REVIEW ARTICLE

RISK OF OCCURRENCE AND WAYS TO IMPROVE THE TREATMENT OF UROLITHIASIS IN PATIENTS WITH A SINGLE KIDNEY

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ABSTRACT

The aim: To summarize the state of the problem of urolithiasis in patients with a single kidney and consider current views on improving its treatment based on the analysis of world literature.

Materials and methods: The study conducted a thorough analysis of modern scientific literature sources in the international scientometric database, which highlighted the development of urolithiasis in patients with a single kidney and the peculiarities of its treatment. The main ways to improve treatment are identified. A critical assessment of the achievements and shortcomings of various surgical treatments. The authors' own developments are presented in the article.

Conclusions: The topographic position of the kidney in the retroperitoneal space affects not only the occurrence of pathological processes in the kidney, but also the surgical strategy in the treatment of nephrolithiasis. Percutaneous nephrolithotomy is the main treatment for large (> 2 cm) or complex kidney stones. Patients with a single kidney are more prone to bleeding with PCNL treatment than patients with bilateral kidneys because they have an increased thickness of the renal parenchyma as a result of compensatory hypertrophy. RIRS is a reliable choice for patients with a single kidney who is contraindicated in PCNL.

KEY WORDS: single kidney, urolithiasis, treatment, percutaneous nephrolithotomy, retrograde intrarenal surgery

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INTRODUCTION

Urolithiasis is one of the most common diseases of the kidneys and urinary tract. Growing trends in nephrolithiasis along with the development of technology require systematic organization of information for urologists to be able to emulate diagnostic and therapeutic algorithms to optimize patient care [1]. This disease ranks second in the structure of pathology of the kidneys and urinary tract after pyelonephritis, third in the structure of causes of death and fourth - in the structure of disability in urological pathology. Urolithiasis is registered in the population of all countries with a frequency of 10-30 cases per 1000 adults and accounts for 30-40% of all urological diseases [2], 76% of people with disabilities with urolithiasis - people who have a single kidney. There is strong evidence that unilateral radical nephrectomy with kidney donation may increase the overall risk of progression of chronic kidney disease [3].

Nephrolithiasis is currently recognized as both a chronic and systemic disease. Population studies suggest a close association between the presence of nonalcoholic fatty liver disease and an increased risk of urolithiasis [4]. Citrate reabsorption causes hypocitraturia and promotes urinary calcium deposition. Decreased levels of adiponectin [5] can lead to increased levels of ceramide in the liver, it may be the cause of insulin resistance, which contributes to the development of nephrolithiasis. In addition to the high incidence of the disease has a long, often recurrent course. Urolithiasis, followed by malignant neoplasms and pyelonephritis, leads to disability, which is associated with progressive impairment of the anatomical and functional state of the kidneys and urinary tract and often ends in chronic renal failure [6].

The high risk of developing urolithiasis in patients who underwent radical nephrectomy has been proven. The single kidney compensatory increases because it assumes the role of a lost organ: this explains the increase in the frequency of inflammatory processes and other complications that accompany the course of the disease [7]. In experimental studies, the rate of stone formation after unilateral nephrectomy in lithogenic rats was higher compared to control groups with bilateral renal function, however, the problem of morphofunctional analysis of compensatory responses is little studied and requires further development.

Urolithiasis is an integral part of urology practice. Over the past few decades, there has been a shift in the treatment of urolithiasis from open surgery to various endourological procedures, which include percutaneous nephrolithotomy (PCNL), ureterorenoscopy, and retrograde intrarenal surgery (RIRS) [8].

THE AIM

Summarize the state of the problem of urolithiasis in patients with a single kidney and consider current views

on improving its treatment based on the analysis of world literature.

MATERIALS AND METHODS

The study conducted a thorough analysis of modern scientific literature sources in the international scientometric database, which highlighted the development of urolithiasis in patients with a single kidney and the peculiarities of its treatment. The main ways to improve treatment are identified. A critical assessment of the achievements and shortcomings of various surgical treatments. The authors' own developments are presented in the article.

REVIEW AND DISCUSSION

TOPOGRAPHIC AND ANATOMICAL POSITION OF THE KIDNEY AND THE DEVELOPMENT OF UROLITHIASIS

Studies of the relationship between the topographic and anatomical position of the kidney with types of human physique are of clinical interest. Omission of the kidney in combination with pathological rotation due to topographic and anatomical features is accompanied by hemodynamic disorders and the development of urolithiasis. Our mathematical modeling showed that increasing the weight of the kidney leads to its movement down the axis of the kidney and reducing the angle in the frontal projection of the kidney, and changes the physical properties of the environment in which the kidney is located [9].

The latest methods of morphological research are important in solving these issues - computer technologies for reconstruction and morphometry of microscopic structures, histochemical, biomechanical techniques, computed tomography and magnetic resonance imaging [10]. Studies of single kidney size in patients with kidney stones 2-5 years after removal of the kidney using magnetic resonance imaging revealed an increase in kidney size (width, length, thickness) and kidney volume, this knowledge is necessary given the fact that the presence of a single kidney is a risk factor for the early development of chronic renal failure [11].

Omission of the kidney in combination with pathological rotation due to topographic and anatomical features is accompanied by hemodynamic disorders [12] and the development of urolithiasis. Quantitative analysis of the position of a single kidney in three coordinate planes makes it possible to predict the occurrence of kidney disease. Our studies confirmed the relationship between hemodynamic disorders in nephroptosis with the distribution of patients according to the degree of kidney omission. The results of correlation, cluster and discriminant analysis showed that a closer relationship is observed between hemodynamic disorders and the degree of renal rotation. A number of scientists believe that kidney rotation is a more significant factor influencing the patient's condition than its omission.

The topographic position of the kidney in the retroperitoneal space affects not only the occurrence of pathological processes in the kidney, but also the surgical strategy in the treatment of nephrolithiasis. We found that nephroptosis of a single kidney after nephrectomy is most common in women of ectomorphic somatotype. Both women and men are more likely to have a right kidney failure. Depending on the stage of lowering the kidney, its nitrogen excretory function deteriorates and blood pressure rises [2].

Literature data show that in most cases after nephrectomy there is nephrolithiasis in the remaining kidney, decreased renal function, exacerbated pyelonephritis, progressive renal failure. Impaired urinary outflow due to changes in the topographic and anatomical position of the kidney contributes to the formation of large stones - single and multiple. Also, changing the pH of urine to acidic or alkaline contributes to the formation of complex coral-like stones. According to our observations, a significant role in the recurrence of nephrolithiasis of a single kidney is played by changes in its physiological position (nephroptosis and rotation of the kidney due to vicarious hypertrophy) [12]. Changes in the topographic and anatomical position of a single kidney are quite common. Thus, according to the literature, ultrasound observation revealed deviations from the normal position of the single kidney in the sagittal plane in 43% of patients. Urologists find numerous rotations of a single kidney and its nephroptosis.

WAYS TO IMPROVE THE TREATMENT OF UROLITHIASISIN A SINGLE KIDNEY

Scientific developments and technical advances in recent years have contributed to the revision of approaches to the removal of urinary stones and the formation of a new, less invasive direction in the treatment of nephrolithiasis [13]. Different in the method of execution and scope of surgery in each case aims to restore urine outflow and remove the maximum number of stones, which is the main condition for mobilizing reserve functional capacity of the kidney [14].

When choosing a method of surgery for urolithiasis in a single kidney, the following basic principle should be followed: you need to use the most effective and safe in a particular situation method of stone removal in the minimum number of treatment sessions to reduce the risk of reoperation and protect the patient from organ loss . Patients with a single kidney are at high risk for stones. Single kidney stones and coral-like stones are very difficult cases for successful treatment. Coral stones can destroy the entire kidney and cause life-threatening sepsis, so complete removal of the stone and removal of the obstruction is the key to treatment. Patients with a single kidney and kidney stones have a higher susceptibility to risk factors for kidney disease, renal function may be clearly impaired, and patients' quality of life will be reduced [15].

Despite the proven high efficiency of remote shock wave lithotripsy, with stones larger than 2 cm in diameter, percutaneous nephrolithotomy, and especially minimally invasive PCNL, shows better results and lower complications [16]. With the introduction of PCNL there have been revolutionary changes in approaches to surgical treatment

of urolithiasis. To date, the most effective and safe method of treating patients with large and coral-like stones of a single kidney is PCNL [17]. The most formidable complication of percutaneous nephrolithotomy is renal hemorrhage. Before performing PCNL, it is important to identify risk factors that may affect the frequency of bleeding and take active measures to prevent bleeding [18]. For a patient with a single kidney, uncontrolled renal bleeding can be life-threatening.

The American Association of Urologists recommends PCNL as a priority treatment for coral-like stones, based on the high incidence of stone-free cases and an acceptable incidence of postoperative complications. With the improvement of technology and the experience of urologists, PCNL is recommended for the removal of coral-like stones in patients with a single kidney [19]. Postoperative complications in the form of single kidney stones are the most common problems in urological surgery, while coral stones are the most difficult to treat with PCNL. When these two factors are combined, it becomes one of the most difficult and extremely dangerous clinical problems in urological surgery.

Compared with shock wave lithotripsy, more studies have focused on PCNL results in patients with a single kidney. However, most of the evidence was obtained from retrospective studies at a single center with small sample sizes. It is emphasized that although PCNL is becoming an increasingly successful method, the potential complication of major bleeding is a critical factor that may contribute to the choice of alternative therapies such as shock wave lithotripsy [20]. To minimize bleeding during nephrolithotomy, an incision of the kidney was performed along the Bradel line. Bredel's bloodless autopsy line, the avascular area where the anterior and posterior segmental branches of the renal artery converge, is a key anatomical area. The same principle applies to the PCNL procedure. The puncture should ideally cross the relatively vascular Bradel line, thereby reducing the risk of bleeding. The posterior calyx is considered the optimal calyx for puncture because posterior calyces are usually oriented along the Bradel line. When this principle of anatomically correct renal puncture was not followed, the risk of severe bleeding requiring angioembolization after PCNL was significantly increased [21].

After using multiparametric logistic regression models to assess changes in renal function after PCNL in patients with single kidney stones, analysis of renal function showed significant improvement, and PCNL was recognized as a safe procedure for treating kidney stones [22].

The largest study of eight European centers of renal function after laparoscopic renal cryoablation in patients with small renal tumors in a single kidney showed that cryotherapy in this emergency is safe, has a clinically insignificant decrease in renal function, and therefore minimizes the risk of renal failure. [23].

Patients with a single kidney in the treatment of lower calyx stones within 2-3 cm in diameter when using PCNL had a higher frequency of stone removal in 1 session than when using RIRS. However, an alternative may be RIRS with less bleeding and a shorter postoperative hospital stay [24]. RIRS serves as an alternative to PCNL or extracorporeal shock wave lithotripsy in the treatment of kidney stones. It has been shown that a high incidence of stones and a low incidence of complications are achieved. There are few reports in the literature on the use of RIRS for the treatment of kidney stones in patients with a single kidney [25].

A recent published systematic review showed that PCNL provides a higher rate of stone passage compared to RIRS. However, PCNL is also accompanied by a higher incidence of complications and blood loss [26]. Although PCNL is associated with potential surgical complications such as bleeding, infection, lung collapse, and urinary fistula, it remains the gold standard for the treatment of complex kidney stones even for patients with a single kidney, providing acceptable stone-free performance while maintaining function. kidney [27]. With fewer repeat surgical procedures, higher efficacy rates, and comparable overall costs, PCNL is recommended as the first choice for the treatment of large kidney stones in patients with a single kidney.

In the last few years, improvements in endoscopy technology have made RIRS more attractive, even for special circumstances, which has been used as an alternative to PCNL for low-complication kidney stones [28]. RIRS in Europe is often performed as an outpatient operation. In patients with contraindications to PCNL treatment and with adverse treatment characteristics such as obesity, progressive spinal deformities, severe cardiopulmonary disease, or those receiving anticoagulant therapy, RIRS is a reliable choice [29].

Crucial to the management of patients with a single kidney is a method of treatment that preserves the functioning of the functioning renal parenchyma. Unfortunately, RIRS cannot be recommended as first-line therapy because the stone-free rate showed a negative correlation with stone size. However, the use of holmium laser lithotripsy in RIRS to perform dust formation, rather than crushing kidney stones less than 2 cm, has shown high efficacy in patients with a single kidney [30]. One-dimensional and multidimensional logistic regression analysis were used to model the relationship between renal parenchymal thickness and rapid elimination of stone fragments after RIRS. Satisfactory stone removal can be achieved through multisession RIRS in the treatment of kidney stones larger than 2 cm in patients with a single kidney [27]. The latest achievement of RIRS - the development of disposable ureteroscopes - is a significant step in urology. In addition to the technical advantages that have already demonstrated the advantage of a single sight over a multiple, this complete sterile procedure undoubtedly reduces the risk of hospital-associated infections. Some studies also support the idea of cost-effectiveness in favor of disposable devices [31].

The number of results of surgery "without stones" after RIRS was achieved in 30% of patients with stones larger than 2 cm and usually required re-treatment; however, the overall frequency of complications is not related to the size

of the stones. With long-term follow-up, the effectiveness of surgery was 87.3%. [32]. In patients with a single kidney and a stone larger than 2 cm, PCNL was a much more effective alternative to ureterorenoscopy with a comparable incidence of complications. Expanding the use of smaller diameter tubes and the use of laser technology have reduced the number of complications [33]. To date, standards in the treatment of kidney stones are mainly associated with minimally invasive interventions PCNL expanded indications for the treatment of large and coral stones by improving equipment for the destruction of stones on the one hand, on the other hand expanding indications for small stones primarily by reducing traumatic impact while minimizing tool size [17].

The latest literature data show that the joint use of these two methods allows you to quickly remove stones, reduce operation time, increase the rate of "no stones". In addition, combination therapy can reduce the need for a number of tracts, and then reduce blood loss and possible complications associated with multiple tracts. Therefore, combination therapy can be used as a possible treatment option for large kidney stones in patients with a single kidney [27].

CONCLUSIONS

The topographic position of the kidney in the retroperitoneal space affects not only the occurrence of pathological processes in the kidney, but also the surgical strategy in the treatment of nephrolithiasis.

Percutaneous nephrolithotomy is the main treatment for large (> 2 cm) or complex kidney stones. Patients with a single kidney are more prone to bleeding with PCNL treatment than patients with bilateral kidneys because they have an increased thickness of the renal parenchyma as a result of compensatory hypertrophy.

RIRS is a reliable choice for patients with a single kidney who is contraindicated in PCNL.

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