A multidisciplinary approach to urinary system iatrogenic injuries

Vladimir Beloborodov¹, Vladimir Vorobev¹, Igor Golub¹, Aleksandr Frolov¹, Elena Kelchevskaya¹, Darizhab Tsoktoev¹, Tatyana Maksikova²

¹Department of General Surgery and Anesthesiology, Irkutsk State Medical University, Irkutsk, Russian Federation
²Department of Propedeutics of Internal Diseases, Irkutsk State Medical University, Irkutsk, Russian Federation

Introduction
Urinary system iatrogenic injuries appear because of urological, obstetric-gynecological, and surgical manipulations in the retroperitoneal space, pelvis, or perineum. The purpose of this research was to analyze and obtain knowledge about the issue of iatrogenic injuries, to apply injury prevention algorithms, and to assess multidisciplinary perspectives in modern surgery.

Material and methods
The research was interdisciplinary and consisted of several modules: a prospective, single-centre study of urinary system iatrogenic injuries (476 patients) along with four interregional and international procedural types of research.

Results
The analysis results indicate an extremely high significance of urinary system injuries evoking numerous negative consequences that are hard to eliminate. A comparative assessment of interdisciplinary interaction demonstrates the more effective interpretation of examination results, more comprehensive and credible clinical diagnosis, more qualitative evaluation of a patient’s condition, more effective choice of initial treatment policy, and more satisfactory treatment in patients’ opinion. The research allowed for the identification of a typical procedural mistake in the urethral catheter setting causing a high risk of urethra injuries followed by urethra strictures or consecutive infections of the urinary tract.

Conclusions
More complicated treatment procedures cause a higher probability of urinary system iatrogenic injuries. The absence of unified algorithms and typical procedural mistakes cause such incidents. A partial solution to this issue could be found in a more profound interdisciplinary interaction in all treatment phases as well as in identifying and eliminating procedural mistakes.

Key Words: kidney iatrogenic injury • ureter iatrogenic injury • urethra iatrogenic injury • urinary bladder iatrogenic injury • urinary system iatrogenic injury
on his or her own – it is more efficient to use the service of statisticians, special software, and/or artificial intelligence [7, 8].

One of the outstanding branches of interdisciplinary science is tissue-engineered surgery [9], when a team of interacting biologists, urologists, chemists, morphologists, biotechnologists work for a collective goal.

Modern multi-layer spiral computed tomography (MSCT) equipment allows doctors to get highly detailed 3D models of internal organs and pathological processes. Nowadays it is hard to imagine planning a kidney resection concerning the malignant tumor without a 3D model showing vessels, the kidney collecting system, and surrounding organs [10, 11]. Making a high-quality model requires concerted efforts from a urologist, radiologist, IT specialist, and the use of special software. A model can be printed with a 3D printing station and used for rehearsing operation steps and team interaction [11, 12]. A more extensive, though the not less important, application of 3D printing is caused by making consumables (stents, catheters, etc.) considering an individual patient’s anatomic features [13, 14].

The basis of multidisciplinary interaction is an educational program which should consist of modules delivered by different departments helping a student during one semester get mutually supportive information letting to make an overall pattern of a normal or pathological process, a disease function, and progress, and to develop true critical thinking [6, 8, 15]. The current review of urinary tract iatrogenic injuries and multidisciplinary interaction issues has resulted in setting the following goal: to analyze and gain knowledge about the current condition of the issue of iatrogenic injuries, to apply preventive measures algorithms and to assess multidisciplinarity perspectives in modern surgery.

MATERIAL AND METHODS

The research was comprehensive and consists of several modules.

A prospective, single-centre study of urinary system iatrogenic injuries (partially presented) was performed in the urological hospital Irkutsk city clinical hospital Nº1. The clinical part of the research includes an analysis of the examination and treatment results of patients who underwent therapeutic measures for urinary system injuries and their complications from September 2016 to November 2019. The research includes male and female patients, over 18 years old, with an established diagnosis of urinary system iatrogenic injuries. The selection of patients for the study who fit the inclusion criteria was carried out prospectively by the continuous sampling method.

During the research, 615 patients had iatrogenic injuries of the urinary system. The research inclusion criteria fit 476 patients. All included patients received conservative or surgical treatment. Out of 476 patients initially included in the research, 247 were subsequently excluded: 211 patients dropped out due to deviations from the study protocol, and 36 due to personal reasons.

The inclusion criteria were:

- Confirmed acute iatrogenic injury of one of these organs (kidney, ureter, bladder, urethra);
- The patient had complications after the previous injury to one of these organs (kidney, ureter, bladder, urethra);
- The patient is over 18 years old;
- The patient signed a voluntary informed agreement to participate in the study.

The exclusion criteria were:

- Absence of convincing data for the iatrogenic nature of the injury;
- The patient did not sign a voluntary informed agreement to participate in the study;
- The patient refused to participate at any stage of the research;
- Due to any reason, the patient did not complete the planned examination and treatment.

The research has the following endpoints:

- The primary ‘solid’ endpoint is the examination not earlier than three months after treatment and detected relapse at any stage of the postoperative observation.
- The secondary ‘soft’ endpoints are signs of a complication as a result of iatrogenic injury and complication relapse after treatment.

The research incorporated anamnestic, clinical, biochemical, radiological, ultrasound, magnetic resonance, and endoscopic methods. An anamnestic method allows for establishing the possible cause and duration of the disease.

Laboratory tests included clinical analysis of blood and urine, determination of total protein, blood sugar, creatinine, urea, bilirubin, amylase and transaminase activity, and water-electrolyte balance in the blood. All patients underwent bacteriological urine test, electrocardiography, and ultrasound of the urinary tract with an assessment of the residual urine volume. Patients estimated the quality of life (QoL) by using the self-test standard questionnaires. Patients recorded complaints, satisfaction with the state of health, and prescribed treatment. To clarify the nature and degree of pathological changes, examination included uroflowmetry, urethroscopy, urethrocystography, urethrocystoscopy, ureterorenos-
copy, MSCT, or magnetic resonance imaging (MRI) of the urinary system with or without contrast (due to any contraindications) with 3D image reconstruction for the final verification of the diagnosis. Three months after the treatment all patients were recommended follow-up examinations at one-year intervals according to the established research protocol: consultation with a urologist, clinical blood and urine tests, MSCT, or MRI of the urinary system. Also, patients used the QoL scale to assess the subjective quality of life status.

Treatment was prescribed according to clinical guidelines. In the case of acute urethral injury, urethroscopy was performed with a urethral catheter (recanalization) and prolonged drainage (for a period of 2 weeks to 3 months). In case of complications (pelvic and perineal urohema, para-urethral abscess, or phlegmon), patients underwent cystostomy, revision of the lesion area, and recanalization. In cases of the urethral stricture, there were two treatment methods: for short strictures up to 10 mm – internal optical urethrotomy (DIVU), for strictures of greater length – anastomotic, magnifying, or replacement urethroplasty.

In the case of acute bladder injury, depending on its nature and size, treatment included extended urethral drainage (less than 5 mm) or revision and suturing of the defect (more than 5 mm). To eliminate urinary fistulas, reconstructive operations were performed.

In the case of acute ureteral injury (urohema, complete separation of the ureter, partial or complete damage of external intersection, ligation, or ureter necrosis), depending on the nature, length and size of the injured area, the treatment included ureteral stenting, revision, and reconstructive surgery. In the case of complications, one of the methods of reconstructive surgery was performed. No cases required intestinal plastic surgery of the ureter.

In the case of acute kidney injury, depending on its nature, the treatment included ureteral stenting, nephrostomy, vascular embolization or kidney revision, hemostasis, ligation or restoration of vessel integrity, resection, or nephrectomy. In case of damage to the pyelocaliceal system with the development of infectious complications, paraneophritis, and urinary leakage, inspection, and reconstruction of the kidney or nephrectomy were performed.

The study also included four international and regional procedural types of research: from September 2016 to November 2019, the medical staff of several medical institutions in Irkutsk participated in the examination study on the rules for placing and maintenance of a urethral catheter. From September 2019 to November 2019, surgeons of various specialties from different regions of the Russian Federation participated in the examination study on knowledge of the urinary system’s topographic anatomy and signs of injuries. From October to November 2019, doctors of various specialties took part in distant survey-testing (in the Russian Federation, Germany, Israel, United Arab Emirates, France) to identify typical procedural mistakes in bladder catheterization. From September 2016 to November 2019, (if it needed, so – 3 team, 20 nurses, 20 doc’s) analyzed the effectiveness of profound interdisciplinary interaction in the process of conservative and surgical treatment and patients’ and doctors’ satisfaction with that.

The employees of various surgical, therapeutic, neurological, and intensive care units voluntarily and anonymously participated in an examination study on the survey and control of the equipment setting and maintenance of a urethral catheter. The exam consisted of an ‘I know / I don’t know’ assessment. A confidential survey concerning the topographic anatomy and signs of damage of the urinary system was distributed among doctors of different specialties involved in surgeries of the retroperitoneal space and pelvis (general and vascular surgery, purulent surgery (its special surgical department), gynecology, urology, colorectal surgery, oncology). The survey assessed the knowledge of topographic anatomy nuances and understanding of the anatomical orientation principles of the urinary system. By using the ‘I know / I don’t know’ assessment, surgeons described the anatomical landmarks and topography of the kidneys (1st question), ureters in the middle and upper thirds (2nd question), ureters in the lower third (3rd question), and the topography of the bladder (4th question). An incomplete or inaccurate answer to any of the four questions referred to a general level of ‘I don’t know’.

Also, an online virtual survey (using the Google application) concerning the identification of typical procedural mistakes in catheterization of the urinary bladder was voluntarily and anonymously completed by doctors of various specialties (from the Russian Federation, Germany, Israel, United Arab Emirates, France). The survey consisted of 20 questions, with a single or multiple-choice answer, hidden control questions, distracting questions, and without specifying the primary purpose of the survey to increase the reliability of the results.

This article presents the most significant parts of the studies to highlight the problem of interdisciplinary interaction for urinary system iatrogenic injuries. The initial data and the results were analyzed using the STATISTIKA software for Windows 10.0 (Statsoft, Inc, USA), SPSS Statistics 23.0 (IBM, USA), and Stata 14.2 (StataCorp, USA).
RESULTS

A prospective, single-center study of the urinary system iatrogenic injuries problem continued from September 2016 to November 2019. There were 615 patients with confirmed urinary system iatrogenic injuries. The research inclusion criteria applied to 476 patients. All included patients received conservative or surgical treatment.

From the group of 476 patients initially included in the study (intention-to-treat group, ITT), 247 patients dropped out: 211 due to deviations from the study protocol, and 36 due to personal reasons. According to the protocol (per-protocol group, PP), 229 patients completed the study. Table 1 presents the general characteristics of patients in these groups. Presented data analysis showed that the ITT and PP groups are statistically equal in terms of age, gender, and the duration of the disease. Patients included in the study (ITT) and completed the study (PP) demonstrate statistical equality of the ratio for a group of kidney and urinary bladder injuries. There was a discrepancy between the number of patients enrolled in the study (ITT) and completed the study (PP) for the ureter injuries group (greater adherence) and urethra injuries group (less adherence). A significant discrepancy appeared between the number of patients included into the study and

| Parameter | ITT (n = 476) | PP (n = 229) | P |
|-----------|--------------|--------------|---|
| Average age, years | 59.93 ±15.5 | 58.01 ±15.9 | 0.900 |
| Gender, male / female ratio, % | 74/26 | 65/35 | 0.557 |
| The acute injury duration, days | 2 (1; 3) | 2 (1; 4) | 0.694 |
| The ‘overlooked’ iatrogenic injury duration, days | 224 (53; 365) | 365 (38; 365) | 0.826 |
| QoL, points | 4.76 ±0.9 | 4.84 ±0.8 | 0.785 |
| The acute/overlooked injury ratio, % | 78/22 | 54/46 | 0.104 |
| Cases of acute injury, N | 371 | 124 | 0.005 |
| Cases of overlooked injury, N | 105 | 105 | 0.0001 |
| Kidney injury, N | 54 | 34 | 0.247 |
| Ureter injury, N | 68 | 60 | 0.001 |
| Bladder injury, N | 40 | 23 | 0.514 |
| Urethral injury, N | 314 | 112 | 0.027 |

ITT – intention-to-treat; PP – per-protocol; QoL – quality of life; N – number

Table 1. The initial parameters in ITT and PP groups of patients

| Parameter | ITT (n = 68) | PP (n = 60) | P |
|-----------|--------------|--------------|---|
| Average age, years | 52.4 ±17.5 | 54.4 ±17.3 | 0.590 |
| Gender, male/female ratio, % | 15/85 | 13/87 | 0.723 |
| The acute injury duration, days | 3.0 (1; 5) | 3.0 (1; 4) | 0.671 |
| The ‘overlooked’ iatrogenic injury duration, days | 365 (39; 365) | 365 (34.5; 365) | 0.668 |
| QoL, points | 4.7 ±1.0 | 4.7 ±1.0 | 0.923 |
| Internal ureter injury without urohematoma, N | 12 | 7 | 0.412 |
| Internal ureter injury with urohematoma, periarteritis, N | 6 | 4 | 0.674 |
| External ureter injury, N | 5 | 5 | 0.848 |
| Ureteric strictures, N | 45 | 44 | 0.973 |

ITT – intention-to-treat; PP – per-protocol; QoL – quality of life; N – number

Table 3. Initial parameters of ITT and PP groups for ureters iatrogenic injury

| Parameter | ITT (n = 54) | PP (n = 34) | P |
|-----------|--------------|--------------|---|
| Average age, years | 55.5 ±17.1 | 59.7 ±17.3 | 0.304 |
| Gender, male / female ratio, % | 62/38 | 58/42 | 0.772 |
| The acute injury duration, days | 1.5 (1; 4) | 1.5 (1; 4) | 0.907 |
| The ‘overlooked’ iatrogenic injury duration, days | 62.5 (30; 124) | 34 (17; 147) | 0.862 |
| QoL, points | 4.9 ±0.9 | 5.1 ±0.7 | 0.630 |
| Acute kidney parenchyma injury, N | 21 | 15 | 0.754 |
| Acute renal artery/vein injury, N | 3 | 3 | 0.581 |
| Acute pyelocaliceal system injury, N | 9 | 4 | 0.584 |
| Arteriovenous fistulas, pseudo-aneurysms, N | 5 | 3 | 0.949 |
| Acute pyelonephritis, paraneprhitis, urinary leakage, N | 16 | 9 | 0.810 |

ITT – intention-to-treat; PP – per-protocol; QoL – quality of life; N – number

Table 2. The initial parameters of ITT and PP groups for iatrogenic kidney injuries

| Parameter | ITT (n = 40) | PP (n = 23) | P |
|-----------|--------------|--------------|---|
| Average age, years | 64 (54; 72) | 50 (34; 77) | 0.080 |
| Gender, male/female ratio, % | 87/13 | 76/24 | 0.522 |
| The acute injury duration, days | 1 (1; 4) | 1 (1; 1) | 0.135 |
| The ‘overlooked’ iatrogenic injury duration, days | 55 (32; 98) | 55 (32; 98) | 1.0 |
| QoL, points | 4.6 ± 0.9 | 4.5 ± 1.1 | 0.826 |
| Internal bladder injury, N | 7 | 2 | 0.399 |
| External bladder injury, N | 23 | 12 | 0.825 |
| Urinary fistulas, N | 10 | 9 | 0.395 |

ITT – intention-to-treat; PP – per-protocol; QoL – quality of life; N – number

Table 4. The initial parameters of ITT and PP groups for iatrogenic bladder injuries
patients who completed the study in the group of acute injury (a large percentage of exclusion from the study occurred due to various reasons, mainly due to failure to attend the follow-up appointment within the prescribed period) and full compliance with participation in the study for patients with overlooked injuries.

All cases of urinary system iatrogenic injuries had a significant impact on the quality of life. Tables 2 to 5 present the characteristics of the patients in these subgroups (kidney, ureter, bladder, urethra injuries) (Table 2).

The cases of acute kidney parenchyma injury or renal vessel injury appeared as a result of percutaneous nephrostomy (PCN) or percutaneous nephrolithotripsy (PCNL). Acute kidney collective system injury in 3 of 9 (33%) cases were caused by PCN or PCNL, and in 6 cases (67%) – by kidney stenting (Table 3).

All cases of internal ureter injury were a result of ureteroscopy and intraoperative detection allowed for the timely insertion of a drainage stent in order to avoid the development of urogematom (Table 4).

Three cases (42.8%) of internal bladder injury were the result of impaired placement of a urethral catheter and 4 cases (57.2%) developed due to transurethral resection of bladder tumors (Table 5).

The development of urethrorrhagia was caused by incorrect urethral catheter implantation technique in all cases.

**Table 5. The initial parameters of ITT and PP groups for urethra iatrogenic injuries**

| Parameter | ITT (n = 314) | PP (n = 112) | P |
|-----------|---------------|--------------|---|
| Average age, years | 60.8 ±14.3 | 61.1 ±14.7 | 0.907 |
| Gender, male/female ratio, % | 99/1 | 99/1 | 1.0 |
| The acute injury duration, days | 1.0 (1; 1) | 1.0 (1; 1) | 1.0 |
| The ‘overlooked’ iatrogenic injury duration, days | 2.0 (1; 9) | 2.1 (1; 8) | 0.657 |
| QoL, points | 4.6 ±0.9 | 4.5 ±0.8 | 0.494 |
| IPSS before injury, points | 28.2 ±4.5 | 28.8 ±4.3 | 0.391 |
| IIEFS before injury, points | 12.5 (5; 14) | 11.5 (5; 14) | 0.736 |
| Traumatic catheterization, urethrorrhagia, N | 168 | 12 | <0.0001 |
| Injury after transurethral operations, N | 18 | 3 | 0.219 |
| External urethral injury during pelvic organs operations, N | 14 | 12 | 0.027 |
| Urethral fistula, N | 7 | 7 | 0.049 |
| Urethral strictures, N | 107 | 78 | 0.786 |

| Type of injury / complications | Treatment method | PP, n | Recovery, n (%) | Complication / relapse, n (%) |
|------------------------------|------------------|-------|-----------------|-----------------------------|
| Hematuria | Conservative therapy | 15 | 12 (80%) | 3 (20%) |
| Subcapsular / perinephric hematoma | Vessel embolization | 6 | 2 (33%) | 4 (67%) |
| Subcapsular / perinephric hematoma | Revision, hemostasis | 1 | 1 (100%) | 0 |
| Pyelonephritis / paranepluritis | Conservative therapy | 5 | 2 (40%) | 3 (60%) |
| Pyelonephritis / paranepluritis | Kidney revision | 2 | 2 (100%) | 0 |
| Pyelonephritis / paranepluritis | Nephrectomy | 1 | 1 (100%) | 0 |
| Urinary flow | Stenting | 4 | 2 (50%) | 2 (50%) |
| Arteriovenous fistulas, pseudoaneurysms | Conservative therapy | 3 | 0 | 3 (100%) |
| Arteriovenous fistulas, pseudoaneurysms | Embolization | 3 | 1 (33%) | 1 (33%) |
| Arteriovenous fistulas, pseudoaneurysms | Kidney resection | 1 | 1 (100%) | 0 |
| Arteriovenous fistulas, pseudoaneurysms | Nephrectomy | 1 | 1 (100%) | 0 |

| Type of injury / complications | Treatment method | PP, n | Recovery, n (%) | Complication / relapse, n (%) |
|------------------------------|------------------|-------|-----------------|-----------------------------|
| Hematuria | Conservative therapy + stenting | 7 | 7 (100%) | 0 |
| Pyelonephritis / ureteritis | Conservative therapy + stenting | 6 | 6 (100%) | 0 |
| Urohematoma | Stenting | 4 | 2 (50%) | 2 (50%) |
| External ureter injury | Revision, suturing of a defect | 2 | 2 (100%) | 0 |
| Upper ureter stricture | Defect stenting and suturing | 5 | 5 (100%) | 0 |
| Upper ureter stricture | Direct anastomosis | 2 | 2 (100%) | 0 |
| Upper ureter stricture | Renal pelvis grafting | 2 | 2 (100%) | 0 |
| Upper ureter stricture | Ureterocalycostomy | 4 | 4 (100%) | 0 |
| Upper ureter stricture | Nephrectomy | 2 | 2 (100%) | 0 |
| Upper ureter stricture | Nephrostomy | 2 | 2 (100%) | 0 |
| Lower ureter stricture of the middle and lower third | Direct anastomosis | 2 | 1 (50%) | 1 (50%) |
| Lower ureter stricture of the middle and lower third | Reimplantation | 12 | 10 (83%) | 2 (17%) |
| Lower ureter stricture of the middle and lower third | Boari operation | 14 | 12 (85.7%) | 2 (14.3%) |
| Lower ureter stricture of the middle and lower third | Nephrostomy | 4 | 2 (50%) | 2 (50%) |

ITT – intention-to-treat; PP – per-protocol; P – p-value ; n/N – number
QoL – quality of life
All of the per-protocol patients were included in the examination and treatment results analysis. The study contains an indicative analysis of treatment effectiveness depending on the method of primary treatment with an indication of the frequency of any significant complications occurrence of disease relapses. Tables 6 to 9 present the results (Table 6).

The results of the analysis indicate significance of the complications of iatrogenic kidney injury, which resulted in a large number of cases requiring surgical treatment with possible loss of an organ (Table 7).

The results of the analysis indicate the high efficiency of conservative treatment tactics and reconstructive operations of the ureters, which allow for the achievement of recovery in most cases (Table 8).

The results of the analysis indicate the high efficiency of the treatment tactics recommended for bladder perforations, however, the issue of bladder fistula is still not completely resolved (Table 9).

The results of the analysis indicate the extremely high impact of urethral injuries, leading to many negative consequences, the elimination of which seems to be a difficult task.

To evaluate the effectiveness of multidisciplinary interaction, some patients participated in a procedural experiment (double-blind, randomized participation) of interdisciplinary interaction. The treatment results are presented by comparing two groups – the standard treatment group (ST) and the interdisciplinary interaction group (MD). Table 10 presents these comparative results. Evaluation of satisfaction with the treatment was performed by the method of subjective assessment (1 point – poor, 5 points – excellent) (Table 10).

The comparative assessment of interdisciplinary interaction demonstrated a significantly more effective interpretation of the examination results, a more complete and accurate clinical diagnosis, a better assessment of the patient’s condition, a more effective selection of primary treatment tactics, and greater satisfaction with the treatment by the patients.

The survey of knowledge of the urinary system topographic anatomy and signs of damage using ‘I know / I don’t know’ format was passed by 49 doctors of various specialties. An incomplete answer to any of the four questions was interpreted as ‘I don’t know’. Figure 1 reflects the results.

This study demonstrated a high level of understanding of the topographic anatomy nuances among doctors of all specialties, which means that iatrogenic injuries are not the consequences of lack of knowledge, but come from procedural irregularities in clinical situations.

The online-survey testing on common procedural mistakes during bladder catheterization taken by physicians of various specialties (from the Russian

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**Table 8. The treatment effectiveness of patients with iatrogenic bladder injuries**

| Type of damage / complications | Treatment method          | PP, n | Recovery, n (%) | Complication / relapse, n (%) |
|--------------------------------|---------------------------|-------|-----------------|------------------------------|
| Perforation less than 5 mm     | Prolonged urethral drainage | 2     | 2 (100%)        | 0                            |
| Perforation more than 5 mm     | Revision, suturing of a defect | 12    | 12 (100%)       | 0                            |
| Bladder fistula                | Reconstructive surgery    | 9     | 6 (67%)         | 3 (33%)                      |

PP – per-protocol; n – number

**Table 9. The treatment effectiveness of patients with iatrogenic urethra injuries**

| Type of damage / complications | Treatment method          | PP, n | Recovery, n (%) | Complication / relapse, n (%) |
|--------------------------------|---------------------------|-------|-----------------|------------------------------|
| Urethral internal trauma       | Prolonged urethral drainage | 15    | 4 (27%)         | 11 (73%)                     |
| External urethra trauma        | Revision, suturing of a defect | 12    | 4 (33%)         | 8 (67%)                      |
| Urethral fistula               | Reconstructive surgery    | 7     | 4 (57%)         | 3 (43%)                      |
| Urethral strictures, less than 5 mm in length | DIVU | 32    | 14 (43.7%)      | 18 (56.3%)                   |
| Urethral strictures, more than 5 mm in length | Urethroplasty | 46    | 40 (86.9%)      | 6 (13.1%)                    |

PP – per-protocol; DIVU – direct vision internal urethrotomy; n – number

**Table 10. Examination and treatment results of ST and MD groups**

| Parameter                              | ST (n = 190) | MD (n = 39) | P   |
|----------------------------------------|--------------|-------------|-----|
| Errorneous, incomplete or inaccurate diagnosis, % | 32 (16.8%) | 1 (2.5%) | 0.036 |
| Incorrect assessment of the disease severity, % | 45 (23.6%) | 2 (5%) | 0.024 |
| Incorrect or incomplete interpretation of the survey results, % | 76 (40%) | 3 (7.6%) | 0.003 |
| Successful primary treatment tactics, % | 72 (37.8%) | 2 (5%) | 0.001 |
| Satisfaction with treatment, patient, score | 3.2± 1.0 | 4.5 ±0.5 | 0.021 |
| Satisfaction with treatment, doctor, score | 3.9 ±0.7 | 4.5 ±0.5 | 0.087 |

ST – standard treatment group; MD – interdisciplinary interaction group; n – number; P – value
Indirect damage, for example, can lead to interventions and incidents in the vascular system (stenting, prosthetics, occlusion, and embolism) and the central and peripheral nervous systems (spinal surgery, installation of neurostimulators, etc.). Urinary tract infection associated with medical care plays an important role [18].

The increasing number of iatrogenic injuries has brought special attention to their prevention and subsequent treatment [19]. Preventive procedures include identifying errors in the execution of typical procedures, explicit and hidden, which can cause iatrogenic injuries [16, 17]. For example, excessive performing of transurethral surgery, lack of periodic lubrication, and exceeding the recommended duration of a procedure contributes to damage due to leakage and mechanical friction of the instrument in the urethra [20].

**DISCUSSION**

The purpose of this research was to analyze obtain knowledge about the problem of urinary system iatrogenic injuries, to apply injury prevention algorithms and to evaluate the prospects of interdisciplinarity in modern surgical practice.

Damage to the urinary system can be direct or indirect, which leads to a complete or partial loss of function (due to denervation, devascularization, formation of scar contractures or pathological bends, etc.) [16, 17].
In terms of long-term effects, the most significant injuries concern the urethra, and to a lesser extent, kidneys, and bladder. Ureter injuries mostly can be successfully treated [2, 26].

The contribution of operations from related disciplines is minimal. On the opposite side, most of the strictures (96%) and damage to the ureter arose because of bowel surgery, obstetric-gynecological operations, vascular interventions, or external beam radiation therapy [27]. A similar situation was with damage to the bladder and the urethra. However, these pathologies occur due to typical procedural errors (medical: during endourological surgery – the bladder resections, adenoidectomies or prostatectomies; medical surgeries: traumatic catheterization of the bladder), which indicates a defect in the algorithms of work (typical procedural errors) and non-compliance with safety regulations. External injuries in all cases were the results of the work of coloproctologists, gynecologists, and surgeons.

These results highlight the critical importance of multidisciplinary interaction in all operations. Any large surgical center should have a competent urologist who can promptly identify and eliminate iatrogenic lesions, or prevent them in the preoperative period (participating in the diagnosis [28], and performing prophylaxis, for example, catheterizing the kidneys with luminous stents-catheters [22]) or intraoperative period (participating in the operation) [29]. The problem of a multidisciplinary approach becomes especially urgent in terms of treatment, which often requires multiple interventions and long-term rehabilitation. We consider it expedient to introduce the principles of a multidisciplinary approach and principles of teamwork of related specialists at the training stage [30]. Therefore, a multidisciplinary team should perform the training, which correlates with other researchers [31].

The present study also evaluated the effectiveness of multidisciplinary interaction in individual groups (standard treatment, 190 patients; multidisciplinary approach, 39 patients; with P kidney in all aspects of the assessment not more than 0.036), which demonstrated excellent results of such teamwork. An attempt to identify the causes of iatrogenic injuries using the example of bladder catheterization showed no significant contribution from the medical personnel education; however, the correct execution of procedures demonstrated a great influence, which also correlates with the other researchers’ results [30].

The assessment of the understanding of the urinary system organs topographic anatomy features and the risks of their injury, the typical procedural mistakes, as well as the observance of medical intervention algorithms established the main sources of iatrogenic injuries: typical procedural mistakes [32], the violation of injuries prevention algorithms [24] as well as complex clinical situations with problematic anatomical orientation and a risk
of accidental damage to the urinary system organs [33]. The wide geography of the study participants demonstrates the universal nature of the problem. There are no strict standardized clinical algorithms and recommendations for typical procedures. Thus, it is important to study the procedural complications problems, and to develop, and implement common algorithms for typical procedures.

CONCLUSIONS

Interdisciplinary interaction in the prevention and treatment of patients with urinary system iatrogenic injuries showed the highest significance and effectiveness of this approach. The study highlighted such parameters as inaccurate or incorrect diagnosis (p = 0.036), incorrect assessment of the disease severity (p = 0.024), incomplete or incorrect interpretation of examination results (p = 0.003), successful primary treatment tactics in eliminating iatrogenic complications (p = 0.001), patient’s satisfaction with treatment (p = 0.021). We consider it expedient to widely implement this approach in medical care.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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