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 samples were collected aseptically for macroscopic and microscopic 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 bacteriological analysis of stones and urine culture, the same microorganisms were isolated 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
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 (64.31%) was higher compared to infection stones (15.69%) of the same composition. By 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 microorganisms than pre-operative 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 introtys 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 bacteremia, 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 microorganism. 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 medical history with a radiographic examination as well as an analysis of stone, blood and urine composition and an effective individualized treatment.

For the bacteriological study of urine and stone samples, we considered important the need of a further study to document the importance of the connection between urinary stones and urinary infection.
References