

ANNOTATION

to dissertation work "Endovideosurgical correction of pyeloureteral segment obstruction in young children", by Rustem Kakimzhanovich Bishmanov, submitted for the degree of Doctor of Philosophy (PhD) in specialty 6D110100 – Medicine.

The relevance of the research topic is due to the issues of early diagnosis and effective surgical treatment of congenital hydronephrosis (CH). Congenital malformations of the urinary system (CMUS) account for 10-35 percent of all congenital anomalies, with CH accounting for 4.7 percent or 3 out of every 1000 babies, according to various authors. In terms of disorders affecting newborns' retroperitoneal organs, this condition now holds the top spot.

Pregnant women are currently subjected to routine prenatal screening, which aids in the early diagnosis of congenital anomalies like CMUS, which are found in between 0.2 and 2.0 percent of fetuses. A pediatric urologist was consulted in each and every case with CMUS prenatal diagnosis after the baby was born and verified the diagnosis. As a result, patients with CH might receive prompt, highly specialized medical care. In addition, the majority of CH patients are young children in their first year of life, whose distinct anatomical and physiological characteristics raise the need for surgical intervention to cure this condition.

From my own experience, open lumbotomy access to the affected kidney is a rather traumatic method, since access occurs by excision of a relatively wide muscle corset, which increases the risk of possible complications, the duration of hospitalization and the postoperative drug load. Also, the rehabilitation process in the early and late postoperative periods takes a rather long time, since two processes of postoperative healing occur simultaneously in the child's body: renal ureteropelvic anastomosis and a relatively massive surgical wound. At the same time, the process of regeneration of the pyeloureteral segment is also affected by the surgical wound itself, due to its close location and the coincidence of the incision projections with the ureteropelvic segment (UPS), with the risk of involvement in the local adhesive process. In addition, the negative cosmetic effect in the form of rough postoperative scars is not unimportant.

Children with CH can now be treated successfully and receive further postoperative rehabilitation thanks to the active development of pediatric endoscopic surgery.

A team of US surgeons published the first study on laparoscopic pyeloplasty LP for a child with CH in 1995. (Peters K.A., Shlussel R.N. and Retik A.B.). The sole drawback of the LP is the length of the procedure, but there is literature showing that it may be completed in children in 1.5–1 hours or less. The majority of this time (40–1 hour) is used to attach an intracorporeal suture to the pyeloureteral anastomosis.

An report regarding this procedure in 18 children aged 3 months to 15 years old was published by Tan H.L., one of the top professionals in LP, at the start of his career in 1999. A favourable outcome was found in 16 children, and 2 patients who underwent reLP and had successful results. One child's complications included issues with the placement of an intraureteral stent (the first experience of installing an intraureteral stent in LP).

The first experience of drug introduction in the Republic of Kazakhstan was presented in 2012 by a group of authors, headed by V. I. Kotlovsky. Two cases of LP were described in a 7-year-old boy and a 15-year-old girl. Positive postoperative dynamics were noted.

A number of researchers tended to favor open access in a comparative examination of the effectiveness of using LP or minimally invasive lumbotomy access in children under 1 year old, which may account for the shorter time of the procedure. However, the vast majority of authors discuss the benefits of LP in children, including high-quality visual access to the anatomical structures of the kidney, accurate determination of the cause, level, and extent of UPS obstruction, low trauma, reduced blood loss and drug load, short recovery period, improved quality of life, and fewer days spent in the hospital. The removal of the UPS obstruction, however, was unaffected by the access method at the same time. All authors in the conclusion described LP as an equivalent alternative to OP.

LP's disadvantages were also discussed at the time, including its initial high demand on the surgeon's level of experience, its longer operation time and associated anesthesia requirements, its challenges in suturing the pyeloureteral segment, and its frequent challenges in placing an intraureteral stent. The surgeon was constrained by the quite hazardous anatomical and physiological characteristics of young children, which included the instability of the life support systems, the extremely small size of the abdominal cavity, the high level of carbon dioxide absorption into the blood, and the adverse effects of hypothermia in the pneumoperitoneum.

The aforementioned facts thus point to a significant contribution of the dissertation research to the issues with selecting an efficient method of surgical correction of congenital hydronephrosis in children of a younger age group, which necessitates the search for logical treatment strategies and their advancement.

Research purpose. To determine the possibility of using endovideosurgical correction of obstruction of the pyeloureteral segment in children of young age.

Research objectives:

1. To study the results of a comparative evaluation of the effectiveness of open and endovideosurgical correction of pyeloureteral segment obstruction in young children, in the intra- and postoperative periods.

2. To improve the technique of drainage of the upper urinary tract during laparoscopic pyeloplasty in young children.

3. Clarify indications and contraindications for endoscopic correction of obstruction of the pyeloureteral segment in young children.

4. To develop an algorithm for surgical treatment of patients with congenital obstruction of the pyeloureteral segment.

Scientific novelty:

As a result of the dissertation research performed for the first time:

1. It has been determined how common congenital hydronephrosis is in children hospitalized for urological pathology.

2. A thorough urological examination was used to determine the primary etiology and clinical signs of hydronephrosis in children.

3. Endovideosurgical correction of the pyeloureteral section in children has been shown to have a good clinical efficacy.

4. The indications, technical issues, and effectiveness of surgical procedures for the treatment of congenital hydronephrosis were all determined.

5. Laparoscopic pyeloplasty has a streamlined and highly successful way of stenting the upper urinary tract.

6. Intra- and postoperative outcomes of the various surgical procedures used to treat congenital hydronephrosis were examined.

7. The clinical effectiveness of the applied types of surgical treatment of congenital hydronephrosis was evaluated in a comparative aspect.

Practical value.

1. The best surgical approach for treating congenital hydronephrosis was verified and its indications and contraindications were made clear.

2. The upper urinary tract draining technique's length has been shortened while its effectiveness has increased, making it more effective for laparoscopic treatment of congenital hydronephrosis.

3. Kazakhstan received patent (SD No. 35393 22/04/2022) for its invention, "Method of laparoscopic pyeloplasty in children."

Object and methods of research.

As part of this study, a retrospective analysis of the case histories of patients operated on for hydronephrosis at the Department of Urology of JSC «Scientific Center of Pediatrics and Pediatric Surgery» in the period from 2017 to 2018 was carried out.

In the nosological structure of those hospitalized in the urology department of the SCPPS CH amounted to 34.7% (262 patients) in 2017, and 33.5% (265 patients) in 2018.

Operations for congenital hydronephrosis accounted for 12.5% in 2017 and 14.5% in 2018 of the total number of surgical procedures in the department, second only to corrections for hypospadias (18.8-18.7%, respectively).

A thorough analysis of the treatment of 50 patients diagnosed with CMUS Congenital hydronephrosis was carried out. Of these, 25 children with grade 3 CH aged from 3 months to 3 years, 11 boys and 14 girls, were operated on using the LP method. The comparison group consisted of 25 children with grade 3 CH,

aged from 3 months to 3 years, 10 boys and 15 girls, who were operated on by traditional lumbotomy access.

All patients underwent an in-depth examination, which consisted of assessing the anatomical and functional state of the kidneys, the nature of their blood supply.

There is no characteristic clinical picture of hydronephrosis. Moreover, most often this disease is asymptomatic, which makes it difficult to diagnose. In 86%, the pathology was detected in the prenatal period according to the ultrasound of the fetus. In 4%, changes in urine tests in the form of leukocyturia served as a further examination and detection of kidney pathology.

Analyzing the degree of dysplastic changes in the kidney tissue is crucial for a thorough evaluation of the kidney's condition in hydronephrosis since it enables you to foresee potential consequences of reconstructive plastic surgery. Currently, the widely accepted Onen-2016 classification is used to determine the severity of renal tissue dysplasia.

The extent of the collector system's dilatation, the thickness of the kidney parenchyma, and its differentiation were initially evaluated during the ultrasound examination.

To systematize the clinical symptom complex in children with CH, a database was specially created in the Excel 365 program, which includes a passport part, which makes it possible to determine the age and sex composition of patients, the history of the disease, and the average duration of the patient's hospital stay. The map reflects the data necessary to identify the size of the kidneys, the severity of the inflammatory process and the duration of the disease, the reflection of the course of the operation, the features of the postoperative period, and the remote data. All data are obtained from medical information systems (electronic medical record).

When preparing a patient for surgery, the criteria for choosing a method of surgical treatment were the parameters corresponding to the classification of CH Onen 2016. These included the functional state of the kidney, the dimensions of the parenchyma thickness and the transverse size of the pelvis. Similar criteria were taken into account by us when selecting patients in the analyzed group in order to create the most homogeneous groups.

Methods of surgical treatment of CH:

Surgical treatment with open access to the kidney.

Open pyeloplasty was performed in 25 patients. The position of the patient is - laying on a healthy side. Traditional open access to the kidney through all anatomical layers by a sharp and blunt way, at the level of the XII rib, in the projection of the anterior and middle axillary lines. Surgical manipulations are carried out in the retroperitoneal space, then the pelvis and ureter are freed from pararenal tissue, the condition of the UPS and the cause of the obstruction are assessed. The upper and lower poles of the pelvis are fixed with holders, then the pelvis is resected. After that, spatulation of the ureter in a healthy area and

excision of the obstruction of the UPS. The next step is a side-to-side ureteropyeloanastomosis (Hines-Anderson-Kucher (HAK) method) with interrupted sutures with a 6/0 absorbable suture, then an intraureteral stent 3-4Ch. A drainage tube is installed in the perirenal space and the wound is sutured in layers with the restoration of anatomical integrity. A Nelaton 6Ch urethral catheter is inserted into the bladder. The drainage tube was removed on the 3rd-4th day after the operation, the urethral catheter was removed on the 5th day after the operation.

Endovideosurgical access to the kidney.

Laparoscopic pyeloplasty was performed in 25 patients.

Before the operation, the obligatory installation of a nasogastric tube, an intestinal vapor tube and a Nelaton urethral catheter 6Ch. Confident fixation of the neutral electrode. The position of the patient on a healthy side, with mandatory fixation to the operating table. At the first stage, a pneumoperitoneum is created through the Veress needle, the gas flow rate is 6 l/min, the pressure is 8-10 millimeters of mercury. The first 5 mm trocar was placed over the umbilical ring to introduce a 300-degree optic. One 5 (3) mm manipulative trocar was placed on the side of the affected kidney, according to the principle of a rhombus figure, where the top of the kidney is, and the base is a trocar with optics. Access to the kidney is carried out by mobilization of the hepatic or splenic angles of the ileum, or with CH on the left, there is the possibility of access transmesenterically. After the kidney is exposed, the pelvis and ureter are mobilized, the cause of the obstruction is determined. Further, the upper pole of the pelvis is "suspended" and fixed with a thread to the anterior abdominal wall. UPS is resected, spatulation of the ureter and pyeloplasty according to the HAK method, with interrupted sutures, absorbent suture 6/0. After suturing the posterior wall of the anastomosis, an intraureteral stent 3-4Ch. is placed through the trocar or Veress needle. Next, the peritoneal defect was hermetically sutured, leaving a 12Ch drainage lumbostomy. A control examination of the abdominal cavity and complete desufflation, stitches on the wounds are carried out. The drainage tube was removed on the 1st-2nd day after the operation, the urethral catheter was removed on the 3rd-4th day after the operation.

Method of installing a ureteral stent in laparoscopic pyeloplasty in children.

We have developed a method for installing an intraureteral stent in children. In the first cases of LP, the intraureteral stent was installed intracorporeally through one of the instrumental trocars. This was accompanied by technical difficulties, such as intra-abdominal gas due to an open valve, loss of sharpness, fogging and loss of contamination of the optics, detection of stent navigation (springing, slipping of the wall from the organs), as well as a complete lack of tactile sensitivity when hitting the wall of the thin lumen of the ureter, which was followed by duration duration. In order to improve this procedure, we have developed a new technique. The lumen of the Veress needle corresponds to

the size of the ureteral stents 3-4 Ch, due to which the volume of gas from the abdominal cavity is reduced; at the time of installation, the Veress needle plays the role of a stent as additional wiring, realizing easy control of the direction of movement; the installation of the stent occurs without auxiliary tools, hence the high level of tactile sensitivity, control of the speed and tension of the installation of the stent; risk of damage to the wall of the ureter and violation of the stent of the colon.

This method of laparoscopic pyeloplasty was performed in 18 children.

Basic provisions for defense:

1. Rationale for the use of the method of laparoscopic pyeloplasty in young children in order to reduce the postoperative period, speedy rehabilitation of the child, restore the normal architectonics of the kidney, as well as the advantages in cosmetic results, which are confirmed by evidence-based medicine.

2. Improvement of one of the main stages of laparoscopic correction of congenital hydronephrosis - a method of simplified stenting of the upper urinary tract (SD No. 35393 22/04/2022) allows expanding the indications for its implementation, as well as increasing the effectiveness of its use in children of a younger age group. Mandatory internal drainage of the upper urinary tract after LP in children, for a safer postoperative period.

Statistical analysis

Three resources were used for the statistical analysis: stanly.statpsy.ru, stattech.ru, and medstatistic.ru. % and frequency were used to express categorical variables. There were descriptive statistics offered. One-way ANOVA was used to assess continuous variables, which were reported as mean and standard deviation (SD). to contrast continuous variables that aren't normally distributed with ones that are (interquartile range). We calculated the 95 percent confidence intervals (CI) and crude and adjusted odds ratios (OR) for relationships between potential risk factors using logistic regression. Assuming it to be statistically significant, the alpha level was set to 0.03-0.05. We used the chi-square test to test the hypothesis that the observed sample belongs to some theoretical distribution law, the Fisher exact test was used because the sample size is less than or equal to 25, the Mann-Whitney test was used to assess the differences between two independent samples in terms of the level of any attribute, measured quantitatively with a non-normal distribution.

Research results.

The average age of children in group 1 was 0.73 ± 0.59 years, and in group 2 it was 0.77 ± 0.77 years; there were no statistically significant differences in the age of patients between groups.

The cause of CH in the LP group was fibromuscular dysplasia of the ureteral wall in 22 patients (88%), an additional lower segmental vessel in 1 patient (4%), and ureteral stricture in 2 patients (8%). In the OP group, CH was caused by fibromuscular dysplasia of the ureteral wall in 20 patients (80%), an

accessory lower segmental vessel in 2 patients (8%), and ureteral stricture in 3 patients (12%).

Drainage of the pelvicalyceal system in all cases was carried out by antegrade internal stenting of the JJ ureter with a 3-4 Ch stent.

The duration of operations differed significantly ($p=0.05$). The average duration of operations performed by the open method was 84.4 minutes (± 11.58), by the laparoscopic method - 162.8 minutes (± 47.3). Comparison of the arithmetic mean values shows that this value is approximately two times higher for the group operated by the laparoscopic method. In LP, the time was lengthened by certain features of anesthesia, difficulties in applying intracorporeal interrupted sutures to the pyeloureteral anastomosis, and the technical complexity of installing an intraureteral stent. The duration of the surgical intervention with the accumulation of experience was reduced, approaching the duration of the operation by the OP method. The maximum duration of the LP operation is 240 minutes, the minimum time is 100 minutes. The duration of the operation was also reduced due to the methods of simplified antegrade placement of the ureteral stent. Due to the proposed method of placing the ureteral stent, the duration was reduced from 20-30 minutes to 3-10 minutes, with a successful result in all cases. The proposed method of laparoscopic pyeloplasty made it possible to significantly reduce the duration of the installation of the ureteral stent, as well as to simplify and increase the success of this, tactically very important, manipulation. All patients showed effective functioning of the intraureteral stent, as well as positive postoperative dynamics.

In the course of the operation and in the initial postoperative phase, there were no problems (bleeding, urine leakage, or pyonephrosis).

For endovideosurgical operations, conversion—the change from a closed to an open intervention—was not a distinct consequence.

After endovideosurgical procedures, patients' recuperation times were noticeably cut down. This is because typical surgical access results in significant trauma. Compared to patients who underwent laparoscopic pyeloplasty, patients who underwent OP required pain management more frequently and for a longer period of time.

With LP after surgery, the child spent 90–120 minutes in the intensive care unit until awakening and extubation, after which he was transferred to the intensive care unit, under dynamic observation for an average of 20 hours. The lumbostomy was removed on the 2nd day after the operation, the urethral catheter on the 3rd. Antibacterial, infusion and symptomatic therapy was significantly reduced and did not require long-term use as in OP. Thus, in LP, 15 (60%) patients received symptomatic therapy for 2 days, the remaining 10 (40%) for 3 days. After open pyeloplasty, 21 (84%) patients received therapy for 4 days, the remaining 4 (16%) patients received therapy for 5 days.

With LP, from the first day, the children showed motor activity, they could roll over, sit, crawl and walk.

In the postoperative period after LP, children were discharged as soon as they began to feel comfortable, on days 4–5 - 68%, on days 6–7 - 32%. There was no concept as a long strict bed rest.

Surgical dressings consisted in the treatment of wounds with a skin antiseptic (the absence of painful dressings).

After 6 weeks, under anesthesia, cystoscopic removal of the ureteral stent and ultrasound control of the urinary system organs were performed. Further, 6 months after the operation, a control urography was performed.

Statistical analysis of the data obtained showed that the differences in the length of stay in the hospital between the group, open and laparoscopic pyeloplasty are statistically significant ($p=0.05$).

Additionally provided were statistics on the transverse dimensions of the pelvis prior to and six months after the procedure. Due to the dynamics of the reduction in transverse size, it is evident that the pelvis' size has drastically shrunk in both the LP and OP. With a probability of 0.95, it can be claimed that the mean value in a bigger sample won't go beyond the discovered interval. The mean value prior to surgery in the LP was 225mm, and OP was 24.125.13mm. OP=12.762.45 mm, with a mean value of LP of 11.961.88 mm - six months following surgery. We can draw the conclusion from this that both methods exhibit the same efficiency when given the identical input data prior to the operation.

When the results of an ultrasound examination of the kidneys were analyzed, it became clear that the central pole of the kidney parenchyma had grown in size in the majority of cases. In group 1 patients with OP, 24 patients (96%) showed an increase in the size of the kidney parenchyma in the middle pole ($p=0$, according to the Mann-Whitney test). According to the Mann-Whitney criterion, 24 of the 25 patients in group 2 LP (96%) ($p=0$) displayed an increase in the size of the kidney parenchyma in the middle pole. The results obtained are statistically significant. Statistical difference in the size of the kidney parenchyma in the middle pole between the compared groups $p=0.05$.

In the remote postoperative period, unsatisfactory result of treatment, recurrence of stricture, not a single patient was recorded.

Conclusions

1. Laparoscopic pyeloplasty, along with open surgery, is an effective method for treating hydronephrosis in children. This method of treatment has advantages over open operations in terms of the severity of the pain syndrome (reduction of the duration of symptomatic therapy by 1.76 days, the average duration with LP = 2.4 days), restoration of the child's activity on the first day, and reduction in the length of stay in the clinic after surgery to 2.08 days, the average length of stay is 5.04 and the cosmetic result (there is no concept of a relatively large surgical wound). Also, the analysis of the results of 25 endovideosurgical operations showed that the positive dynamics of the size of the pelvis and parenchyma in case of obstruction of the ureteropelvic segment after surgery occurs in a deterministic time frame and does not depend on the choice of access.

2. All surgical procedures involving the pyeloureteral segment should involve the mandatory drainage of the kidney collecting system. This will guarantee the avoidance of complications including urine leakage, renal block, and recurrence of hydronephrosis. Internal drainage systems should be prioritized because they can drastically cut down on a patient's hospital stay. It is recommended to use ultrathin JJ stents 3–4 Ch. in younger children for upper urinary tract drainage. Additionally, during the course of the study, a straightforward and very efficient technique for inserting an intraureteral stent was put forth, allowing for both the reduction in the time required for this manipulation and the elimination of any potential for complications.

3. All cases of primary unilateral hydronephrosis of the third degree (classified by N.A. Lopatkin 1969 + Onen 2016) with intact kidney function and no concurrent anomalies of kidney fusion or location are indications for laparoscopic pyeloplasty. According to instrumental investigations, a history of abdominal organ procedures, the possibility of a complex vascular conflict with the ureteropelvic pelvic segment, hydronephrosis relapse, and parental refusal are all contraindications to laparoscopic pyeloplasty.

4. To improve timely diagnosis and, consequently, determine an appropriate surgical technique for correcting the pyeloureteral segment, which is a key component in the successful outcome of treating children with this anomaly, a clear algorithm for managing patients with congenital hydronephrosis is proposed.

Practical recommendations

1. In order to assess the severity of congenital hydronephrosis, it is recommended that the kidneys be examined using expert-class equipment using ultrasonography.
2. Choosing the best trocar configuration is essential for the effectiveness of endoscopic procedures for congenital hydronephrosis. The zone of interest should be placed so that each trocar is equally spaced apart from the other.
3. When using endovideosurgical pyeloplasty in the treatment of hydronephrosis, a prerequisite is the use of a complex of surgical techniques aimed at reducing the time of surgical intervention (with laparoscopic access, the use of a transmesenteric approach in the case of left-sided pathology, the use of a thread-holder for better visualization of the resection zone, the method of simplified installation of an intraureteral stent).
4. Manipulation in the abdominal space must be especially careful to avoid damage to surrounding organs, due to the small size of the cavity.
5. Pyelostomy or ureteropyelonephrostomy can be used successfully to divert urine in the postoperative phase if there are technical issues with installing the internal drainage system.
6. Using a simulator to practice the method for creating a ureteropyeloanastomosis can improve treatment outcomes and shorten the length of the procedure.

Approbation of work

1. XV Conference of young medical scientists of the CIS countries «Modern problems of theoretical and clinical medicine». (Astana, 2017);
2. IV International scientific-practical conference of students and young scientists. (Almaty, 2017);
3. «Akan Readings: Relevant Issues of Medicine and Health Care»: V International Scientific and Practical Conference of Students and Young Scientists «Science and Medicine: Modern View of Youth» IX International Scientific and Practical Conference «Actual Issues of Public Health» (Almaty, 2018);
4. Scientific and practical conference for doctoral students, undergraduates and residents: «Actual issues of modern pediatrics and pediatric surgery» (Almaty, 2018);
5. 4th Scientific and Practical Conference of Urologists of the Northwestern Federal District (St. Petersburg, 2018);
6. IX Congress of pediatric doctors of Kazakhstan "Achievements and prospects for the development of pediatrics and pediatric surgery" (Almaty, 2021);
7. International Pediatric Endoscopy Group 2021 Annual Meeting (Online, 2021).

Publications. The main results that were obtained during the dissertation research were published in 4 publications, out of which:

- 3 articles published in journals recommended by the Committee for Quality Assurance in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan;
- 1 article published in a journal indexed by Scopus and Thomson Reuters and at a 69% Q2 percentile at the time of publication;

Received 1 patent for the invention «Method of laparoscopic pyeloplasty in children» (SD No. 35393 22/04/2022).

The structure of the dissertation

The dissertation is presented on 112 pages, consists of an introduction, a review of the literature, materials and research methods, 3 sections of original research, a conclusion, including practical recommendations, a list of references from 153 titles. The work is illustrated with 8 tables and 51 figures.