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Original Research Article

The Management of Renal Matrix Calculi in a Tertiary Care Teaching Hospital

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Abstract:

Background: Matrix stones are an uncommon form of urinary calculi, presenting a diagnostic and therapeutic dilemma to the practicing urologist. Endourological procedures like PCNL and URSL are safe and efficacious for the management of matrix calculi in recent times. Based on this aim of present study is to define incidence of renal matrix calculi in pts undergoing PCNL. Also to describe clinical, laboratory and radiological features and efficacy of PCNL in treating matrix stones

Methodology: We retrospectively reviewed the records of 800 PCNLs performed from June 2011 to May 2016, and identified 16 patients in urology department of tertiary care teaching hospital and collected all related data.

Results: Flank pain was commonest mode of presentation followed by recurrent urinary tract infection. Pyuria was present in 12 patients and urine culture showed significant growth in 10. A plain X- ray showed a small radio-opaque calculus in 8 patients. Computed tomography diagnosed calculi in missed patients too. PCNL was abandoned initially in four patients due to pyonephrosis. The mean hospital stay was 4.52 days and decrease in hemoglobin was 0.92 g/dL.

Conclusions: Matrix calculi occurred in 1.24% of patients undergoing PCNL. PCNL rendered patients stone-free with minimum morbidity. In future, prospective multicentric studies are necessary to provide insights into the aetiopathogenesis of this rare entity. Histochemical investigation can also provide an insight into the possible sequence of events in normal stone formation.

Keywords: Kidney Stone, PCNL, Matrix Stone.

Introduction

Matrix stones are an uncommon form of urinary calculi, presenting a diagnostic and therapeutic dilemma to the practising urologist [1]. By contrast with the normally brittle calciferous calculi, they are soft, pliable and amorphous [2]. These radiolucent concretions are composed primarily of a non-crystalline mucoprotein matrix. Since the first description by Marcet et al. in 1817, there have been infrequent case reports of these calculi.

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. The high protein content and low calcium content cause these calculi to be radiolucent, making it difficult to detect them on plain radiograph [3]. Pure matrix calculi with no mineral content are too soft to produce acoustic shadowing making it difficult to detect them on ultrasound [4]. CT is a valuable tool for the evaluation of these calculi. Patients with matrix calculi may show a non-enhancing soft tissue mass within the pelvicalyceal system on a CT scan [5].

Matrix calculi occupying the pelvicalyceal system or ureter may also appear as filling defects on imaging making it difficult to differentiate it from urothelial tumours or fungal ball in the urinary tract. The clinical presentation of patients with matrix stones is similar to those of calciferous stones. Unusual presentations of acute renal failure due to bilateral renal matrix calculi and emphysematous pyelonephritis have also been described in literature [6]. Though open surgery was used in the past for treating matrix stones, Endourological techniques have now replaced them [6]. Extracorporeal Shockwave Lithotripsy (ESWL) is not an effective option due to the gelatinous nature of these calculi and the lack of breakable mineral content [7]. Endourological procedures like PCNL and URSL are safe and efficacious for the management of matrix

calculi in recent times [8]. Matrix calculus of the urinary tract is, thus, a rare and challenging clinical condition, with no clear recommendations for its management.

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.

Based on this aim of present study is to define incidence of renal matrix calculi in pts undergoing PCNL. Also to describe clinical, laboratory and radiological features and efficacy of PCNL in treating matrix stones

Material and Methods

We retrospectively and prospectively reviewed records of 800 PCNLs performed at our institute from June 2011 to May 2016, and identified 16 patients. PCNL was planned for the treatment of large renal or upper ureteric calculi. All patients with normal serum creatinine levels had IVU for the functional evaluation and to provide anatomical information for surgery. All patients had serum calcium, phosphorus and uric acid levels estimated, in addition to other routine biochemical investigations. Urine samples were analysed and cultured in all patients before PCNL and patients were given culture-specific antibiotics for 2 days before the procedure. CECT All PCNLs were performed with the patient under general anaesthesia, by one urologist. Haemoglobin levels were estimated on the first day after PCNL in all patients. Patients with supracostal access received intensive chest physiotherapy and spirometry. They also had chest radiography on the first day.

Patients received diclofenac sodium or tramadol hydrochloride for pain management. A plain X-ray and nephrostogram were taken in all patients on the second day, once the urine cleared; when in doubt, check flexible nephroscopy was used and residual fragments, if any, were removed. The nephrostomy tube was then removed after 48 hours. The Foley catheter was removed 72 hours. Culture specific antibiotics for 2 days before procedure. Ureteric stent removed after X-Ray KUB / USG after 4-6 weeks and stones were analyzed

Results

The patients' demographics are as below, ten patients were women and rest was male in our study. Age range was from 26 to 71 years and mean age was 44.53 years. 10 had right side stone and rest 6 had left side stones. Flank pain was seen in 10 patients, recurrent UTI in 5 patients and one patient as asymptomatic.

Also, six patients had had previous surgical procedures for stone disease; none of these patients were known to have matrix calculi previously. The serum calcium, phosphorous and uric acid levels were normal in all the 16 patients. Diabetes mellitus was present in 6 patients and renal failure in 3 patients.

Table 1: Urine culture sensitivity

Urine culture sensitivity	Number of patients
Pyuria on urine analysis	14
Urine culture	
Sterile	6
Significant growth	10
E.Coli	8
Klebsiella	1
Pseudomonas	1
Proteus	2

In our study population pyuria was present in 14 among 16 patients among which growth was present in 10 patients. E coli being more common organism. A plain abdominal X-ray was normal in 8 patients, suggesting the presence of pure radiolucent calculi in rest 8 patients. Mean stone size was 2.2 cm (1.2-3.5). USG identified stones in 10 cases while CT diagnosed stone in all patients.

Table 2: Outcomes of PCNL

Variable	Mean
Access tract	
Single	12
Multiple	4
Supracostal access	2
Duration of Surgery	42 min (29 – 63 min)
Pyonephrosis (procedure abandoned)	4
Duration btw initial perc. Nephrostomy and PCNL	15.2 days
Duration of Foley's catheterization	2.65 days
Hospital stay	4.52 days
Fall in Hb after PCNL	0.92

All except four patients needed a single access tract. Access was supracostal in 2 patients, including 11 with an 11th rib intercostal space tract and two with a 10th rib intercostal space tract. The mean (range) duration of surgery was 42 (25–98) min. The initial procedure was abandoned in four patients due to pyonephrosis. The mean duration between initial percutaneous nephrostomy and definitive PCNL in these patients was 15.2 days, the mean duration of Foleys catheterization was 2.65 days, the mean hospital stay was 4.52 days and decrease in haemoglobin after PCNL was 0.92 g/dL.

The commonest complication after PCNL was fever, in three patients. No patients needed a blood transfusion. Of 14 stones analyzed, three were composed entirely of proteins and the remaining 11 patients had crystalline components in their stones. Two patients had recurrence on follow up.

Discussion

Matrix calculi are an uncommon form of urinary tract concretion. Of 800 patients who had PCNL from April 2003 to March 2008 at our center, 16 (2%) had matrix calculi. By contrast with normal calciferous renal calculi, which are more common in males, matrix calculi are more common in females; Stoller et al. [2] found that they were three times more common in females. They also have tendency to occur in patients who are stone-formers, especially if they have previously had surgery for stone disease. In the present series six had undergone previous surgery for stone disease. None of these patients were known to have matrix calculi in the past.

UTI, usually with Escherichia coli, is a known predisposing factor for developing matrix calculi. Although only five of the present 16 patients had a history of symptomatic recurrent UTI, urine analysis showed pyuria in 14, and urine culture showed significant growth in 10. The bacteria isolated were E. coli, Proteus, Klebsiella and Pseudomonas. We did not culture the matrix stones directly.

In present study, three patients had chronic renal failure; however these patients also had a positive urine culture suggesting an associated UTI. It is difficult to differentiate whether UTI is a cause or effect of matrix calculi in these patients. Similarly Branten et al. [9] described a case of matrix calculi in a non-dialyzed patient with chronic renal failure. Flank pain and UTI are the most common presentations of matrix calculi, but these calculi can conform to the shape of the ureter and cause urinary tract obstruction. Singh et al. [10] and Matthews and Spirnak [11] described cases of bilateral ureteric obstruction and acute renal failure secondary to bilateral matrix calculi. Patients can also rarely develop emphysematous pyelonephritis [12].

Although matrix calculi are usually considered radiolucent, a plain X-ray detected a small radio-opaque calculi or faint laminated calcifications in 8 of the 16 patients. Similar findings were reported from the Mayo Clinic, where the authors found central or peripheral calcification in four of their five patients.

CT can usually identify a non-opaque calculus and distinguish it from other causes of radiolucent filling defects in the collecting system. Kim et al. [13] described a case of a stone lacking acoustic shadowing on ultrasonography. There is also a report of a matrix calculus with no mineral content and soft-tissue attenuation on CT [14]. Such cases might need diagnostic ureteroscopy for confirmation

The successful management of urinary matrix calculi depends on a high index of suspicion. They are best treated by percutaneous or surgical extraction, sterilization of the urine and maintenance of dilute urine. Open surgery was the method of choice for treating these patients in the past. Due to the soft consistency, methods like milking the proteinaceous material from the ureter into the bladder, or using a bottle brush to clear the pelvicalyceal system were used during open surgery [15]. However, recently open surgery was replaced by endourological intervention. PCNL was found to be safe and effective in four patients with matrix calculi. These findings were confirmed in the present study too.

Fortunately, these stones have a very low recurrence rate once the stone is completely cleared. In a large series of 40 patients with infection stones, with a mean follow-up of 7 years, the recurrence rate was only 2.5% [16]. Those authors concluded that the negligible recurrence rate emphasizes that these stones are caused by urea-splitting bacteria, rather than metabolic disorders. In our study 2 patients had recurrence.

We think that our protocol of leaving a nephrostomy tube in every patient for a postoperative nephrostogram, and flexible nephroscopy when in doubt, regardless of the results of intraoperative endoscopy and radiography, ensures complete stone clearance. The main limitation of our study is the lack of a long-term follow-up.

Conclusion

Matrix calculi occurred in 1.24% of patients undergoing PCNL. PCNL rendered patients stone-free with minimum morbidity. In future, prospective multicentric studies are necessary to provide insights into the aetiopathogenesis of this rare entity. Histochemical investigation can also provide an insight into the possible sequence of events in normal stone formation.

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