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EVALUATION OF POSTOPERATIVE COMPLICATIONS OF TRANSURETRAL LITHOTRIPSY IN CHILDREN BY USING THE MODIFIED CLAVIEN-DINDO CLASSIFICATION

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Resume

Ureter stones are reason of many serious complications; therefore, it is necessary to eliminate supraspinal obstruction in short term with minimal invasive methods using.

Material et methods: Transurethral ureter lithotripsy (TUULT) is method of choice in ureter stones. This type of surgery may be accompanied by complications. A review of the literature shows that currently there is no consensus on how to distribute ureter lithotripsy postoperative complications according to severity. This, in turn, makes it difficult to perform a comparative analysis of the results of ureter lithotripsy produced in various clinics.

The aim of this study was: to evaluate the effectiveness of TUULT in children and to systematize postoperative complications using the modified Clavien-Dindo classification.

The study was conducted in a group of 126 children with ureteral stones from January 2012 to December 2018. According to the authors, it was revealed that after TUULT, 120 (95.2%) children managed to completely rid the children of stones and their fragments. In the postoperative period after TUULT, deviation from the standard course was observed in 34 (27%) cases, regarding this situation as a complication, according to the modified Clavien-Dindo classification. Hyperthermia without signs of exacerbation of UTI was observed in 6 (4.7%) cases; hematuria that does not require the use of hemostatic, additional infusion therapy, diuretics - in 3 (2.4%); clinical and laboratory exacerbation of chronic pyelonephritis - in 6 (4.7%); the need for non-steroidal anti-inflammatory drugs more than 48 hours after surgery - in 12 (9.5%); stein Strasse - in 4 (3.2%); nephrostomy drainage replacement - in 1 (0.8%); urosepsis (including SIRS) - in 1 (0.8%) cases. The results showed that the use of the modified Clavien-Dindo classification for the assessment of postoperative complications allows an objective comparison of the results of different authors, however, appropriate changes should be made regarding the results of the use of TUULT in children.
ОЦЕНКА ПОСЛЕОПЕРАЦИОННЫХ ОСЛОЖНЕНИЙ ТРАНСУРЕТРАЛЬНОЙ ЛИТОТРИПСИИ У ДЕТЕЙ С ПОМОЩЬЮ МОДИФИЦИРОВАННОЙ КЛАССИФИКАЦИИ CLAVIEN-DINDO

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Резюме

Камни мочеточника у детей являются причиной тяжелых осложнений, поэтому необходимо устранить суправезикальную обструкцию в короткие сроки, используя оперативные методы с минимальной агрессией.

Материал методы: Трансуретральная уретеролитотрипсия (ТУУЛТ) является методом выбора при камнях мочеточника. Уретеролитотрипсия может сопровождаться осложнениями. Однако нет единого мнения, каким образом оценить послеоперационные осложнения при использовании ТУУЛТ по степени тяжести, что затрудняет выполнение сравнительного анализа результатов операции, произведенных в различных клиниках.

Целью данного исследования явилось: оценить эффективность ТУУЛТ у детей и систематизировать послеоперационные осложнения используя модифицированную классификацию Clavien-Dindo.

Результаты: Исследование было проведено в группе из 126 детей с камнями мочеточника за период с января 2012 по декабрь 2018 года. Средний возраст пациентов составил 12,9±1,6 лет (диапазон от 5 до 18 лет). Используя ТУУЛТ полностью избавить детей от камней и их фрагментов, удалось в 120 (95,2%) случаях. В послеоперационном периоде в 34 (27%) случаях наблюдали отклонение от стандартного течения, расценивая эту ситуацию как осложнения, согласно модифицированной классификации Clavien-Dindo. Гипертермию без признаков обострения инфекции мочевого тракта выявили в 6 (4,7%) случаях; гематурию, не требующую применения гемостатиков, дополнительной инфузионной терапии и диуретиков - у трех (2,4%) пациентов; обострение хронического пиелонефрита - в 6 (4,7%) случаях; потребность в нестероидных противовоспалительных средствах было у 12 (9,5%) больных; каменная дорожка выявлена в четырех (3,2%) случаях; замена
нефростомического дренажа выполнена у 1(0,8%) детей; уросепсис был в одном (0,8%) случае. Полученные результаты позволили оценить тяжесть и частоту послеоперационных осложнений при выполнении ТУУЛТ у детей.

Ключевые слова: ТУУЛТ, трансуретральная уреролитотрипсия, дети, классификация Clavien-Dindo, мочекаменная болезнь, послеоперационные осложнения.

MODIFIKATSIYALANGAN CLAVIEN-DINDO TASNIFI YORDAMIDA BOLALARDADA TRANSURETRAL LITOTRIPSIYA AMALIYOTAN KEYING ASORATLARNI BAHOLASH

Muxtarov Sh.T.1, Xodjayev Sh.N.1, Nadjmitdinov Ya. S.2

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2Toshkent Tibbiyot Akademiyasi

Rezyume

Bolalarda siydik nayi toshlari og’ir asoratlarga olib kelishi extimoli katta, shu sabab supravezikal obstruktsiyani qisqa muddatda minimal invaziv usullarni qo’llagan xolda bartaraf etish zarur. Transuretral ureterolitotripsiya siydik nayida joylashgan toshlar davosida tanlov usuli xisoblanadi. Bu muolajani o’zi a’soratlarga olib kelishi mumkin. Bu asoratlarni baholashda yagona tizim tuzilmagan, shu sabab turli hil tibbiyot muassasalarda jarrohlik amaliyotlari natijalarini qiyosiy tahlilini o’tkazishda qiyinchiliklar tug’iladi. Ushbu tadqiqot maqsadi bolalarda modifikatsiyalan gan Clavien-Dindo tasnifi yordamida TUULT samaradorligini baholash. Izlamish guruhi 2012 yil yanvar oyidan 2018 dekabr oyigacha murojaat qilgan 126 nafar boladan iborat bo’ldi. Bolalarni o’rtacha yoshi 12,9±1,6 yosh (5 dan 18 yoshgacha diapazonda) tashkil qildi. TUULT muolajasidan so’ng 120ta (95,2%) bola butunlay tosh va uning fragmentlaridan halos bo’ldi. Postoperatsion davrda 34 nafar (27%) bolada standart kechimdan og'ish kuzatildi, va bu vaziyat Clavien-Dindo tasnifi yordamida ko'ra asorat deb baholandi. Siydik yo'ilari infektsiyasi belgilarisiz gipertermiya 6 nafar bolada (4,7%); gemostatiklar, qo'shimcha infusion terapiya va diuretiklarda ehtiyoj tug’dirmagan gematuriya – 3ta (2,4%); surunkali piyelonefritni klinik-laborator zo’rayishi – 6ta (4,7%); jarrohlik amaliyotidan 48 soat o’tgach yallig’lanishga qarshi nosteroid dori vositasida ehtiyoj – 12ta (9,5%); toshli yo’lakcha – 4ta (3,2%); nefrostomik drenaj almashtirilishi – 1ta (0,8%); urosepsis – 1ta (0,8%) bolada kuzatildi. Aniqlangan natijalar ko’rsatdiki, bolalarda TUULTni postoperatcion asoratlani baholashda
Relevance

Ureter stones in children are less common than in adult patients and account for about 7% of the total number of urinary tract stones [1]. However, ureteral stones in children are a cause of great suffering and often lead to serious complications, in connection with which it is necessary to eliminate supravesical obstruction as soon as possible, while using minimal invasive technologies. Due to the higher risk of relapse and the characteristics of children anatomy, in the presence of calculi in the urinary tract, preference should be given to minimally invasive methods of intervention [2].

The use of endoscopic instruments to remove stones located in the ureter in children was considered by many urologists as a difficult operation. Therefore, it has long been believed that extracorporeal shock wave lithotripsy (ESWL) is a first-line treatment for children with ureteral stones. Over the past decade, the opinion of pediatric urologists has changed, moreover, with a comparative assessment of the results of ESWL and ureterolithotripsy, it turned out that the endoscopic method for removing stones is more effective, especially if stones are larger than 10 mm [3, 4]. In addition, the effectiveness of remote lithotripsy decreases with "unfavorable" anatomy of the ureter, especially with cystine and urate stones due to the difficulty of visualizing them and determining localization. Therefore, the method of choice in such situations is to rid patients of stones using endoscopic instruments. Moreover, with the advent of small-caliber instruments, transurethral ureterolithotripsy (TUULT) is considered by urologists as the method of choice for ureteral stones in children, which allows you to completely get rid of them in a short time [1,3]. Although ureterolithotripsy has been proven effective, any minimally invasive ureterolithotripsy intervention may be associated with complications. However, so far there is no consensus on how to distribute postoperative complications according to severity, which makes it difficult to perform a comparative analysis of the results of ureterolithotripsy produced in various clinics. The classification of complications Clavien-Dindo is widespread among surgeons, and used in a modified form by urologists [5]. Moreover, the European Association of Urology considers it necessary to use this scale in the study of complications of urological operations [6]. Evaluation of ureterolithotripsy complications with the use of this classification has been used in adult patients with ureteral stones [7,8]. Despite these suggestions, there are currently no standard guidelines or criteria for gradation of surgical complications in pediatric urology. It should be emphasized that the Clavien – Dindo classification allows only postoperative
complications to be standardized, while an attempt to adapt intraoperative complications to this classification can lead to a distortion of the study results.

**Aim.** The aim of this study was: to evaluate the effectiveness of TUULT in children and to systematize postoperative complications using the modified Clavien-Dindo classification.

**Materials and methods**

A retrospective study of TUULT results had performed in 126 children with ureteral stones during the period from January 2012 to December 2018. The average age of the patients was 12.9 ± 1.6 years (range from 5 to 18 years). Children under the age of 7 years were 21 (16.7%), the oldest age group was 105 (83.3%) children; from 126 patients, girls were 35 (34%), boys - 91 (72.2%). Ureterolithotripsy was performed using a rigid 8 Ch ureteroscope, under general anesthesia. The stones were located in the distal ureter in 96 (76.2%) children and in the middle section in 30 (23.8%). Patients with a stone located in the proximal ureter were not included in the study, because stone removal in such cases is performed in our center using antegrade access. The average size of calculi was 10.3 ± 0.4 mm (range from 7 to 16 mm). The stone was located in the left ureter in 56 (44.4%) patients, in the right - in 70 (55.6%) cases. Before the operation, all patients underwent ultrasonography of the urinary tract, kidney-ureteres-bladder and intravenous urography, computed tomography was used in cases where, according to other radiological methods of research, it was not possible to detect calculus and determine kidney function from the lesion side. TUULT was performed only in the presence of renal function according to excretory urography, including normal levels of urea and creatinine in blood serum. In the presence of pyuria, antibiotic therapy was carried out, taking into account the revealed microflora and its sensitivity to drugs, the intervention was performed with a multiple decrease in the number of leukocytes in the urine. All patients, depending on the size of the stone, were divided into two groups: less than 10 mm and more than 10 mm.

Fragmentation of the stone was carried out with using a holmium laser (Actech, China) in 80% of cases; in the other patients - with using a pneumatic lithotripter (Electro Medical Systems S.A., Switzerland). After the operation, a urethral catheter was installed, which was removed for 2-3 days. It should be noted that TUULT was performed by two urologists with rich experience in endourological operations in adult patients and have passed specialization in pediatric urology.

Given the absence of specific gradations of TUULT complications in the Clavien-Dindo classification in children, we designed a “standard” course of the postoperative period taking into account the specifics of the child’s body for optimal adaptation to the results of operations, and considered any deviation from this course as a complication.

An increase in body temperature during the first day to 38 °C, if such a condition white blood cell differential was not manifested by signs of sepsis (no chills, tachycardia,
decreased blood pressure and a shift in blood leukoformula to the left, an increase in the number of leukocytes in the urine) were not considered as a complication. However, hyperthermia was regarded as a complication in cases when episodes of an increasing body temperature were repeated in more than 48 hours and there was a need to correct antibiotic therapy (change of antibiotic to another, belonging to the next generation, or a second drug was added to the receiving), additional infusion therapy or injectable drugs to lower body temperature using. It should be noted that after the operation, as a rule, all patients were prescribed non-steroidal anti-inflammatory drugs (NSAIDs) in the form of syrup for 36 hours. Postoperative use of injected NSAIDs 24 hours after the intervention was also regarded as a deviation from the standard course. Hematuria, which was intense and was accompanied by a decreasing in the hemoglobin concentration in peripheral blood, a decreasing in blood pressure, the formation of blood bundles in the urinary tract, which were the cause of urodynamics disturbances and required the use of any additional manipulations, was also regarded as a complication. It should also be noted that all cases of deviation from the standard course in the postoperative period, which were the reason for the increase in the length of the patient’s stay in the hospital, were considered as complications. However, in those cases when, when performing ureterolithotripsy, and stone fragment was mixed into the pyelocaliceal system and percutaneous access was used to remove it, this situation was regarded as an intraoperative complication.

Statistical processing of the material was carried out using the program MS Office Excel 2007, StatSoftStatistica 8.0 using the Student and Fisher criteria.

Results and discussion

After TUULT, 120 (95.2%) children were completely spared from stones and their fragments. It should be noted that in patients with stones less than 10 mm in size, “stonefree” index was 100%, and in 94.7% of cases calculi were localized in the distal ureter. The average duration of surgery for stones with size less than 10 mm was 46.5 ± 12.4 minutes, whereas in the group of patients with a calculus greater than 10 mm this indicator was 64.7 ± 16.5 minutes (p> 0.05).

An internal ureteral stent for the upper urinary tract drainage after lithotripsy was used only in 6 (4.8%) cases. Nephrostomy drainage was established in two patients (1.6%), since when performing ureteroscopy, the stone moved to the pyelocaliceal system and nephrolithoextraction was performed to remove it. In these two cases, the stone size was less than 10 mm and they were located in the middle section (in one case) and the distal section (in one case) of the ureter. There wasn’t damage of ureter walls during TUULT was not in any case.

The ureter steinstrasse, which was located in the distal ureter after TUULT, was detected in three patients (2.4%), the length of which ranged from 2 to 25 mm, while the size of the stone fragments did not exceed 2-3 mm. However, there were no clinical manifestations of supravesical urinary tract obstruction in these children; stone fragments
were removed using alpha-1-blockers. Thus, with the help of TUULT it was possible to completely remove stones and their fragments in 123 (97.6%) children. There were no additional interventions after TUULT, in any case.

According to the modified Clavien-Dindo classification, in the postoperative period after TUULT in 34 (27%) cases, a deviation from the standard course was observed and assessed this one as a complication (table 1). Hyperthermia, in which lytic therapy was used to lower body temperature, without signs of UTI exacerbation was observed in 6 (4.7%) cases. In the presence of hematuria lasting for more than three days, only in three (2.4%) cases there was a necessity for infusion therapy, but hemostatic or diuretic drugs were not used in the treatment of these patients. Clinical and laboratory exacerbation of pyelonephritis, which was accompanied by an increase in body temperature of more than 38 °C for 24 hours after TUULT and leukocytouria was observed in 7 (5.5%) cases. due to the correction of antibiotic and infusion therapy, pyelonephritis was resolved in 6 cases. However, in one (0.8%) child, an exacerbation of urinary tract infection led to a systemic inflammatory response syndrome (SIRS), which served as the reason for his transfer to the intensive care unit. The reason for this situation was dysfunction of nephrostomy drainage due to its transposition. The patient in the operating room under intravenous anesthesia was replaced drainage. Aggressive antibiotic therapy and adequate drainage of the kidney cavities in this case avoided more serious complications. Due to pain in the urethra and the presence of nephrostomy drainage in 12 (9.5%) cases, NSAIDs were used for 3-4 days.

We also examined some factors that could have an impact on the frequency of complications (table 2). Neither the patient’s gender, nor the side, nor the level of the location of the stone in the ureter, nor the presence of a urinary tract infection, had an impact on the frequency of postoperative complications at TUULT performing in children. Nevertheless, the age of the patients (younger age group), the size of the stone, and the duration of the surgical intervention were significant factors increasing the frequency of complications. It should be noted that the length of hospital stay in the group of patients with complications was longer compared to those whose postoperative period did not go beyond the accepted standard (3.4 ± 0.2 and 5.6 ± 0.4 days, respectively, P > 0.05).

<table>
<thead>
<tr>
<th>Degree</th>
<th>Complication</th>
<th>Patient’s absolute number ( %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hyperthermia</td>
<td>6 (4,7%)</td>
</tr>
<tr>
<td></td>
<td>Transient increase in serum creatinine</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Hematuria, which requires the use of hemostatics, additional infusion therapy, diuretics.</td>
<td>3 (2,4%)</td>
</tr>
</tbody>
</table>

*Table 2. The distribution of patients depending on the degree of complications after TUULT according to the modified Clavien-Dindo classification (n = 126).*
Clinical and laboratory exacerbation of chronic pyelonephritis
The need for non-steroidal anti-inflammatory drugs more than 48 hours after surgery.
Obstruction and renal colic due to blood clot requiring additional conservative therapy.

<table>
<thead>
<tr>
<th>II</th>
<th>Blood transfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIIa</td>
<td>Steinstrasse</td>
</tr>
<tr>
<td>IVb</td>
<td>Urosepsis (including SIRS)</td>
</tr>
<tr>
<td>V</td>
<td>Fatal outcome</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IIIb</th>
<th>Double-J installation (due to edema of the ureteral mucosa) for long term</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVa</td>
<td>Insufficiency of any organ (including necessity for hemodialysis)</td>
</tr>
<tr>
<td>V</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 2. Distribution of patients with complications in the postoperative period depending on various factors (n = 126).

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Complication rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absent (n=89)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>25 (71,4)</td>
</tr>
<tr>
<td>Boys</td>
<td>64 (70,3)</td>
</tr>
<tr>
<td>Up to 7 years</td>
<td>5 (23,8)</td>
</tr>
<tr>
<td>Over 7 years old</td>
<td>84 (16)</td>
</tr>
<tr>
<td>Right side</td>
<td>49(70)</td>
</tr>
<tr>
<td>Left side</td>
<td>40(71,4)</td>
</tr>
<tr>
<td>Stone size:</td>
<td></td>
</tr>
<tr>
<td>less than 10 mm</td>
<td>61 (82,4)</td>
</tr>
<tr>
<td>more than 10 mm</td>
<td>28 (53,8)</td>
</tr>
<tr>
<td>Stone location (ureter sections):</td>
<td></td>
</tr>
<tr>
<td>Distal</td>
<td>21 (70)</td>
</tr>
<tr>
<td>Middle</td>
<td>68 (70,8)</td>
</tr>
<tr>
<td>The growth of microflora in the urine:</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>9(75)</td>
</tr>
<tr>
<td>Negative</td>
<td>80 (70,2)</td>
</tr>
<tr>
<td>The average duration of surgery (in min)</td>
<td></td>
</tr>
<tr>
<td>46,5±12,4</td>
<td>62 (83,9)</td>
</tr>
<tr>
<td>64,7±16,5</td>
<td>27 (51,9)</td>
</tr>
</tbody>
</table>

Ureterolithotripsy is now recognized as an effective and safe method for treating children with ureteral stones, including preschool age [9]. It should be noted that due to the organizational features of our center, the minimum age of children who have undergone TUULT was 5 years.

Jalbani M.H. performed ureterolithotripsy in 19 children, the average age of which was 7 years and the size of the stones was 7 mm to 1.2 cm [10]. It was possible to completely get rid of stones in 95% of cases, and this indicator was observed in patients with stones of the distal ureter. The author did not use the classification of complications, but noted that in three cases he observed hematuria and two children had urosepsis.
To date, Dogan H.S. and co-authors has the largest experience in the use of ureteroscopy in children who performed surgery using a semi-rigid endoscope in 642 patients aged four months to 17 years [9]. The effectiveness of ureterolithotripsy was 90.3%. Autor used Satava classifications (to assess the intraoperation complications), Clavien, wherein the overall complication rate was 8.4% and in half the cases it was intraoperative. In a one-dimensional analysis, the frequency of complications that are assigned to I, II and III degrees according to the Clavien classification was influenced by the duration of the surgical intervention, the patient’s age, the experience of the surgeon, the presence of an internal ureteral stent, and the size of the stone. However, multivariate analysis showed that only the duration of the operation was the only statistically significant parameter affecting the frequency of complications. We performed the removal of stones from the ureter using a rigid ureteroscope and this is possible, therefore, the age of the patients (younger age group), the size of the stone and the duration of the surgical intervention were significant factors that increased the frequency of complications.

Various lithotripsy methods are used to fragment the stone, so Halinski A. and co-authors performed ureterolithotripsy in 87 preschool children using ultrasound and a laser for these purposes. It was completely eliminated stones in 93.3% According to the Clavien-Dindo classification, there were the following complications, including microscopic hematuria (I degree) in 9.2% and hyperthermia. In 80% of cases, we performed laser lithotripsy, hyperthermia in children after TUULT was due to an exacerbation of UTI, wherein impaired urodynamics of the upper urinary tract had significant importance. Such situation may be the cause of SIRS, which we observed in one case, although according to the data of Halinski A. et al., no child had sepsis. The authors consider that modern minimally invasive methods should be used by experienced pediatric urologists in clinics with a large volume of endourological operations, which allow to obtain good results. It should be noted that in our center more than 2000 surgeries have been performed annually with the use of endourological equipment since 1996, and minimally invasive technology in children with urolithiasis has been used since 2000.

The presence of an internal ureteral stent affects the rate of complications when using the Clavien-Dindo classification (the number of cases of degrees I and II increases). Despite this fact, many urologists consider it necessary to use a stent because of possible swelling of the ureteric orifice after the intervention, especially in cases when balloon dilatation is performed. We did not use a targeted expansion of the
ureteric orifice with the help of additional tools, but we performed its dilatation only with the help of a ureteroscope tube. Fragments of the stone were extracted using forceps, and in no case did they use the Dormia basket, the use of which often causes damage to the ureter. Therefore, due to the need to perform a second intervention to remove the ureteric stent, we used the stent only at the initial stages of TUULT application in children and subsequently refused to drain the upper urinary tract using this device. Moreover, we join the opinion of Mokhless I. et al. That the use of a ureteral stent in children after removal of the stone often leads to “stent syndrome”, causing the use of additional medications and requiring repeated anesthesia to remove it. Another circumstance that allows to abandon the ureteric stent is that the duration of the operation does not exceed 90 minutes and changes in the ureter due to the stone are minimal [12]. We also agree with the opinion of Galal E.M. and co-authors who recommend using a stent for intraoperative complications (for example, perforation of the ureter) [13]. According to our data, the duration of TUULT did not exceed 70 minutes; there was no damage to the ureter wall; therefore, we consider that the rejection of ureteral stenting was justified.

It should be noted that all surgical interventions in the center of urology were performed by urologists with extensive experience in similar operations in adult patients. We doubted whether attention should be paid to this, but found a publication by Sforza S. et al on this topic [15]. The authors concluded that an experienced endourologist practicing in adult urology is also able to perform TUULT in children. Perhaps this situation was one of the reasons for a small number of complications, according to our TUULT data performed in children.

**Conclusion**

Transurethral ureterolithotripsy is an effective and safe method in the treatment of children with stones located in the distal and middle parts of the ureter. Despite the fact that, according to our data, the complication rate was 27%, nevertheless, they could be easily eliminated (grade I, II, III) and they did not have a significant impact on the quality of life of children. The age of the patients (younger age group), the size of the stone and the duration of the surgical intervention were significant factors increasing the complications rate. Of course, the results of TUULT are affected by the experience of a surgeon who performs endourological interventions and doctors directly involved in the operation (anesthetist). Moreover, given that the use of endoscopic equipment is a technically complex manipulation, it is advisable to perform such interventions in centers where there is a wide experience of such
interventions. Using the modified Clavien-Dindo classification to evaluate postoperative complications allows you to objectively compare the results of different authors, however, appropriate changes should be made regarding the results of the use of TUULT in children.

LIST OF REFERENCES:


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