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UDC:

DOI: https://doi.org/10.2298/VSP181014199J

When the final article is assigned to volumes/issues of the Journal, the Article in Press version will be removed and the final version appear in the associated published volumes/issues of the Journal. The date the article was made available online first will be carried over.
POSSIBLE RISK FACTORS FOR POSTOPERATIVE URINARY TRACT INFECTION FOLLOWING URETEROSCOPIC LITHOTRIPSY

MOGUĆI FAKTORI RIZIKA ZA NASTANAK POSTOPERATIVNE URINARNE INFEKCIJE NAKON URETEROSKOPSKЕ LITOTRIPSIJE


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Risk factors for infection after lithotripsy

Faktori rizika za infekciju nakon litotripsije
Abstract

Background/Aim. Ureteroscopic lithotripsy is today a safe method of endoscopic destruction of stone in the kidney and ureter with a small number of complications of which the most common is postoperative urinary tract infection. Risk factors for the occurrence of urinary tract infection after the ureteroscopic destruction of stones in the ureter and kidney in the previous studies are not clearly defined. Methods. The study included 389 patients with ureteroscopic lithotripsy and possible risk factors were analyzed: age of the patient, sex, diabetes, presence, and degree of hydronephrosis, stone size, stone localization, wear of ureteral JJ stent and percutaneous nephrostomy catheter, type of surgical procedure and the duration of the operation. The frequency of postoperative urinary tract infection was statistically analyzed in relation to the possible risk factors. Results. 10% of patients had postoperative urinary tract infection. The higher incidence of postoperative urinary tract infection was found in patients with diabetes ($X^2=22.918; p<0.001$), who before surgery carried a ureteral JJ stent ($X^2=4.620; p=0.040$) and percutaneous nephrostomy catheter ($X^2=8.240; p=0.004$), which had a larger stone ($Z=-3.301; p=0.001$), and in patients whose surgery lasted longer ($t=4.261; p<0.001$). Discussion. The risk of postoperative urinary tract infection following ureteroscopic lithotripsy is not negligible and is not clearly defined in the existing literature. Many authors examined risk factors for the emergence of postoperative urinary tract infections after ureteroscopic lithotripsy with different results and frequency. The frequency of postoperative urinary infection and risk factors for its emergence in our study are in line with the results of studies by other authors. Conclusion. Patients with diabetes, who preoperatively carried JJ stent or a percutaneous nephrostomy catheter, who had large stones and in which the operating time is longer have a greater risk of developing postoperative urinary tract infection. Accordingly, the importance of identifying these patients in the preparation for ureteroscopic lithotripsy contributes to the appropriate preoperative preparation and decreases the frequency of postoperative urinary tract infection to a minimum.

Key words: ureteroscopy; lithotripsy; postoperative infection; risk factors.

Apstrakt

Uvod. Ureteroskopska litotripsija je u današnje vreme sigurna metoda endoskopskog razbijanja kamena u bubregu i ureteru, sa malim brojem komplikacija, od kojih je najčešća postoperativna urinarna infekcija. Faktori rizika za pojavu urinarne infekcije nakon ureteroskopskog razbijanja kamena u ureteru i bubregu u dosadašnjim radovima nisu jasno definisani. Metode. Istraživanje je obuhvatio 389 pacijenata kod kojih je urađena ureteroskopska litotripsija, a od mogućih faktora rizika analizirani su: starost pacijenta, pol, dijabetes, prisustvo i stepen hidronefroze, veličina kamena, lokalizacija kamena, nošenje ureteralne JJ sonde i perkutanog nefrostomskog katetera, vrsta operativne metode i dužina trajanja operacije. Statistički je analizirana učestalost postoperativne urinarnih infekcija u odnosu na pomenute moguće fakte rizika. Rezultati. Postoperativnu urinarnu infekciju imalo je 10% pacijenata Veća učestalost postoperativne urinarnih infekcija nađena je kod pacijenata koji su imali dijabetes ($X^2=22.918; p<0.001$), koji su preoperativno nosili
Introduction

The endoscopic destruction of ureter and kidney stone or ureteroscopic lithotripsy (URSL) is a standard procedure in surgical treatment of urinary stones (1). Previous studies have shown that ureteroscopic lithotripsy is a safe method with few complications and with a success rate of up to 85.6% (2). The most common postoperative complications are infectious complications, which include the transient febrile condition and urinary tract infection with a frequency of 1.7-18.8% (3,4,5). Urosepsis is one of the most severe complications after ureteroscopic lithotripsy (6).

In previous studies that have been published, factors that are directly related and lead to infectious complications and sepsis are not clearly defined (7,8,9,10).

The importance of identifying possible risk factors for the occurrence of urinary tract infection after ureteroscopy because of ureter and kidney stones, either pneumatic or laser lithotripsy, would be crucial in order to take specific measures for the prevention of severe forms of postoperative urinary tract infection and sepsis (11,12).

As individual risk factors for the development of urinary tract infections after ureteroscopic lithotripsy, so far were investigated: age, sex, diabetes, bacteriuria and pyuria, acute pyelonephritis, the presence of percutaneous nephrostomy catheter and ureteral JJ stent, the presence of hydronephrosis, the use of antibiotic therapy before ureteroscopic lithotripsy, duration of surgery, the presence of kidney and heart diseases, the use of anticoagulant therapy, number, size and localization of the stone (13,14,15).

Methods

The study includes 389 patients, 200 male and 189 females who underwent ureteroscopic lithotripsy with semi-rigid and/or flexible ureteroscope in a five-year period, from January 2010 to December 2014. The stone was fragmented using a laser with a power of 10 watts or pneumatic stone breaking device.

Preoperative clinical data included patient related characteristics, stone characteristics, and type of procedures prior to surgery. Thus, preoperative clinical information regarding
the patient which is analyzed are the age of the patient, sex, diabetes, the presence and degree of hydronephrosis.

Preoperative clinical data, which was analyzed in the study and is related to the stone are stone size, stone localization, the presence of ureteral JJ stent and/or percutaneous nephrostomy catheter prior to surgery.

Surgery information included: the type of surgical procedure (pneumatic or laser lithotripsy with semi-rigid and/or flexible ureteroscope) and the duration of the operation.

In all of the patients, the characteristics and degree of postoperative urinary tract infection were analyzed according to the modified Klavien-Dindo classification (MCCS) (16), and for the definition of urinary tract infection, we used the provisions of the EAU Section of Infection in Urology (ESIU) (17).

For the definition of sepsis, in addition to the criteria of ESIU, we used the provisions of the International Conference on the definition of sepsis and organ failure and guidelines for the use of innovative therapies in sepsis of American pediatricians and critical care organizations (Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis, The ACCP / SCCM Consensus Conference Committee, American College of Chest Physicians / Society of Critical Care Medicine), established in 1992 and supplemented 2001/2003 (18). According to these criteria, sepsis is defined as the presence of the source of infection and SIRS (Systemic Inflammatory Response Syndrome). For SIRS, it is characteristic that two or more of the following criteria are present: body temperature > 38°C or <36°C; heart rate > 90/min; respiration rate of 12/min or CO2 partial pressure <32 mmHg; leukocytosis: 12000 or 4000/mm³. Severe sepsis is characterized by organ dysfunction and septic shock by acute circulatory collapse with persistent arterial hypotension (19).

All data in this study will be processed in the SPSS 20.0 (IBM Corporation) software package. The selected level of significance or the probability of the first type error is 0.05. The examinees were classified into two groups. In the first group, patients who had ureteroscopic lithotripsy and did not have postoperative urinary tract infection were analyzed. In the second group, patients with ureteroscopic lithotripsy who had postoperative urinary tract infection were analyzed.

**Results**

Of the 389 patients who had ureteroscopic lithotripsy, in the group without postoperative urinary tract infection, were 350 (90%) patients and 39 (10%) patients in the group with postoperative urinary tract infection.

The average age of patients in the study was 55 (13-92) years. The average size of the stone was 13 (4-50) mm. In 94 (24.2%) patients lithotripsy was performed in the kidney, and in 295 (75.8%) patients in the ureter. According to kidney localisation, in the lower calyx lithotripsy was performed in 19 (4.9%) patients, in the middle calyx at 7 (1.8%), in the upper calyx at 2 (0.5%), and in the renal pelvis at 66 (17.0%) of patients. According to ureter localisation lithotripsy in the lower ureter was performed in 68 (17.4%) patients, in the middle ureter in 94 (24.2%), and in the upper ureter in 133 (34.2%) patients. Laser lithotripsy was performed in 237 (60.9%) patients and lithotripsy with pneumatic probe in 152 (39.0%) patients. The laser was used for lithotripsy in the lower ureter in 15 (3.9%) patients, in the middle ureter at 44 (11.3%), in the upper ureter at 95 (24.4%), in the lower calyx at 19 (4.9%) of patients, in the middle calyx at 7 (1.8%), in the upper calyx at 1 (0.2%) and in the renal pelvis in 56 (14.4%) patients. Pneumatic probe was used in the
lower ureter in 53 (13.6%) patients, in the middle ureter at 50 (12.9%), in the upper ureter at 38 (9.8%), in the upper calyx at 1 (0.2%) and renal pelvis in 10 (2.6%) patients. The average duration of the operation was 40 minutes. The shortest duration of the operation was 5 minutes, and the longest 185 minutes. Semi-rigid ureteroscope was used in 357 (91.8%) patients, flexible in 28 (7.2%), and in 4 (1.0%) patients both types of ureteroscope were used. In all patients for the localization of stones in the ureter, only the semi-rigid instrument was used: in the lower ureter at 68 (17.4%), in the middle ureter in 94 (24.4%) and in the upper ureter in 133 (34.2%) patients. Semi-rigid instrument was used for lithotripsy in the renal pelvis at 61 (15.7%) and in the upper calyx at 1 (0.2%) of the patient. Flexible urethroscope was not used for lithotripsy in the ureter, but only in the kidney: in the lower calyx in 19 (4.9%) patients, in the middle calyx at 7 (1.8%), in the upper calyx at 1 (0.2%) and renal pelvis in 1 (0.2%) patient.

Infectious complications in our study were reported in 73 (18.7%) patients (Table 1). In 34 (8.7%) patients a transient febrile state lasting up to 48 hours occurred, and these patients, apart from the use of antipyretics, were not further treated. Postoperative urinary tract infection, according to the definitions defined by EAU/ESIU and Definitions for sepsis and organ failure and Guidelines for the use of innovative therapies in sepsis, The ACCP / SCCM from the International Sepsis Definitions Conference, had 39 (10%) of patients (17,18,19). In these patients, the treatment included the use of antipyretics, additional antibiotic, infusion, inotropic and supportive therapy, and in 2 (0.4%) patients additional procedures were performed for placing the ureteral JJ stent and the percutaneous nephrostomy catheter.

A higher incidence of postoperative urinary tract infection was found in 32 (8.2%) patients who had diabetes ($X^2 = 22.918; p <0.001$), in 48 (12.3%) patients who had an inserted ureteral JJ stent prior to surgery ($X^2 = 4.620; p = 0.040$) and in 52 (13.3%) patients who had a percutaneous nephrostomy catheter ($X^2 = 8.240; p = 0.004$) (Table 2). It was also reported in patients with larger stones ($Z = -3.301; p = 0.001$) and in patients in whom the operation lasted longer ($t = 4.261; p <0.001$) (Table 3).

In our study no statistically significant difference was found between groups with and without postoperative urinary infection in relation to age, sex, hydronephrosis, the side where lithotripsy was performed, stone localization, type of ureteroscope, and type of stone fragmenting.

In all of the patients with postoperative urinary tract infections, an infective agent in the urinary culture was isolated. The most common bacteria was *Escherichia coli* (43.6%), followed by *Pseudomonas aeruginosa* (25.6%), *Klebsiella species* (12.8%), *Enterococcus faecalis* (5.1%), *Proteus mirabilis* (5.1 %), *Pseudomonas a. + Escherichia coli* (5.1%) and *Proteus m. + Pseudomonas a. + Enterococcus f.* (2.7%).

**Discussion**

This study examined some of the possible risk factors for the occurrence of postoperative urinary tract infection in patients following ureteroscopic lithotripsy.

Although ureteroscopic lithotripsy is a safe procedure today, the risks of occurring postoperative infectious complications are not negligible (14) and are not clearly defined in the existing literature (1).

Diabetes (*Diabetes mellitus-lat.*) is associated with older age and other chronic diseases. Daels analyzes the data from the CROES database of a multicentre study of Endourological Society, which included 114 hospitals from 32 countries and 11885
patients with ureteroscopic lithotripsy, concluded in his paper that the risk of complications is greater in elderly patients suffering from associated diseases (20). It has been found that there is a significant risk of complications in patients suffering from cardiovascular disease, diabetes, obesity and patients using anticoagulant therapy. In many studies, diabetes was analyzed as a risk factor for the occurrence of infectious complications following ureteroscopic lithotripsy. Uchida analyzes diabetes and frequency of SIRS following ureteroscopic laser lithotripsy but does not find statistical significance between groups without and with postoperative signs of SIRS (p = 0.71) (10). Similar results are published by Berardinelli, Moses, and Sohn in their papers (16,7,14). However, in our study of 32 patients with diabetes, who had ureteroscopic lithotripsy, 11 (34.4%) patients had a postoperative urinary tract infection. By univariate analysis, it was concluded that there was a statistically significant difference between groups without and with postoperative urinary tract infection (p <0.001). Diabetes as a risk factor for postoperative urinary tract infection is examined by Martov in his study in 2015, which analyzes the data of a multicentre study from the CROES database and concludes that in patients with diabetes the incidence of postoperative infections is higher (p <0.05) (21).

By multivariate analysis in our study preoperatively placed ureteral JJ stent represents as a significant risk factor for the occurrence of postoperative urinary tract infection (p = 0.024). The JJ stent was preoperatively placed due to verified obstructive pyelonephritis. The preoperatively placed JJ stent had 48 (12.3%) patients. The JJ stent was left in place an average 4 weeks, and in the group with postoperative urinary infection for 8 weeks. Also, by univariate analysis, statistical significance exists between groups without and with postoperative urinary infection in relation to the preoperatively placed JJ stent (p = 0.040). In a study by Japanese authors (Mitsuzuka et al.) preoperatively placed JJ stent was associated with a higher incidence of postoperative febrile urinary tract infection in the univariate (p = 0.013), but not in multivariate analysis (p = 0.529). In this study, the univariate (p<0.001) and multivariate (p = 0.044) analysis of acute pyelonephritis was a significant risk factor for the occurrence of postoperative urinary infection, and half of the patients with a JJ stent had preoperatively acute pyelonephritis, so it was not entirely clear in what degree the preoperatively placed JJ stent independently influences the occurrence of a postoperative urinary infection (22). The presence of a preoperative JJ stent was associated with the appearance of SIRS in a study by Japanese authors (Uchida et al.), which was proven by univariate analysis (p<0.001), but not by multivariate analysis (10). There is possible bacterial colonization on the surface of the stent (bacterial "biofilm"), and due to the reflux of urine from the urinary bladder, the risk of pyelonephritis and sepsis increases (11). In a study published by Moses in 2016, 550 patients underwent ureteroscopic laser lithotripsy and in 327(60%) patients a JJ probe was placed for passive dilatation of the ureter (7). Postoperative urinary tract infection was more frequent in the group with a JJ stent (p = 0.025). However, these results are in contrast to the study published by Blackmur and show that the preoperatively placed JJ stent reduces the risk of postoperative SIRS in patients with preoperative positive urine culture (12).

Percutaneous nephrostomy catheter, as well as a ureteral JJ stent, is most often preoperatively placed in patients with obstructive pyelonephritis. In our study, 52 (13.4%) patients had a percutaneous nephrostomy (PNS) catheter prior to ureteroscopic lithotripsy. The PNS catheter was necessarily placed in a patient who had a preoperatively verified hydronephrosis of 3rd or 4th grade according to the 2007 classification by Onen (23). In case of suspicion of obstructive pyelonephritis, renal failure, and renal impairment, a PNS catheter is installed regardless of the degree of hydronephrosis. A univariate analysis
concluded that patients with a preoperatively established PNS catheter recorded a higher incidence of postoperative urinary tract infection ($p = 0.004$), which is in line with a study published by Sohn, in which patients who had preoperatively a PNS catheter have a greater incidence of infectious complications (14). However, in a study by Japanese authors (Uchida et al.) in patients with a preoperatively introduced PNS catheter no higher incidence of postoperative infectious complications was found ($p = 0.42$). The study states that the PNS catheter plays an important role during the ureteroscopic lithotripsy itself to improve intraoperative irrigation and reduce intrarenal pressure (10). This discrepancy between studies, and the higher incidence of postoperative urinary tract infection in our study and in Sohn's study, can also be explained by the fact that patients who had a PNS catheter prior to surgery were mainly patients with multiple stones, big stone and preoperative bacteriuria (due to colonization of the PNS catheter surface with bacterial biofilm), which also had an effect on the occurrence of postoperative urinary tract infection.

The size of the stone in our study was from 4 to 50 millimeters. In patients who had multiple stones, but at one localization, the total size of the stone was taken as the sum of the diameters of all the stones. Uchida analyzes the cumulative volume of the stone as the volume of the each stone, but also the cumulative diameter of the stone which in its study amounts to 10 millimeter (3-47) and does not find that the volume and size of the stone is significant for the occurrence of postoperative urinary tract infection (10). In our study, in the group of patients with postoperative urinary tract infection, the mean stone size was 16.1 millimeters, and in the group of patients who did not have a postoperative urinary infection, the mean stone size was 12.7 millimeters. These results of our analysis may also be an explanation for the statistical significance of the occurrence of postoperative urinary tract infections after ureteroscopic lithotripsy ($p = 0.001$) in our study in relation to a study published by Uchida since the cumulative stone diameter in our study is higher. In a study by Japanese authors from 2015 (Mitsuzuka et al.) who also analyze the size of the stone as a risk factor for the occurrence of postoperative urinary tract infection, and in the case of more stones, the total stone size as the sum of all stones is expressed, no statistical significance of this parameter was found ($p = 0.139$). In this study, the stone size is divided into stone sizes that are smaller than 20 millimeters and are 20 or more millimeters (22). In a group of patients with a stone size below 20 millimeters, 15.2% of patients had a postoperative urinary infection, and 25% of patients had a postoperative urinary infection when a stone was disintegrated was 20 or more than 20 millimeters.

The average length of surgery in our study was 44.4 (5/185) minutes, and in the group of patients with postoperative urinary infection 60.0 (20/130) minutes. Multivariate analysis showed that there was a statistically significant difference between groups without and with postoperative urinary tract infection in relation to the length of the operation ($p <0.001$). It is understandable that the length of ureteroscopic lithotripsy may also depend on the severity of the case, the technical deficiencies of the existing equipment, the size of the stone, the type and the location of the stone. The length of the operation increases the intraoperative exposure to the bacteria that are located on the surface of the stone or are released from stone breaking. Knipper finds in his study that longer operating time is associated with complications (24). Moses states that if the operative time is over 120 minutes this is associated with postoperative urinary tract infection ($p <0.001$) (7). The identical results are found by Fan ($p = 0.026$) and Martov ($p <0.001$), who in their studies suggest that the length of the operation has an effect on the higher incidence of postoperative urinary tract infection (25,21). However, Berardinelli, Mitsuzuka, and Sohn
state that the length of the operation did not affect the higher incidence of postoperative urinary infection (16,22,14). The explanations for the difference of our results with the results in Berardinelli, Mitsuzuka, and Sohn studies are that in these studies the total diameter of the stone was smaller. Also, there was a higher number of patients in our study who had a preoperatively and postoperatively placed ureteral JJ stent, which prolonged the duration of the operation and exposure to bacteria.

Infectious complications in our study were reported in 73 (18.7%) patients. Postoperative urinary infection, according to the definitions defined by EAU/ESIU and Definitions for sepsis and organ failure and Guidelines for the use of innovative therapies in sepsis, The ACCP / SCCM, from the International Sepsis Definitions Conference, had 39 (10%) of patients. According to these criteria, all 39 (10%) patients had complicated postoperative urinary tract infection because they all had an elevated body temperature(≥38°C) and leukocytosis (12000 / mm³) and their treatment required the use of antipyretics, additional antibiotic therapy, infusion, inotropic and supportive therapy. In 2 (0.5%) patients, additional procedures for placing a JJ stent and percutaneous nephrostomy catheter were made.

In our study, 34 (8.7%) patients had a transient febrile state lasting up to 48 hours and defined according to MCCS as Grade I complications. Infectious complications Grade I in our study were not classified as postoperative urinary tract infection because patients did not require additional pharmacological treatment or the use of antibiotic therapy, except for the use of antipyretics. Mitsuzuka states that febrile status following ureteroscopic lithotripsy occurred in 15% of patients, and the total number of infectious complications after ureteroscopic lithotripsy in his study was 18.3% (22). As in our study, the Mitsuzuka febrile condition with a body temperature up to 38°C, without the need for additional treatment or administration of antibiotics is classified as an infectious complication of Grade I.

Of the 39 patients with postoperative urinary tract infections, in our study, 35 (8.9%) patients had infectious complications Grade II, of which 32 (8.3%) had characteristic signs for SIRS (with a measured body temperature of 38°C and leukocytosis over 12000). Uchida reports 5.7% of patients with SIRS following ureteroscopic laser lithotripsy. Of the 27 patients who had SIRS in our study, the condition of one patient required admission to the intensive care unit, but no fatal outcome was registered. This indicates that SIRS does not necessarily lead to a fatal outcome, but requires a long treatment that has an impact on the physical and economic status of the patient (10). Of 35 patients in our study with infectious complications Grade II, 3 (0.9%) patients developed sepsis, which was confirmed by a positive hemoculture. These 3 patients besides the signs for SIRS had hypotension and cardiovascular collapse and required treatment with additional antibiotic therapy and the use of infusion solutions and inotropic drugs, but their condition did not require staying in an intensive care unit, although the finding of hemoculture was positive. In all 3 patients, Staphylococcus coag. (-) was isolated. In 2 (0.5%) patients with Grade III complications, obstructive pyelonephritis and sepsis were postoperatively verified, and apart from the application of antibiotic therapy, it was necessary to place a JJ stent in one patient, and a percutaneous nephrostomy catheter in the second. In one patient, Escherichia coli was isolated from the hemoculture, and in the second Staphylococcus coag. (-). Two patients in this study had Grade IV complications and were treated in an intensive care unit due to circulatory collapse and cardiorespiratory dysfunction, under the diagnosis of severe sepsis and septic shock. They were intubated and ventilated, with simultaneous administration of several antibiotics, inotropic drugs, and colloidal and nutritional solution infusions.
Escherichia coli was isolated from hemoculture in both patients. Sepsis after ureteroscopic lithotripsy is one of the most severe complications. In our study, 7 (1.8%) patients developed clinical signs of the sepsis. Out of this number 5 (1.4%) patients were treated in the department, and 2 (0.4%) required monitoring and treatment in the intensive care unit. In other studies that deal with risk factors for the occurrence of postoperative urinary tract infection, the frequency of sepsis is between 1-3%. In his study, Mitsuzuka reports 1.3% of patients with sepsis following ureteroscopic lithotripsy (22). In the existing literature, only a few studies analyze the frequency of sepsis following ureteroscopic lithotripsy. Geavlete reports that 1.13% of 2735 patients had sepsis after ureteroscopic lithotripsy with a semi-rigid ureteroscope (26). Eswara analyzed 328 patients who had endourological procedures, of which 11 (3.0%) had sepsis (15). However, Blackmur in his analysis of the risk factor for the occurrence of sepsis after ureteroscopic lithotripsy in 462 patients, reports that 34 (7.4%) of patients had sepsis (12). This somewhat larger number of patients who had sepsis after ureteroscopic lithotripsy can be explained that the study included both patients with bilateral ureteroscopic lithotripsy and a large number of patients who had associated cardiovascular disease and diabetes, a high ASA score and a larger volume of stones.

Our study may have several shortcomings and limitations. All of 389 patients were referred for treatment from smaller hospitals and they already had a complicated state with large or infected stone since our institution is a tertiary reference center for the treatment of urolithiasis. Most of these patients had associated comorbidities, and previously failed procedures in other hospitals. These are the possible reasons for a greater incidence of postoperative urinary tract infections following ureteroscopic lithotripsy in our study than in reference studies. Additional intraoperative urinalysis for bacterial examination and bacteriological examination of stones and fragments obtained during the procedure, that provides additional information in the selection of antibiotics for the prevention of severe infectious complications, have not been done in this study.

However, despite some shortcomings, the benefits of the study are the broad age group of patients who were analyzed, the evaluation of a large number of variables and the use of standardized criteria in the identification of risk factors for the emergence of postoperative urinary tract infection after ureteroscopic lithotripsy. Also, the use of a standardized classification system for infectious complications (MCCS) has made it easier and more accurate to compare with reference studies.

**Conclusion**

The postoperative infectious complications are a common and significant problem following ureteroscopic lithotripsy. Especially since indications for this procedure are nowadays extended and include the treatment of large and complicated stones in the ureter and kidney, as well as the application of ureteroscopic lithotripsy in elderly people with multiple associated diseases (diabetes, renal failure, heart disease, patients on anticoagulant therapy). The secondary postoperative urinary tract infection may be caused by the spread of pathogenic bacteria during the procedure from the lower urinary tract in the upper, procedure on infectious stone and the use of high-pressure irrigation liquids leading to bacteremia.

Patients with diabetes, preoperatively placed JJ stent or a percutaneous nephrostomy catheter, large stones and in with prolonged operating time, have a higher risk of developing a postoperative urinary infection. Accordingly, adequate preoperative
preparation and antibiotic prophylaxis can contribute to preventing infectious complications and postoperative urinary tract infection in these patients.

REFERENCES


Table 1.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Patients n (%)</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradus I Temporary febrile condition</td>
<td>34 (8,7%)</td>
<td>Antipyretics</td>
</tr>
<tr>
<td>Gradus II SIRS</td>
<td>32 (8,3%)</td>
<td>Antibiotic therapy</td>
</tr>
<tr>
<td>Sepsis solution</td>
<td>3 (0,9%)</td>
<td>Antibiotic therapy, Parenteral infusion solution</td>
</tr>
<tr>
<td>Gradus III Obstructive sepsis- pyelonephritis</td>
<td>2 (0,4%)</td>
<td>Endoscopic intervention, Placement of JJ stent or</td>
</tr>
<tr>
<td>PNC Gradus IVa Severe sepsis management</td>
<td>1 (0,2%)</td>
<td>Intesive care unit</td>
</tr>
<tr>
<td>PNC Gradus IVb Septic shock management</td>
<td>1 (0,2%)</td>
<td>Intesive care unit</td>
</tr>
</tbody>
</table>

n – number of patients; PNC percutaneous nephrostomy catheter
Table 2.

Diabetes, preoperatively inserted JJ stent and percutaneous nephrostomy catheter as possible risk factors for predicting postoperative urinary tract infection following ureteroscopic lithotripsy

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Postoperative urinary tract infection</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (%)</td>
<td>Yes (%)</td>
<td></td>
</tr>
<tr>
<td>Number of patients</td>
<td>389 (100%)</td>
<td>350 (90,0%)</td>
<td>39 (10,0%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>32 (8,2%)</td>
<td>21 (65,6%)</td>
<td>11 (34,4%)</td>
</tr>
<tr>
<td>Preoperatively inserted JJ stent</td>
<td>48 (12,3%)</td>
<td>39 (81,2%)</td>
<td>9 (18,8%)</td>
</tr>
<tr>
<td>PNC</td>
<td>52 (13,3%)</td>
<td>41 (78,8%)</td>
<td>11 (21,2%)</td>
</tr>
</tbody>
</table>

PNC  percutaneous nephrostomy catheter

Table 3.

Stone size and operative time as possible risk factors for predicting postoperative urinary tract infection following ureteroscopic lithotripsy

<table>
<thead>
<tr>
<th>Postoperative urinary tract infection</th>
<th>Number of patients</th>
<th>Stone size* (mm)</th>
<th>Operative time</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>350</td>
<td>12.7 (4-50)</td>
<td>42.6 (5-185)</td>
</tr>
<tr>
<td>Yes</td>
<td>39</td>
<td>16.1 (5-35)</td>
<td>60.0 (20-130)</td>
</tr>
<tr>
<td>Total</td>
<td>389</td>
<td>13.2 (4-50)</td>
<td>44.4 (5-185)</td>
</tr>
</tbody>
</table>

* Stone size was calculated as the sum of the diameter of each stone in case of multiple stones

Received on October 14, 2018.
Revised on December 2, 2018.
Accepted on December 14, 2018.
Online First December, 2018.