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Conservative management of staghorn stones

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ABSTRACT

INTRODUCTION Since the seminal works by Singh and Blandy in the 1970s, the management of staghorn stones has almost exclusively involved surgical intervention. In contrast, a more recent study found that conservative management was not as unsafe as previously believed. The present review sought to examine the available literature to understand the implications of a conservative strategy.

METHODS A systematic search of the literature was carried out using MEDLINE®, Embase™ and the Cochrane Central Register of Controlled Trials. All papers looking at management of staghorn calculi were reviewed and studies with a conservative management arm were identified. Outcomes of interest were recurrent or severe urinary tract infections, progressive renal deterioration, dialysis requirements, morbidity and disease specific mortality. Owing to the lack of relevant data, a descriptive review was carried out.

RESULTS Our literature search yielded 10 suitable studies involving a total of 304 patients with staghorn stones managed conservatively. Progressive renal deterioration occurred in 0–100% of cases (mean 27.5%) with a higher rate among bilateral staghorn sufferers (44% vs 9%). Dialysis was required in 9% of patients (20% bilateral, 6% unilateral). The mean rate of severe infection was 8.7% and recurrent urinary tract infections occurred in as high as 50% of cases (80% bilateral, 41% unilateral). Disease specific mortality ranged from 0% to 67% (mean 20.5%).

CONCLUSIONS It appears that conservative management of staghorn calculi is not as unsafe as previously thought and selection of patients with unilateral asymptomatic stones with minimal infection should be considered.

KEYWORDS
Staghorn – Stones – Calculi – Conservative – Management

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Introduction

Staghorn calculi are defined as branched stones that occupy a large part of the collecting system.[1] In the 45 years since the seminal works by Singh and Blandy,[2,3] the management of staghorn stones has almost exclusively involved surgical intervention. In their two retrospective cohort studies comparing conservative management with pyelolithotomy, the authors found significantly inferior outcomes with conservative management regarding mortality and morbidity from infection, renal failure and subsequent need for nephrectomy. At times, the delay of nephrectomy rendered this procedure a risky endeavour. Mortality was reported to be as high as half the cohort, with mortality higher in patients who did not undergo urgent nephrectomy in the event of deterioration.[2] The conclusion was that surgical intervention was almost always indicated.

However, since Singh and Blandy's work, several other papers have emerged that challenge this idea, suggesting that conservative management of staghorn stones is not as unsafe as previously thought. This review aims to explore the evidence supporting this.

Methods

A literature search was performed using MEDLINE®, Embase™ and the Cochrane Central Register of Controlled Trials to identify relevant papers published between January 1980 and December 2018. The search terms comprised 'staghorn', 'calculi', 'stone' and 'conservative management'. Boolean operators (AND, OR) were used to refine the search.

Outcomes of interest were severe or recurrent urinary tract infections (UTIs) and urinary sepsis, progressive renal deterioration, dialysis requirement, morbidity (as accounted for by hospital admissions) and disease specific mortality. Secondary outcome measures were age, sex, laterality of calculus, duration of follow-up period and reasons for use of conservative management. Owing to the nature of the included studies and an absence of

relevant data, the results were not suitable for a pooled analysis and so a descriptive review is presented.

Results

The search process yielded ten studies suitable for inclusion in our review (Table 1).[2–11] These comprised seven retrospective analyses, two case series and one prospective cohort study. Full texts were retrieved for six articles and four were only available in abstract form. The 10 studies involved a total of 868 patients, 304 of whom had staghorn calculi that were managed conservatively. The follow-up period ranged from 1 to 20 years. Age data were available in only four papers, with a combined range from 6 to 86 years. The median patient age was 46 years. The reasons for choosing conservative management over surgical intervention were described in six of the ten studies (Table 2).

Progressive renal deterioration and dialysis requirement

Nearly all papers included data on rates of progressive deterioration in renal function (Table 3). This ranged from 0% to 100% (mean 27.5%). The highest rate was seen in the cohort of Teichman *et al* although this likely reflects the small sample size of three patients.[10] Among all other studies, the rate varied between 0% and 36% (mean 19.4%). Singh *et al* identified a higher frequency of deterioration for bilateral staghorn sufferers with 4/9 (44%) versus 4/45 (9%) for unilateral stones.[2]

Data regarding rates of dialysis requirement were extremely scarce; only three papers provided figures for this. While Burchardt and Morgan *et al* reported no complications or renal deterioration requiring dialysis among their patients,[4,8] Deutsch and Subramonian noted that 2 (9%) of their cohort of 22 patients received dialysis.[5] Once again, the risk was greater for bilateral calculi

Table 2 Reasons for choosing conservative management

Paper	Reasons for non-intervention
Blandy, 1976[3]	Not described
Burchardt, 1982[4]	Inoperable
Deutsch, 2016[5]	Comorbidities (59%), patient choice (36%), poor access/anatomy (5%)
Flamm, 1987[6]	Clinical reasons but no further elaboration
Koga, 1991[7]	Not described
Morgan, 2018[8]	Comorbidities (48%), patient refusal (41%), aberrant anatomy (10%)
Rous, 1977[9]	Not described
Singh, 1973[2]	Not described
Teichman, 1995[10]	Surgical refusal
Vargas, 1982[11]	Surgical refusal or hazardous clinical condition

Table 1 Summary of studies included in review

Paper	Type of study	Sample size	Conservative management	Age range (median) in years	Unilateral staghorn stones	Bilateral staghorn stones	Maximum follow-up period (mean) in years
Blandy, 1976[3]	Retrospective analysis	185	40	Not available	148	37	20
Burchardt, 1982[4]	Retrospective analysis	20	20	Not available	Not available	Not available	7
Deutsch, 2016[5]	Prospective cohort study	22	22	Not available	17	5	Not available (8.1)
Flamm, 1987[6]	Retrospective analysis	24	24	Not available	Not available	Not available	9
Koga, 1991[7]	Retrospective analysis	167	61	17–84 (51)	143	24	18 (7.8)
Morgan, 2018[8]	Retrospective analysis	29	29	61–81 (74)	23	6	2
Rous, 1977[9]	Retrospective analysis	95	30	Not available	Not available	Not available	Not available
Singh, 1973[2]	Retrospective analysis	54	54	Not available	45	9	Not available
Teichman, 1995[10]	Retrospective analysis	177	3	17–86 (50)	Not available	Not available	Not available (7.7)
Vargas, 1982[11]	Retrospective analysis	95	21	6–83	85	10	6
Total		**868**	**304**	**6–86 (46)**			

sufferers, with 1 (20%) of 5 bilateral cases requiring dialysis versus 1 (6%) of 17 unilateral cases.

Severe UTIs and recurrent UTIs

For the purposes of this review, severe UTI encapsulates pyonephrosis, pyelonephritis or urinary sepsis. The aggregated mean rate of serious infections was 8.7%. Recurrent infection rates were as high as 50%, as seen in Deutsch and Subramonian's study, with rates higher among patients suffering from bilateral staghorns than among those with unilateral stones (80% vs 41%).[5]

Five papers included information on severe UTIs. Burchardt's cohort had no serious infections or complications.[4] Conversely, Koga *et al* stated that there was one patient with pyelonephritis,[7] Morgan *et al* reported one patient with pyelonephritis and one with severe urinary sepsis,[8] and Vargas *et al* identified four patients with pyonephrosis, two with pyelonephritis and two with urosepsis.[11] Blandy and Singh's early cohort included 16 cases of pyonephrosis.[3]

Morbidity and disease specific mortality

Table 4 summarises the data on morbidity and mortality. Deutsch and Subramonian reported that six (27%) of the patients in their study required hospital admission for stone related morbidity.[5] Eighty per cent of those with bilateral staghorns versus twelve per cent with unilateral calculi were readmitted and this difference was statistically significant (p=0.003), with bilateral stone formers being 6.8 times more likely to require admission than unilateral stone formers. Morgan *et al* reported only one related admission (3%) for pyelonephritis.[8]

Disease specific mortality during the follow-up period was the one universally reported attribute. This ranged from 0% to 67% (mean 20.5%). The highest rate was again observed in Teichman *et al*'s cohort, with two of the three patients dying of disease specific causes.[10] Aside from this small study, the next highest rate (30%) was seen in Rous and Turner's cohort.[9] Death was usually due to progressive renal failure and uraemia or urosepsis. However, this was often not clearly defined by the authors beyond being classified as stone related. The mortality rate among bilateral staghorn patients in all studies with available data was 27.8% compared with 11.8% for unilateral cases.[2,3,5–7,10,11] The most recent series had a much lower figure of 9%, comprising 2 patients with bilateral calculi in a cohort of 22.[8]

Delayed nephrectomy

Singh *et al* commented on the need for delayed nephrectomy in 4 (44.4%) of 9 patients with bilateral staghorns versus 12 (26.7%) of 45 patients with unilateral

Table 4 Morbidity and disease specific mortality

Paper	Morbidity	Disease specific mortality
Blandy, 1976[3]	Not available	9/40 (22.5%)
Burchardt, 1982[4]	Not available	0/20 (0%)
Deutsch, 2016[5]	6/22 (27.3%)	2/22 (9.1%)
Flamm, 1987[6]	Not available	6/24 (25.0%)
Koga, 1991[7]	Not available	7/61 (11.4%)
Morgan, 2018[8]	1/29 (3.4%)	2/29 (6.9%)
Rous, 1977[9]	Not available	9/30 (30.0%)
Singh, 1973[2]	Not available	13/54 (24.1%)
Teichman, 1995[10]	Not available	2/3 (66.7%)
Vargas, 1982[11]	Not available	2/21 (9.5%)
Total	**7/51 (13.7%)**	**52/304 (17.1%)**

Table 3 Primary outcome measures

Paper	Progressive renal deterioration	Dialysis requirement	Severe urinary tract infection	Recurrent urinary tract infection
Blandy, 1976[3]	9/40 (22.5%)	Not available	16/40 (40.0%)	Not available
Burchardt, 1982[4]	0/20 (0%)	0/20 (0%)	0/20 (0%)	Not available
Deutsch, 2016[5]	3/22 (13.6%)	2/22 (9.1%)	Not available	11/22 (50.0%)
Flamm, 1987[6]	6/24 (25.0%)	Not available	Not available	Not available
Koga, 1991[7]	22/61 (36.1%)	Not available	1/61 (1.6%)	0/61 (0%)
Morgan, 2018[8]	10/29 (34.5%)	0/29 (0%)	2/29 (6.9%)	0/29 (0%)
Rous, 1977[9]	Not available	Not available	Not available	Not available
Singh, 1973[2]	8/54 (14.8%)	Not available	Not available	Not available
Teichman, 1995[10]	3/3 (100%)	Not available	Not available	Not available
Vargas, 1982[11]	6/21 (28.5%)	Not available	8/21 (38.1%)	4/21 (19.0%)
Total	**67/274 (24.5%)**	**2/71 (2.8%)**	**27/131 (20.6%)**	**15/133 (11.3%)**

stones.[2] However, there was no statistically significant difference between these two cohorts (p=0.18).

Discussion

This is the first systematic review examining the consequences of conservative management of staghorn calculi. The evolution of the surgical management of stone disease since the early seminal papers by Singh and Blandy has culminated in its acceptance as the current standard of practice.[1,12–14] Given that 28% of the patients treated conservatively in Blandy and Singh's cohort died, and that 40% required a delayed nephrectomy,[3] their arguments were compelling. Until the recent prospective study by Deutsch and Subramonion,[5] very limited work had been published on disease progression in those individuals who are unwilling or unable to undergo intervention.

In the six papers identifying reasons for non-intervention,[4–6,8,10,11] the most common were patient refusal or being anaesthetically unfit. Deutsch and Subramonian were the only authors who described the extent of the comorbidities using the American Society of Anesthesiologists (ASA) physical status classification system.[5] Nine per cent of their patients had an ASA grade of 2 and forty-one per cent an ASA grade of 3; the majority of these individuals refused surgical intervention. Other reasons cited by Deutsch and Subramonian included challenging anatomy, obesity, comorbidities such as spina bifida, ischaemic heart disease, diabetes, stroke, chronic obstructive pulmonary disease, Parkinson's disease and malignancy.

The most frequent complication faced by the cohort of conservatively managed patients was progressive renal deterioration, with a mean of 27.5% across the ten studies. Teichman *et al* reported a 100% rate of renal deterioration in their small cohort of three patients.[10] The data available from the other studies in this review were more encouraging, with Burchardt reporting no renal deterioration,[4] and Deutsch and Subramonian reporting a rate of 14%.[5] Comparing the outcomes of bilateral versus unilateral stone sufferers, Singh *et al* reported 44% of the former suffering renal deterioration versus 9% of the latter.[2]

Requirement for dialysis can only be inferred from Deutsch and Subramonian, who reported 9% requiring renal replacement therapy.[5] Similarly, the dialysis rate in Deutsch and Subramonian's cohort was 20% vs 6% when looking at bilateral versus unilateral calculi. On this evidence alone, it would seem prudent not to attempt a conservative approach in bilateral stone sufferers other than in extenuating clinical circumstances.

UTIs and large staghorn calculi are linked, with one often propagating the other and them subsequently exacerbating each other.[5,11,15] Pathological examination by Koga *et al* identified chronic infection secondary to stone disease as the principal cause of subsequent deterioration.[7] Five papers in our review reported on severe forms of UTIs (as defined above) during the follow-up period.[3,4,7,8,11] Only Burchardt's cohort had no cases of severe UTI.[4] The mean rate of severe UTIs among the five studies was 17.3%. One paper highlighted worse outcomes in this domain with bilateral calculi (80% vs 41%).[5] For recurrent UTIs, the mean across the four papers reporting this outcome was 17.3%[5,7,8,11] although the most recent prospective study reported a rate of 50%.[5]

With regard to disease specific mortality, it is interesting to note the wide variation from 0% to 67%. Allowing for the outlier in the study by Teichman *et al* with its small sample size of three patients,[10] the highest rate still stands at 30%.[9] In contrast, the most recent studies report mortality rates of 7% and 9%.[5,8] Deaths were more frequent among bilateral stone sufferers in the papers that provided this information[2,3,5] but this difference was not statistically significant (p=0.12).

Deutsch and Subramonian attribute the decrease in mortality and reduced loss of renal function in their conservatively managed cohort to the significant advancements in antibiotic and renal replacement therapy.[5] In considering the former, antibiotic treatment is still one of the pillars of successful sepsis treatment. Initial management should involve empirical antibiotic therapy that is guided by local antimicrobial recommendations as well as review of individual patients' urine culture and antibiotic resistance profile.[16]

A general recommendation for patients with obstructive pyelonephritis is the use of broad spectrum antibiotics to cover Gram negative pathogens, adding antibiotics to target Gram positive pathogens in those presenting with sepsis.[17] Conversion to culture specific antibiotics should be attempted as soon as possible. Various forms of renal replacement therapy are now available in the management of critically ill patients with an acute kidney injury. Intermittent haemodialysis is preferred in cases where hyperkalaemia supervenes whereas continuous renal replacement therapy is the modality of choice in cases of unstable uraemia or metabolic acidosis.[18] Ultimately, the chosen method must reflect local expertise and resource availability.

Conclusions

Our findings lead us to conclude that the conservative management of staghorn calculi is not as unsafe as previously thought. Mortality rates are lower when taking an aggregated mean of 21.8% compared with the early work in this area. The most recent studies indicate that a mortality rate of 7–9% in conservatively managed groups may be a more useful figure when counselling patients.[5,8]

However, in terms of renal decline, the evidence would support the early hypothesis that bilateral stone formers are (unsurprisingly) more likely to suffer. Singh *et al* reported in 1973 that 44% of bilateral staghorn formers experienced a decline in function compared with only 9% of unilateral cases[2] and in 2016, Deutsch and Subramonian demonstrated a similar theme (20% vs 6%).[5] The likelihood of dialysis being required was 9% in Deutsch and Subramonian's cohort, and the role of infection (both recurrent UTIs [23%] and severe urosepsis [18%]) is not to

be underestimated, once again being higher in patients with bilateral stones. This observation led Deutsch and Subramonian to consider the role of prophylactic antibiotics in their cohort, which further research would do well to address.

On this evidence alone, it would seem prudent not to attempt a conservative approach for bilateral staghorn calculi other than in extenuating clinical circumstances. On the other hand, in comorbid and/or unwilling patients with asymptomatic stones, conservative management may be a safer option than previously concluded from the original influential studies in this field.

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