REVISTA
MEXICANA DE
ANGIOLOGÍA

PERMANYER

Check for updates

ORIGINAL ARTICLE

Use of polytetrafluoroethylene graft in vascular reconstruction of living donor kidney transplant in a reference center

Uso de injerto de politetrafluoroetileno en la reconstrucción vascular del trasplante renal de donante vivo en un centro de referencia

Lorena Noriega-Salas, Arlette Robledo-Melendez, Germán Bernaldez Gómez, Rolff R. Pohlenz-Aviles, Angélica Pérez-Padilla, and José Cruz-Santiago

Transplant Unit, Hospital de Especialidades, Centro Médico Nacional La Aaza, IMSS, Mexico City, Mexico

Abstract

Background: *Kidney transplant is the best replacement therapy for kidney function in renal disease; the surgical technique is currently standardized; however, unexpected situations may happen during the surgical event that may require modification to it. Right nephrectomies from living donors are technically challenging due to a shorter and thinner vein than the contralateral kidney, with a higher incidence of thrombosis in the recipient.* **Objective:** *We analyzed the implementation of the use of polytetrafluoroethylene (PTFE) graft in selected cases for venous reconstruction in kidney transplant in our center.* **Method:** *An analysis was carried out from January 2018 to March 2023, with the number of living donor kidney transplants (LDKTs) and the laterality of the nephrectomy, as well as the number of patients who required reconstruction with a PTFE graft.* **Results:** *From 2018 to 2023, a total of 389 LDKTs were reported, with 12% of right kidney nephrectomies (n = 46). The number of recipients who required venous reconstruction with PTFE was 3 (6.5% of the living donor right nephrectomies).* **Conclusion:** *The use of synthetic vascular grafts is feasible, with an accurate and meticulous surgical technique, combined with the use of prophylactic antiplatelet aggregation, monitoring of the recipient's renal function.*

Keywords: *Kidney transplantation. Living donor kidney transplant. Vascular surgery. Vascular grafts.*

Resumen

Antecedentes: *El trasplante renal es la mejor terapia sustitutiva de la función renal en enfermedad renal crónica. La técnica quirúrgica está estandarizada, sin embargo pueden ocurrir situaciones inesperadas durante el evento quirúrgico que requieran su modificación. Las nefrectomías derechas de donador vivo son técnicamente desafiantes, debido a una vena más corta y delgada que el riñón contralateral, con mayor incidencia de trombosis en el receptor.* **Objetivo:** *Analizamos la implementación del uso del injerto de politetrafluoroetileno (PTFE) en casos seleccionados para la reconstrucción venosa en el trasplante renal en nuestro centro.* **Método:** *Se realizó un análisis de enero de 2018 a marzo de 2023, con el número de trasplantes renales de donador vivo y la lateralidad de la nefrectomía, así como el número de pacientes que requirieron reconstrucción con injerto de PTFE.* **Resultados:** *En el periodo 2018-2023 se reportaron 389 trasplantes renales de donador*

***Correspondence:**
Lorena Noriega-Salas
E-mail: noriega_lorena@hotmail.com

Date of reception: 22-07-2024
Date of acceptance: 11-10-2024
DOI: 10.24875/RMA.24000049

Available online: 15-11-2024
Rev Mex Angiol. 2024;52(4):132-136
www.RMAngiologia.com

vivo, con un 12% de nefrectomías de riñón derecho (n = 46). El número de receptores que requirieron reconstrucción venosa con PTFE fue 3 (6.5% de las nefrectomías derechas de donante vivo). **Conclusión:** *El uso de injertos vasculares sintéticos es factible, con una técnica quirúrgica precisa y minuciosa, además del uso de antiagregación plaquetaria profiláctica, monitoreo de la función renal del receptor.*

Palabras clave: *Trasplante renal. Trasplante renal de donante vivo. Cirugía vascular. Injertos vasculares.*

Introduction

Kidney transplantation is the best replacement therapy for kidney function due to a better quality of life and survival of patients with end-stage kidney disease. The surgical technique is standardized; however, it may require some modification in case of anatomical or structural variations occurs in the donor and/or the recipient[1].

Vascular complications in kidney transplantation have a changeable frequency depending on the center, with a range from 2 to 15%; these can be immediate or late and present as stenosis, thrombosis, arteriovenous fistulas, mycotic aneurysm, etc., which can cause graft dysfunction and, in severe cases, loss of the transplanted kidney[2].

In kidney transplantation from a living donor, laterality in the selection of the kidney is made based on the specific protocols of the transplant center. The criteria may include performing a kidney computed tomography scan, for the evaluation of the kidney anatomy, and the detection of any anomaly, to keep the best kidney in the donor. In right kidney nephrectomy, the difficulty lies in obtaining the renal vein that has a shorter length; this can cause a complex anastomosis in the recipient. Vascular grafts, whether biological or synthetic, are a tool to consider, providing a safe and effective option to restore blood flow in selected cases[3].

Therefore, due to situations related to the anatomy of the selected renal graft, such as the length of the vein, its thickness, and the presence of technical situations, such as rupture of the renal vein, or the presence of an insufficient length to perform the anastomosis, we analyzed 3 cases of living donor kidney transplant (LDKT) recipients, who required the use of a synthetic vascular graft for the establishment of venous drainage.

Method

An analysis was carried out from January 2018 to March 2023 regarding the total number of LDKTs and the laterality of the nephrectomy in the living donor, as well as the number of patients who required reconstruction with a PTFE graft; this graft was placed in bench surgery, with continuous surging with 6-0 prolene, then an end-lateral anastomosis to the external iliac vein was performed. The donor warm ischemia time was defined as the time from clamping of the aorta or renal artery to cold perfusion. The PTFE-graft patency was inferred due to its proper renal functioning by determining the glomerular filtration rate and the biannual or annual Doppler ultrasound which is carried out in a protocolary manner in the transplant center.

Clinical and surgical records were obtained from the electronic records of the medical unit. We completed the Equator Network Checklist for the case series.

Case presentation

From 2018 to 2023, a total of 389 living donor transplants were reported, 12% were kidneys from right nephrectomy (n = 46). The number of recipients who required venous reconstruction with PTFE was 3 (6.5% of all right nephrectomies) (Table 1).

Clinical case 1

A 26-year-old female patient presented with a history of chronic kidney disease (CKD) of undetermined etiology and peritoneal dialysis (PD) with loss of the peritoneal cavity, subsequently renal function replacement therapy with hemodialysis (HD) for 8 years, with exhaustion of vascular access and was received LDKT from her mother. With a standard immunological risk, she was received basiliximab as induction therapy.

The kidney transplant committee decided to take the right kidney from the donor; during its extraction, an injury to the ureter at its junction with the renal pelvis happened; in 40% of its circumference, it was sutured during bench surgery. One artery and one vein were obtained, with an insufficient length for anastomosis in the external iliac vein; an autologous saphenous graft was taken from the recipient, anastomosis was performed to the renal vein and subsequently to the external iliac vein, arterial anastomosis is completed, with

Table 1. Related variables to kidney transplant recipients with PTFE graft

Variables	Case 1	Case 2	Case 3
Recipient variables			
Sex	Female	Male	Male
Age	26	32	28
BMI	18	35	28
Donor variables			
Sex	Female	Male	Female
Age	48	28	26
Nephrectomy	Laparoscopic	Laparoscopic	Laparoscopic
Transplant surgery			
Multiple arteries	Yes	Yes	No
Cold ischemia time	3 h 50 min	1 h 10 min	2 h 50 min
Warm ischemia time	3 min 30 s	2 min 30 s	4 min 52 s
Clinical evolution of the recipients			
Surgical complications	Urinary fistulae. Ureteral reimplantation	No	No
Postrasplant follow up	12 months	18 months	48 months
Kidney graft survival	Yes	Yes	Yes
Postrasplant anticoagulation	LMWH during hospital staying Rivaroxaban 1 month ambulatory	LMWH during hospital staying ASA 1 month ambulatory	LMWH during hospital staying Rivaroxaban 1 month ambulatory
DGF	Yes	No	No

DGF: delayed graft function; PTFE: polytetrafluoroethylene; ASA: acetylsalicylic acid; LMWH: low molecular weight heparin; Warm ischemia time is defined in: Method; BMI: body mass index.

venous thrombosis immediately upon reperfusion of the graft. The graft was extracted, the preservation solution is infused again, and in a second bench surgery, a PTFE graft is placed in the renal vein; again, anastomosis to the external iliac vein and artery was performed, with adequate reperfusion of the graft upon unclamping, extravesical ureteral reimplantation with double J placement. Extubating was performed in the next 24 h in the intensive care unit (ICU), presenting delayed graft function, requiring HD session once; during her hospital stay, Doppler ultrasound was performed with adequate vascular permeability, and low molecular weight heparin was used during her hospitalization; she was discharged after 10 days.

During follow-up, the patient presented urinary tract stenosis upon removal of the double J, managed with nephrostomy (6-week post-transplant), and at 6 months, a successful ureteral reimplantation was performed.

Clinical case 2

A 32-year-old male patient CKD of unknown etiology, on replacement therapy with HD for 2 years via tunneled dialysis catheter, he has a body mass index of 35. Standard immunological risk received basiliximab as induction therapy. He was received LDKT from his brother; the transplant committee decided to take his right kidney for donation.

Due to technical difficulties during the procurement of the kidney in the living donor surgery, we obtained short segments of graft vessels, with three arteries with diameters of 7 mm, 2 mm, and 1 mm respectively and a renal vein with extrarenal tract 0.5 cm long. A projection of the graft is performed on the recipient, observing the insufficiency in the length of the renal vein. In bench surgery, a 10 mm diameter PTFE graft was placed; the arterial anastomosis was performed from the main artery to the external iliac artery (one anastomosis) and the PTFE graft to the external iliac vein (Fig. 1). Adequate reperfusion of the kidney was observed, as well as immediate uresis. Extravesical reimplantation and use of double J were performed.

During his hospital stay, Doppler ultrasound was performed with adequate vascular permeability, and low molecular weight heparin was used during his hospitalization; he was discharged home after 6 days without complications.

Clinical case 3

A 28-year-old male patient presented with CKD secondary to unspecified chronic glomerulopathy, 5 years from the initial replacement therapy with PD, with loss

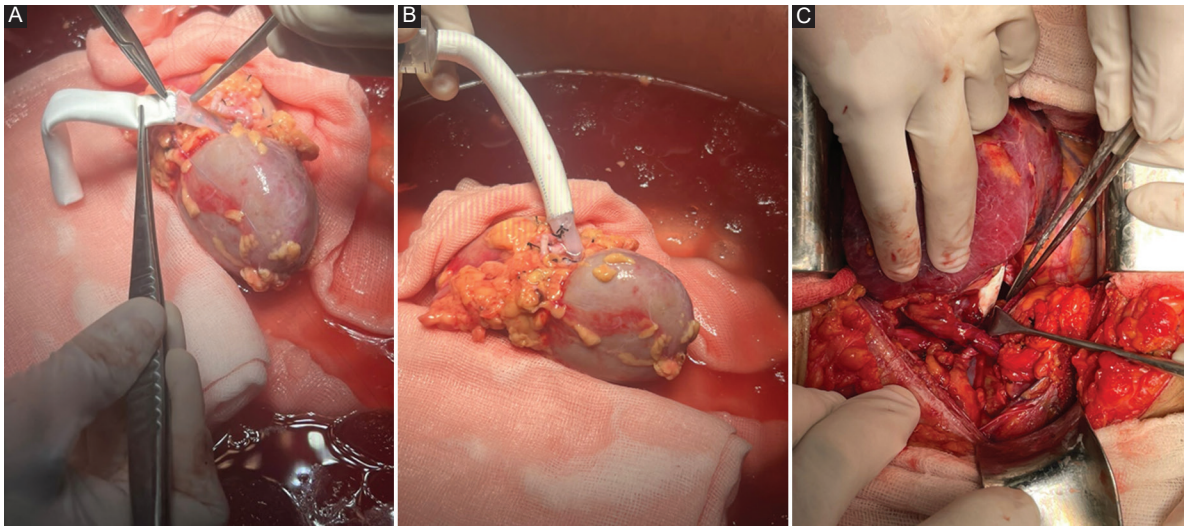

Figure 1. A: anastomosis of the renal vein to polytetrafluoroethylene (PTFE) graft during bench surgery, **B:** PTFE graft placed, **C:** anastomosis of the PTFE graft to the external iliac vein.

of the cavity due to peritonitis, having subsequent replacement therapy with HD with a tunneled catheter. He presented donor-specific antibodies, with high immunological risk; therefore, he was received thymoglobulin as induction therapy at a dose of 1.5 mg/kg for 3 days. The transplant committee decided to take a right kidney from the living donor, his sister.

A right kidney was obtained with two arteries and one vein, the latter with a thin and friable wall. Anastomosis of the main renal artery and renal vein, to the external iliac artery and vein, was performed, with rupture of the vein upon reperfusion of the graft; the iliac vessels were clamped again, and the venous anastomosis was performed again, with its rupture for the 2nd time after unclamping.

The graft was removed, preservation solution is infused again, and during a second bench surgery, a 10 mm diameter PTFE graft is placed into the renal vein. Anastomosis of the renal artery was performed again, and of the PTFE to the iliac vessels, with adequate reperfusion of the renal graft, anastomosis of the second artery was also performed.

During the intraoperative period, a blood loss of 4200 cc was obtained, requiring transfusion of 9 red blood cells and 5 fresh frozen plasmas; extubating is achieved in the next 24 h in the ICU, with slow graft function.

In the next 24 h, Doppler ultrasound of the kidney transplant was reported with vascular permeability, low-molecular-weight heparin was administered during hospitalization, and the patient was discharged home 7-day post-transplant without complications.

Discussion

LDKT should be planned according to safety guidelines for both donor and recipient. The selection of the kidney for donation will depend on the criteria of the transplant committees, considering the variables of the donor and the recipient. In this series, all the cases presented are the product of right donor nephrectomies; when selecting the right kidney, difficulty may happen due to the renal vein, with a retro-aortic trajectory, is shorter and thinner than the contralateral vein; therefore, anastomosis in the recipient may result in increased risk of thrombosis or rupture of the anastomosis; even more so in a scenario of obesity, poor quality of the iliac vessels, second transplant in the recipient, and multiple vessels in the donor[4].

Laparoscopic surgery has been accepted since 1995, when Ratner et al. reported their first experience with its multiple advantages such as shorter hospital stays, shorter recovery time, and better aesthetic results[5]. In cases of right nephrectomy, the length of the vein can be seriously affected using a vascular stapler. In the 3 cases presented, non-absorbable polymer clips (hem- o -lok®) were applied, which are routinely used in our center. In extraordinary cases with the presence of intraoperative bleeding, the presence of multiple vessels, or some other technical difficulty, during nephrectomy, it can result in obtaining vessels that are shorter than required[6-9].

In countries where kidney donation is predominantly from living donors, access to biological vascular grafts from deceased donors can be complex; the use of

synthetic grafts may be a feasible option. PTFE grafts are useful in vascular surgery, providing a safe and effective option to restore blood flow. The surgical technique must be planned to have the necessary vascular material, with grafts of different diameters and lengths, vascular sutures of different calibers, in addition to performing a dissection of the recipient vessels of the vascular graft sufficient, to have a greater probability of success[10,11].

In one case, there was delayed graft function, defined as the requirement for HD in the 1st-week post-transplant, and in another slow function, defined as a < 30% reduction in creatinine between day 1 and 2 post-transplant. According to the UNOS report in an analysis carried out by Khalil et al., right grafts have a greater risk of developing delayed graft function and rejection, associated with a longer intraoperative time, and a delay in the initiation of calcineurin inhibitors[1,4,12].

The indications for antiplatelet agents in transplantation may include history of thromboembolism, vascular reconstruction, or atheromatous disease. Its use has been shown to be safe, adjusting to the kidney function of the recipient, with a low incidence of hemorrhagic events. The indication of low doses of rivaroxaban or acetylsalicylic acid can prevent thrombosis of the arterial beds of the graft[13-16].

Conclusion

Technical and anatomical variations in living donor kidney transplantation should be considered as potential emergent events during transplant surgery. The use of kidneys from right nephrectomy should alert the search for other risk factors to plan transplant surgery. The use of synthetic vascular grafts is feasible, with an accurate and meticulous surgical technique; combined with the use of prophylactic antiplatelet aggregation, with monitoring of the recipient's renal function.

Funding

This research has not received any specific grant from agencies in the public, commercial, or for-profit sectors.

Conflicts of interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred in the article.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

References

1. Musquera Felip M, Peri Cusí L, Alcaraz Asensio A. Surgical aspects of living-donor kidney transplantation. Nefrologia. 2010;30:71-9.
2. Reyna-Sepúlveda F, Ponce-Escobedo A, Guevara-Charles A, Escobedo-Villarreal M, Pérez-Rodríguez E, Muñoz-Maldonado G, et al. Outcomes and surgical complications in kidney transplantation. Int J Organ Transplant Med. 2017;8:78-84.
3. Noriega-Salas L, Cruz-Santiago J, Bernaldez-Gomez G. Right nephrectomy vs left nephrectomy in living donor transplantation, analysis of evolution and prognosis. Report from a tertiary care hospital. Rev Mex Urol. 2022;82:1-9.
4. Khalil A, Mujtaba MA, Taber TE, Yaqub MS, Goggins W, Powelson J, et al. Trends and outcomes in right vs. left living donor nephrectomy: an analysis of the OPTN/UNOS database of donor and recipient outcomes--should we be doing more right-sided nephrectomies? Clin Transplant. 2016;30:145-53.
5. Ratner LE, Ciseck LJ, Moore RG, Cigarroa FG, Kaufman HS, Kavoussi LR. Laparoscopic live donor nephrectomy. Transplantation. 1995;60(9):1047–1049.
6. Giron-Luque F, Baez-Suarez Y, Garcia-Lopez A, Patino-Jaramillo N. Safety and intraoperative results in live kidney donors with vascular multiplicity after hand assisted laparoscopy living donor nephrectomy. Res Rep Urol. 2022;14:23-31.
7. Posselt AM, Mahanty H, Kang SM, Stoller ML, Meng MV, Roberts JP, et al. Laparoscopic right donor nephrectomy: a large single-center experience. Transplantation. 2004;78:1665-9.
8. Bollens R, Mikhaski D, Espinoza BP, Rosenblatt A, Hoang AD, Abramowicz D, et al. Laparoscopic live donor right nephrectomy: a new technique to maximize the length of the renal vein using a modified Endo GIA stapler. Eur Urol. 2007;51:1326-31.
9. Choi SW, Kim KS, Kim S, Choi YS, Bae WJ, Hong SH, et al. Hand-assisted and pure laparoscopic living donor nephrectomy: a matched-cohort comparison over 10 yr at a single institute. Clin Transplant. 2014;28:1287-93.
10. Kamel MH, Thomas AA, Mohan P, Hickey DP. Renal vessel reconstruction in kidney transplantation using a polytetrafluoroethylene (PTFE) vascular graft. Nephrol Dial Transpl. 2007;22:1030-2.
11. Chang WB, Shin YH, Park HS, Kim DH, Lee T. The use of polytetrafluoroethylene graft for damaged renal artery in ABO-incompatible living donor kidney transplantation: a case report. Korean J Transplant. 2022;36:67-72.
12. Chang WB. The use of polytetrafluoroethylene graft for damaged renal artery in ABO-incompatible living donor kidney transplantation: a case report. Korean J Transplant. 2022;36:67-72.
13. Wang CJ, Tuffaha A, Phadnis MA, Mahnken JD, Wetmore JB. Association of slow graft function with long-term outcomes in kidney transplant recipients. Ann Transplant. 2018;23:224-31.
14. Van den Berg TA, Lisman T, Dor FJ, Moers C, Minnee RC, Bakker SJ, et al. Antithrombotic management in adult kidney transplantation: a European survey study. Eur Surg Res. 2023;64:169-76.
15. Berkowitz SD, Bauersachs RM, Szarek M, Nehler MR, Debus ES, Patel MR, et al. Prevention of arterial and venous thrombotic events in symptomatic peripheral arterial disease patients after lower extremity revascularization in the VOYAGER PAD trial: dual anticoagulant/antiplatelet regimen vs antiplatelet therapy alone. J Thromb Haemost. 2022;20:1193-205.
16. Leon J, Sabbah L, Aubert O, Anglicheau D, Delavenne X, Zuber J, et al. Efficacy and safety of direct oral anticoagulants in kidney transplantation: a single-center pilot experience. Transplantation. 202;104:2625-31.