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Descriptive Profile of Urolithiasis Cases in a Tertiary Hospital in Sabah

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ABSTRACT

Urolithiasis is a common urological problem in Malaysia. Stones can be formed by precipitation or crystallization of minerals and urinary constituents. It is a multifactorial, recurrent disease distributed worldwide with a trend of increasing incidence. This study aims to describe the characteristics of patients with urolithiasis in a tertiary centre in Sabah. Patients seen in the urology clinic or inpatient ward in the Department of Urology, Hospital Queen Elizabeth, Sabah, who had urolithiasis confirmed on plain CT KUB were reviewed. Demographic data regarding age, gender, race, address, and BMI were recorded. Details regarding fluid intake and family history of urolithiasis associated with medical conditions like diabetes, hypertension, and gout were collected during the interview with the patient. Routine urine and blood investigations for urolithiasis were performed, and results with CT scan findings were recorded in a data collection sheet. A total of 300 patients with urolithiasis were reviewed. The median age was 54 years, with similar gender distribution. BMI above normal was found in 69% of participants, and 55% had underlying hypertension. The highest incidence was seen in the Kadazan-Dusun population. Those who consume < 2 L/day of fluid also had a higher frequency of urolithiasis. 60.6% of stones were unilateral, whereas 43.7% were found to be renal. There were 39.7% of patients who had CKD stage 2. The mean Hounsfield unit of stones was 1,091. In conclusion, urolithiasis is a common problem worldwide, and it is apparent that its burden on the healthcare system is increasing. These findings will help better understand local clinical characteristics to prevent and reduce morbidity and mortality by urolithiasis.

INTRODUCTION

Urolithiasis is a common urological problem increasing in prevalence in many high-incidence nations and worldwide (Trinchieri et al., 2000). The prevalence of urolithiasis appears to have increased over the last 30 years in the USA (Stamatelou et al., 2003). This leads to a substantial economic burden on the healthcare systems in various countries. Data from Hospital Episode Statistics in the UK shows a 63% increase in the incidence of urolithiasis between the year 2000 to 2010 (Turney et al., 2012). In Asia, an increasing trend of urolithiasis is seen in Japan, China, and Korea. The prevalence of urolithiasis in China was 6.5% in 2015 (Yang et al., 2016). In Korea, the incidence rate was 457 per 100,000 Koreans in 2002, higher than in most of Asia (Bae et al., 2014).

Malaysia is situated in the Asian 'stone belt' region with a high incidence of urolithiasis. However, there is still a paucity of data on demographics, clinical characteristics, and stone profiles. The prevalence of kidney stone disease among patients admitted to Hospital Universiti Sains Malaysia (HUSM) from 2012 to 2016 was 1.8% (Nouri & Hassali, 2018). A study on the incidence and management of urinary stones in Malaysia between 1980 – 1989 showed no difference in urinary stone disease occurrence among the Malay, Chinese and Indian races (Sreenevasan & Moynihan, 1990). Those working in conditions that cause dehydration, such as construction workers, firefighters, farmers, or those who delay urination when needed, such as nurses, pilots, and truck drivers, are at increased risk for urolithiasis (Goldfarb & Arowojolu, 2013).

Individuals with a family history of the stone disease have a 2.5 × higher risk of developing urolithiasis (Curhan et al., 2004). Diabetes mellitus, hypertension, and obesity have been correlated with urolithiasis. Insulin resistance causes impaired ammonia formation by the kidney, which lowers urinary pH, leading to uric acid stone formation (Daudon et al., 2006). The renal stone disease has been associated with renal impairment due to the renal stone per se (obstruction, infection), parenchymal damage induced by the primary condition leading to stone formation (e.g., nephrocalcinosis), frequent urological interventions with large stone burden, and co-existing medical disease. An increasing number of studies have been done over the past few years concerning the relationship between urolithiasis and the development of chronic kidney disease. A registry study on residents of Olmsted County, Minnesota, confirmed that stone formers were at higher risk for ESRD after adjusting for diabetes, hypertension, dyslipidaemia, gout and CKD (El-Zoghby et al., 2012). The marked variations in the occurrence of urolithiasis can identify causes and help in planning prevention. This study aimed to give insights into the epidemiological aspects of urolithiasis in Sabah by determining the sociodemographic characteristics of patients treated at Hospital Queen Elizabeth.

MATERIALS AND METHODS

This is a prospective descriptive analysis study of patients with urolithiasis in Hospital Queen Elizabeth, Sabah, a public hospital serving a multi-ethnic population, with ethical permission by the Ethics Committee of Kementerian Kesihatan Malaysia (NMRR-21-513-59200). A random sample of 300 patients diagnosed with urolithiasis and presented to the urology clinic or ward for one year (1 January 2019 to 31 December 2019) was included in this study. Diagnosis of urolithiasis was confirmed using non-contrasted CT KUB in all patients. Patients reviewed in outpatient clinics or inpatients with urolithiasis were either newly diagnosed or under follow-up and treatment, and those above the age of 12 years were included in this study. Those below 12 years of age and non-citizens were excluded from this study. This is because the paediatric age group (below 12 years) was seen and managed at a different hospital/

centre, whereas non-citizen patients tended to be lost during treatment and follow-up. A data collection sheet was used where demographic information such as gender, address, BMI, family history, and medical history was collected during the interview with the patient. In addition, routine investigations such as urine FEME, culture and sensitivity, blood urea, and electrolytes were sent, and results were later put in the datasheet. Estimated GFR was calculated using the MDRD formula. CT scans were reviewed to determine the side and site of stones, and Hounsfield unit calculation was done using the Radiant DICOM software. Data collected was analyzed by descriptive statistical analysis using IBM SPSS software version 26.

RESULTS

Figure 1 shows the age and sex distribution of urolithiasis across different age groups in males and females. The participants in this study were predominantly middle-aged, of which 61 – 70 years were the most frequently seen in both males and females.

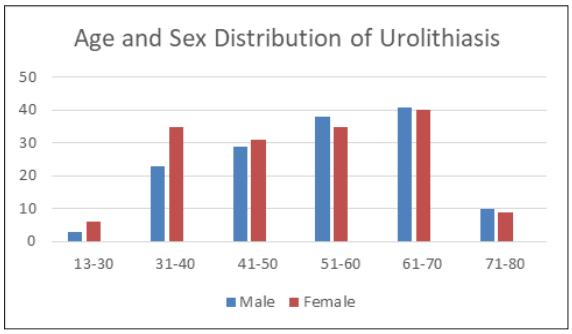

Figure 1 Age and sex distribution of urolithiasis across different age groups in males and females

The demographics and clinical characteristics of participants are summarized in Table 1. The median age of patients with urolithiasis was 54 years. Almost equal incidence of stone disease was found among males (48%) and females (52%). In addition, 40% of patients with urolithiasis were overweight, and 19.3% were obese. The Kadazandusun people had the highest incidence of urolithiasis (37%), the largest ethnic group in Sabah, followed by the Bajau. Others who form 24% of patients with urolithiasis consist of people in the less common ethnic groups such as Bugis, Suluk, Kedayan, Lundayeh, etc. Most participants consumed less than 2 L of fluids per day (63.3%) and had unilateral stone disease (60.6%). More than half of patients with urolithiasis had hypertension (55%), and almost a quarter had diabetes mellitus. Only 17.3% of patients with stone disease had a positive urine culture.

Table 1 Demographics and clinical characteristics of participants

Characteristics	n (%)
Age, median (years)	54
Gender	
Male	144 (48)
Female	156 (52)
BMI	
Underweight	10 (3.3)
Normal	112 (37.3)
Overweight	120 (40)
Obese	58 (19.3)
Race	
Kadazandusun	111 (37)
Bajau	43 (14.3)
Murut	14 (4.7)
Malay	21 (7)
Chinese	39 (13)
Others	72 (24)
Fluid Intake	
< 2 L/day	190 (63.3)
> 2 L/day	110 (36.7)
Diabetes Mellitus	
Yes	74 (24.7)
No	226 (75.3)
Hypertension	
Yes	165 (55)
No	135 (45)

Ischaemic Heart Disease	
Yes	14 (4.7)
No	286 (95.3)
Gout	
Yes	44 (14.7)
No	256 (85.3)
Urine Culture	
Positive	52 (17.3)
Negative	248 (82.7)
Stone Side	
Unilateral	172 (60.6)
Bilateral	37.3 (39.4)

The distribution number of patients with urolithiasis seen from various regions in Sabah who were treated in Hospital Queen Elizabeth is shown in Figure 2. Kota Kinabalu had the highest number of patients as it is the capital city and the most densely populated in Sabah. The map chart also shows higher incidences of urolithiasis among those living in coastal regions than in the interiors.

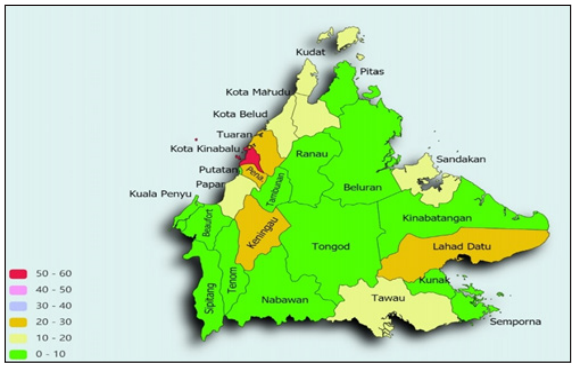

Figure 2 Map chart showing distribution number of patients with urolithiasis who were treated at Hospital Queen Elizabeth

The anatomical location of urinary tract calculi and frequency of occurrence is shown in Table 2. The analysis showed that the highest incidence of uroliths was seen in the kidney, followed by multiple sites and ureter.

Table 2 Anatomical location of urinary tract calculi and frequency

Anatomical site	Number	Percentage (%)
Renal	131	43.7
PUJ	19	6.3
Ureter	54	18.0
VUJ	10	3.3
Bladder	14	4.7
Urethra	2	0.7
Multiple sites	70	23.3
Total	**300**	**100.0**

Figure 3 shows the chronic kidney disease stage based on the estimated glomerular filtration rate (eGFR) calculation. The analysis shows that only 23.7% of the study population had an eGFR of 90 or higher, with the most significant number of patients with urolithiasis having stage 2 CKD.

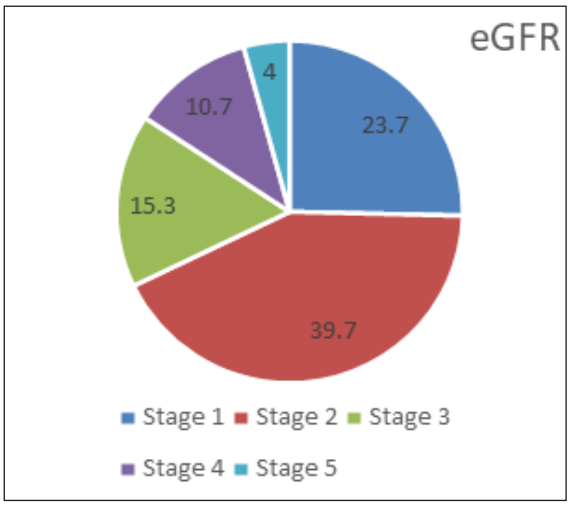

Figure 3 Stage of chronic kidney disease based on estimated glomerular filtration rate (eGFR)

Figure 4 shows the incidence of proteinuria being 56% among the study population, which is associated with renal disease and is a predictor of end-organ damage in patients with hypertension. Data for stone density from CT scans were available for 170 of the study population. The mean stone density measured in the Hounsfield unit (HU) was 1091.

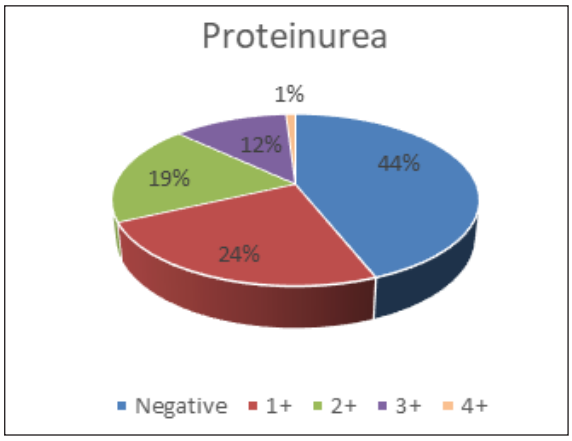

Figure 4 Incidence of proteinuria among patients with urolithiasis

DISCUSSION

The lifetime prevalence of kidney stones is approximately 10% in developed countries, with the most affected in the middle-aged group (Romero et al., 2010). Historically urinary stone disease was found to be more frequent in men. Scales et al. (2007) found a change in the prevalence by gender from a 1.7:1 to 1.3:1 male-to-female ratio in the United States. In Sabah, most patients with urolithiasis were between 51 – 70 years, with an almost equal incidence among males and females. The race has been proposed as a significant factor, where higher incidences of urolithiasis were observed in Caucasians compared to African-Americans and Asians (López & Hoppe, 2010). This study observed that 59.3% of patients had BMI above normal. A higher BMI affects urinary homeostasis by lowering urinary pH and increasing urine calcium and uric acid secretion, promoting stone formation (Schwalfenberg, 2012).

We found a higher incidence of urolithiasis among patients from coastal regions of Sabah. The coastal city stretches on land near a coast, less than 10 km from the coastline. A similar finding was also reported by Yang et al. (2016), who found a higher risk of urolithiasis in coastal provinces of China. Underdeveloped road networks from the interior to Kota Kinabalu and financial constraints to travel are the main factors for a reduced number of patients with urolithiasis seen in these regions. Supersaturation of urine with stone-forming salts leads to the formation of urinary stones. Increased fluid intake leads to higher urine output and flow and dilution of stone-forming salts (Siener & Hesse, 2003). Those who consume fluid less than 2 L/day were more frequent to have a stone disease.

Cappuccio et al. (1999) reported that the incidence and risk of developing kidney stone disease were higher in hypertensive than in normotensive men. Hypertension is a significant predictor of kidney stone disease rather than a consequence of renal damage caused by stones. Similar findings were seen in this study, where 55% of the study population with urolithiasis had hypertension. A higher urinary H+ ion concentration in primary gout was associated with urolithiasis (Alvarez-Nemegyei et al., 2005). The role of diet in urolithiasis pathogenesis and relapse proves to be very significant. Higher intake of animal-derived protein, salt, and supplemental calcium increases the risk of urinary stone formation, whereas dietary calcium, citrate, and total fluid per day reduce the risk (Curhan et al., 2004). A total of 14.7% of patients had gout, which is a risk factor for uric acid stone formation in this study.

Various urinary stones are based on their chemical composition, such as calcium oxalate, calcium phosphate, uric acid, ammonium urate, struvite, cysteine, etc. A retrospective study conducted in Taiwan analysed the impact of different urinary stone compositions on renal function. They found that the patients with uric acid and struvite stones had significantly lower estimated glomerular filtration rates than those with other stone components. Struvite stones may impair renal function due to recurrent urinary tract infections or obstruction (Chou et al., 2011). We found that 17.3% of patients in our study had a positive urine culture and were at risk of developing struvite stones.

Furthermore, stone constituents influence the treatment chosen, e.g., brushite and cystine stones are harder and, therefore, more resistant to shock wave lithotripsy. Similarly, pharmacotherapy such as potassium citrate can alkalinize urine as part of medical management in patients with uric acid stones (Preminger et al., 2007). The Hounsfield unit calculated from non-contracted CT KUB estimates stone density. This helps plan the most appropriate treatment for the patient, e.g., stones with HU more than 900 were more resistant to shockwave lithotripsy (Nakasato et al., 2015).

An increasing number of studies have been done over the past few years concerning the relationship between urolithiasis and the development of chronic kidney disease. The possible causes and risk factors for renal function impairment in patients with urolithiasis include anatomical abnormality (e.g., obstructive uropathy), infection and inflammation with parenchymal scar formation, underlying metabolic disorders (e.g., chronic urate nephropathy), environmental factors, repeated interventions, dietary factors, and molecular or genetic factors (Worcester et al., 2003). This study found that only 23.7% of the total study population had a normal eGFR. Proteinuria was observed in 57.3% of patients, where the urine FEME showed at least a protein 1+ result. The presence of proteinuria is a sign of kidney damage. Therefore, it is essential to identify proteinuria early to reduce and prevent further loss of renal function.

This study provided information on sociodemographic factors associated with urolithiasis formation and comorbid conditions that may contribute to the onset or progression of chronic kidney disease among patients in this region. One drawback of this study is excluding patients aged 12 years and below, as children are at increased risk of recurrent stone formation and require detailed metabolic evaluation. Another limitation of this study is that data for stone density was not available for all patients. In addition, not all radiologists report on stone density, and softcopy for CT scans was unavailable for all patients.

CONCLUSION

Urolithiasis is a common problem, and the burden on the healthcare system is increasing worldwide. To our knowledge, the demographics of urolithiasis in Sabah have not been previously described. These findings will help better understand local clinical characteristics to prevent and reduce morbidity and mortality by urolithiasis. More research is warranted, such as identifying the incidence, prevalence, and chemical composition of urinary stones commonly encountered in this region. There has been no published literature on the chemical composition of uroliths in Malaysia.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article.

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