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Endovascular treatment of the pseudoaneurysm using stent-graft after transplant nephrectomy

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Abstract

Introduction. *Vascular complications after transplant nephrectomy are rather rare. The aim of this article is to analyze the effectiveness of the stent-graft implantation in the treatment of pseudoaneurysm after transplant nephrectomy.*

Clinical case. *In the previous 23 years, a 50-year-old patient underwent 3 kidney transplantations from a cadaveric donor and 2 transplant nephrectomies. At 12 years after the left transplant nephrectomy he complained of abdominal pain and was admitted for a pulsating mass in his left pelvic region. Computed tomography angiography, ultrasonography, and arteriography were performed and showed a large pseudoaneurysm arising from the left external iliac artery. The stent-graft implantation solved the problem providing successful clinical and radiological results.*

Conclusion. *Treatment options in this case were open or endovascular techniques. Surgical revision associated with high risk of complications. Endovascular treatment had the benefits of a minimally invasive approach with low blood loss.*

Keywords: renal transplantation, pseudoaneurysm, stent-graft

Conflict of interests Authors declare no conflict of interest

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CDU, color Doppler ultrasonography

CT, computed tomography

PA, pseudoaneurysm

US, ultrasonography

Introduction

Kidney transplantation is used to treat patients with end-stage renal disease. Various vascular complications are possible after transplantation. Open reconstructive surgery in these cases can be associated with the possibility of further complications and a graft loss. Endovascular techniques represent an alternative modality for the treatment of vascular complications after kidney transplantation.

The total number of all vascular complications in our Institute by 2013 had made 18 cases per 429 kidney transplants in 421 patients, including thrombosis in microvasculature resulted from the development of the acute humoral or mixed rejection resistant to therapy in 9 cases, an acute rejection that led to the graft rupture and emergency transplantectomy in 4 cases; thrombosis of the main artery in 1 patient, renal artery stenosis identified in 2 cases, and venous thrombosis observed in 2 patients [1].

D. Dimitroulis et al. [2] performed 1367 kidney transplantations and noted 38 serious vascular complications that led to the loss of the renal graft, and 19 renal artery stenosis followed by successful treatment in most cases.

S. Aktas et al. [3] identified 47 different vascular complications (2.55%) after 43 transplants (2.33%) in 1843 patients: most often they were renal artery stenosis (14), renal artery kinking (7), renal vein kinking (7), renal artery thrombosis (5), renal vein rupture (4), renal artery rupture (3), renal vein thrombosis (2), renal artery dysfunction (2), renal and iliac vein obstruction due to lymphocele pressure (1), renal artery and vein obstruction due to hematoma pressure (1) and arteriovenous fistula after percutaneous graft biopsy (1).

M. Salehipour et al. [4] reported 133 complications (8.86%) after 1500 transplant operations, primarily, bleeding (6.1%), renal graft artery stenosis (1.7%), renal artery thrombosis (0.6%) and renal vein thrombosis (0.5%).

According to the data obtained by A. Srivastava et al. [5], vascular complications occurred in 25 patients (1.29%) among 1945 kidney transplants, the most often were artery stenosis in 11 patients (0.58%), arterial thrombosis in 9 (0.46%), vein thrombosis in 3 (0.15%) and a false aneurysm formation in 2 patients (0.1%).

Among 843 kidney transplants performed, P. Orlić et al. [6] revealed subsequent vascular complications in 57 patients (6.76%), including 3 (0.35%) patients in whom a pseudoaneurysm (PA) was formed.

Y-H. Lin et al. [7] searched MEDLINE (from 1950 − November 4, 2016) and EMBASE (from 1970 - November 4, 2016) for all reports of extrarenal PA or ruptured artery after kidney transplantation and found 45 case reports or series that met the inclusion criteria. According to their

review, the mortality rate was 13.8%; in 56.3% of reported cases, the loss of the transplanted kidney graft was non-fatal. Among the selected 87 patients, 73 (83.9%) had vascular complications at the anastomosis site. The majority of patients (79.3%) were diagnosed with PA, and 18 (20.7%) of 87 patients had an artery rupture. Meanwhile, only 33 patients (37.9%) did not develop a pathogenic infection. In cases of its occurrence, C. albicans was the most common (24 patients).

As follows from the above data, the formation of false aneurysms after kidney transplantation is a rare complication.

PA can also occur after a necessitated removal of the transplanted kidney [8–13], and there arise a need for reconstructive vascular surgery. The stent graft implantation could be an alternative. Here is a clinical case report.

Clinical Case Report

Patient D., 50 years old, was transferred to the Institute with complaints of the presence of a pulsating mass in the left iliac region. The patient was experiencing the swelling within about 50 days; a few hours before the admission, the body temperature acutely elevated to 38°C, and there was an increase in the volume of the mass in the left iliac region.

From the medical history, it was known that the patient had received treatment for many years, during which he underwent a number of surgical interventions in another medical institution: cadaveric kidney allotransplantation on the left in 1997, transplantectomy and repeated cadaveric kidney allotransplantation on the right in 2008; he experienced an acute rejection crisis in 2009, recurrent chronic renal failure in 2013, he received peritoneal dialysis. In 2016, repeated cadaveric kidney allotransplantation was performed on the left (an anastomosis with the common iliac artery was formed).

Diagnosis: chronic glomerulonephritis, end-stage chronic renal disease, condition after repeated (third) allotransplantation of a cadaveric kidney dated 31.05.2016. Graft dysfunction. A mixed type rejection of the kidney graft of 17.09.2019. Chronic viral hepatitis B and C.

At examination, a pulsating mass of 4 cm x 5 cm in size was seen in the left iliac region without alterations of the skin integument over it.

Computed tomography (CT) angiography showed a broken integrity of the left external iliac artery with the formation of a delimited hematoma.

At triplex scanning, an anechoic round-shaped formation of 5.5 cm x 4.0 cm in size with clear even contours with thrombotic masses along the anterior wall was located along the anterior lateral wall of the left iliac artery; at the same site, along the anterolateral wall, an anastomosis with an artery was visualized; at colour Doppler ultrasonography (CDU), a turbulent blood flow with a spontaneous contrast passage was identified. In the iliac region of the retroperitoneal space on the left, a kidney graft of 11.5x5.8 cm in size was located, the parenchyma being up to 1.7 cm; the renal pyelocaliceal system was expanded up to 2.3 cm due to the renal pelvis, up to 1.3 cm due to the calyces. At CDU, the blood flow was visualised up to the capsule. Conclusion: echo signs of false aneurysm of the iliac artery on the left, echo signs of calicopyelectasia of the transplanted kidney.

As the patient had a rupture and a pseudoaneurysm, an angiographic study was performed on 21.02.2020 (Fig. 1a), followed by the stenting of the left external iliac artery: a balloon-expandable LifeStream stent-graft from *Bard* ("C.R. Bard, Inc. Ireland) was implanted, the pressure was up to 12 atm, the diameter of the expanded stent graft being 10.2 mm, its length being 54.5 mm. (Fig. 1 b, c). The PA

was excluded from the blood flow, the blood flow in the left lower limb passed via the main vessel.

Figure. a–c: a, the artery stump rupture of the transplanted kidney with the pseudoaneurysm formation, the condition after the transplant nephrectomy; b, c, the aneurysm exclusion from the blood flow after the stent-graft implantation into the external iliac artery, contrast passage

The control ultrasound examination (US) on day 4 demonstrated the main vessel type of the blood flow via through the iliac and femoral arteries, the stent-graft was visualized, a voluminous heterogeneous mass of 6.4 cm x 6.3 cm in size, of medium to increased echogenicity with an

anechoic zone of 2.7 cm x 2.9 cm was visualized intimately adjacent to the artery; the examination in the CDU mode demonstrated no blood flow in the mass.

The postoperative course was uneventful. The patient was discharged home in satisfactory condition.

Discussion

The patient underwent the removal of a non-functioning kidney graft (the anastomosis of the graft artery with the left external iliac artery). Meantime, the section of the graft artery was retained. Turbulent low-velocity blood flow existed in the vessel stump for a long time. According to Bernoulli's principles of fluid dynamics, the lower is the speed of the fluid, the greater is the pressure on the vessel wall, and vice versa, the higher is the speed of the fluid, the lower is the pressure on the vessel wall. Over time (12 years), there was a gradual degradation of the artery wall. Possible causes can also be infection and the vascular stump rejection [8–10].

Thus, after transplantectomy, in the artery stump, there was an increased pressure on the artery wall with a gradual degradation of its layers, which ultimately resulted in the rupture of the stump, the PA formation, and the need for the endovascular diagnosis and intervention.

Aneurysms after kidney transplantation can occur as:

1. PA at the site of vascular anastomosis [8, 9, 11, 14-28].
2. True aneurysms of the renal graft artery [29].
3. PA, dissections in the iliac artery after surgery [30–32].
4. PA of the iliac artery or renal artery stump after transplantectomy [8-13].
5. PA and arteriovenous fistulas in the renal parenchyma after biopsy [33–35].

PAs are usually detected by ultrasound in the CDU mode; CT angiography is a confirmation test for treatment planning [33]. Conservative treatment is possible only in cases of small PAs without a tendency to increase in size and without infection [33, 34]. Surgical or endovascular treatment is necessary to prevent/repair the rupture and save the graft.

There are various options for surgical and endovascular treatments in PA. The choice of the treatment option depends on the anatomical features of the artery in the transplanted kidney graft and the PA, the patient's condition, and the presence of infection. Meantime, endovascular techniques have significant advantages, as they are less invasive and associated with fewer complications. However, all reports of endovascular treatment are either single cases or small case series.

Minimally invasive treatment options:

1. PA embolization [19, 23, 33–35].

The embolization with microcoils of various types is possible both for PA of anastomoses [19, 23, 33], and superselective embolization for PA that have occurred after biopsy [34, 35].

2. Embolization in combination with a stent-graft implantation [11].

3. PA embolization in combination with a simultaneous dilatation, stenting of revealed stenosis of the graft artery [23, 28].

Thus, G. Fananapazir et al. [23] performed the coil embolization for PA in patient P., and then implanted 2 drug-eluting coronary stents in the renal artery branches.

Certain technical difficulties can arise with PA having a wide neck. In such cases, the following two methods are used to solve the problem.

4. Stent-assisted embolization [17, 18, 21, 29].

5. The use of the safety balloon catheter for embolization [26], which blocks the aneurysm neck and prevents the coils from displacing at the time of endovascular surgery.

6. Implantation of a stent, stent-graft [8-15, 20, 23, 27, 30-33] in PAs of anastomoses, and in PAs after nephrectomy.

R. Vijayvergiya et al. [30] restored the blood flow in the iliac artery and the graft artery by stenting the iliac artery during its iatrogenic dissection. R.K. Peel et al. [32] implanted a stent-graft in case of inflammatory non-specific PA of the iliac artery after kidney transplantation.

U.M. Bracale et al. [8, 9] reviewed the treatment of 11 patients. PAs of the anastomosis of the graft renal arteries and the iliac arteries developed in 5 (group 1), and PA of the iliac arteries after removal of the transplanted kidney occurred in 6 (group 2). The PA after transplant nephrectomy was an extension of the donor renal artery stump. Endovascular treatment was used in 3 patients (1 pts in group 1; 2 pts in group 2); 8 patients underwent open surgery. The stenting was performed via an ipsilateral femoral incision under local anesthesia; the stent-grafts of 8–10 mm in diameter and of 50 mm or 60 mm in length were used. Blood flow in the limb was salvaged in 100% of cases. None of the patients developed late infection, a failed vascular repair, or PA recurrence.

M.R. Smeds et al. [14] reported a case of endovascular treatment for PA with 2 "kissing" stent-grafts with a complete exclusion of PA and restoration of an excellent blood flow in the transplanted kidney and the lower limb.

Y. Tshomba et al. [27] presented a case of endovascular repair of a 9.5 cm pseudoaneurysm originating from the anastomosis between the graft renal artery and the external iliac artery after 10 months following

simultaneous pancreas-kidney transplantation. The pseudoaneurysm exclusion by using a covered stent graft preserved the normal perfusion and the function of both transplanted organs.

B.C. McIntosh et al. [10] successfully implanted a stent-graft for PA after transplant nephrectomy.

7. Stent-graft implantation and the thrombin injection into the PA cavity [16, 28].

J.A. Poels et al. [16] described the use of thrombin and a stent-graft for the treatment of PA while preserving the renal function; and C. Kubal et al. [28] in the treatment for PA of 6 cm in diameter, injected thrombin into the cavity and implanted a stent-graft, performed the dilatation of the intraorgan branches using balloon catheters of 3 mm in diameter, and achieved a rapid improvement in renal function.

8. Injection of thrombin into the aneurysm cavity [22, 25, 33].

Under ultrasound guidance, a percutaneous puncture of the PA is performed and thrombin is injected, which results in PA getting trombosed and excluded from the blood flow.

If the desired effect has not been achieved by a single intervention, it is possible to perform a repeated endovascular operation [17]: in the treatment for PA of the renal graft artery, a stent was initially implanted from the orifice of the graft artery into the middle third of the external iliac artery, and PA embolization was performed through a microcatheter (8 microcoils were placed). The control ultrasound examination showed that the effect achieved by embolization appeared incomplete. After the additional embolization coils had been inserted at the second stage, the complete hemostasis in the aneurysm sac was noted at control ultrasonography examination; a small area of 0.3 cm x 0.3 cm with blood flow in the PA neck still remained.

The treatment of patients with mycotic aneurysms is of particular difficulty [11, 12, 15]. G. Zavos et al. [15] placed stent-grafts in 3 patients with PA at anastomoses. Two of these aneurysms were caused by fungal infection. An 8-week antifungal therapy was successful in preventing the risk of developing infection of the stent-graft material: no signs of stenosis or infection were observed during follow-up from 2 months to 3 years.

P. Leonardou et al. [11] presented the largest case series that included 5 patients with mycotic PA and a treatment combination of antibiotic therapy, reconstructive surgery, and endovascular interventions

Endovascular operations were performed for PA of anastomoses in 3 cases, for PA after transplantectomy in 2 cases. Stent grafts were implanted to 4 patients, one patient underwent embolization and a stent graft placement, and after the PA recurrence, a second stent-graft was implanted; later, in addition, transplantectomy and reconstruction of the iliac arteries were required. In another case of PA after transplant nephrectomy, the implantation of 3 stent-grafts did not solve the problem due to their subsequent infection, and therefore, the surgery was performed to remove the mycotic PA and stents, and to perform the bypass grafting.

D.D. Zhao et al. [12] reported 2 cases in whom the prevention of fungal infection with fluconazole after kidney transplantation resulted in bleeding development. One patient underwent nephrectomy, but the bleeding recurred, and a stent-graft was placed at the site of the anastomosis with the iliac artery, after that no bleeding recurred. In the second case, due to massive bleeding after transplantation, the transplant nephrectomy and the exclusion of PA from the blood flow by using a stent-graft were required.

Conclusion

Retaining a long stump of the donor kidney artery after the transplant nephrectomy can lead to the pseudoaneurysm formation and its rupture. The use of a stent-graft makes it possible to exclude the pseudoaneurysm from the blood flow, while retaining the main blood flow, an adequate blood supply to the lower limb, and to avoid open reconstructive surgery. As you can see, there are various options for a successful use of endovascular treatment methods for pseudoaneurysms formed after kidney transplantation or transplant nephrectomy.

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