

OPEN

Vascular Complications in Renal Transplantation: Surgical Salvage of Renal Artery Dissection

Mackenzie Mayhew, BS,¹ Rachele Solomon, MPH,² Heather LaGuardia, MD,² Kathryn Shaw, MD,² Juan Arenas, MD, MBA, FACS,² Tjasa Hranjec, MD, MS-CR, FACS^{2,3}

Vascular complications in the setting of kidney transplantation occur in 3%–15% of patients.^{1–4} They include transplant renal artery stenosis, transplant renal artery or vein thrombosis, biopsy-induced vascular injuries, pseudoaneurysm formation, and hematomas.⁵ Transplant renal artery dissection (TRAD) is a rare and serious event that can lead to allograft loss or severe dysfunction without immediate diagnosis and appropriate intervention.⁶ In the case that TRAD results in ischemia to the lower pole, ureteral complications, namely urine leaks, should be anticipated.⁷ We report a case in which TRAD was discovered intraoperatively, shortly after reperfusion, requiring transplant nephrectomy, followed by renal artery resection and reimplantation of the allograft. Postoperatively, a urine leak, which developed in the setting of lower pole ischemia, was treated conservatively with excellent preservation of long-term kidney function.

CASE DESCRIPTION

A 65-y-old African American man with end-stage renal disease secondary to hypertension received a kidney transplant from a 59-y-old brain-dead donor following cocaine overdose. Total cold ischemia time was 22 h, and the kidney remained on a pump for 15 h. Back-table evaluation of the kidney, and specifically renal artery and vein, revealed no obvious evidence of injury (Figure 1).

Renal vein and artery anastomoses were performed in the usual end-to-side fashion with the external iliac vessels (warm ischemia time was 52 min) using 5-0 and 6-0 running prolene, respectively. Following reperfusion, kidney appeared ischemic even after multiple maneuvers including warming of the allograft, repositioning of retractor blades, and injection of intra-arterial verapamil. Intraoperative ultrasound initially showed a patent renal artery and vein although minimal to no intraparenchymal flow (Figure 2). Within 15 min, transplant renal artery started to appear discolored (cyanotic) with development of a palpable cord-like structure. Intraoperative ultrasound confirmed formation of an intramural thrombus (Figure 3A and B).

In an attempt to rescue the allograft, kidney was explanted, flushed with histidine-tryptophan-ketoglutarate solution and placed on ice for 78 min while the transplant vessels were examined and reconstructed. A small intimal flap 1.5 cm beyond the renal artery ostium (Figure 4A and B) led to a false lumen with thrombus propagating into one of the side branches and deep into the renal parenchyma of the lower pole. The renal artery was shortened beyond the intimal tear with most of the clot extracted from the false lumen, while the renal vein was shortened. The kidney was then reimplanted,

Received 11 February 2022. Revision received 31 March 2022.

Accepted 15 April 2022.

¹ Florida International University Herbert Wertheim College of Medicine, Miami, FL.

² Division of Transplantation, Memorial Regional Hospital, Hollywood, FL.

³ Division of Trauma/Acute Care/Critical Care Surgery, Memorial Regional Hospital, Hollywood, FL.

M.M. participated in writing and revising the article. R.S. participated in revising and critically reviewing the article. H.L., K.S., and J.A. participated in the clinical care of the patient and in writing the article. T.H. participated in the clinical care of the patient, writing, and revising the article.

The authors declare no funding or conflicts of interest.

Correspondence: Mackenzie Mayhew, BS, Florida International University Herbert Wertheim College of Medicine, 11200 SW 8th St, Miami, FL 33199. (mmayh003@fiu.edu).

Copyright © 2022 The Author(s). *Transplantation Direct*. Published by Wolters Kluwer Health, Inc. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

ISSN: 2373-8731

Transplantation Direct 2022;8: e1340; doi: 10.1097/TXD.0000000000001340.



FIGURE 1. Transplant renal artery with no obvious external injury.

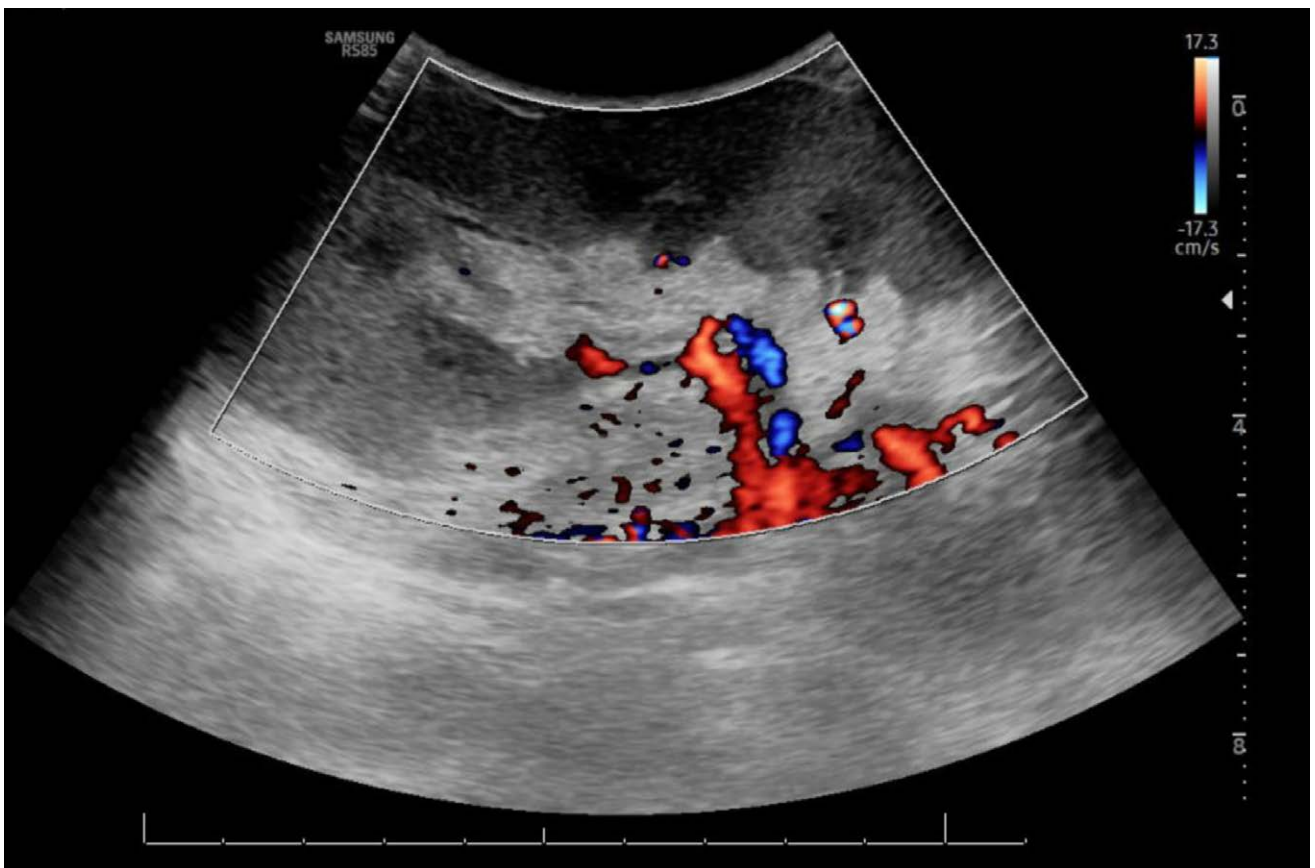


FIGURE 2. Initial intraoperative ultrasound evaluation of the transplant kidney showing patent vessels but poor perfusion of renal parenchyma.

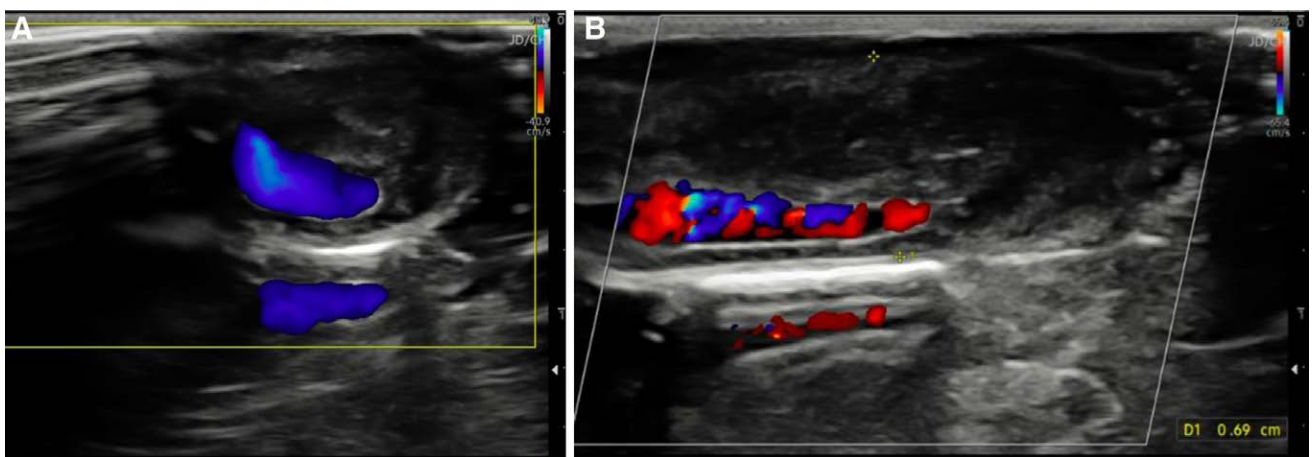


FIGURE 3. Intraoperative ultrasound confirming the formation of intramural thrombus with continued decreased bloodflow (cross section [A] and longitudinal [B]).

and arterial reconstruction was performed using a parachuting technique for the back wall continuing anteriorly to the front wall using 6-0 prolene (second warm ischemia time was 40 min). Ureteroneocystostomy was constructed over a ureteral stent using standard Lich-Gregoir technique. Patient was placed on a heparin drip in an attempt to dissolve any intraparenchymal thrombus that may have formed during the low-flow state. Ultrasound revealed immediate improvement in renal perfusion (Figure 5), although there was a small area at the lower pole that remained ischemic (Figure 6A and B)

as a result of a thrombosed arterial lower pole side branch. Initial postoperative course was complicated by delayed graft function. Ureteral stent was removed on postoperative day 14, whereas surgically placed drain was removed on postoperative day 6 with minimal output. Patient was discharged after 20 d with slowly downtrending creatinine at 6.6 mg/dL and urine output of >2 L/d. Ultrasound on discharge showed a persistent area of parenchymal ischemia (Figure 7).

One month following the transplant and 15 d following ureteral stent removal, the patient presented with hypertension,

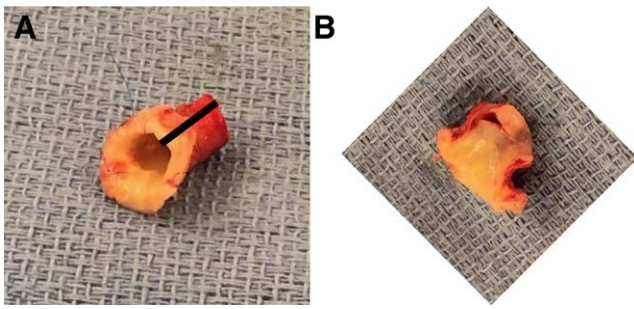


FIGURE 4. Removed segment of the transplant renal artery following reconstruction. A, Transplant renal artery transected along the black line. B, Transplant renal artery showing intimal flap 1.5 cm beyond the renal artery ostium.

seemingly decreased urine output, and ever-increasing urine leakage from his abdominal incision. Ultrasound confirmed that the previously known small area of parenchymal ischemia had now resulted in complete necrosis leading to a urine leak. Foley catheter was placed initially for distal urinary decompression followed by interventional radiology-guided percutaneous nephrostomy and nephroureteral stent to divert urine drainage (Figure 8). Perinephric fluid collection (urine), which was compressing the kidney, was treated using computed tomography-guided catheter placement (Figure 9). Three months after the initial transplant, interventional radiology confirmed resolution of the urine leak, upon which all catheters were removed sequentially. The patient continues to have a decline in his creatinine, currently at 2.2 mg/dL, with excellent kidney function.

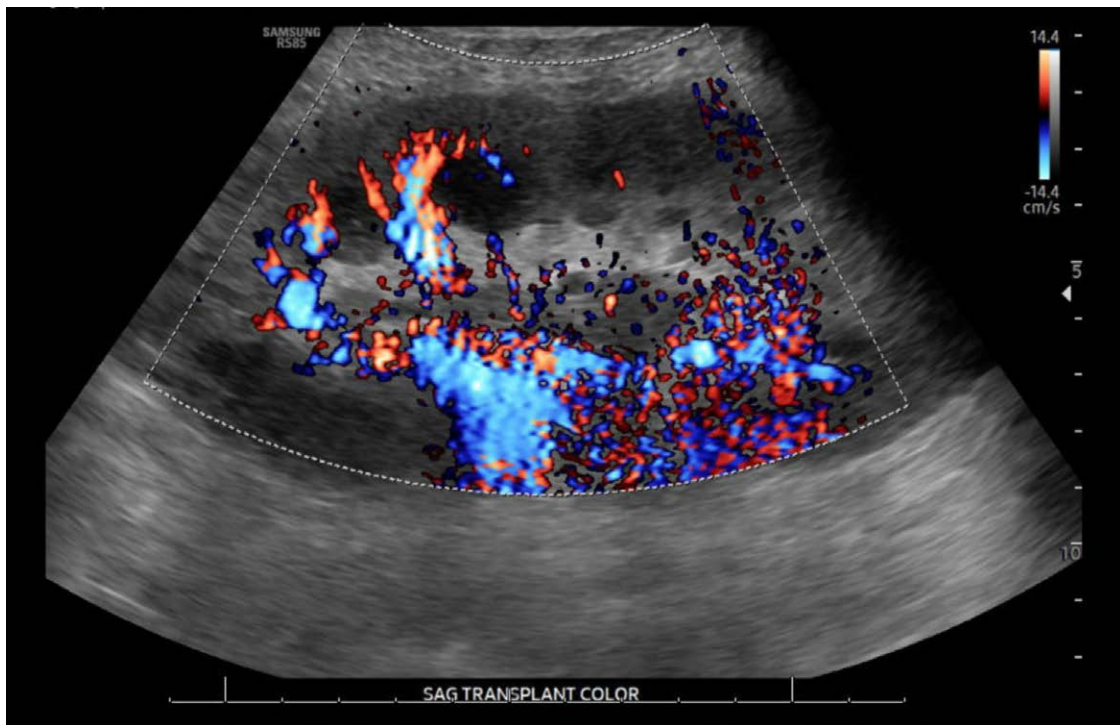


FIGURE 5. Ultrasound demonstrating improved renal parenchyma perfusion following resection of renal artery to exclude intimal dissection.

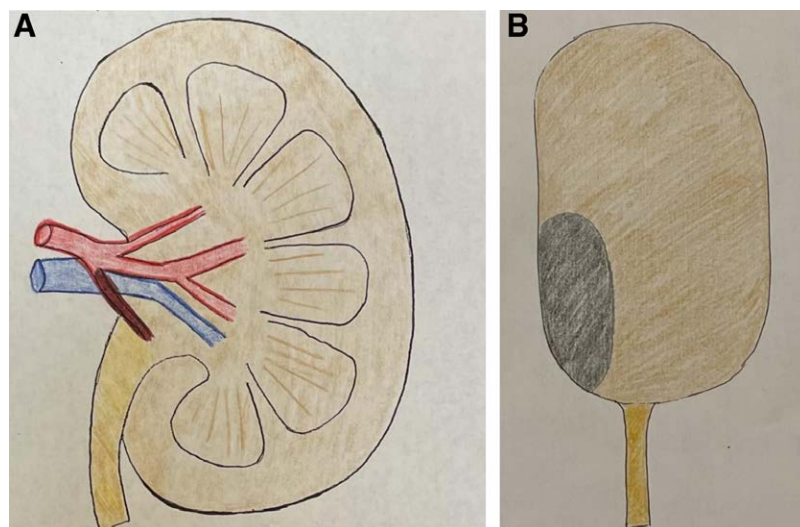


FIGURE 6. Illustrations of the allograft kidney depicting persistent lower pole ischemia due to thrombosed arterial branch. Cross section of the kidney demonstrating thrombosed arterial branch (A) and area of ischemia in the lower pole (B).

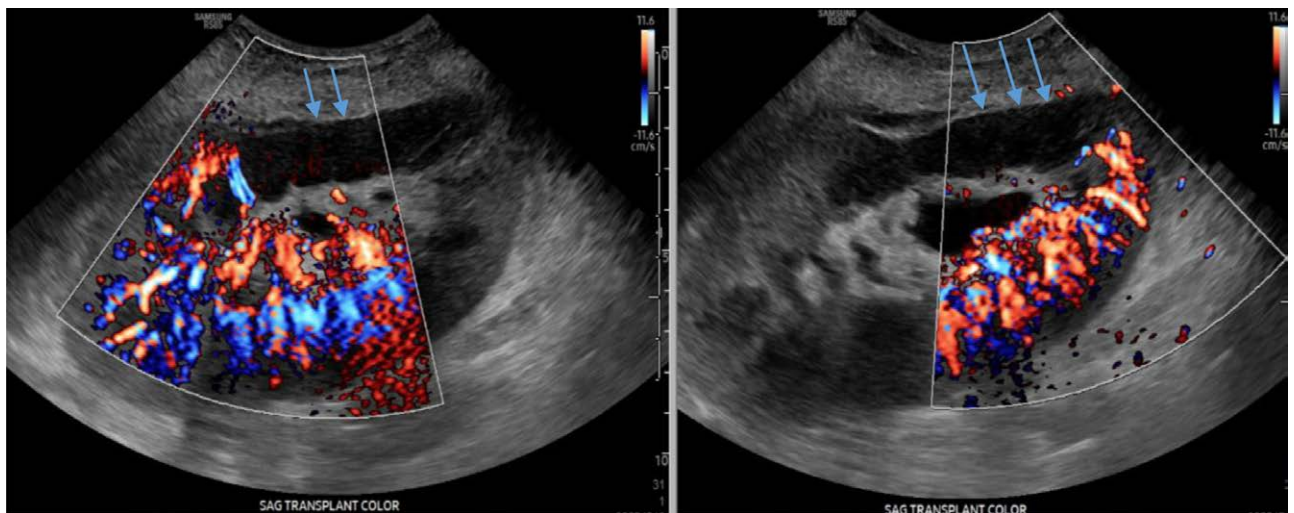


FIGURE 7. Ultrasound at the time of discharge from initial hospitalization showing improved perfusion but persistent absence of perfusion in the anterior mid to lower pole (arrows).



FIGURE 8. Interventional radiology–guided percutaneous nephrostomy and nephroureteral stent placement showing urine leak at the lower pole of the kidney.

Ethics Statement

This article was exempt from an ethics review board and did not require institutional review board approval with written consent given the manuscript type.

DISCUSSION

We report a unique case of renal artery dissection in the setting of kidney transplantation that required immediate surgical revision to rescue the allograft. The case was complicated by delayed graft function, persistent ischemia to the lower pole of the kidney, and urine leak, all of which were treated nonoperatively. This case demonstrated that in the setting of lower pole ischemia, even partial, ureteral complications, especially urine leak, need to be anticipated.

Renal artery dissection is an uncommon but potentially devastating vascular complication of kidney transplantation as ischemia quickly ensues. Donor factors like cocaine use or poor surgical technique including excessive traction of the vessels during procurement or transplantation, clamp injury, and cannulation during perfusion can lead to vessel injury.^{6,8-11}

Dissection may present intraoperatively, as in our case, or postoperatively as renal artery stenosis, in which case treatment typically requires stent placement.^{6,9,10} Intraoperative diagnosis of dissection can be made by visualizing discoloration of the renal artery wall as intramural thrombus propagates or via poorly perfused parenchyma of the kidney.^{10,12} Intraoperative ultrasound can aid in the diagnosis.¹² Intraoperative cases of dissection are typically managed with urgent renal artery repair.^{6,9,10,12} Although it is rare, should renal artery dissection be suspected, only prompt diagnosis followed by appropriate management can salvage the allograft.

Urologic complications, including ureteral necrosis, stricture, obstruction, and leak, occur at a rate of 2%–14%.^{13,14} Various techniques for urinary tract reconstruction exist, though the most common is ureteroneocystostomy with extravesical compared with intravesical techniques having fewer complications.¹⁴ More specifically, the Lich-Gregoir technique, which was used in our case, has been found to significantly decrease the incidence of urine leaks when compared with the Leadbetter-Politano and Taguchi techniques.¹⁵ Literature has also shown that prophylactic stenting reduces the risk of urologic complications, although it is uncertain if there is a difference in complications between early (<15 d) and late (>15 d) removal of stent.^{16,17} Our patient presented with a delayed urine leak 15 d after stent removal. Urine leak typically manifests within the early posttransplantation period as excess drainage of fluid from the incision or surgical drain, reduced urinary output, perinephric fluid collection, lower abdominal fullness, tenderness, or graft dysfunction.^{6,18} The most common cause of urine leak in the setting of renal artery dissection is decreased blood supply to the donor ureter.^{6,19} In our patient, the injury to the golden triangle, bordered by the lower pole of the kidney, junction between renal vein and vena cava,



FIGURE 9. Computed tomography of the abdomen and pelvis demonstrating suspected urine leak.

and gonadal vein, led to the necrosis of the parenchyma.^{6,20} Nonoperative treatment including placement of nephrostomy, nephroureteral stents, and percutaneous drains to eliminate kidney compression and allow for urine drainage resulted in good allograft outcomes.^{6,21} Although the allograft was successfully salvaged, this case reinforces the need for careful handling of allografts during procurement and transplantation and anticipation of ureteral complications in the setting of lower pole ischemia.

REFERENCES

1. Kobayashi K, Gensullo ML, Rossman LL, et al. Interventional radiologic management of renal transplant dysfunction: indications, limitations, and technical considerations. *Radiographics*. 2007;27:1109–1130.
2. Reyna-Sepúlveda F, Ponce-Escobedo A, Guevara-Charles A, et al. Outcomes and surgical complications in kidney transplantation. *Int J Organ Transplant Med*. 2017;8:78–84.
3. Di Carlo HN, Darras FS. Urologic considerations and complications in kidney transplant recipients. *Adv Chronic Kidney Dis*. 2015;22:306–311.
4. Fervenza FC, Lafayette RA, Alfrey EJ, et al. Renal artery stenosis in kidney transplants. *Am J Kidney Dis*. 1998;31:142–148.
5. Dimitroulis D, Bokos J, Zavos G, et al. Vascular complications in renal transplantation: a single-center experience in 1367 renal transplantations and review of the literature. *Transplant Proc*. 2009;41:1609–1614.
6. Peregrin JH, Lacha J, Adamec M. Successful handling by stent implantation of postoperative renal graft artery stenosis and dissection. *Nephrol Dial Transplant*. 1999;14:1004–1006.
7. Buttigieg J, Agius-Anastasi A, Sharma A, et al. Early urological complications after kidney transplantation: an overview. *World J Transplant*. 2018;8:142–149.
8. Edmondson DA, Towne JB, Foley DW, et al. Cocaine-induced renal artery dissection and thrombosis leading to renal infarction. *WMJ*. 2004;103:66–69.
9. Verove C, Bridoux F, Abou-Ayache R, et al. Fibromuscular dysplasia of the allograft renal artery with early post-operative dissection: successful treatment with intravascular stent insertion. *Nephrol Dial Transplant*. 1999;14:1571–1573.
10. Hori S, Yoneda T, Tomizawa M, et al. Unexpected presentation and surgical salvage of transplant renal artery dissection caused by vascular clamping: a case report. *BMC Nephrol*. 2020;21:29.
11. Renders L, Goerig M, Schreiber M, et al. Successful surgical revascularization of a kidney transplant after PTA-induced arterial dissection of the allograft renal artery. *Nephrol Dial Transplant*. 1997;12:1264–1266.
12. Sharma R, Stokes A, Jain A. Right renal artery reconstruction with dacron graft following arterial dissection post reperfusion in a living donor renal transplant and successful reimplantation. *Tren Transplant*. 2020;13:1–2.
13. Choate HR, Mihalko LA, Choate BT. Urologic complications in renal transplants. *Transl Androl Urol*. 2019;8:141–147.
14. Saidi RF, Elias N, Hertl M, et al. Urinary reconstruction after kidney transplantation: pyeloureterostomy or ureteroneocystostomy. *J Surg Res*. 2013;181:156–159.
15. Alberts VP, Idu MM, Legemate DA, et al. Ureterovesical anastomotic techniques for kidney transplantation: a systematic review and meta-analysis. *Transpl Int*. 2014;27:593–605.
16. Wilson CH, Rix DA, Manas DM. Routine intraoperative ureteric stenting for kidney transplant recipients. *Cochrane Database Syst Rev*. 2013;6:CD004925.
17. Thompson ER, Hosgood SA, Nicholson ML, et al. Early versus late ureteric stent removal after kidney transplantation. *Cochrane Database Syst Rev*. 2018;1:CD011455.
18. Gunawansa N, Sharma A, Halawa A. Post-transplant urinary leak; the perennial “Achilles heel” in renal transplant surgery. *Tren Transpl*. 2018;11:1–4.
19. Eufrásio P, Parada B, Moreira P, et al. Surgical complications in 2000 renal transplants. *Transplant Proc*. 2011;43:142–144.
20. Streeter EH, Little DM, Cranston DW, et al. The urological complications of renal transplantation: a series of 1535 patients. *BJU Int*. 2002;90:627–634.
21. Elsayed S. Early urological complications post kidney transplant. *Urol Nephrol Open Access J*. 2020;8:1–4.