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THE ROLE OF VARIOUS METHODS OF KIDNEY DRAINAGE IN OBSTRUCTIVE PYELONEPHRITIS

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The study is devoted to the analysis of methods for drainage of the renal pelvis in the presence of a symptom complex of acute purulent obstructive pyelonephritis, comparison of various drainage methods (internal and external), analysis of the severity of inflammatory changes in the blood and urine, dynamics of laboratory parameters. In two groups of patients, the corresponding indicators were analyzed when performing internal (stenting) and external (nephrostomy) drainage of the urinary tract. According to the results, a more rapid decrease in blood and urine leukocytosis in the external drainage group was noted, the hyperthermic reaction of the body was also reduced faster, and there were more positive changes in the ultrasound picture. According to the results of the study, we can say that both methods of drainage are indicated in the presence of obstructive pyelonephritis as one of the components of treatment, and the method of external drainage is more effective than internal stenting.

Key words: urethral stent, pyelonephritis, inflammation, infection, nephrostomy

Д.М. Іващенко, М.О. Дудченко, М.І. Кравців, Р.А. Прихідько, М.П. Шевчук, Д.М. Щасний РОЛЬ РІЗНИХ МЕТОДІВ ДРЕНУВАННЯ НИРОК ПРИ ОБСТРУКТИВНОМУ ПІЄЛОНЕФРИТІ

Дослідження присвячене аналізу методів дренивання ниркової миски при наявності симптомокомплексу гострого гнійного обструктивного пієлонефриту, порівняно різних методів дренивання (внутрішнього і зовнішнього), аналізу перебігу запальних змін з боку крові і сечі, динаміці лабораторних показників. У двох групах хворих проаналізовані відповідні показники при виконанні внутрішнього (стенування) і зовнішнього (нефростомія) дренивання сечових шляхів. За результатами відзначено більш швидке зниження лейкоцитозу крові і сечі в групі зовнішнього дренивання, також швидше була вирізана гіпертермічна реакція організму, були більш виражені позитивні зміни на УЗД картині. За підсумками дослідження можна сказати що обидва методи дренивання показані при наявності обструктивного пієлонефриту як один з компонентів лікування, а метод зовнішнього дренивання має більш високу ефективність у порівнянні з внутрішнім стентуванням.

Ключові слова: уретральний стент, пієлонефрит, запалення, інфекція, нефростома

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Acute pyelonephritis is the most frequent bacterial infectious disease of the urinary system, which is a companion of patients with urolithiasis [1], with diabetes mellitus, prolonged catheterization of the urinary tract, kidney transplantation and operations on the pelvic-ureteric system.

The pathogenesis of pyelonephritis may depend on the virulence of the infectious pathogen, the host-pathogen interaction, and the host's response to pathogens, in addition to other factors such as urinary tract obstruction [2, 3]. The main factor in the development of complicated pyelonephritis is a disorders of urodynamics, the most common cause of which is urolithiasis.

Despite the introduction of ultrasound diagnostic methods into clinical practice, the development of a differentiated approach to the choice of tactics for the treatment of complicated pyelonephritis, open operations for purulent pyelonephritis are still being performed [9].

In modern urology, two methods can be used to restore the passage of urine from the upper urinary tract. The first of them is internal drainage of the urinary tract [4], which is carried out by endoscopic placement of special stents through the bladder and ureter into the renal pelvis. The advantages of this method are its safety, ease of implementation, no need for special control during and after surgery. Also, it is more convenient for patients, because there are no external parts of the drainage, this minimizes the risk of external infection [5, 6]. The disadvantages of this method are the sometimes impossibility of technically performing this manipulation with wedged ureteral calculi, in the presence of strictures of the urethra, ureters, neoplastic diseases of the bladder, prostate [10]. Cases of migration of the stent along the urinary tract or its incorrect installation in the absence of X-ray control are also described [8]. Also, the ureteral stent has a rather small diameter, so it can be obstructed which will lead to the loss of its functionality. Also, internal drainage causes reflux syndrome in some patients, which reduces the quality of life.

External drainage (percutaneous puncture nephrostomy) is a technically more complex manipulation, the meaning of which is to place an external drainage into the renal calyx system in the lumbar region. This method allows the outflow of infected urine directly from the pathological focus, the catheter has a larger diameter and is less prone to obstruction. Also, the state of the urinary tract, the presence of calculi, tumors, anatomical abnormalities does not matter. The disadvantages are the need for a large amount of equipment for manipulation, the possibility of external infection getting through the drainage [7], discomfort for the patient associated with caring for the puncture site, the possibility of damage to the renal vessels and the occurrence of perirenal and intrarenal hematomas.

In the last 5–10 years, foreign guidelines indicate the need for urinary tract drainage in the presence of purulent obstructive pyelonephritis, but there are still no clear and direct recommendations on the choice of the method of this drainage, and it remains for the doctor to choose based on his preferences and technical capabilities.

The purpose of the work was to study and compare the efficacy of methods for urinary tract drainage (endoscopic stenting and percutaneous nephrostomy), to identify their advantages and disadvantages and their role in the presence of acute obstructive pyelonephritis in a patient.

Materials and methods. The study included 24 patients, aged 20–60 years, treated at the bases of the 3rd and 2nd city hospitals in the city of Poltava in 2019–2021, who at the time of admission to the hospital had a clinic of acute purulent obstructive pyelonephritis, which was expressed in the hyperthermic reaction of the body, the presence of leukocytosis of the blood and urine, the presence of thickening and hypoechoogenicity of the kidney parenchyma during ultrasound examination, the expansion of the colon-pelvic system.

The study did not include patients with oncological diseases, with renal decompensation on dialysis, patients with one kidney, patients with decompensated chronic diseases (hypertension, diabetes mellitus, severe blood clotting disorders), with impaired vital functions and consciousness.

There were formed 2 statistically representative groups among themselves: 1st – patients who underwent internal drainage of the urinary tract. Depending on the cause, this manipulation was performed under spinal anesthesia (if the cause was occlusive stones of the lower third, in which it was possible to perform primary lithotripsy), or under local anesthesia with a gel containing 2 % lidocaine and 0.05 % chlorhexidine (if the decision was made to conduct only stenting without revision of the ureter, in the absence of calculi or calculi of the upper and middle third). The stent was placed along the guidewire, with ultrasound control of the presence of the guidewire and the stent in the renal pyelocaliceal system and subsequent intraoperative X-ray control of the position of the proximal end of the stent. The stents used were 6 and 7 Fr.

The second group included patients who underwent percutaneous drainage of the pyelocaliceal system. The operation was performed under local infiltrative anesthesia with bupivacaine hydrochloride 0.25 %. Punctures of the pelvic system of the kidney were performed under ultrasound control with placement of 12–14 Fr j-stents along the guidewire, and X-ray confirmation of its presence in the pelvic system at the end of the manipulation. Decisions on the placement of external drainage were made mainly for calculi of the upper and middle third, where there was a low probability of performing primary lithotripsy.

After manipulations, patients of all groups were prescribed conservative treatment, which consisted in the use of antibacterial drugs of the 3rd generation cephalosporin 1.0 gram 2 t/d, levofloxacin 500 mg 2 t/d, metronidazole 500 mg 2 t/d, adequate infusion detoxification therapy, antispasmodics. When received on the 3rd day of urine cultures with sensitivity, antibiotic therapy could be changed depending on the sensitivity.

The efficiency of drainage was assessed according to the following parameters: the presence and duration of the relief of hyperthermic syndrome, the number of leukocytes and their fractions in the general blood count, the presence of leukocytosis in urine, the creatinine index in the biochemical blood test, on the 3rd and 7th day of therapy. Also, these days, urine cultures were carried out to quantitatively and qualitatively determine the growth of microorganisms with the determination of their sensitivity to antibiotics. On the 5th and 10th days, an ultrasound examination of the kidneys was performed to determine the thickness of the parenchyma, the size of the kidney, the presence and degree of expansion of the calyx-pelvic system as indicators of a decrease in the inflammatory response. The presence, severity and duration of hematuria, reflux syndrome, the need for additional manipulations were also assessed.

Results of the study were statistically processed by using the Microsoft Excel package and Statistica 6.0. package. Specificity, sensitivity and accuracy of the study were calculated using generally accepted formulas. The data were processed using parametric and nonparametric statistical methods by

calculating the arithmetic mean and its statistical error using the Student's t-test method, the results obtained are presented as the mean and the arithmetic mean error, with a confidence level of $p < 0.05$.

Results of the study and their discussion. After completing our research, we obtained the following data. Obstructive pyelonephritis was caused by: urinary tract calculi in 20 patients (83.3 %), of which the lower third – in 10 (41.6 %), the middle third – 6 (25 %), the upper third – 4 (16.6 %). Also, in 4 patients (16.6 %), the presence of obstructive pyelonephritis was not associated with the presence of an obstruction, but rather with the occlusion of the ureter by fibrin clots due to inflammation. The duration of complaints of pain in the projection of the kidneys or urinary tract was 9 ± 2.8 days in the 1st group, 11 ± 2.3 days in the 2nd group, while the duration of the hyperthermic reaction (an increase in body temperature above 38.1°C , in the 1st group it was 3.1 ± 0.9 days, in the 2nd group it was 3.6 ± 0.8 days.

Regarding the technical aspects of performing manipulations on urinary tract drainage, it can be noted that in two (16 %) patients in the 1-st group with calculi in the middle third, it was initially impossible to perform endoscopic stent placement and these patients were transferred to group № 2 after subsequent external drainage. This is due, in our opinion, in both cases, with the presence of large wedged stones (1.5×0.9 cm and 1.3×1.0 cm). In the rest of the patients with calculi less than 10 mm, there were no technical difficulties with internal drainage. In the presence of calculi in the lower third in 8 cases (80 %) out of 10, the stone-free state was achieved.

In patients of group 1 with an internal stent in the postoperative period, we observed reflux syndrome in 5 (41 %) people, which manifested itself in periodic pain along the urinary tract. But only 2 patients (16 %) noted that it brings them discomfort, the rest noted periodic pain as “insignificant”. The reflux syndrome was not the reason for the transition to a different drainage method, we did not observe cases of inadequate functioning of stents, the need for their replacement and rearrangement, although the possibilities of such a development of events are described in the literature.

Patients of the 2nd group after external drainage had the following complications of the operation – in 1 patient (8 %) hematuria was observed, which lasted 2 days and required the appointment of hemostatic therapy, and in 2 patients (16 %), small perinephric hematomas (up to 2.5 cm/d according to ultrasound data), which did not require any clinical action, were asymptomatic and did not affect the postoperative period.

During the study, no cases of stent migration or obstruction were detected in both groups.

In the postoperative period, on the 3rd and 7th days, there was a decrease in the level of blood leukocytes, which was more pronounced by 17–18 % in patients of the 2nd group, and in the 2nd group, the dynamics of the decrease in leukocytosis and the level of creatinine was faster. in biochemical analysis.

These dynamics of laboratory parameters are presented in table 1.

Table 1

Data of the blood and urine analysis before surgery, on the day 3 and 7

Parameter	Group 1	Group 2
Before surgery		
Blood leukocytes ($\cdot 10^9/\text{L}$)	14.2 ± 3.4	14.9 ± 3.1
% of neutrophilic leukocytes	66 ± 7.2	73 ± 5.4
Creatinine ($\mu\text{mol}/\text{L}$)	164 ± 12.5	161 ± 15.6
Urine erythrocytes	“++”, “+++”	“++”, “+++”
Urine leukocytes	“+++”	“+++”
Day 3		
Blood leukocytes ($\cdot 10^9/\text{L}$)	12.1 ± 1.9	10.4 ± 2.1
% of neutrophilic leukocytes	64 ± 6.8	65 ± 5.8
Creatinine ($\mu\text{mol}/\text{L}$)	134 ± 16.4	130 ± 14.6
Urine erythrocytes	“++”, “+++”	“++”
Urine leukocytes	“++”, “+++”	“++”
Day 7		
Blood leukocytes ($\cdot 10^9/\text{L}$)	9.3 ± 1.4	7.9 ± 1.2
% of neutrophilic leukocytes	58 ± 3.9	51 ± 4.6
Creatinine ($\mu\text{mol}/\text{L}$)	126 ± 10.8	124 ± 9.4
Urine erythrocytes	“+”, “++”	“+”
Urine leukocytes	“++”	“+”, “++”

Notes: “+” – up to 10–50 in the field of view; “++” – 50 – 1/2 in the field of view; “+++” – the entire field of view.

When analyzing changes in laboratory parameters, it can be seen that all patients had pronounced neutrophilic leukocytosis in the general blood test before treatment, leukocytes were detected in large numbers in the general urine analysis, and the creatinine level was also slightly increased. Erythrocytes in

the analysis of urine were present before surgery in those patients whose pyelonephritis was caused by urolithiasis, but the number of red blood cells was not statistically significant before surgery.

When analyzing changes from the general urine analysis, it was found that a statistically significant regression of pathological parameters, such as leukocytes and erythrocytes, occurs in the 2nd group. This is most likely due to the fact that with external drainage, the stent is located directly in the pathological focus, without irritating the urinary tract throughout and not contributing to the manifestations of persistent hematuria, and the larger diameter of the nephrostomy allows accelerating the eradication of pathologically altered urine from the body, thus reducing degree of intoxication.

When analyzing the parameters of hyperthermia, the following data were obtained (fig 1).

It was revealed that at the beginning of therapy in all groups, it was febrile (38.7 ± 1.3 in the first group, 38.9 ± 2.4 in the second group). In the second group, the acceleration of the normalization of body temperature was statistically significant, on the 3rd day the temperature in most patients became subfebrile (37.9 ± 1.2), in contrast to the patients of the 1st group, where in 8 patients (66 %), on the 3rd day, febrile values were still noted (38.1 ± 1.6). On the 7th day, subfebrile temperature was noted in both groups (37.4 ± 2.1 in group 1), but it was also less pronounced in group 2 (37.2 ± 0.9).

The microbiological spectrum is presented in Table 2.

□bl□2

Microbiology of urine

Pathogenic microorganism	Group 1	Group 2
Escherichia coli	4 (33.3 %)	5 (41.6 %)
Klebsiella spp.	3 (25 %)	3 (25 %)
Enterococcus faecalis	2 (16.6 %)	1 (8.4 %)
Bacterial associations	2 (16.6 %)	1 (8.4 %)
S. aureus	1 (8.4 %)	1 (8.4 %)
Pseudomonas	–	1 (8.4 %)
Enterobacter	1 (8.4 %)	–

When analyzing microbiological urine cultures on the 3rd and 7th days, it was revealed that the source of infection in a large number of cases was E. coli, in second place was Klebsiella, in third – Enterococcus faecalis, then – bacterial associations.

When analyzing the number of microorganisms, the following data were obtained (fig 2).

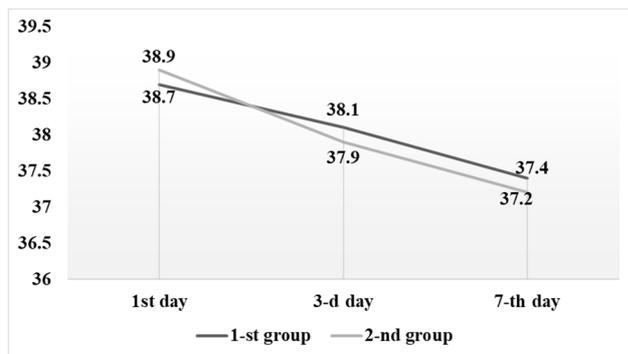


Fig 1. Patient's body temperature dynamics during treatment

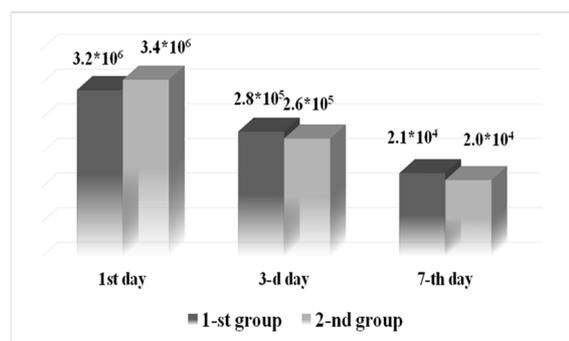


Fig 2. Number of colony-forming units of microorganisms in the urine

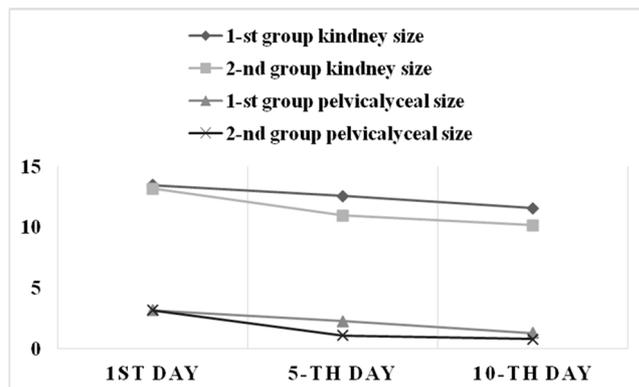


Fig 3. Ultrasound kidney dynamics

Already on the 3rd day, positive shifts appeared in both groups, but their analysis did not reveal statistical significance, the identification of these patterns requires additional research and a larger number of observed patients. It is important to note that changes in the microflora and the addition of new pathological nosocomial strains were not identified, which indicates the safety of the selected methods.

We analyze the dynamics of ultrasonic changes in the structure and size of the kidneys (fig 3).

It can be seen that external drainage contributes to a more rapid decrease in the total size of the affected organ, accelerates the reduction of inflammation in the kidney parenchyma and the size of the calyx-pelvic system. This is apparently achieved due to the large size of the drainage tube and the absence of reflux along the inner stent

Studying the obtained data and their connection with the works performed in the world, we can say that recommendations on the need for drainage of the kidney in the presence of obstructive pyelonephritis are proven and necessary [2, 8]. When analyzing the possibilities of minimally invasive methods of urinary tract drainage, our findings indicate a slight advantage of external drainage, which is confirmed in the work of Yoo MJ, Bridwell RE, Inman BL, Henderson JD, Long B [9]. The presence of a nephrostomy provides a faster de-escalation of the patient's body temperature, most likely due to the direct outflow of pathological urine from the focus of inflammation and a decrease in the absorption of toxins into the blood. In the same way, the normalization of laboratory parameters of blood and urine is accelerated. The ultrasound picture confirms the improvement in the size of the renal parenchyma, these data correlate with the results of other researchers [3]. If we talk about the choice of the drainage method, then according to the data of foreign authors, the external drainage method is statistically more likely to have complications associated with both the drainage technique and the attachment of external microflora after surgery [1, 4]. Our results showed the relative safety of both methods; although adverse events were registered, they did not lead to the need to change the therapy. Also, microbiological analysis did not reveal a statistically significant difference in the isolated cultures, both in quantitative and qualitative components. Technically, the method of internal drainage turned out to be simpler and less costly, and we can recommend it as a quick opportunity to handle with the pathological process, leaving the external drainage to a conditions of a advanced inflammatory process or anatomical anomalies in patients.

Conclusions

1. Nephrostomy provides faster regression of laboratory changes in urine and blood by 17 % and 21 %
2. External drainage provides a more expressed decrease in the expansion of the renal pyelocaliceal system by the 5th day of the disease.
3. Internal urinary tract drainage is a safer method and also requires less equipment and specialized placement skills.
4. In terms of pain syndrome and the quality of the postoperative period in patients, the methods of external and internal drainage are comparable to each other.
5. If the patient has acute obstructive pyelonephritis, it is necessary to use any method of drainage, as this significantly accelerates the patient's recovery.

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