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Urology

THE MANAGEMENT OF RENAL MATRIX CALCULI: A SINGLE CENTRE EXPERIENCE OVER 7 YEARS

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ABSTRACT

Introduction: To report our experience with the treatment of renal matrix stones, an infrequent form of urinary calculi whose diagnosis and treatment are often difficult.

Materials and Methods: Retrospective & prospective study, June 2011 – May 2018, PCNL done for 1400 Pts. 32 for matrix calculi, Pre-procedure investigations included-CECT KUB,Urine Routine and culture. PCNL procedure was performed in all, Post op follow up was done.

Results: Incidence in our population was 2.2%. Mean age was 44.3 years. Flank pain was commonest mode of presentation. Most common predisposing factors being previous urolithiasis. A plain X-ray showed a small radio-opaque calculus in 16 patients. Non-contrast computed tomography diagnosed calculi 32 patients with mean Hounsfield units being 550HU. The mean stone size was 2.2cms.The mean hospital stay was 4.3 days and decrease in haemoglobin was 0.89 g/dL. One patient developed sepsis. Of 24 stones analysed, 6 were composed entirely of proteins and the remaining 18 had crystalline components. At a mean follow-up of 12.2 months, no patients had recurrence of stones.

Conclusion: Percutaneous lithotripsy has been confirmed as the first option for matrix stones.

KEYWORDS : MATRIX STONE, PCNL

Introduction:

Renal matrix stones - also known as fibrinomas, colloid calculi or albumin calculi - are a rare form of calculi first described in 1908 by Gage and Beal [1]. In contrast to the normally brittle calcium stones, they are soft, pliable and amorphous, since the matrix component accounts for approximately 65% of their dry weight instead of 2.5%; accordingly, matrix stones appear radiolucent or weakly radiopaque due to their very low content of mineral components [2].

In most cases, conventional radiological techniques are unable to make a correct diagnosis of renal matrix stones. Intravenous urography does not always help distinguish between matrix stones and other filling defects, whereas computed tomography (CT) is more reliable in diagnosing this particular type of calculi. However, an unquestionable diagnosis is usually made at surgery.

To the best of our knowledge, up to now 60 cases have been reported. All patients were treated with surgical approach or, since 1990, with percutaneous nephrolithotripsy (PCNL) [3,4,5]. Herein, we report our experience with the endourological treatment of this relatively rare entity.

Aim:

- To define incidence of renal matrix calculi in pts undergoing PCNL
- To describe clinical, laboratory and radiological features
- To study efficacy of PCNL in treating matrix stones

Materials and Methods:

This was an observational study conducted at the Institute of Urology, Madras Medical College from June 2011 to May 2018. Retrospective & prospective study. PCNL done for Pts – 32 for matrix calculi. Pre-procedure investigations included

- CECT KUB
- Routine biochemical examination , S.Ca, P, Uric acid
- Urine Routine and culture

Culture specific antibiotics for 2 days before procedure.

§PCNL procedure was performed in all. Nephrostomy tube removed after 48 hrs. Foleys removed after 72 hrs. Ureteric stent was placed in situ for 4-6 wks. Stent removed after X-Ray KUB / USG. Stones analysis was done.

Results :

Figure 1: Mean Age: 44.3 years(26-71)

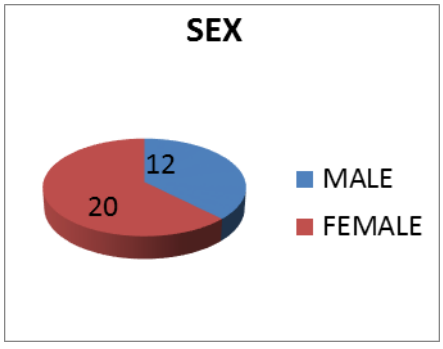


Figure 2: LATERALITY

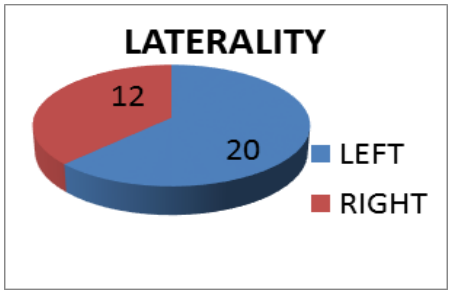


Figure 3 : PRESENTING COMPLAINT

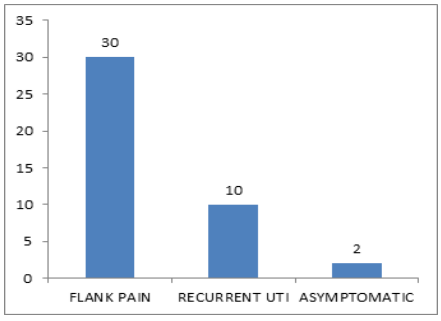


Figure 4 : PREDISPOSING FACTORS

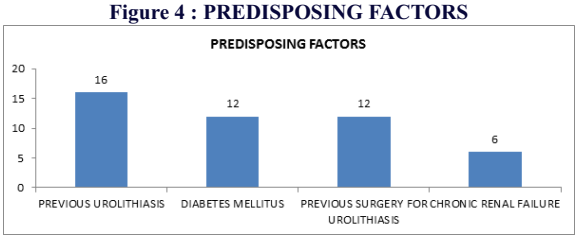


Figure 5: Investigational Findings

Variables	Mean
Pyuria on urine analysis	28
Urine culture	
Sterile	12
Significant growth	20
E.Coli	16
Klebsiella	2
Pseudomonas	2
Proteus	4

Figure 6: Imaging(per renal unit)

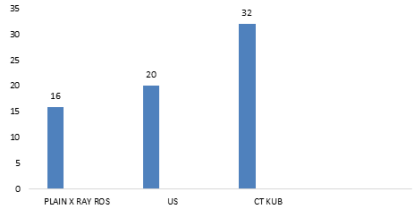
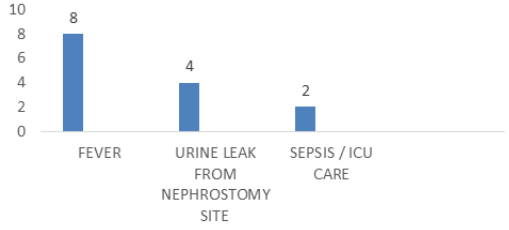


Figure 7 : Operative data

Variable	Mean
Access tract	
Single	24
Multiple	8
Supracostal access	4
Duration of Sx	42 min(25-98 min)
Pyonephrosis(procedure abondoned)	8
Duration btw initial perc. Nephrostomy and PCNL	14.6 days(4-35)
Duration of Foley's catheterisation	2.8days(1.9-9.2)
Hospital stay	4.2 days(2-13)
Fall in Hb after PCNL	0.89(0.2-1.6)

Figure 8: Complications



Follow up

Median follow up -12.2 months
Recurrence – 4 patients
Stone analysis- 24 stones
Entirely protein-6
Crystalline components-18

Discussion:

Matrix stones are an uncommon form of renal lithiasis. The matrix bulk accounts for approximately 65% of dry weight, with a very low percentage of the mineral components [2]. Boyce and Garvey [6] demonstrated that this organic substance is similar, but not identical, to the matrix component of the calcareous stones. According to their analysis, the matrix consisted of mucopolysaccharide (one third) and protein (two thirds); the main components of carbohydrates were hexose and hexosamine, whereas threonine, leucine, serine, tyrosine, arginine and lysine were the most common amino acids of the protein component.

Despite their fibrillar structure - as shown by electron microscopy analysis of matrix stones formed in similar patients with proteinuria and on hemodialysis - the proteinaceous material differs from Tamm-Horsfall protein [7].

The role of the matrix substance in crystalline calculi is not completely understood. Matrix might provide a framework for deposition of crystals or be a co-precipitate in a mineralogical environment [8,9]. The reason for the failure of crystal deposition in matrix stones is also unknown. Histological examination shows laminar concentric rings of organized matrix with an orderly, layered deposition of mineral. Bani-Hani et al. [4] believe that reduced urinary excretion of calcium by the affected kidney is responsible for the lack of calcifications, but it is possible that the normal calcium excretion by the contralateral kidney compensates for the 24-hour urinary calcium amount. Indeed, all our patients were normocalciuric and we did not find any alteration at metabolic screening.

While normal stones are more common in males, matrix calculi are more frequently seen in females [3]. The main risk factors for this type of stones are previous surgery for stone disease [5] and/or recurrent UTIs, especially due to *P. mirabilis* or *Escherichia coli*. In our group of 9 female patients, 3 had been affected by symptomatic recurrent UTI and 2 had asymptomatic bacteriuria, all of them with urine culture positive for *E. coli*. Only 1 patient had previously been repeatedly (11 times) treated for stone disease. In this patient, urine culture was positive for *P. mirabilis*.

The link between kidney matrix stones and chronic kidney failure is of interest, especially in patients on maintenance hemodialysis, in whom proteinuria and/or UTI or positive urine culture could represent risk factors for developing matrix stones [5,7].

The clinical presentation of patients with matrix stones is similar to those with calcium nephrolithiasis, flank pain and UTI being the most common symptoms. The tendency of these stones to adapt themselves to the shape of the renal pelvis and ureter may lead to gradual obstruction of the urinary tract, sometimes resulting in acute renal failure in patients with bilateral disease [10,11].

The imaging of matrix stones can be difficult because no specific radiological investigation is available: in most cases, the diagnosis is only made after surgery [5]. The radiological appearance of these stones can be variable. Bani-Hani et al. [4] reported the presence of gas in the renal pelvis, probably secondary to active infection. Intravenous urography in these patients is often of poor diagnostic value due to impaired renal function, which makes the contrast medium inadequate to outline the filling defects. Retrograde pyelographic studies can help see the filling defects, which, however, must be evaluated in the differential diagnosis with tumors, clots, polyps or other types of calculi.

Ultrasound imaging shows a solid structure without the classic hyperechogenicity of stones and acoustic shadowing, depending on the amount of mineralization.

The CT scan appearance of matrix stones varies, depending on mineral volume, composition and internal distribution. Some authors described egg-shaped matrix stones with a mineral rim and soft tissue center [4,12,13]. In our series the Hounsfield units (HU) were evaluated just for 1 patient (No. 9), the value being between 500 and 600 HU. This value is not suitable to define the chemical composition of stones and it does not help in the diagnosis of matrix stones. In fact, just for HU >1,000 or <400 it is possible to predict the stone composition (CaOx vs. urate) [4,12,13]. For the same reason the CT density does not help in distinguishing matrix stones from other disease.

Magnetic resonance imaging has also been tested for the diagnosis of matrix stones disease because of the low nephrotoxicity of gadolinium. Typically, matrix stones show a hypointense signal in T1-weighted images and a slight hyperintense signal in T2-weighted images [14].

When treatment is planned, two factors should be considered: the

probability of fast growth and the possibility of a spontaneous, although exceptional, expulsion. Lower-size calculi usually have a negligible chance of progression along the urinary tract and therefore treatment is mandatory.

In the past, open surgery was the preferred technique [3]. Due to the soft consistency of the stones, methods like milking of the proteinaceous material from the ureter into the bladder or use of a special bottle brush to clear the pelvicalyceal system were used during this procedure [8,15].

Nowadays, the most appropriate choice in the treatment of matrix stones is the endourological option. Both procedures, the antegrade (PCNL) and the retrograde (RIRS) one, have been used by various authors [3,4,5,16,17,18]. PCNL may be safe and effective to remove matrix calculi in a single session, while the ureteroscopic approach is often inadequate with large bulk of stones. Therefore, RIRS may represent a valid option especially for lower-size and for recurrent calculi: in case of stones >2 cm, multiple sessions should be considered. Otherwise, the retrograde approach provides a correct diagnosis in doubtful cases.

SWL is usually ineffective due to the stones' gelatinous component and a lack of breakable mineral content [4]. In our series, SWL was only employed for residual mineral fragments.

At variance with some reported evidence of early recurrences in patients with persisting UTI, these stones have a very low recurrence rate, and with the first approach the problem can be definitely solved [5]. Both washing the pelvis and the calyces after the endourological procedures and eliminating infections can be critical to prevent recurrences. Prophylaxis with antibiotics is believed to be effective to avoid matrix stone recurrences. Unfortunately, however, the length of the treatment period has never been clearly established. Several preparations for lowering urine pH might also be useful in treating patients with infected renal stones [19,20].

Conclusion:

Matrix calculi occurred in 2.2% of patients undergoing PCNL. Although considered radiolucent, plain X-ray showed a small radio-opaque calculi or faint laminated calcifications. PCNL rendered patients stone-free with minimum morbidity.

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