Role of Open Surgery in the Management of Staghorn Calculus

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Objective: To evaluate the role of open surgery in the management of staghorn calculi by comparing it with other available modalities of treatment i.e. percutaneous nephrolithotomy (PCNL) and extracorporeal shockwave lithotripsy (ESWL) and assessing improvement in the renal function (parenchymal thickness & glomerular filteration rate (GFR) after stone removal. **Design:** Institutional- based prospective study. **Place and Duration of study:** This study was conducted at the department of Urology, Nishter hospital, Multan from January 2000 to February 2002 (2 years). **Subjects & Methods:** A total of fifty patients with staghorn calculi who underwent open surgery in the department & completed a three-month follow-up were included in the study. All patients had a complete blood examination (CBE), complete urine examination (CUE) (including culture & sensitivity (C/S), renal parameters (urea & creatinine), renal tract ultrasonography (USG) preoperatively & at first, second & third month of follow-up to assess the improvement in heamoglobin, control of urinary tract infection (UTI), parenchymal thickness & postoperative complications. Tc^{99m} DTPA scan was employed before surgery & at third month of follow-up to evaluate the improvement in GFR for operated kidney. **Results:** The male to female ratio was 2.1:1, with a mean age of presentation of 42.70 years. Pain in the lumbar region (58%) was the most common presentation followed by lower urinary tract symptoms (LUTS 32%) & renal insufficiency (16%). Fever (36%) was the most common postoperative complication. The mean cortical thickness increased to 10.68 mm at third month of follow-up, compared to 9.26mm before surgery. The mean preoperative Hb was 10.84gm/dl. It fell to 10.21 gm at first month of follow-up but increased to 11.89 gm by the third month. . The mean GFR before surgery was 77.18ml/min, which increased to 81.56ml/min after surgery at third month of follow-up. The mean GFR of the kidney with stones was 32.46 ml/min before surgery, which increased to 39.84-ml/ min after surgery. **Conclusion:** Staghorn stones if left untreated lead to chronic UTI & renal insufficiency. Removal of the stone is the only way these consequences can be avoided. Non-availability of resources, a poor health care system, the lack of PCNL & ESWL facilities&/or expertise, the cost & need for multiple sessions &/or ancillary procedures in these minimally invasive techniques & the vigorous follow-up required still make open surgery a viable & an applicable option in our socioeconomic setup.

Key words: Staghorn calculi, open surgery, PCNL, ESWL, GFR.

Urolithiasis is a common disease with a worldwide distribution. It affects about 2-3% of the world population[1]. Urinary calculi are a major problem in Pakistan & account for the commonest urological ailment in this country[2]. Staghorn calculus is the description used to describe a stone, which fills the renal pelvis & calices. A complete staghorn calculus is a cast of the entire renal pelvis & calices. A complete staghorn calculus can be further classified into C4 type (extends into calices) or C5 type (extends into three or more calices) [3]. A partial staghorn calculus involves the renal pelvis & extends into at least two infundibula (or one calyx) [3]. Partial & complete staghorn calculi constitute 15% of all calculi treated in Pakistan & 12.5% of the stones treated in the West.[4] Most stones of staghorn variety are infection related & composed of magnesium ammonium phosphate (MAP/Struvite) along with calcium phosphate &/or carbonate-apatite.

The availability of new techniques like PCNL & ESWL has revolutionized the management of staghorn calculus in the last decade. Staghorn calculi can be treated by conventional open surgery, ESWL, PCNL or a combination of any of these modalities. A few composed of urate, can be dissolved by oral alkali therapy or percutaneous irrigation.

The aim of this study was to evaluate the role of open surgery in the management of staghorn calculi & its comparison with other modes of treatment available. Another objective of the study was to assess the improvement in renal function & chronic UTI after removal of the stone. A staghorn calculus may remain symptom less for a number of years & may only be detected as an incidental finding. Renal failure is an important & common mode of presentation of such calculi. Twelve percent of admissions to Nephrourological units in Pakistan are for renal failure from calculus disease[5].

Material and methods:

This study was conducted in the department of Urology Nishter Hospital, Multan from January 2000 to February 2002 (2 years). Fifty patients who underwent open surgery during this time & completed the follow-up protocol were included. In order to assess the improvement in renal function after open surgery, patients at extremes of age (< 5 years & > 70 years) were excluded to avoid the effects of extremes of age on normal renal function. Similarly those with underlying medical/congenital/surgical conditions/diseases (effecting the renal function) were excluded. These included hypertension, Diabetes Mellitus, Polycystic Kidney disease, Genitourinary Tuberculosis, Neuropathic Bladder, Renal Malformations (Horse shoe

kidney/Ectopic kidney), PUJ obstruction, ureteric & urethral obstruction (stricture, stone, neoplasm), prostate enlargment & retroperitoneal fibrosis. Finally patients with a total GFR (of both kidneys) of <20ml/min & differential GFR of <10 ml/min (in the kidney with staghorn calculus), were also excluded from the study as the chances of renal function recovery after surgery were in doubt.

All patients had a complete blood examination, complete urine examination (including culture & sensitivity), random blood sugar, serum electrolytes (sodium & potassium) & renal parameters (urea & creatinine). In every patient an X-ray KUB & renal tract ultrasonography were obtained. Intravenous urogram was carried out in patients with normal renal parameters. A Tc^{99m} DTPA scan with GFR was performed in all patients before open surgery.

All patients in the study underwent open surgery. The various modalities used included pyelolithotomy, extended pyelolithotomy (Gil-Vernet pyelolithotomy), pyelonephrolithotomy, anatrophic nephrolithotomy & nephrectomy. Postoperative follow-up was carried out to assess improvement in renal function, hemoglobin, parenchymal thickness, control of urinary tract infection & early/late postoperative complications. CBE, CUE (including culture in case of UTI), renal parameters & USG (renal tract) were performed at first, second & third month of follow-up. Tc99m DTPA renal scan with GFR was only carried out at third month of follow-up. In addition of the above a stone analysis was done in every patient to determine the stone composition.

Results:

34(68%) patients were male & 16(32%) were females (Male to female ratio 2.1:1). Patient age ranged from 9 to 70 years (mean 42.70 years). The mean age in males was 41.50 years while the mean age in females was 45.25 years. Pain in the lumbar region was the most common presentation seen in 29 (58%) patients, followed by LUTS in 16(32%) patients. Renal insufficiency was present in 8 (16%) patients on presentation. Bilateral staghorn stones were present in 7(14%) patients, of which 5 were females. Family history of stone disease was noted in 7 (14%) of the patients. 17 (34%) patients had past medical history of stone management with 11 (22%) undergoing open surgery & 6 (12%) patients had ESWL. In this series, 23 (46%) patients had a pyelolithotomy, 18(36%) underwent pyelonephrolithotomy, 4 (8%) had an extended pyelolithotomy, 3 (6%) an anatrophic nephrolithotomy & 2 (4%) a nephrectomy. Fever was the most common postoperative complication noted in 18(36%) patients. Residual stones were present in 4 (8%) patients. Pure MAP stones were present in27 (56%) patients. 14 (28%) patients had MAP stones in combination with other chemical compounds. While staghorn calculi without struvite component were present in only 9 (18%) patients.

The mean preoperative Hb of 10.84 gm/dl fell to 10.21 gm at first month of follow-up, but increased to 11.04gm & 11.89 gm at second & third month of follow-up respectively. The mean cortical thickness increased to 10.68 mm at third month of follow-up, compared to 9.26 mm before surgery. 33 (66%) had UTI at presentation, with Proteus Mirabalis being the most common pathogen involved in 24 (48%) patients. 8 (16%) had UTI at first month of follow-up. 3 (6%) patients at second month & 2 (4%) at third month of follow-up still had UTI. Escherichia Coli was the most common pathogen identified in the follow-up period.

The mean GFR before surgery was 77.18 ml/min, while the mean GFR of the kidney with the stone was 32.46 ml/min. (Mean GFR of 57 kidneys in 50 patients, as 7 patients had bilateral stones). After surgery the mean GFR at third month of follow-up was 81.56 ml/min & mean GFR of the kidney with stone turned out to be 39.84 ml/min. The mean GFR for the operated kidney in patients who underwent pyelolithotomy/extended pyelolithotomy was 41.66 ml/min compared to 37.31 ml/min in patients who had a nephrolithotomy (pyelonephrolithotomy/ anatrophic nephrolithotomy).

Table 1

Variables	Pre-Operative	Post-Operative (3rd Month)
Heamoglobin	10.84 gm/dl	11.89 gm/dl
Parenchymal thickness	9.26mm	10.68mm
Mean Total GFR	77.18ml/min	81.56ml.min
Mean GFR of kidney with stone	32.46ml/min	39.84ml/min
After Pyelolithotomy/ Extended Pyelolithotomy	_	41.66ml/min
After Nephrolithotmy/ Pyelo-Nephrolithotomy Anatrophic Nephrolithotmy	_	37.31ml/min

Preoperative & Postoperative comparison in Heamoglobin, cortical thickness & renal function. (Table I)

Discussion:

Staghorn calculi are associated with urinary infections, obstructive & gradual loss of renal function. Renal related or sepsis related mortality rates in the past for patients having staghorn calculi & treated conservatively were as high as 30%. With rates of only 5% for those managed with early operative intervention[5]. The management of staghorn calculi is one of the most demanding tasks in urology. Although the indications to intervene in patients with staghorn calculi are clear, there is no consensus regarding the most appropriate form that the intervention should take. However there is general agreement that the intervention must be individualized with specific consideration given to the size & configuration of the stone & the level of renal function, total & in the involved

kidney. The primary considerations in the management of staghorn calculi are three fold

1. To minimize the rates of residual stones & recurrent stones.
2. To minimize urinary tract infections.
3. To preserve renal function.

Due to the availability of ESWL, PCNL & other endourological techniques in the developed countries, an emphasis has shifted from open surgery to these alternatives. ESWL revolutionized the treatment of urolithiasis since its introduction in the 1980's. It is a preferred method of treating renal stones smaller than 3cm[6]. Success rates decrease with increasing stone size. ESWL as monotherapy for staghorn calculi has been reported. The residual stone rate of approximately 50% for larger stones managed this way however is significantly higher than that for open surgical intervention & percutaneous management [7,8]. Furthermore post ESWL infection related stones clearly are associated with unacceptably high rates of recurrent infection & stone growth[9].

PCNL for the management of staghorn calculi was first reported by Clayman & associates[10]. Whether a given staghorn stone is suitable for PCNL will depend upon the stone shape size & intrarenal anatomy. In some patients two to three tracts are required to make patient stone free. Few reports are available that evaluate PCNL solely for infection calculi. As these calculi are usually branched or staghorn shaped, multiple nephrostomy tracts must often be placed to access all stones. In these complex cases, multiple procedures are the rule rather than the exception[11].

In the present study, 34 patients were male & 16 were female. Contrary to the previous studies in which more common occurrence of staghorn stones in females were reported [11] this was not the case in the present study. This could be due to the fact that the males are the sole bread earners of the family & are given priority to health care access in our society. In most developing countries patients with renal calculi present late for definite treatment. The mean interval between appearance of symptoms & presentation for treatment was 15 months in males & 27 months in females.

The main aim of this study was to assess the two parameters, which were crucial in deciding the outcome, namely improvement in renal function & postoperative control of UTI. 33 patients had UTI on admission. At first month of follow-up 8 patients still had UTI. 3 patients had Proteus Mirabalis, 4 had E.Coli & 1 had Kleibsella. Four of these patients had residual stones. At two months of follow-up, 3 patients had documented UTI. 2 patients carried E. Coli & 1 had Proteus infection. All three patients had residual stones. Two of the three patients had ESWL sessions during the second month of follow-up. The third patient could not be subjected to ESWL due to renal insufficiency. At the third month of follow-up, 2 patients with residual stones still presented with UTI, E. Coli being the offending agent in both cases. UTI is an important factor in the morbidity associated with staghorn & infection calculi. Struvite calculi, which comprise the major part of staghorn stones, harbor infective bacteria within their interstices. Stamey et al demonstrated that bacteria cultured from these stones could be preserved in formalin for years [11]. The penetration of antibiotics into these stones is inadequate for cure. Therefore as long as the infected calculi remain in the collecting system it becomes almost impossible for the urinary tract to be sterilized[12].

In the present study, the mean GFR improved from 77.18ml/min preoperatively to 81.56ml/min after surgery (an increase of 4.38ml/min at three months). The mean GFR of the kidney with the stone improved from 32.46ml/min preoperatively to 39.84ml/min after surgery (an improvement of 7.38ml/min at three months). The mean total GFR was marginally higher in males compared to females (4.88 ml/min for males versus 3.32 ml/min for females). This may be due to two reasons. First due to the physiological difference between the two sexes & secondly the majority of the patients presenting with bilateral renal stones & renal insufficiency were women. The effect of this increase in GFR had a definite impact on the prognosis of the patients. At presentation 8 patients had some degree of renal insufficiency. Five patients were dialyzed preoperatively & after surgery only 2 patients required maintenance dialysis. This improvement in mean GFR was marginally better in patients undergoing pyelolithotomy & extended pyelolithotomy compared to patients who had a nephrolithotomy. The mean GFR for the operated kidney in patients with pyelolithotomy/ extended pyelolithotomy was 41.66 ml/min compared to 37.31 ml/min for patients who had a nephrolithotomy. This could be linked to more traumatic surgery during nephrolithotomy leading to greater damage to parenchymal segmental blood supply. This observation also supports the largest study done in this regard by Kawmura et al in which functional improvement in operated kidney was greater in patients who had a pyelolithotomy than in patients who had undergone nephrolithotomy[13]. To date no individual study has been done exclusively to study the functional improvement after anatrophic nephrolithotomy. A comparison of PCNL & anatrophic nephrolithotomy has shown a higher stone free rate with the latter[14]. In the present series all patients who had an Anatrophic Nephrolithotomy had an uneventful recovery as far as the functional status of the kidney was concerned. None of these patients had renal insufficiency or UTI at third month of follow-up.

Conclusion:

In Pakistan the lack of PCNL & ESWL facilities &/or expertise, the poor health care system, the cost & need for multiple treatment sessions &/or ancillary procedures &

the vigorous follow-up required in these minimally invasive procedures still make open surgery a viable & worthwhile option. The favorable results obtained in the present study with special reference to improved renal function & overall clinical status (UTI & Hb) make open surgery a useful modality to consider. Keeping in view the socioeconomic aspects of our society, open surgery is the best option available in the management of staghorn calculi.

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