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CADAVERIC KIDNEY ALLOGRAFT TRANSPLANTATION USING THE DA VINCI ROBOTIC SURGICAL SYSTEM. INITIAL EXPERIENCE IN THE RUSSIAN FEDERATION

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Kidney transplantation is the treatment of choice for patients with end-stage renal disease. In order to reduce the number of postoperative complications following open surgeries, a number of clinics in the USA and Europe are currently developing robot-assisted surgical techniques. Studies have shown that robotic surgery facilitates kidney transplantation under optimal ergonomic position for the surgeon, with functional results and patient safety comparable to those obtained under an open approach. We herein present our initial experience (in the Russian Federation) on heterotopic cadaveric kidney transplantation by laparoscopic surgery using the Da Vinci robotic surgical system.

Keywords: kidney transplantation, Da Vinci robotic surgical system.

INRODUCTION

Minimally invasive surgery can reduce postoperative pain syndrome and the number of early postoperative complications in comparison with traditional open surgery, which, in turn, contributes to earlier activation of patients [1–5]. The role of minimally invasive surgery is especially important in a number of patients who have undergone kidney transplantation, since they often have severe concomitant pathology, accompanied by immunodeficiency after surgery. Such patients have a very high risk of postoperative complications, which undoubtedly affects not only the duration of rehabilitation, but also endangers both the viability of the graft and the life of the patient himself [6–9].

The technique of minimally invasive operations in kidney transplantation has been described quite recently [10–12]. In 2010 Modi et al. developed a laparoscopic method of kidney transplantation [10]. Giulianotti et al. first performed and described the technique of robotic transplantation [11]. Nevertheless, the authors noted a slower recovery of graft function compared to open surgery [13, 14]. Initially, a surgical technique was used without cooling the renal graft. To reduce the time of thermal ischemia, a number of authors modernized the technique [15] and began to use all kinds of devices for intraoperative, intraperitoneal graft cooling, which we also used in the operation. In total, clinics in the USA and Europe have accumulated experience of up to 500 such operations. In the domestic literature, it was not possible to find publications on the conduct of this type of surgical intervention. In our clinic, kidney transplants have been performed since 2009, as of 01.01.2020 467 kidney operations have been performed. Since December 2014 at the Ochapovsky Regional Clinical Hospital No. 1 (Krasnodar, Russian Federation), it became possible to perform operations using the Da Vinci Si robotic system. From that moment to January 2020, more than 900 robotic-assisted surgical interventions of various complexity categories were performed: radical prostatectomy with extended pelvic lymphadenectomy, kidney resection in case of tumor lesion, with a high RENAL index, radical cystectomy with orthotopic and heterotopic intestinal urine diversion in men and women, plastic surgery of the pelvic-ureteric segment, ureterocystoanastomosis, adenomectomy and other surgical interventions. Thanks to the extensive experience of Professor V.L. Medvedev and his team, performing both open and laparoscopic and robotic operations, as well as performing kidney transplantation, it became possible to successfully perform this operation.

MATERIALS AND METHODS

Clinical case 1

The recipient, a woman, 55, body mass index (BMI) 36.9 (Fig. 1). In 2000, the patient was diagnosed with autosomal dominant polycystic kidney disease. Since 2004, renal failure has occurred, and therefore conservative treatment was щукformed. In February 2008, terminal renal dysfunction was diagnosed, which required renal replacement therapy by hemodialysis 3 times a week for 5 h. Due to the large size of the kidneys, to prepare for transplantation in 2013, nephrectomies were performed sequentially on the right and left with the lumbotomic approaches. The patient is on the WL for transplantation.

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Fig. 1. The appearance of patient № 1 before surgery

The recipient was called from the waiting list for a kidney transplant, according to the tiping protocol (03.19.16). Blood group A (II). No hemotransfusions. Laboratory data upon admission to the hospital: urea 11.65 mmol/l, creatinine 487 mmol/l. The donor, a man, 50, and the recipient are identical by AB0 and HLA system antigens (I and II classes).

Clinical case 2

The recipient, a man, 28, BMI 37.8 with alimentary obesity (Fig. 2). Since 2012, the patient has noted an increase in blood pressure (BP) up to 200/120 mm Hg.

Fig. 2. The appearance of patient № 2 before surgery

Since July 2017, he has been feeling a worsening of his condition in the form of uncontrolled hypertension, severe general weakness and shortness of breath. On August 10, 2017, the patient was admitted to the central district hospital for hypertensive crisis. The examination revealed azotemia (urea – 26.8 mmol/l, creatinine – 800 μmol/l). The clinical diagnosis of chronic glomerulonephritis, hypertensive variant. The patient began to receive renal replacement therapy using programmed hemodialysis. From 23.01.2018 he was included in the WL for kidney transplant, on 11.10.18 was called from the waiting list according to the tiping protocol. Blood group (0) 1. No hemotransfusions. Laboratory indicators upon admission to the hospital: urea 14.16 mmol/l, creatinine 612.9 mmol/l. The donor, a woman, 27, and the recipient are identical by AB0 system and HLA system antigens (I and II classes).

TECHNIQUE AND STAGES OF OPERATION

Patient position and port location

Patients on the operating table were in the position, as in a standard developed intervention on the pelvic organs, lying on the back with legs apart [16, 17]. In the first patient, a vertical skin incision up to 4 cm long was made 4–5 cm above the navel along the midline, and an open entrance to the abdominal cavity was made under visual control (considering the previously performed ventral hernia repair). In the second patient, the main telescopic trocar was installed in a closed way. Other ports, including three 8mm robotic ports and one 12mm assistant port were installed as shown in Fig. 3 [16, 18].

Fig. 3. The position of the ports (trocars)

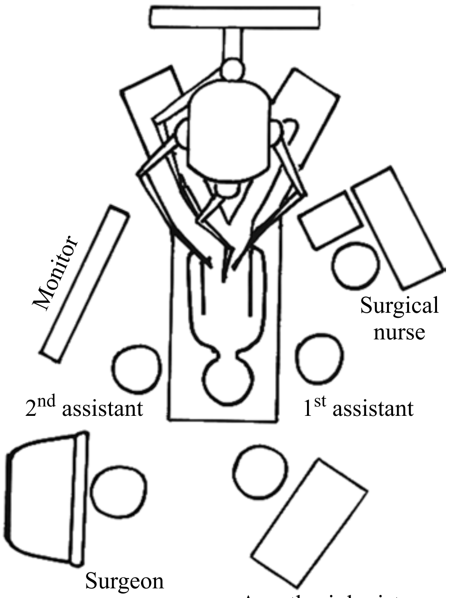

Fig. 4. The location of the patient, the operating team and the robot system in the operating room

Then the operating table was moved to the Trendelenburg position, and the Da Vinci Si robotic system (Intuitive Surgical, Sunnyvale, CA, USA) was located at the foot end of the table and the manipulators were fixed (Fig. 4).

Preparation of vessels

In both cases, the initial stages of the operation were the same. Laparoscopy and revision of the abdominal cavity with 30 ° camera lens was performed. No pathological changes were found in the abdominal cavity. The right external iliac vessels were identified; the parietal peritoneum was dissected above their projection. The right common, external, internal arteries and veins were identified, after which the vessels were taken to the turnstiles (Fig. 5, 6).

Renal graft preparation

Simultaneously with the preparation of the recipient and the beginning of the robotic stage, a cadaveric kidney was collected in the adjacent operating room and the renal graft was dissected. In each case, the cadaveric kidney was isolated from the perirenal tissue, the renal vessels were dissected (1 artery and 1 vein in both cases), and the ureter with the mesentery was mobilized. The kidney transplant was wrapped in several rounds of gauze napkin, pre-soaked with ice crumbs and saline sodium chloride solution, and placed in a sterile polyethylene container with ice, into which a 12 cm long, 16Ch diameter vinyl chloride tube was inserted. The latter was connected to an ice-cold saline infusion system to maintain further intraperitoneal cooling. The renal

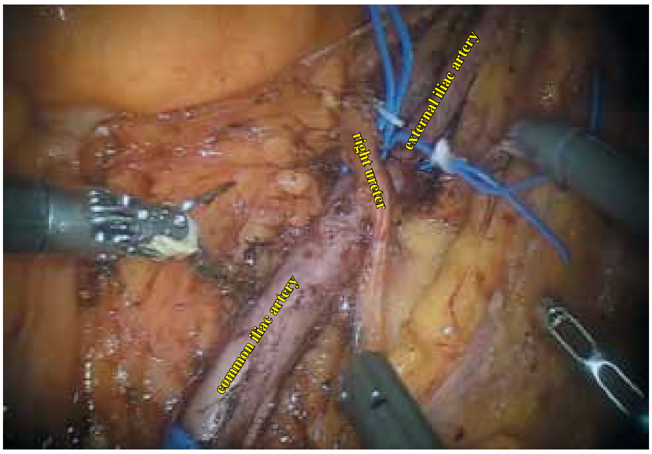

Fig. 5. Right iliac (common, external and internal) arteries

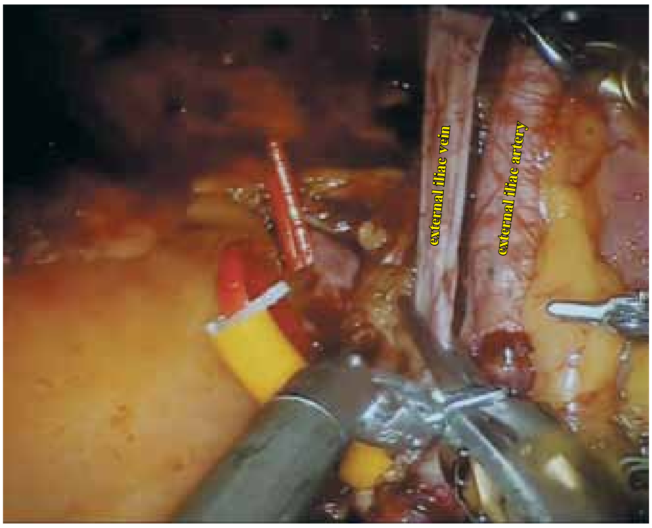

Fig. 6. Right external iliac artery and vein

Fig. 7. Renal transplant preparation

vessels of the graft were taken out through the opening in the container (Fig. 7).

In the first case, the patient's uterus was taken on holders with separate sutures and laid forward and upward to the anterior abdominal wall. In the rectouterine pouch, in

Fig. 8. The stage of transvaginal input of renal transplant

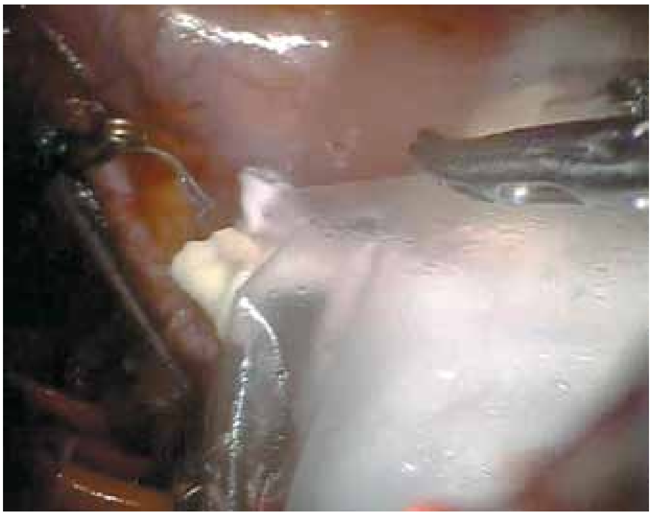

Fig. 9. The position of the transplant container in the abdominal cavity

the projection of the posterior fornix of the vagina up to 5 cm wide, a transverse incision of the peritoneum was made, and the wall of the vagina was dissected to the full depth, and a polyethylene sleeve was passed through the vagina, along which a graft in a container was inserted into the abdominal cavity and placed in the right iliac region (Figs. 8–11).

The vaginal vault was sutured continuously with a resorbable suture. The peritoneum is sutured.

In the second case, a mini laparotomy was performed with Pfannenstiel approach. A renal graft in a container is immersed in the pelvic cavity through a polyethylene sleeve. The laparotomic wound was sutured tightly in layers.

Through a separate puncture in the right iliac area, a system was inserted into the abdominal cavity for supplying and irrigating the graft with physiological sodium chloride solution +2 ° C in order to minimize the time of renal warm ischemia (Fig. 12).

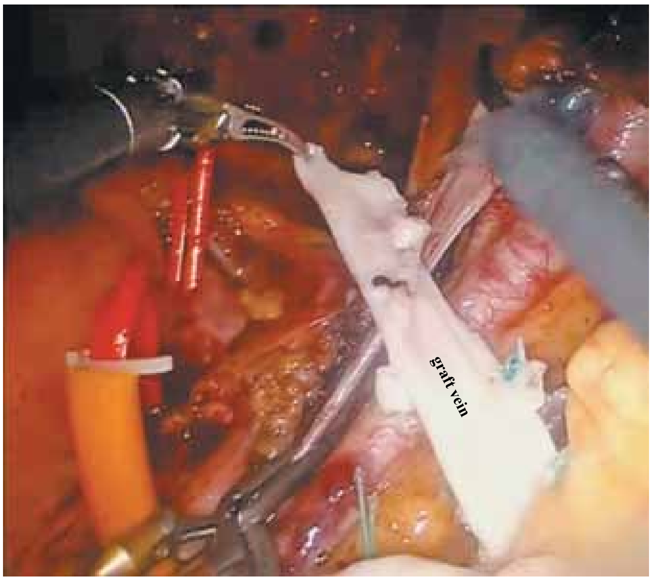

Fig. 10. The position of the renal vein of the graft relative to the iliac vessels of the recipient before performing the anastomosis

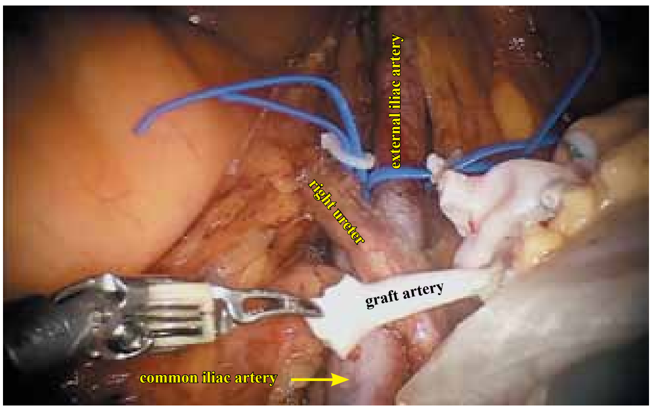

Fig. 11. The position of the renal artery transplant relative to the iliac vessels of the recipient before performing anastomosis

Fig. 12. Connecting the transplant irrigation system with ice-cold saline

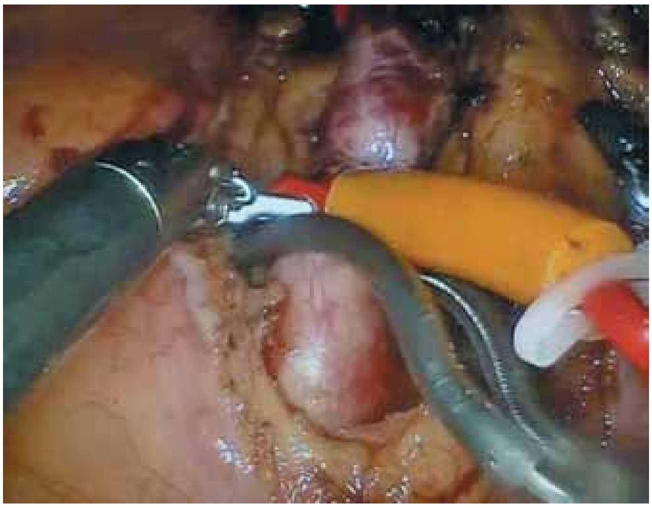

Fig. 13. The application of the vascular clamp type “bulldog” on the right common iliac artery

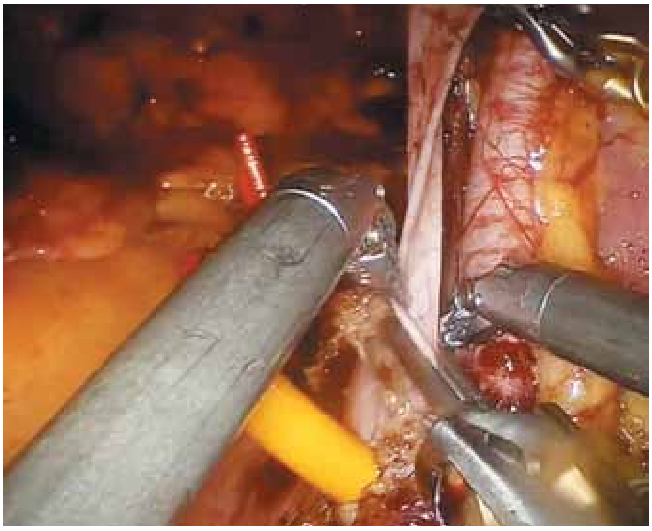

Fig. 14. The application of the vascular clamp type “bulldog” on the right external iliac vein

Venous anastomosis

The vascular stage of the operation began with a venous anastomosis. Bulldog-type vascular clamps were applied to the proximal and distal ends of the previously isolated iliac vessels (arteries and veins) in order to stop the blood flow (Fig. 13, 14).

Initially, the wall of the external iliac vein was opened and resected in size slightly wider than the diameter of the graft vein (about 12 mm). The lumen of the iliac vein was flushed with a heparin solution (5000 units of heparin per 100.0 physiological sodium chloride solution) through a 6Ch catheter. An end-to-side anastomosis was made with a continuous suture using Gore-Tex 5/0 suture material (WL Gore & Associates Inc, Flagstaff, AZ, USA) (Fig. 15, 16), while a needle holder was used in the “right hand” of the robotic system , and in the left hand is a bipolar forcept “Maryland forceps” Da Vinci (Intuitive Surgical, Sunnyvale, CA, USA). Before completing the venous anastomosis, the lumen of the vein is flushed again with heparinized saline sodium chloride solution in an amount of 20 ml.

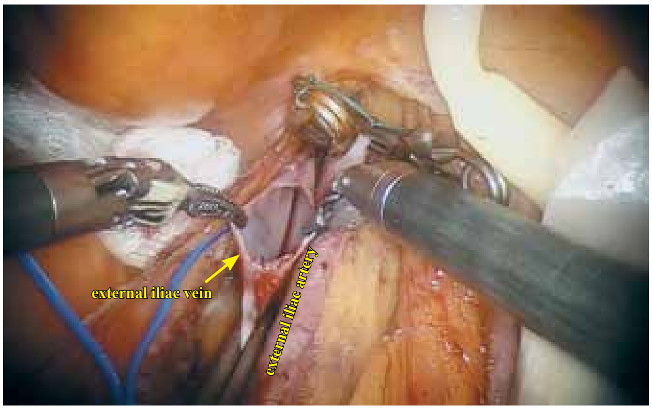

Fig. 15. Dissection of the lumen of the right external iliac vein

Arterial anastomosis

A circular arteriotomy with a diameter of up to 10 mm was performed in the wall of the right common iliac artery using robotic scissors. The lumen of the artery is also flushed with heparinized sodium chloride solution 20 ml. An end-to-side anastomosis was made with a renal graft artery, which was about 6 mm in diameter, with a continuous suture using Gore-Tex 5/0 suture material (Fig. 17, 18). Similarly, before completing the arterial anastomosis, the lumen of the vessels is flushed again with heparinized sodium chloride solution 20 ml.

A layer of BioGlue® for additional suture sealing (CryoLife USA) was applied to the area of vascular ana-

Fig. 16. Performing a vascular anastomosis between the renal vein and the right external iliac vein

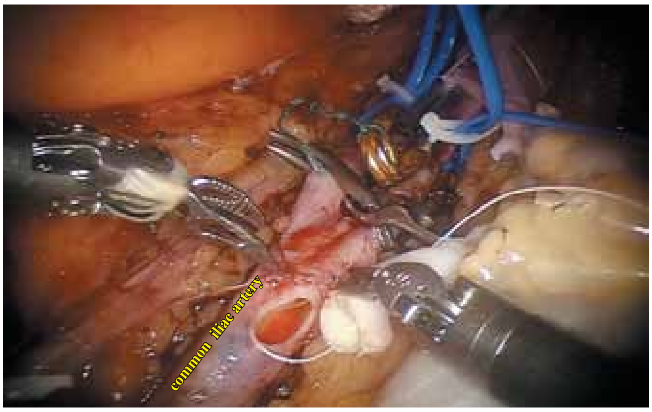

Fig. 17. Performing a vascular anastomosis between the renal artery and the right common iliac artery (beginning)

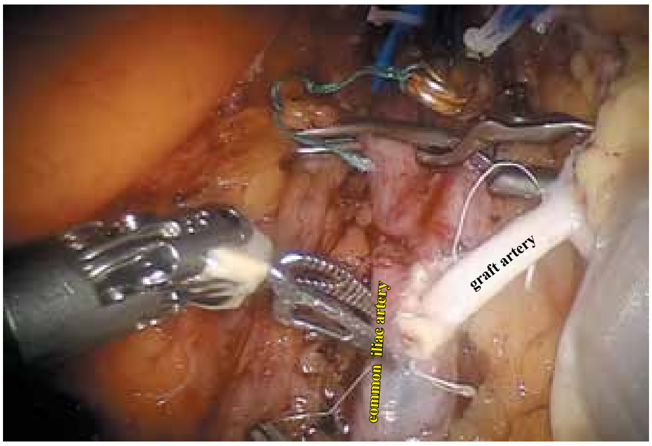

Fig. 18. Performing a vascular anastomosis between the renal artery and the right common iliac artery (completion)

stomoses. According to the standard protocol for kidney transplantation, methylprednisolone 1000 mg is injected intravenously into the recipient before starting the blood flow in the graft. Vascular clamps were removed one by one, starting from the distal venous, then cranial, then arterial. After the resumption of blood flow and control of the tightness of the anastomoses, the vascular clamps were removed from the abdominal cavity (Figs. 19, 20).

It should be noted that during the resumption of blood flow into the renal graft, it is necessary to be ready for immediate hemostasis. For this purpose, a gauze napkin was placed in the area of vascular anastomoses for 2–3 minutes. In case of ongoing bleeding, diastasis and / or perforation in the vessels are sutured with separate Z-shaped sutures using Prolene 5/0 suture (Ethicon, USA). The pulsation of the artery and blood filling of the graft were visually assessed. At this stage of the operation, it is extremely important to medically increase the recipient's blood pressure to high numbers – 130–140 mm Hg. From the distal end of the graft ureter, approximately 3–5 minutes after the start of the blood flow, light urine was dripped. After control of patency, tightness of vascular anastomoses, hemostasis, the graft irrigation system with ice solution was disconnected. The container and gauze pad, which was wrapped around the kidney graft, were cut with scissors and removed from the abdominal cavity through the assistant's 12 mm port.

Ureterocystoanastomosis

Into the bladder of recipients through a pre-installed urethral catheter under sterile conditions, 200 ml of physiological sodium chloride solution was introduced. In the area of the bottom of the bladder, a longitudinal section of its wall up to 2.5 cm long was made using monopolar electric shears of a robotic system. The distal end of the graft ureter was spatulated for 2 cm. Ureterocystoanastomosis was placed with a continuous suture with Biosyn 4-0 thread (Covidien, USA). After suturing

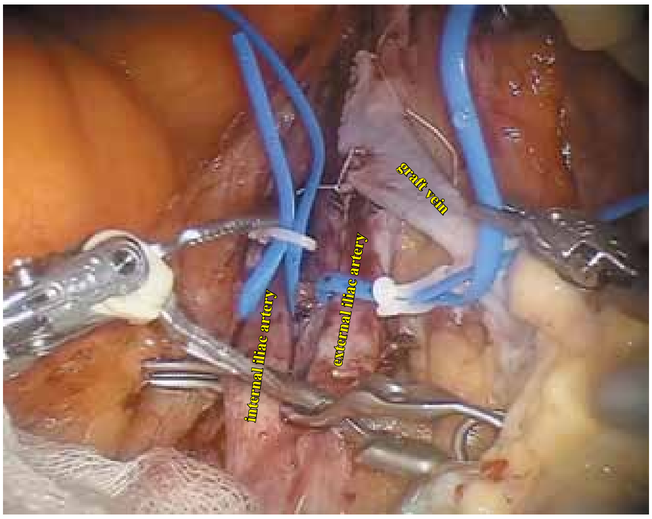

Fig. 19. Removing the clamp from the external iliac vein

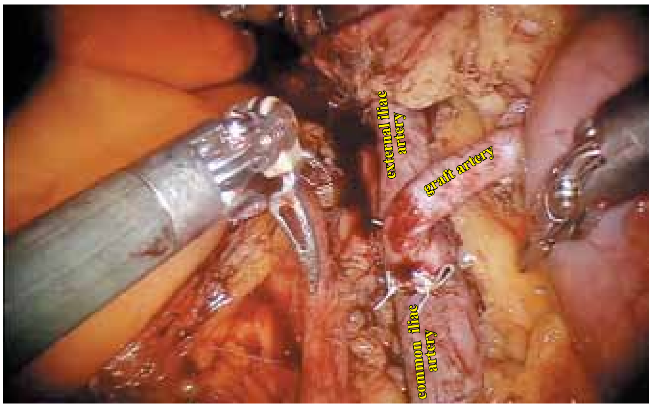

Fig. 20. Restoring blood flow to the graft

the lateral lip of the anastomosis, a Ch 7/22 double J stent (RuschGmbh, Germany) was inserted into the abdominal cavity through the 12-mm assistant port. The stent was installed at one end into the pelvis of the graft, with the other into the bladder cavity, after which the medial lip

Fig. 21. Performing ureterocystoanastomosis (beginning)

Fig. 22. Performing ureterocystoanastomosis (completion)

of the ureterocystoanastomosis was sutured. Analogous to open surgery, an important point in this stage of the operation is the creation of an antireflux mechanism of the ureter. In our clinical cases, we did this by suturing the detrusor fibers over the distal end of the ureter with the Leach – Gregoire technique [19, 20] (Figs. 21, 22).

Final stage, retroperitonization and drainage

The renal graft was immersed in a pocket that had previously been formed in the right iliac fossa between the retroperitoneal fascia and the peritoneum. The integrity of the peritoneal leaf over the graft was restored with a continuous suture with V-Loc™ 3-0 suture (Covidien, USA). Final hemostasis was performed. Through a robotic port in the right iliac region, a safety tubular silicone drainage with a diameter of 20Ch was installed into the newly formed retroperitoneal space on the right to the renal graft. The manipulators are disabled, the robotic stage of the operation is completed. Trocar holes were sutured under visual control using a furrier needle. Intradermal sutures to the skin. Aseptic stickers.

The operation time in the first case was 405 minutes, in the second observation, taking into account the accumulated experience of the first operation, the operation time was 190 minutes. The main stages of the operation in time intervals are presented in the Table. A longer time of some stages of the operation, in comparison with open ones, is associated with the development of the technique. The volume of blood loss did not exceed 80 ml in the first observation and 50 ml in the second.

Immunosuppressive therapy was carried out intraoperatively according to the standard scheme: induction with basiliximab 20 mg intravenously before the start of the incision 10 min. Before starting the blood flow in the graft, administration of methylprednisolone 1000 mg. From the first day after the operation, the scheme of immunosuppressive therapy was as follows: in the first observation – cyclosporine 300 mg/day, methylprednisolone 14 mg/day, mycophenolate mofetil 360 mg 2 r/day; in the second observation – methylprednisolone 4 mg 4 r/day, from the 3rd day after the operation, tacrolimus 5.5 mg 2 times a day, and from the 10th day – 5.5 + 4.5 mg per day.

Postoperative period

After the end of the operation, the recipients were taken to the boxed ward of the intensive care unit, where they were kept for 7 days. The next day after the transplantation, the patients became more active and began to walk within the ward. Anesthesia with narcotic analgesics was not required. The graft function is urgent. In the first observation, the diuresis on the first day was 4000 ml, in the second – 2200 ml. As can be seen from the presented graph (Fig. 23, 24), from the 3rd day after the operation, the first patient established a certain stable volume of diuresis, which was about 3000 ml/day. In the second patient, on the 10th and 12th days of the postoperative period, polyuria was noted up to 7500 and 5700 ml per day, respectively.

In both patients, there were no clinical manifestations of postoperative intestinal paresis, which made it possible to prescribe food for the next day after the operation and to fully feed the patients from the second day after the surgery. The insurance drains were removed on the 2nd day after the operation. There were no infectious, wound complications during the entire observation period. Controlled blood concentration of immunosuppressive drugs at 2 times a week was adequate. According to the ultrasound of the graft, which was periodically performed in patients, there were no abnormalities in the echostructure of the grafts and signs of impaired urodynamics. Blood flow data from day 10 after surgical treatment stabilized and averaged the following indicators: total Vmax 58 cm/s, RI 0.7; segmental Vmax 40 cm/s, RI 0.6, arc Vmax 22 cm/s, RI 0.6 (Figs. 25–28).

According to laboratory blood tests for a 30-day follow-up period, the level of blood leukocytes did not exceed 9.0×10^9/l, erythrocytes and hemoglobin did

Table

Stages of operation in time intervals

Operation stages	Time, min	
	Case 1 (19.03.2016)	Case 2 (11.10.2018)
Installing ports	15	12
Opening the peritoneum, isolating the iliac vessels	25	20
Graft preparation	35	25
Opening of the posterior vaginal fornix, transvaginal graft insertion	20	–
Pfannenstiel laparotomy, transplant placement, wound closure	–	35
Венозный анастомоз	25	20
Arterial anastomosis	25	15
Starting blood flow, hemostasis	20	10
Ureterocystoanastomosis with stent placement	40	25
Drainage installation, peritonization	35	30
Removing, suturing ports	15	15
Warm ischemia time	10	10
Cold ischemia time	120	90
Console running time	315	155
Total operation duration	405	190
Anesthesia duration	435	220

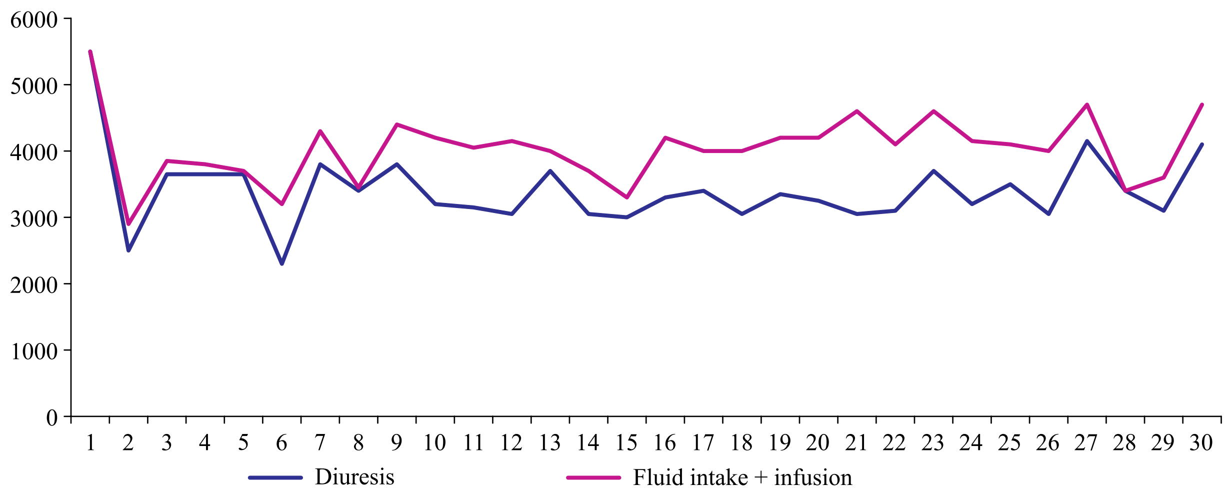

Fig. 23. Dynamics of diuresis and fluid intake with infusion therapy (ml) in the postoperative period in observation No. 1

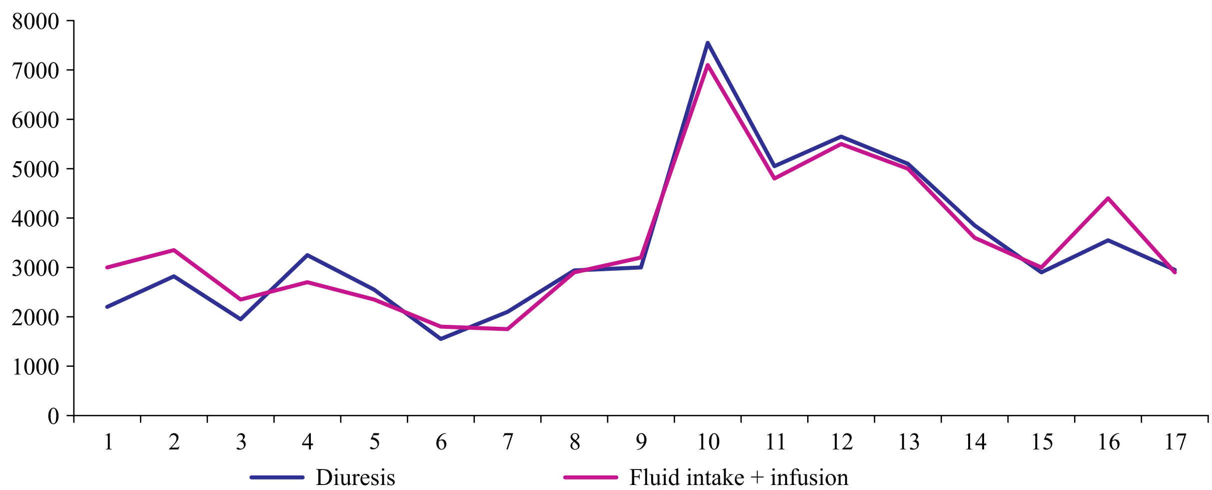

Fig. 24. Dynamics of diuresis and fluid intake with infusion therapy (ml) in the postoperative period in observation No. 2

not decrease below 3.0×10^{12}/l and 94 g/l, respectively. In the biochemical blood test, as shown in the graph (Fig. 29, 30), the urea and creatinine values in the first patient decreased steadily and remained relatively stable from 5–6 days after kidney transplantation (on average 4.64 mmol/L – for urea and 115 μmol/l – for creatinine).

The urethral catheter was removed on the 7th and 10th days (in the 1st and 2nd observation, respectively), and the ureteral stent – on the 21st day after surgery. On the 30th day, the patients were discharged from the hospital in a satisfactory condition.

Patients are regularly (once every 3 months) examined by a nephrologist. Throughout the entire period of observation and to this day, the state of health of the patients is satisfactory, they have the opportunity to travel freely. Renal transplants are functioning satisfactorily. There are no data for renal failure in terms of blood urea and creatinine (Fig. 31).

At the moment, the woman is receiving immunosuppressive therapy in the amount of: mycophenolic acid – 360 mg 2 times a day, cyclosporine – 50 mg in the morning and 75 mg in the evening, methylprednisolo-

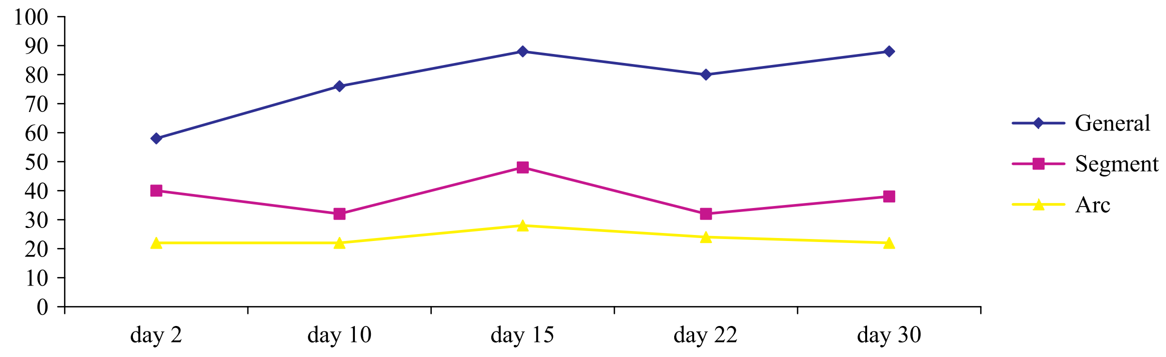

Fig. 25. Transplant blood flow data in the 1st observation Vmax (cm/s)

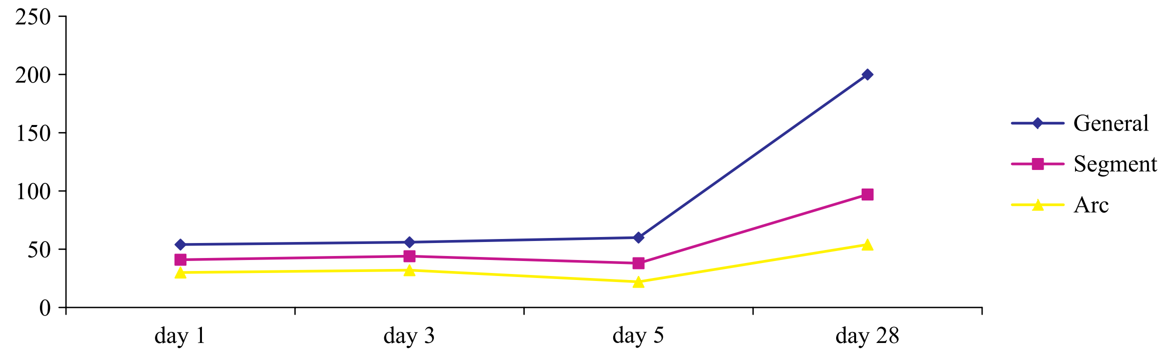

Fig. 26. Transplant blood flow data in the 2nd observation Vmax (cm/s)

Fig. 27. Ultrasound image of a renal transplant of clinical case № 1

Fig. 28. Ultrasound image of a renal transplant of clinical case № 2

ne – 4 mg once a day. The second patient was prescribed the following therapy: mycophenolic acid – 360 mg 2 times a day, tacrolimus – 1.5 mg in the morning and 2.0 mg in the evening, and methylprednisolone – 4 mg in the morning.

CONCLUSION

The advantages of kidney transplantation using the Da Vinci robotic system in comparison with open surgery include a significant reduction in surgical trauma and, as a result, minimal postoperative pain syndrome

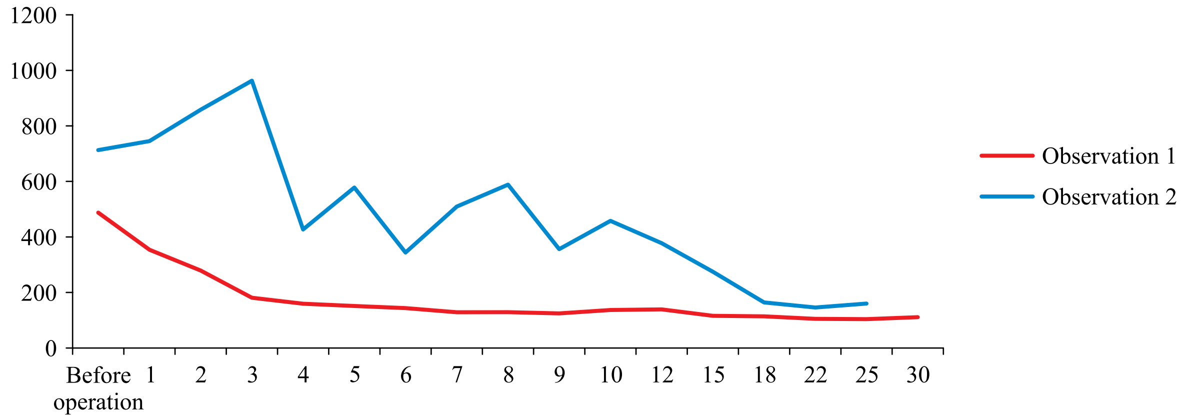

Fig. 29. Indicators of blood creatinine in the postoperative period (μmol/l)

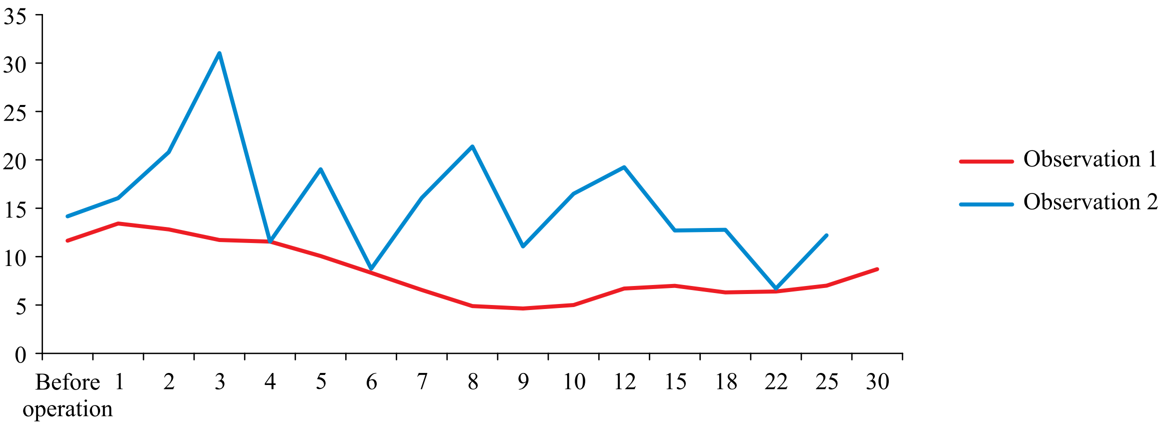

Fig. 30. The indicators of blood urea in the postoperative period (mmol/l)

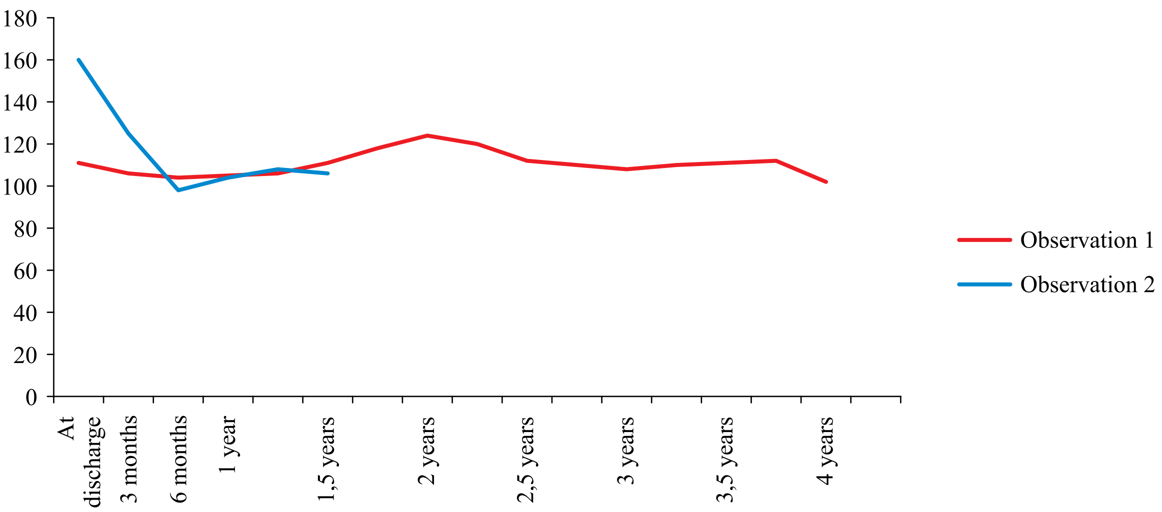

Fig. 31. Indicators of creatinine in the blood of patients during dynamic observation (μmol/l)

that does not require the use of narcotic analgesics, the convenience of visualization for the surgeon when manipulating in the pelvic cavity, the possibility of precise imposition anastomoses.

Besides, this type of surgery allows minimizing the risk of wound infectious complications, activating patients the next day after surgery, which is especially important for patients with diabetes and obesity due to the risk of thrombotic complications and hypoventilation changes in the lungs.

Among the disadvantages of the technique, it is necessary to note the long duration of the operation at the stage of development, the rather high cost of tools and equipment.

However, if the surgeon has sufficient experience in working with the Da Vinci robotic system, the equipment of the hospital, highly qualified specialists and the well-coordinated work of the team, the operation is technically feasible.

Compliance with all the rules of conservative treatment by experienced personnel, constant laboratory and instrumental control allow achieving satisfactory functional results in the treatment of patients who underwent kidney transplantation using minimally invasive technology.

To obtain statistically reliable results, it is necessary to perform a greater number of such operations, which will improve the surgical technique, reduce the time of surgical intervention and shorten the time of recipient stay in the hospital, thereby improving the quality of life of this category of patients and reducing material costs for rehabilitation.

The authors declare no conflict of interest.

REFERENCES

1. *Trinh QD, Sammon J, Sun M et al.* Perioperative outcomes of robotassisted radical prostatectomy compared with open radical prostatectomy: results from the nationwide inpatient sample. *Eur Urol*. 2012; 61: 679–685.
2. *Nguyen NT, Goldman C, Rosenquist CJ et al.* Laparoscopic versus open gastric bypass: a randomized study of outcomes, quality of life, and costs. *Ann Surg.* 2001; 234: 279–289.
3. *Park A, Birch DW, Lovrics P.* Laparoscopic and open incisional hernia repair: a comparison study. *Surgery*. 1998; 124: 816–821, discussion 821–822.
4. *Park Y, Ha JW.* Comparison of one-level posterior lumbar interbody fusion performed with a minimally invasive approach or a traditional open approach. *Spine*. 2007; 32: 537–543.
5. *Romy S, Eisenring MC, Bettschart V, Petignat C, Francioli P, Troillet N.* Laparoscope use and surgical site infections in digestive surgery. *Ann Surg*. 2008; 247: 627–632.
6. *Giral-Classe M, Hourmant M, Cantarovich D et al.* Delayed graft function of more than six days strongly decreases long-term survival of transplanted kidneys. *Kidney Int*. 1998; 54: 972–978.
7. *Lynch RJ, Ranney DN, Shijie C, Lee DS, Samala N, Englesbe MJ.* Obesity, surgical site infection, and outcome following renal transplantation. *Ann Surg*. 2009; 250: 1014–1020.
8. *Matas AJ, Gillingham KJ, Payne WD, Najarian JS.* The impact of an acute rejection episode on long-term renal allograft survival (t1/2). *Transplantation*. 1994; 57: 857–859.
9. *Osman Y, Shokeir A, Ali-el-Dein B et al.* Vascular complications after live donor renal transplantation: study of risk factors and effects on graft and patient survival. *J Urol*. 2003; 169: 859–862.
10. *Modi P, Rizvi J, Pal B et al.* Laparoscopic kidney transplantation: an initial experience. *Am J Transplant*. 2011; 11: 1320–1324.
11. *Giulianotti P, Gorodner V, Sbrana F et al.* Robotic transabdominal kidney transplantation in a morbidly obese patient. *Am J Transplant*. 2010; 10: 1478–1482.
12. *Boggi U, Vistoli F, Signori S et al.* Robotic renal transplantation: first European case. *Transpl Int*. 2011; 24: 213–218.
13. *Modi P, Pal B, Modi J et al.* Retroperitoneoscopic living-donor nephrectomy and laparoscopic kidney transplantation: experience of initial 72 cases. *Transplantation*. 2013; 95: 100–105.
14. *Oberholzer J, Giulianotti P, Danielson KK et al.* Minimally invasive robotic kidney transplantation for obese patients previously denied access to transplantation. *Am J Transplant*. 2013; 13: 721–728.
15. *Menon M, Abaza R, Sood A et al.* Robotic kidney transplantation with regional hypothermia: evolution of a novel procedure utilizing the IDEAL guidelines (IDEAL phase 0 and 1). *Eur Urol*. 2014; 65: 1001–1009.
16. *Menon M, Shrivastava A, Kaul S et al.* Vattikuti Institute prostatectomy: contemporary technique and analysis of results. *Eur Urol*. 2007; 51: 648–658, discussion 657–658.
17. *Jeong W, Sood A, Ghani KR et al.* Bimanual examination of theretrieved specimen and regional hypothermia during robot assisted radical prostatectomy: a novel technique for reducing positive surgical margin and achieving pelvic cooling. *BJU Int*. In press. http://dx.doi.org/10.1111/bju.12573.
18. *Menon M, Tewari A, Peabody J.* Vattikuti Institute prostatectomy: technique. *J Urol*. 2003; 169: 2289–2292.
19. *Riedmiller H, Gerharz EW.* Antireflux surgery: Lich-Gregoir extravesical ureteric tunnelling. *BJU Int*. 2008; 101: 1467–1482.
20. *Hoznek A, Zaki SK, Samadi DB et al.* Robotic assisted kidney transplantation: an initial experience. *J Urol*. 2002; 167: 1604–1606.

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