results have been reported for selected groups of staghorn stones: those with minimal calyceal dilatation, peripheral stone burden and stones of uric acid or struvite composition[2,4,5]. The aim of this paper is to review our experience of ESWL monotherapy for staghorn stones using the EDAP LT-01 piezoelectric lithotripter and to identify the factors favouring this form of treatment.

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## MATERIAL AND METHODS

Fifty-eight renal units with staghorn stones underwent ESWL monotherapy on the EDAP LT-01 piezoelectric lithotripter over a 4-year period from 1987 to 1990. There were 30 males and 26 females with 2 of the males having bilateral staghorn stones. Their ages ranged from 26 to 74 years with a mean age of 54.6 years.

The stones were categorised into 3 groups: borderline, partial and complete. Borderline staghorn stones were defined as stones which occupy 2 calyces with extension into the renal pelvis. Stones that filled more than 80% of the pelvicalyceal system were termed complete staghorn stones. Stones that fall in between these criteria were grouped together as partial staghorn stones (Fig 1). Stone burden was calculated as the sum of the greatest length and width of the stone measured on the plain radiogram. The stone types and burdens of our study population are listed in Table I.

Nine of the staghorn stones were recurrent stones. Seven of these renal units had previous surgery while 2 stones were successfully treated by chemolysis.

Intravenous urogram was performed in all but 3 of our patients. Forty-one renal units (74.5%) had minimal or no evidence of calyceal dilatation.

Urine culture results were available for 47 patients. Ten showed pathogens of significant counts. *Proteus* was the commonest organism isolated. Other pathogens included *E. coli, Pseudomonas, Citrobacter* and *Klebsiella*. Antibiotics were administered for all patients with positive urine cultures.

Fig 1 – Classification of stones

| Borderline | Partial | Complete |
|---|---|---|
| n = 13 | n = 34 | n = 11 |
| (22%) | (59%) | (19%) |

**Table I – Summary of results**

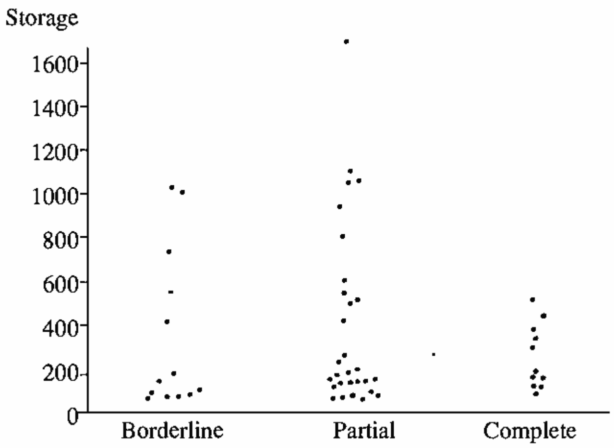
| Stone Type | No of renal units | Stone Burden (mm) | | Stone-free | With inclusion of fragments < 4 mm |
|---|---|---|---|---|---|
| | | Mean | Range | | |
| Borderline | 13 | 43 | 30- 60 | 7 (54%) | 11 (85%) |
| Partial | 26 | 55 | 33- 95 | 15 (58%) | 22 (85%) |
| Complete | 9 | 96 | 68-122 | 3 (33%) | 4 (44%) |
| | 48 | | | | (p < 0.01) |
| Calyceal Dilatation | | | | | |
| No/mild | 34 | | | 22 (65%) | 30 (88%) |
| Dilated | 14 | | | 3 (21%) | 6 (43%) |
| | 48 | | | (p < 0.05) | (p < 0.02) |

*Only 48 renal units were included in the final analysis (8 were lost to follow-up and 2 did not complete their treatments)

Prophylactic ureteric stents were inserted in 24 renal units (43%). Double-J (DJ) stents were used in all instances. Twenty of the stents were inserted for those with stone burdens more than 50 mm.

The mean number of ESWL sessions was 3.1 sessions (range: 1 to 8). The total energy used was expressed in storage; where storage is a function of the number of shock waves and the power used. The average storage for borderline staghorn stones was 306, partial staghorn 364 and complete staghorn stones 255 (Fig 2). The lower storage recorded in the complete staghorn group can be attributed to the mainly struvite composition of these stones as well as early abandon of ESWL monotherapy in 6 patients when poor fragmentation were noted.

Fig 2 – Shockwave energy received




Mean storage : Borderline 306
Partial 364
Complete 255

The mean follow-up for our study group was 13 months (range 3 to 40 months). Ten renal units were not available for the final analysis because 8 were overseas patients while 2 of the patients opted out of the treatment soon after starting treatment. All patients had regular plain radiograms and urine cultures when indicated.

Chi-squared test was applied where appropriate.

## RESULTS

Stone-free rate at 10 months was 52% (25 of 48 renal units). When clinically insignificant residual fragments less than 4mm were included, the clearance rate was 75% (36 renal units).

Borderline and partial staghorn stones had better stone-free rates (54% and 57% respectively) compared to complete staghorn stones (33%). The results were 85%, 85% and 45% respectively if clinically insignificant fragments were included ($p < 0.01$) (Table I).

The extent of associated pelvicalyceal obstruction also affected stone fragmentation. Forty-one renal units with mild or no calyceal dilatation managed a stone-free rate at 10 months of 65% compared to 21% if significant calyceal dilatation was present ($p < 0.05$). The results were 88% and 42% respectively if clinically insignificant fragments were included ($p < 0.02$).

Treatment complications were noted in 22 renal units (39%). Urosepsis was the commonest, occurring in 18 renal units (32%). Two patients (4%) required admission for control of post-treatment colic. Ureteric obstruction with proven pelvicalyceal dilatation on ultrasound was noted in 7 renal units (13%). Six of these 7 renal units had in-situ DJ stents. The complications rates were directly proportional to stone burden (borderline 23%, partial 41.2%, complete 54.5%)

The urosepsis rate for renal units with stone burdens of more than 50mm was 39% (15 of 39). It was noted that in this group, those with prophylactic ureteric stents had higher incidence of urosepsis (50%, 10 of 20) than those without stents (26.3%, 5 of 19).

Auxiliary procedures were required in 10 renal units (18%). They included nephrostomy tube insertion (1), percutaneous nephrolithotripsy (3), ureteroscopic lithotripsy (5), and combined percutaneous nephrolithotripsy and ureteroscopic lithotripsy (1).

Long-term follow-up showed a recurrence rate of 17% (6 renal units), with the mean time to recurrence of 17.8 months. All these stones were regrowth from residual fragments. Three of the stones were successfully treated with repeat ESWL while the others are still under observation.

Twenty-eight stone fragments were available for analysis. Of these, 8 had struvite composition, 1 urate, 3 oxalate while the others were composite stones of oxalate and urate(1), urate and phosphate(6), oxalate and phosphate(8) and with one showing the presence of triple phosphate and urate.

## DISCUSSION

Management of staghorn stones by ESWL monotherapy has been reported by various authors to be unsatisfactory[2,4]. However, certain subgroups of staghorn stones have shown favourable results with ESWL monotherapy; in particular the urate or struvite stones with a predominantly peripheral stone burden occurring in renal units with a non-obstructing architecture of the calyces and causing minimal calyceal dilatation[2,4,5].

Our study has identified the following favourable factors for ESWL monotherapy for staghorn stones: incomplete staghorn calculus in a non-obstructed pelvicalyceal system. The type of lithotripter does not seem to influence the outcome. Our experience on the EDAP LT-01 piezoelectric lithotripter is comparable to the results of other authors using other types of

**Table II – Results of other studies**

| Series | Lithotripter | Stone-free rate |
|---|---|---|
| Eisenberger (1987)[2] | Dornier HM-3 | 50% (18 months) |
| Winfield (1987)[4] | Dornier HM-3 | 61% ( 8 months) |
| Fuchs (1987)[5] | Dornier HM-3 | 61% ( 8 months) |
| Vandeursen (1990)[8] | Siemens Lithostar | 56% ( 3 months)<br>74% (remnants < 4mm) |
| Current series | EDAP LT-01 | 52% (10 months)<br>75% (remnants < 4mm) |

lithotripters (TableII).

The higher complication rate and the frequent need for auxiliary procedures were cited as objections to ESWL monotherapy for staghorn stones[3,4]. Prophylactic ureteric stenting was suggested as a solution to reduce the obstructive complications when treating large renal stones[5-7]. It was reported that the need for post-treatment nephrostomy drainage can be reduced by as much as 20%[7]. However, this advantage was not realised in our study. Six of the 7 renal units who developed clinical ureteric obstruction in our series had in-situ DJ stents. Asymptomatic obstruction has been demonstrated by routine ultrasound in 60% to 80% of patients who had ESWL for staghorn stones in spite of having a ureteric stent inserted[5]. Vandeursen et al noted that while his patients without ureteric stents had uncomplicated evacuation of fragments, those with stents showed more than 50% of the stents when removed had impaction of stone fragments with 25% of these resulting in clinical obstruction[8]. Similarly, Bierkens et al in a randomised trial of 64 patients with large renal calculi treated by ESWL concluded that ureteric stents did not reduce post-ESWL complications, were associated with additional morbidity and did not improve stone passage markedly[9].

In our experience, ureteric stents are associated with a higher incidence of post-treatment urosepsis (50% vs 26%). The introduction of a foreign body into a system laden with pathogens and with a tendency to obstruct the passage of post-ESWL fragments may be the cause of this finding.

## CONCLUSION

The introduction of ESWL has revolutionised the management of urinary calculous disease. This anaesthesia-free treatment which can be performed on an outpatient basis has tremendous advantages over invasive treatments. ESWL monotherapy can be satisfactorily employed in selected staghorn stones. Though multiple sessions are required and auxiliary procedures necessary in a proportion of cases, the non-invasive nature of the treatment makes it an attractive alternative. The larger staghorn stones with calyceal dilatation will still require percutaneous nephrolithotripsy with adjuvant ESWL treatment for the residual fragments. Prophylactic ureteric stenting may not pre-empt ureteric obstructive complications.

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