VASCULAR COMPLICATIONS AFTER KIDNEY TRANSPLANTATION.

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ABSTRACT
Vascular complications remain the major surgical concern after kidney transplantation. They particularly include renal artery thrombosis, transplant renal artery stenosis, renal vein thrombosis, transplant renal artery kinking and arterial injury. Although being uncommon, they may lead to serious consequences including renal transplant dysfunction and allograft loss. Precise diagnosis and treatment of such conditions are crucial for graft and patient survival. Therapeutic options include both surgical and interventional radiologic methods. The risk of vascular complications in renal transplant recipient can be minimized with careful transplantation technique. Understanding of etiological factors of may lead to their elimination in the future, resulting in better outcomes of kidney transplantation procedures.
kidney transplantation has become the gold standard of treatment for end-stage renal disease, improving quality of life and prolonging life itself. However, surgical complications still represent an important cause of graft dysfunction [1]. Despite of advances in surgical technique, vascular complications are still the major barrier after kidney transplantation [2]. Incidence of vascular complications after kidney transplantation, according to the retrospective studies, accounts for 2.1 - 2.7% [2, 3, 4] (Table 1). Vascular complications can be divided in the following categories:

1. renal artery thrombosis and stenosis,
2. renal vein thrombosis,
3. transplant renal artery kinking,
4. arterial injury.

Understanding the etiology of vascular complications formation may lead to their elimination in the future, resulting in better outcomes of kidney transplantation procedures.

RENAL ARTERY THROMBOSIS (RAT)

The incidence of RAT is accounted for 0.9 - 3.5% [3]. Renal artery thrombosis may occur as either early or late incident after kidney transplantation. Early renal artery thrombosis leads frequently to graft loss. This complication is mostly caused by technical problem such as intimal dissection, kinking or torsion of the vessels. Risk factors include poor cardiac output, hyperacute rejection, unresponsive acute rejection and a hypercoagulable state [3, 5]. The clinical symptom of RAT is a rapid onset of oliguria. Late renal artery thrombosis occurs usually due to graft rejection. It can be also attributed to renal artery stricture, or its manipulation postoperatively. Diagnosis of RAT is established by color flow Doppler imaging or during the explorative surgery [5]. The surgical treatment of RAT includes thrombectomy and ultimately a possible graft nephrectomy.

TRANSPLANT RENAL ARTERY STENOSIS (TRAS)

Transplant renal artery stenosis is the most common vascular complication after kidney transplantation. TRAS affects 3-23% of renal transplant recipients, depending on diagnostic criteria adopted by transplant centers [6, 7]. TRAS usually occurs during the first 12 months after kidney transplantation [7]. The predisposing factors for TRAS include [3, 8-13]:

- transplantation from deceased donor,
- end-to-end anastomosis,
- inadequate suturing technique,
- surgical clamp injury,
- long or kinking artery,
- intimal dissection,
- prolonged cold ischaemia time,
- atherosclerosis of the donor or the recipient arteries,
- renal artery trauma,
- acute cellular rejection,
- vascular-type rejection,
- cytomegalovirus infection,
- cyclosporine toxicity.

The symptoms of TRAS in the immediate post-transplant period include oliguria or anuria and dialysis dependency [10, 11, 14]. TRAS may cause severe renovascular hypertension. If TRAS is not treated properly in due time, it could lead to renal transplant dysfunction [5]. Non-invasive imaging allows to evaluate for transplant renal artery stenosis. Treatment options for TRAS include both surgical and interventional radiologic options [3]. The first one is percutaneous transluminal angioplasty (PTA), with or without stent placement. PTA success rate in case of TRAS treatment is 60-94%. Surgical treatment of TRAS is reserved for anastomotic stenosis or severe distal artery stenosis that are unreachable by PTA [3]. Surgical success rate is 63-92% [15]. Re-stenosis occurred in 12% of the patients [6].

RENEAL VEIN THROMBOSIS (RVT)

Renal vein thrombosis is one of the most serious vascular complications, most often leading to the graft loss [16-20]. The incidence of RVT is accounted for 0.5% to 6% [16, 21-24]. It occurs within the first 2 weeks after kidney transplantation, with 80% occurrence in the first month [11] and 93% within the first year [3, 11, 25, 26].

Etiology of renal vein thrombosis is multifactorial and remains unexplained in most cases [16]. The risk factors of RVT include [16, 18, 19, 24, 27, 28]:

- right kidney transplantation,
- surgical transplant placement in left iliac fossa,
- long ischemic time,
- acute tubular necrosis,
- hemodynamic status during transplantation,
- diabetes mellitus,
- peritoneal dialysis,
- uremic coagulopathy,
- systemic lupus erythematosus connected with end-stage renal disease,
- cold hemagglutinins,
- factor Leiden 506Q mutation,
- antiphospholipid and anticardiolipin antibodies,
- male sex,
- young or old age of donor.

Clinical symptoms of RVT include oliguria, hematuria with a tender swollen graft, which if ruptured, is accompanied by life-threatening bleeding and rising serum creatinine [25]. The immediate treatment is necessary in case of RVT. Thrombectomy procedure is recommended early, within 1 hour following the thrombosis incident [5]. Several authors describe endoluminal therapy for renal graft thrombosis. However, the accurate role of interventional radiologic treatment is not yet well-established [26, 29].

TRANSPLANT RENAL ARTERY KINKING

Arterial kinking is usually caused by long renal graft artery, especially in case of right kidney transplantation. Arterial kinking is one of the main issues caused by improper positioning or torsion. Differential diagnosis
between TRAS and arterial kinking is often difficult, however it is necessary to graft detorsion. CT and MR imaging are recommended to reveal changes in renal graft orientation and vascular pedicle kinking. The primary treatment for arterial kinking remains surgery [5].

**ARTERIAL INJURY**

Arterial injury includes arteriovenous fistula, pseudoaneurysm, arterial dissection and arteriocalyceal fistulae [3]. Arteriovenous fistula (AVF) is the most common biopsy-induced vascular injury [32]. The frequency of arteriovenous fistula accounts for 1-18% of renal allograft biopsies [30,31]. AVF may be formed when both arterial and venous walls are punched by the biopsy needle. AVF is usually asymptomatic, rarely may cause hematuria, hypertension and deterioration of renal function [5]. Up to 70% of AVF resolve spontaneously within 2 years [3].

Pseudoaneurysm occurs when the artery is lacerated. It may result from percutaneous kidney biopsy (intrarenal pseudoaneurysm), surgical injury in arterial anastomosis or local perivascular infection (extrarenal pseudoaneurysm) [32]. The prevalence of extrarenal arterial pseudoaneurysm is less than 1%. Extrarenal pseudoaneurysm is usually asymptomatic and rarely can cause renal dysfunction [33]. There is a strong recommendation to surgical remove of the extrarenal pseudoaneurysm, when it becomes large because of high rupture risk [5].

**CONCLUSIONS**

Vascular complications after renal transplantation are uncommon but important because they may result in renal function deterioration or in loss of the allograft. Vascular complications in renal transplant recipient can be minimized with careful transplantation technique. Precise diagnosis and treatment of vascular complications are crucial for graft and patient survival.

**CITE THIS AS**


**ABBREVIATIONS**

AVF – Arteriovenous fistula  
PTA – Percutaneous transluminal angioplasty  
RAS – Renal artery stenosis  
RAT – Renal artery thrombosis  
RVT – Renal vein thrombosis  
RAK – Renal artery kinking  
TRAS – Transplant renal artery stenosis

**REFERENCES**


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Tab. 1. Most common vascular complications after kidney transplantation [2, 3, 4]

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<th>RAS (%)</th>
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<td>Atkas n=1843</td>
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<td>2 (0.1%)</td>
<td>7 (0.3%)</td>
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<td>Soy n=2594</td>
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