Bacteriological Study of Urinary Stones

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Background: Despite modern antibiotic therapy and technological advances in lithotripsy, the presence of infection in patients with urinary stones, as well as with infectious stones is still a significant cause of morbidity and mortality. Recent findings lend more theories as to how infection leads to stone formation.
Aim: The bacteriological study of urine and stone samples from patients with urinary tract infections (UTI) and the correlation of the bacteriological analysis results of stones and urine culture.
Method: We enrolled patients admitted to the urology department of Mures Emergency Hospital, from December 2008 to March 2009; all 50 patients who were diagnosed by the urologist as having urinary stones were included in this study. Bacteriological study was conducted on pre-operative urine and operated renal stones. Pre-operative urine sam¬ples were collected aseptically for macro-scopic and micro¬scopic examination. Both pre-operative urine and operated renal stones were processed for bacteriological culture. The isolated microorganisms were identified by standard techniques.
Results: From the 50 patients included in this study, 20 had both infected stones and UTI. While correlating the results of bacteriologi¬cal analysis of stones and urine culture, the same microorganisms from urine culture and stone culture were isolated in 12 (60%) out of 20 cases, but different microorganisms in 8 (40%). The bacteriological study of urine and stone samples revealed that the most common pathogens were E.coli, Pseudomonas aeruginosa.
Conclusion: The incidence of infectious urinary stones in patients with UTI was higher than in the sterile ones. The preponderant identified microorganisms were E. coli, followed by Pseudomonas aeruginosa. In more than half of the cases, the same microorganisms were found both in UTI and within the urinary stones.

Keywords: urinary tract infection, urinary stones, microorganisms

Introduction

Renal stone disease has been recognized in many parts of the world since antiquity. It is one of the most painful and most common urological disorders [1].

The association of stones and putrefaction has been known since Hippocrates. In 1817, it was pointed out that the alkalinization that attends putrefaction of urine results in crystallization of dissolved urinary phosphate [2].

In 1925, Hargar and McGrath suggested that urease was the biochemical basis for stone formation in infected urine [3]. The lifelong prevalence of kidney stone has increased throughout the 20th century. It occurs in up to 15% of the population of the United States of America. The incidence of new cases and recurrences may continue to rise. Therefore, new approaches in treatment and prevention could have a huge economic effect over and above benefits in terms of reduced morbidity [4].

Therefore the present study was undertaken to evaluate chemical composition and bacteriological spectrum of renal stones and culture of their pre-operative urines.

Material and method

The present study was conducted on 50 patients of urolithiasis admitted in the Urology and Surgical departments of Targu Mures Hospital for management of renal stones.

Bacteriological study was conducted on pre-operative urine and operated renal stones. Pre-operative urine samples were collected aseptically for macroscopic and microscopic examination. Both pre-operative urine and operated renal stones were processed for bacteriological culture.

From December 2008 to March 2009, all 50 patients diagnosed by the urologist as having urinary stones were included in this study. Ethical clearance to conduct the research was obtained from the hospitals. Informed consent was obtained from all participants. There were no refusals to participate. A questionnaire was administered to patients to collect demographic data and information on congenital anomalies, previous urinary stone, family history of urolithiasis and dietary habits.

Patients were examined by a physician; those with lower urinary tract stone disease, renal stone disease with renal failure, renal tumors and previous history of renal stones were excluded.

Processing of stones for bacteriological culture was done as described by Ohkawa et al. [5]. The renal stones were thoroughly rinsed in sterile physiological saline and then crushed with a sterile hack-saw. The crushed stone core was cultured in 5ml thioglycolate broth which was incubated at 37°C for 18-24 hours and then subcultures were made on blood agar and MacConkey's agar plate for isolation of etiological agents.

The isolated organisms were identified by standard techniques.

Chemical analysis of renal stones for oxalate calcium magnesium, ammonium and phosphate were performed as described by Bradley and Sutor [6,7].

A specially designed proforma, containing general information about the patient, urinary symptoms and signs, was filled out for every patient included in this study. After clinical examination every patient was investigated in this manner: urine analysis, imagistic methods, blood examination, and biochemical composition of the stone and bacteriological culture of stones.

Results

The incidence of renal stone was higher in females 29 (58%) compared to males 21 (42%), in the ratio of 1:1.4. The incidence of sterile kidney stones was 22 (44%) whereas the percentage of infection stones was 28 (56%).

The incidence of sterile renal stones composed of calcium oxalate and calcium phosphate (84.31 %) was higher compared to infection stones (15.69%) of the same composition. By contrast the incidence of infection stones was more in stones composed of triple phosphate (84.62%) compared to triple phosphate along with calcium oxalate (61.54%).

E. coli (32.25%) was the predominant microorganism cultured from about one-third of crushed stones followed by Pseudomonas aeruginosa (22.58%). Staphylococcus aureus, coagulase negative staphylococci, Enterococcus faecalis and Klebsiella spp. were recovered in a smaller number of cases. E. coli was isolated mostly from stones composed of calcium oxalate and calcium phosphate (50%), triple phosphate (27.27%) and triple phosphate and calcium oxalate (37.50%). Out of 8 stones of calcium oxalate and calcium phosphate, the isolation rate of Pseudomonas aeruginosa was 50% and in case of triple phosphate stone it was isolated in 27.27% cases.

Out of the 50 investigated cases we obtained the following results:

- 29 (58%) positive urocultures and 21 (42%) negative
- 28 (56%) infected stones and 22 (44%) sterile stones

Therefore we had:

- 20 cases (40%) with positive bacteriological examination, both for urine and urinary stones
- 9 cases (18%) with positive urocultures and sterile stones
- 13 cases (26%) where both the urocultures and the stones were sterile
- 8 cases (16%) with negative urocultures and infected stones

Out of the 20 cases with positive uroculture and infected stones, 12 (60%) revealed the same organisms which were isolated from pre-operative urine culture, while 8 cases (40%) showed different micro-organisms than preoperative urine culture.

Discussions

As expected, the incidence of infected stones was higher in women than in men (as females are more prone to urinary tract infection due to their short urethra). A change in genitourinary tract mucosa due to menopause may play a role in colonization of the introits by coliforms, a major background factor for recurrent bladder infection in females [8, 9].

It appears that the bacteriological testing of urine samples does not always reflect the bacteriology of urinary tract stones, which is in agreement with the results of previous studies [10, 11]. This might be due to an intermittent release of a small number of microorganisms from the stone, which may or may not be isolated from urine.

The explanation for the presence of bacteria within the calculi may be due to insignificant intermittent bacteriemia, from where the bacteria are excreted in renal pelvis and may act as a nidus for deposition of crystals either by damaging the mucous coat or perhaps also by acting as a nidus for crystallization of salts [12]. Thus, a vicious cycle starts, the infection leading to stone formation and then the stone causing infection [13,14]. Most of the current literature on the subject focuses on pathogenesis of infectious urinary stones. Griffith et al. showed that bacterial urease is a primary cause of infection stones [15]. The remaining literature highlights difficult cases, outcomes of treatments, and overall reviews of the subject [16]. Further investigation is critically needed to improve the outcomes of patients suffering from infections with urinary stones and infectious stones.

The bacteriological study of urine and stone samples revealed that commonest pathogens were E.coli, Pseudomonas aeruginosa, Enterobacter spp. and Proteus spp. E.coli is not a urease producing organism and is not considered to be a stone producing micro-organism. However the present study revealed that E.coli was predominant microorganism recovered from mixed stones (calcium oxalate, triple phosphate and calcium phosphate). The present findings are consistent with the study of Dajani and Bratell et al. [17, 18].

For many patients, clues to the stone formation are obtained with an extensive search for risk factors. Such an outcome most certainly reflects our incomplete understanding of the stone formation or the way we usually collect and analyze urine. Despite the obvious shortcomings, it is important to reveal a correlation between the various risk factors by a careful medial history with a radiographic examination as well as an analysis of stone, blood and urine composition and an effective individualized treatment.

Conclusions

Our study revealed the following aspects:

- The incidence of urinary stones was slightly higher in women compared to men, with a higher rate of infectious stones compared to sterile ones.
- The preponderant microorganisms found in the stones and urine were Escherichia coli and Pseudomonas aeruginosa.
- We consider important the need of a further study to document the importance of the connection between urinary stones and urinary infection.

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