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SHORT REPORT

A Tubular Vena Cava Conduit Used to Lengthen a Kidney Transplant Renal Artery Injured During Organ Procurement

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Introduction: Organ transplantation is limited by the supply of transplantable organs, and the supply of organs cannot meet the needs of patients on the waiting list. Ensuring transplantation of any procured organ is therefore mandatory. Organ injury, mostly to the organ's vasculature, can occur during multi-organ procurement, preventing subsequent transplantation. In such a context, vascular reconstructions of arterial or venous organ injuries can be useful.

Report: This report describes the case of an obese 64 year old female with a history of diabetic nephropathy who underwent a cadaveric kidney transplant (right kidney with one main renal artery, one inferior polar artery, one vein, and one ureter). The *ex situ* preparation of the graft revealed that the main renal artery was injured and cut close to the renal hilum (0.8 cm length, 6 mm diameter), not allowing graft implantation. In order to increase the length of the main renal artery, the donor inferior vena cava was used to create a tubular conduit, allowing subsequent graft implantation. Cold and warm ischaemic times were respectively 12 hours and 36 minutes, with immediate graft function. The patient was discharged on day 8 (serum creatinine level was 95 µmol/L). Twelve month follow up was uneventful (serum creatinine level was 108 µmol/L and duplex ultrasonography showed homogeneous blood flow throughout the graft).

Discussion: This case report highlights the possibility of overcoming an injured kidney graft artery by creating a tubular vena cava conduit in order to allow subsequent transplantation. Vascular reconstructions of organs injured during procurement should be considered.

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INTRODUCTION

Organ transplantation is a life saving intervention for patients with organ failure. However, the supply of organs cannot meet the needs of patients on the waiting list, resulting in prolonged morbidity and higher mortality rates.[1] Accordingly, organ transplantation is nowadays less limited by the ability to maintain viability of allografts after the transplantation than by the supply of transplantable organs.[1,2]

It is therefore mandatory that any potentially transplantable organ should be procured in an optimal and safe manner, in order to ensure subsequent transplantation. Few data exist in the literature regarding organ injury during procurement, but loss of potentially transplantable organs due to intra-operative procurement injury does occur, and most of the related damage involves the organ's vasculature.[3,4] In order to allow further transplantation, arterial or venous organ repair is then mandatory.[5,6]

Kidney transplantation is performed in an open fashion, where the kidney is placed heterotopically in the pelvis, anastomosing the renal vein and artery to the recipient external iliac vessels and the ureter to the recipient bladder. The aortic patch is preserved for the anastomosis to the external iliac artery, including polar arteries if there are any. When the right kidney from a deceased donor is used, the renal vein is usually extended using the vena cava.[6]

A case where the length of the graft main renal artery was lengthened using a tubular vena cava patch allowing subsequent graft implantation is reported.

CASE REPORT

The case of a 64 year old female with a history of diabetic nephropathy who started haemodialysis three years previously is reported. Her body mass index was 36.9 kg/m^2. She underwent bilateral greater saphenous vein stripping 10 years previously.

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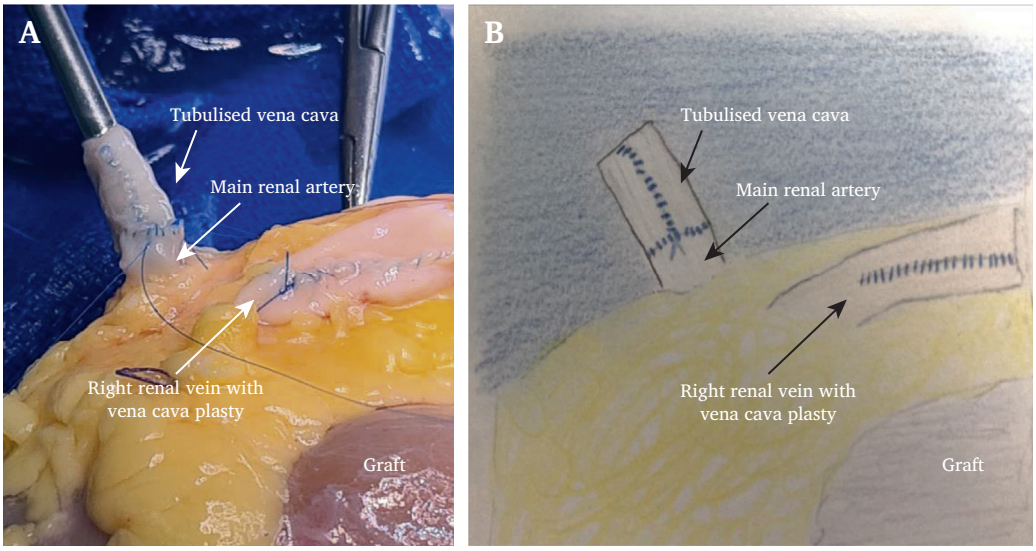

Figure 1. (A,B) *Ex vivo* graft preparation on back table. Elongation of the renal vein was performed using a vena cava plasty. The remaining part of the donor inferior vena cava was used for the main renal artery elongation: part of the donor inferior vena cava (2 cm × 4 cm) was tubulised and sutured with a 7.0 polypropylene monofilament in order to obtain a 4 cm long and 6 mm diameter conduit. This newly created conduit was sutured end to end to the main renal artery using a 7.0 polypropylene monofilament running suture.

A right kidney graft from a deceased donor presenting with one main renal artery, one inferior polar artery, one vein, and one ureter was harvested. *Ex vivo* examination of the graft showed one main renal artery (6 mm diameter), one inferior polar artery (2 mm diameter), one vein, and one ureter. However, vascular injuries occurred during multi-organ procurement: the graft renal arteries were cut close to the renal hilum rather than including a segment of the donor aorta. The remaining length of the main renal artery was 0.8 cm, not allowing implantation. The remaining length of the inferior polar artery was six cm. During *ex vivo* graft preparation on a back table, since a wide part of the donor inferior vena cava was available, an elongation of the renal vein was performed. The remaining part of the donor inferior vena cava was used for elongation of the main renal artery. Part of the donor inferior vena cava (2 cm × 4 cm) was tubulised and sutured with a 7.0 polypropylene monofilament to obtain a 4 cm long and 6 mm diameter conduit. This newly created conduit was sutured end to end to the main renal artery using a 7.0 polypropylene monofilament running suture (Fig. 1).

Graft implantation was then performed by implanting the renal vein onto the left iliac vein first, the extended main renal artery was sewn end to side to the recipient external iliac artery, and the inferior polar artery was spatulated and sewn end to side to the recipient external iliac artery separately (Fig. 2). Uretero-vesical anastomosis completed the procedure. Cold and warm ischaemic time were respectively 12 hours and 36 minutes.

The kidney graft displayed immediate graft function, the serum creatinine level declined rapidly (401 µmol/L before transplantation, 346 µmol/L at day 1, 312 µmol/L at day 2,

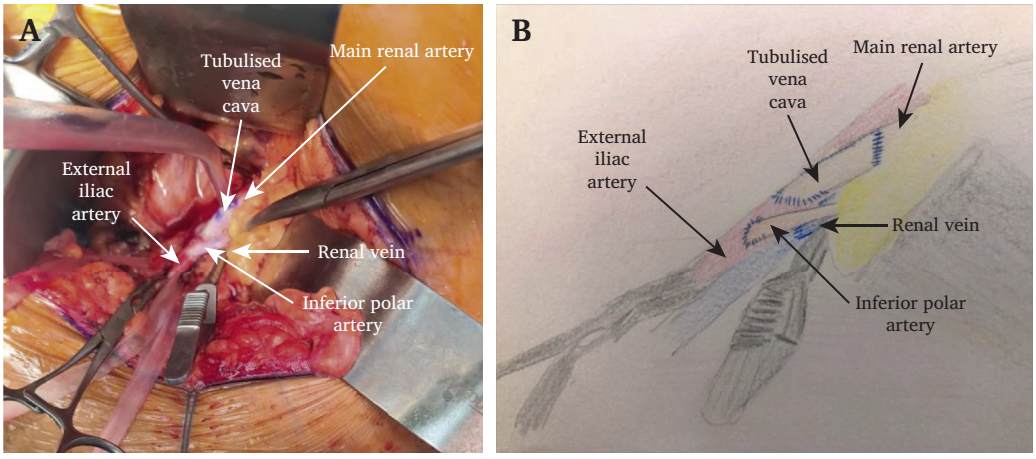

Figure 2. (A,B) Intra-operative view after graft implantation. Graft implantation was performed by implanting the renal vein on the left iliac vein, the extended main renal artery was sewn end to side to the recipient external iliac artery, and the inferior polar artery was spatulated and sewn end to side to the recipient external iliac artery separately.

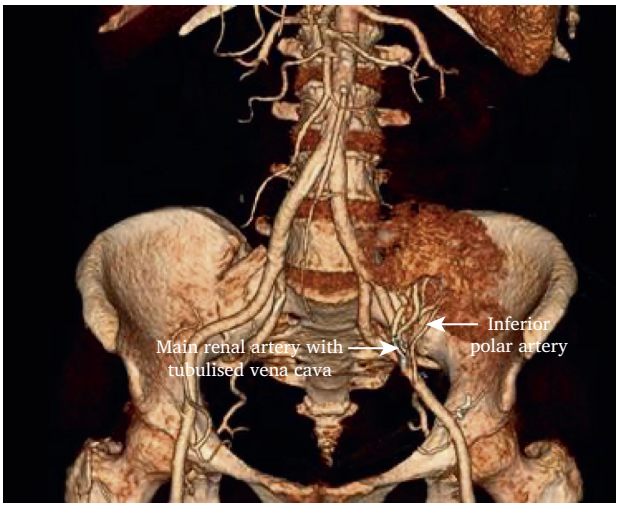

Figure 3. Computed tomography angiography reconstruction.

224 µmol/L at day 3, and 94 µmol/L at day 5) and urine output was around 2 L/day. Duplex ultrasonography demonstrated good contrast resolution between the cortex and medulla, with normal homogeneous blood flow throughout the graft, as well as normal renal vein and renal artery waveforms on spectral Doppler ultrasound. The resistive index was normal (0.84). Computed tomography angiography was performed on post-operative day 2 due to a suspicion of haematoma. No haematoma was found, but the vascular reconstructions could be checked (Fig. 3). The patient was discharged on day 8. She was ambulatory, had no wound complication, and the serum creatinine level was 95 µmol/L. Twelve month follow up was uneventful (serum creatinine level was 108 µmol/L, duplex ultrasonography showed homogeneous blood flow throughout the graft, as well as normal renal vein and artery waveforms, with normal resistive index).

DISCUSSION

A vascular reconstruction for a short renal artery using a tubular substitute made of a vena cava patch is reported. It is thought that using a vena cava patch to repair the kidney graft artery has not been described before.

Other substitutes have been proposed to repair kidney graft arteries, such as recipient saphenous veins, synthetic grafts,[7] or even the gonadal vein.[8] The recipient had previously undergone bilateral great saphenous stripping, so using a saphenous vein interposition graft to repair the graft artery was not an option. Synthetic grafts, although commonly used in vascular surgery, present inherent challenges such as susceptibility to infection and thrombotic events, especially in obese patients, which could significantly jeopardise the success of the transplant. Considering these potential complications in the present case, an alternative option seemed appropriate. The graft and the recipient's gonadal veins were explored, but none were suitable for arterial reconstruction since both diameters were less than 2 mm. The internal iliac artery of the recipient was also explored, but was heavily calcified and was not suitable as conduit.

Another option would have been to use a cryopreserved arterial allograft, since this substitute has been described for open repair of kidney transplant renal artery stenosis.[9] This substitute would have been the substitute of choice, since it does not allow exposure to infection risk and cryopreservation moderates thrombogenicity.[10] However, no cryopreserved arterial allograft was available at the time of the procedure and would have had to be ordered from a biobank with a delivery delay of 24 hours. Accordingly, it was decided to use a tubular substitute made of the graft vena cava. This technique allowed effective repair of the renal artery and subsequent kidney transplantation, ensuring optimal blood flow, and minimising the risk of complications associated with other substitutes.

In conclusion, creating a tubular conduit from the donor vena cava to lengthen the graft artery, when injured during multi-organ procurement, could be an option allowing graft implantation. Vascular reconstructions of injured organs should be considered asit can salvage them and allow transplantation.

FUNDING

None.

CONFLICT OF INTEREST

None.

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