



Early Post transplant vascular complications after renal transplantation: A single centre experience

Dr. Shruti Mehta¹, Dr. Kajal Patel², Dr. Pranjal Modi³, Dr. Harsh Sutariya⁴, Dr. Vaidehi Pandya⁵

^{1,2,4} Associate Professor, Department of Radiology & Imaging, G. R. Doshi and K. M. Mehta Institute of Kidney Diseases and Research Centre (IKDRC) Dr. H.L. Trivedi Institute of Transplantation Sciences (ITS), Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat, India

³ Professor and Head of department, Department of Urology and Transplantation G. R. Doshi and K. M. Mehta Institute of Kidney Diseases and Research Centre (IKDRC) Dr. H.L. Trivedi Institute of Transplantation Sciences (ITS), Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat, India

⁵ Assistant Professor, Department of Radiology and Imaging, G. R. Doshi and K. M. Mehta Institute of Kidney Diseases and Research Centre (IKDRC), Dr. H.L. Trivedi Institute of Transplantation Sciences (ITS), Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat, India

Abstract

Introduction: Vascular complications following renal transplantation are important cause of graft dysfunction and loss in early post-transplant period and have significant negative influence on graft survival.

Aim: To determine the incidence of vascular complications that occurred within 6 months post transplantation period, its clinical presentation and outcome in our centre and to discuss on relative role of each imaging techniques in detection of vascular complications.

Material and Method: This is a retrospective study of a cohort of 2667 consecutive renal transplant over a period of 8 years in Institute of Kidney Diseases and Research centre from 1st January 2010 to 30th December 2017. All patients underwent colour and duplex Doppler ultrasound examination on the 1st postoperative day, in conditions of decreased or absent urine output, altered serum creatinine or other biochemical parameters. Further radiological investigations were performed as and when necessary.

Results: Out Of 2667; 2190 transplants were living donor renal transplantation and 477 were deceased donor transplantation. During 6 months post-transplant period; vascular complications were found in 39 patients. (Incidence: 1.46 %); out of these; 30 were living and 9 were deceased donor transplantation. We found no significant statistical difference in incidence of vascular complication between live and deceased donor transplantation. We found renal artery stenosis was most common vascular complication and Rise in serum creatinine was most common presenting symptom. Out of 39; 21 grafts were salvaged by appropriate treatment. (51.28%)

Conclusion: Awareness of different radiological imaging appearance played a key role in diagnosis of vascular complications. Immediate diagnosis and early intervention of vascular complication could salvage the graft.

Keywords: vascular complication, renal transplantation, imaging

Introduction

Vascular complications following renal transplantation are infrequent but important cause of graft dysfunction and graft loss and have significant negative influence on graft survival. Imaging plays a major role in assessing renal transplant.

Aim

To determine the incidence of vascular complication that occurred within 6 months period post- transplantation, its clinical presentation and its outcome at our centre.

To discuss relative role of imaging techniques in detection of vascular complications with special emphasis on ultrasound, Doppler and Multislice CT scan.

Materials and Methods

This is a retrospective study of a cohort of 2667 consecutive renal transplant performed over a period of 8 years at Institute

of Kidney Diseases and Research centre from 1st Jan 2010 to 30th Dec 2017. The data was retrieved from a prospectively maintained computerised database and imaging reports. Permission from Academic council was taken to review the data.

Renal transplant vessels were anastomosed in end to side fashion to external iliac vessels of recipient in virtually all patients. In case of dual renal transplantation deceased aortic patch with both renal arteries was anastomosed to external iliac artery. Exclusion criteria included Post biopsy complications, other than end to side anastomosis with external iliac vessels, complications secondary to early acute rejection and patients who lost follow up during first 6 months.

All patients underwent colour and duplex Doppler ultrasound examination on the 1st postoperative day, then regularly according to internal schedule and always in condition of

decreased or absent urine output, altered serum creatinine or other biochemical parameters. Doppler study was carried out on Accuson 500 from Siemens or Cx50 machine from Philips. Multislice CT scan with CT angiography was performed on Somatom sensation 64 CT scan to confirm Doppler findings or for detailed evaluation in some cases.

All collected data entered into IBM SPSS V20. Qualitative data expressed as counts as well as in percentages. Chi-square and Fischer exact test was used to calculate p value. P value <0.05 shows statistical significance.

Results

Out Of 2667; 2190 transplants were live related renal transplantations and 477 were deceased donor transplantations. The age of patients ranged from 12 to 58 years (mean: 31years). Male to female ratio is 5:1

During first 6 months post transplant period vascular complication were found in 39 patients. (Incidence: 1.46 %); out of these 29 were live related transplantation, 1 was live related cross donor transplantation and 9 were deceased donor transplantation. Vascular complications were found in 7 paediatric recipients. We found no statistical significant difference in incidence of vascular complication between live and deceased donor transplantation. (Table 1). Table 2 shows the type of vascular complication and its incidence. Out of 30

living donor renal transplantations; 19 were donor's left kidney and 11 were donor's right kidney. We did not find statistical significant difference of any vascular complication between right and left donor nephrectomy (Table 3). Transplant renal artery stenosis was the most common vascular complication followed by renal vein thrombosis according to our observations. None of our patient had anastomotic leak.

Rise in serum creatinine was the most common symptom followed by anuria. Some of the patients presented with multiple symptoms. One of patients of iliac artery thrombosis presented with symptoms of peripheral arterial disease. Table 4 shows clinical features of patients presented with vascular complications.

Out of 39 patients, 19 patients lost graft (48.71 %) and mortality due to vascular complication was 8%. Immediate surgical exploration was done in all cases of renal artery thrombosis and in all cases of complete renal vein thrombosis but unfortunately all required nephrectomy. Successful open surgery was performed to salvage graft in 3 patients. Eight patients successfully treated by percutaneous transluminal angioplasty (PTA). Two had Post PTA stent thrombosis resulting in graft loss. Nine patients were treated conservatively with close follow up. Out of 39; 20 grafts were salvaged by appropriate treatment. (51.28%).

Table 1: Incidence of early vascular complications after live and deceased Donor renal transplantation.

	No. of transplant patients	No. of patients presented with vascular complication	Incidence of vascular complication
Total renal transplantation	2667	39	1.46 %
Living donor transplantation	2190	30	1.36%
Deceased donor transplantation	477	9	1.90%
		Liver vs. Deceased	P=0.52

Table 2: Type of vascular complication, its incidence and comparison between live and deceased related renal transplantation

	No. of vascular complications (n=45)	Incidence (%)	Total no. of living donor renal transplantation (n =2190)	Total no. of deceased donor renal transplant (n=477)	P value
Renal artery thrombosis	4	0.15	3	1	0.77 (NS)
Renal vein thrombosis	8	0.30	4	4	0.05 (NS)
Iliac artery thrombosis	2	0.07	2	0	0.79 (NS)
Iliac vein thrombosis	3	0.11	2	1	0.65 (NS)
Renal artery stenosis	17	0.63	14	3	0.77 (NS)
Extra parenchymal pseudoaneurysm	5	0.19	4	1	0.62 (NS)
Kinking of artery	3	0.11	2	1	0.65 (NS)
Torsion of graft after laproscopic transplantation	2	0.07	2	0	0.79 (NS)
Iliac artery dissection	1	0.03	1	0	0.40 (NS)
Total no.of complication			34	11	0.38 (NS)

*More than one vascular complication was found in 6 grafts

Table 3: Incidence of vascular complication (n=30) in relation to right or left living donor nephrectomy

	Donor left nephrectomy (n=19)	Donor right nephrectomy (n=11)	P value
Renal artery thrombosis	3	0	0.54(NS)
Renal vein thrombosis	3	1	0.81(NS)
Iliac artery thrombosis	2	0	0.82(NS)
Iliac vein thrombosis	2	0	0.82(NS)
Renal artery stenosis	7	7	0.14(NS)
Extra parenchymal pseudo aneurysm	3	1	0.81(NS)
Kinking of artery	0	2	0.18(NS)
Torsion of graft after laproscopic transplantation	2	0	0.81(NS)
Iliac artery dissection	1	0	0.70(NS)

Table 4: Clinical features of patients presented with vascular complication

	Symptoms	percentage
Asymptomatic	8	21%
Rise in creatinine	18	46.1%
Hypertension	2	5.2%
Pain at graft site	1	2.6%
Graft tenderness	8	21%
Anuria	9	23.7%
Decreased urine output	5	13.1%
Symptoms of peripheral arterial disease	1	2.6%
Hematuria	4	10.4%

*13 patients presented with more than one symptom

Discussion

As compared to dialysis, renal transplantation gives better long term survival rate and offers potential for complete rehabilitation in end-stage renal disease. The vascular complications following renal transplantation are infrequent, occur in approximately 1%–2%;^[1] but can cause sudden loss of renal allograft. If detected early, they are amenable to early treatment and graft sparing early surgery or intervention.

Major vascular complication following renal transplantation are : Renal artery thrombosis, Renal artery stenosis, Renal vein thrombosis, Pseudo aneurysm, Anastomotic leak- hemorrhage, Kinking of artery, Torsion of renal graft (seen in intraperitoneal placement of transplant only) and External iliac artery thrombosis or dissection. Selective angiography is the gold standard for diagnosis of these complications; however, it is invasive and may cause various complications. Hence it is not used as a screening tool, but reserved for either patients with inconclusive results on the non-invasive screening tests or patients with Transplant renal artery stenosis requiring treatment. Non invasive imaging like ultrasound, Doppler, scintigraphy, CT and MR angiography plays major role to evaluate them.

Risk factors for vascular complications are multiple renal arteries,^[2] atherosclerosis of the donor or recipient vessels, hypercoagulable state, faulty suture technique producing incomplete intimal re-approximation with secondary intraluminal fibrosis, postoperative hypotension, trauma to the donor artery during perfusion, wide disparity in vessel size, torsion of the graft during performance of the anastomosis, kinking of artery and angulations of the vein owing to improper location of the graft or to the anastomosis^[3]. In present study, multiple arterial anastomosis were found in 2 out of 39 patients and atherosclerosis found in 1 recipient.

Renal artery thrombosis (RAT)

It occurs in the early postoperative period and almost invariably leads to graft loss, the reported incidence ranges from 0.5% to 3.5%^[4]. It most commonly occurs as a consequence of technical problems at the arterial anastomosis. Renal allograft has no collateral arterial supply, so irreversible injury occurs. Patient generally presents with anuria.

On ultrasound, transplanted kidney appears enlarged and hypo echogenic with absence of any arterial or venous flow on color, spectral and power Doppler study. Renal artery thrombosis can be diagnosed by Doppler sonography with 100% sensitivity and specificity and hardly any other imaging study

is required for diagnosis^[5].

In our study, risk factors of RAT were present in 2 out of 4 patients; one patient had hypercoagulable status with thrombosis of both artery and vein and other had three renal artery – 2 of them were thrombosed. All grafts affected by RAT in our study required nephrectomy. Zilinska *et al.* reported 4 patients of RAT from 103 patients with incidence of 3.9%; one was salvaged by thrombectomy and subsequently stent placement^[6]. Jordhan *et al.* and Akcetin *et al.* reported loss of all grafts affected by RAT^[7,8].

Renal Artery Stenosis (RAS)

Its incidence varies depending on the definition and diagnostic techniques used, from 1% to 23%^[9]. It can occur as early as 2 days or as late as several years after the procedure. Anastomotic stenosis generally occurs as a result of surgical trauma along with postoperative fibrosis while diffuse and multiple stenosis occurs as a result of immunological injury. Clinical findings are - rise in serum creatinine and hypertension.

Doppler ultrasonography is the procedure of choice to evaluate graft perfusion before and after revascularization. On gray scale there is lack of normal post-transplant hypertrophy. On color Doppler stenotic segments appear as regions of focal color aliasing. On spectral Doppler study, peak systolic velocity in main renal artery >300 cm/sec and Ratio of PSV in transplanted main renal artery and external iliac artery greater than or equal to 1.8 are highly suggestive of significant stenosis. Indirect criteria are low resistive index < 0.56, Acceleration time > 0.07 sec, Acceleration index < 3 meter/sec and Intrarenal tardus-parvus waveform. (Figure 1) Results of Doppler strongly depends on the operator's individual experience and skill. PSV measurements require an angle parallel to the vessel, which is not always obtainable by Doppler ultrasound. Identification of the renal artery may be time-consuming and difficult in patients with multiple arteries. Contrast enhanced ultrasound does not require identification of the renal artery, nor is angle-dependent. It can be used to quantify total organ and regional nutrient blood flow to the kidney.^[10] But it is costly and not easily available. Multislice CT provides 3D of the vascular tract that may be superior to those of selective angiography. (Figure 2) CT angiography yields fewer false-positive results than ultrasound. It is less prone to artifacts due to postoperative clips than MR imaging in the diagnosis of renal artery stenosis.

In present study, we found 12 patients with significant (>60%) and 5 patients with non-significant renal artery stenosis (<60%) in early post-transplant period. Ten patients treated with PTA. Patency rate at 6 month follow-up in our study is 80%. In Avinash Patil study patency rate after endovascular therapy at 6 months follow-up was 95.8^[11].

We found renal artery stenosis is the most common vascular complication in early post-transplant period contradictory to Zilinska *et al.* which found RAT most common vascular complication^[6].

The term pseudo TRAS refers to thrombosis or stenosis of iliac artery or aorta proximal to transplant renal artery. We found 2 patients with iliac artery thrombosis (figure 3) one of them presented with symptoms of peripheral arterial disease. We found one case of iliac artery dissection (figure 4) as a

result of surgical trauma during laproscopic transplantation in badly atherosclerotic vessels; which was converted to open surgery and treated conservatively.

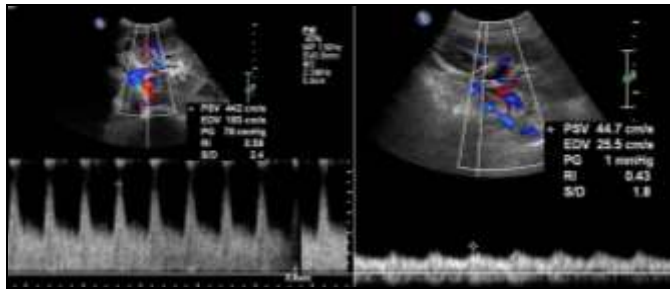


Fig 1: Ultrasound and Doppler image showing high peak velocity at anastomosis of renal artery (a) with intrarenal tardus parvus pattern (b) suggestive of significant renal artery stenosis in transplanted kidney.

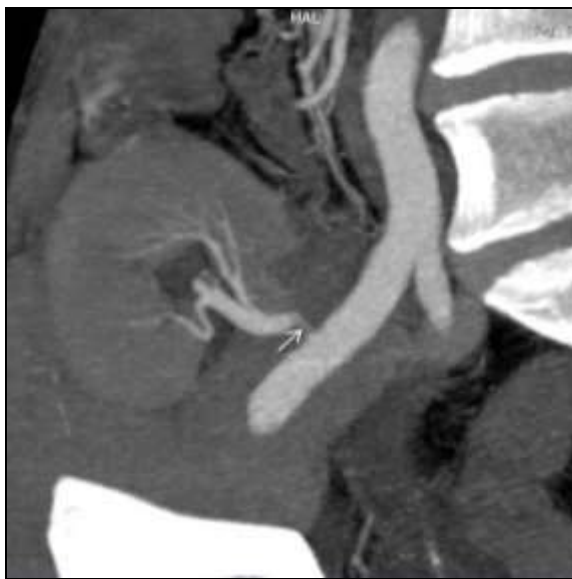


Fig 2: CT angiography- maximum intensity projection, coronal image showing 80% stenosis at anastomosis of graft renal artery to external iliac artery.

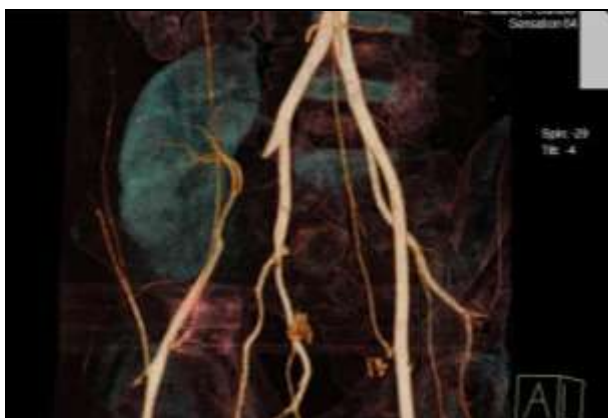


Fig 3: CT angiography volume rendered image showing absence of contrast filling of proximal part of external iliac artery suggestive of thrombosis.



Fig 4: CT angiography arterial phase image showing linear filling defect (arrow) in external iliac artery suggestive of iliac artery dissection.

Kinking of artery

Kinking of graft renal artery is more common in cases of right donor nephrectomy due to long right renal artery. We found 3 cases of kinking of renal artery- two were live related transplant with right donor nephrectomy and one was deceased donor transplantation. On Doppler study we found tardus parvus pattern intrarenally, but anastomotic renal artery was not traceable in whole length. CT angiography was performed in all three patients showed kinking of artery. All three cases underwent immediate surgical exploration, successful de-kinking of anastomotic renal artery was done and graft was survived.

Renal vein thrombosis: (RVT)

It usually occurs in the first week following the transplantation. Reported incidence varies between 0.9 to 4.5% [12]. Hypercoagulable status of recipient and donor's right kidney are major risk factor for RVT because of short and thin-walled right renal vein. Patients generally presents clinically as sudden onset of oliguria, haematuria, graft tenderness and swelling. In more severe cases, graft swelling can result into rupture of graft and exponential haemorrhage. On Ultrasound the graft appears swollen and hypo echoic. Doppler shows absent venous flow and renal arterial Doppler spectrum shows absent or reversal of diastolic flow. (Figure 5) Contrast enhanced CT may help in case of equivocal findings on Doppler study and precisely demonstrate extent of thrombosis. Immediate thrombectomy may salvage the graft. Endoluminal therapy for renal graft thrombosis has been described but its role is not well established [13]. In present study, we had 7 patients with complete renal vein thrombosis resulted in graft loss while one patient had partial renal vein thrombosis treated conservatively. 50% of our patients were live related transplantation among them only one has right donor nephrectomy. Two patients had thrombosis extending into external iliac vein. Graft tenderness was the most common presenting symptom in RVT in our study.

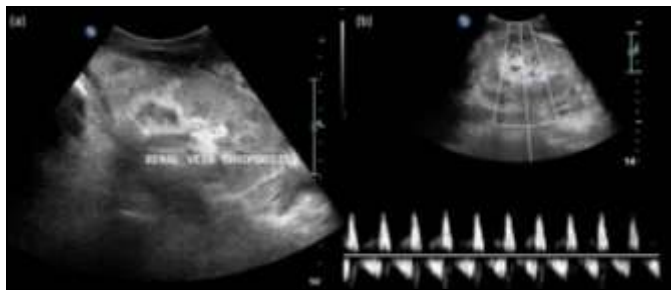


Fig 5: Grey scale ultrasound image (a) showing echogenic material filling the renal vein and Doppler image (b) showing reversal of diastolic flow in intrarenal arterial system suggest renal vein thrombosis.

Torsion of graft

Torsion of graft is an extremely rare complication, unique to intraperitoneal graft placement resulting from graft rotation around its vascular pedicle. It may lead to vascular occlusion and if not corrected leads to necrosis and graft loss.

Intraperitoneal torsion is suspected when there is change in axis of the kidney with abnormal perfusion. CT and MR images can show change in renal allograft orientation and vascular pedicle kinking. (Figure 6) We detected 2 patients with torsion of renal graft; one graft was salvaged by open surgery and fixation of graft to peritoneum and other graft was lost. In one meta-analysis done by Ania *et al.* [14] Total number of 16 cases of torsion were reported between 1954 to 2010. Out of those seven (44%) grafts were de-rotated and salvaged, three (19%) grafts were de-rotated but subsequently lost and six (38%) patients underwent immediate nephrectomy.

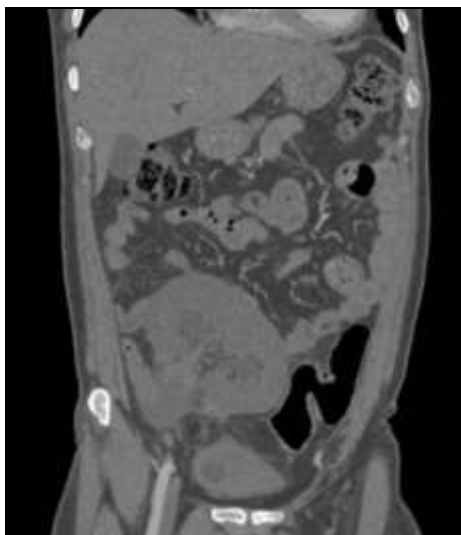


Fig 6: Contrast enhanced CT image after laparoscopic renal transplantation, showing change in axis of the kidney with absent perfusion suggestive of torsion of renal graft.

Extra parenchymal pseudo aneurysm

It is a rare vascular complication accounting for less than 1% of cases after renal transplantation [15]. It usually located at anastomosis site, commonly caused by poor surgical technique or perivascular infection. Clinically, these patients are usually asymptomatic and aneurysms are found incidentally on Doppler study. They may present with

systemic symptoms of sepsis or may cause symptoms due to their mass effect leading to graft dysfunction.

On gray scale ultrasound it appears as cystic lesion which shows color flow and to and fro spectral pattern on Doppler study. (figure7) Pseudo aneurysm of transplant renal artery is potentially life threatening as its sudden rupture can lead to massive haemorrhage. Therapeutic options for the management of pseudo aneurysm include conservative approach with close follow up, open surgical repair, endovascular treatment with covered stent placement to exclude aneurysm, and ultrasound-guided percutaneous injection of thrombin into the aneurysmal sac or graft nephrectomy. We found 5 patients with pseudo aneurysm at anastomosis with incidence of graft survival 20 %.



Fig 7: Ultrasound image (a) showing anechoic lesion at anastomosis of graft renal artery; CT angiography image (b) showing extra parenchymal pseudo aneurysm at anastomosis in graft kidney and wedge shaped hypo dense areas in cortex suggestive of cortical infarcts.

Conclusion

There is no statistical significant difference in vascular complication between live related and deceased donor transplantation. We found renal artery stenosis is the most common vascular complication in early post-transplant period. Awareness of different radiological imaging appearance played a key role in diagnosis of vascular complications. Immediate diagnosis and early intervention of vascular complication could salvage the graft.

References

1. Kocak T, Nane I, Ander H, Ziylan O, Oktar T, Ozsoy C. Urological and surgical complications in 362 consecutive living related donor kidney transplantations. *Urol Int.* 2004; 72:252-256.
2. Nghiem DD. Donor aortoplasty for transplantation of kidney with multiple arteries. *J Urol.* 1994; 152:2055-6.
3. Novick AC, Magnusson M, Braun WE. Multiple-artery renal transplantation: Emphasis on extracorporeal methods of donor arterial reconstruction. *J Urol.* 1979; 122:731-5.
4. Rouvière O, Berger P, Béziat C, Garnier JL, Lefrançois N, Martin X, *et al.* Acute thrombosis of renal artery: Graft salvage by means of intra-arterial fibrinolysis. *Transplantation.* 2002; 73:403.
5. Sandhu JS, Sandhu P, Saggat K. Sonographic evaluation of renal allograft. *J Assoc Physicians India.* 2004; 52:568-72.
6. Zilinska Z, Chrastina M, Trebaticky B, Breza J

- Jr, Slobodnik L, Breza J. Clinical study Bratisl Lek Listy. 2010; 111(11):586-589.
7. Jordan ML, Cook GT, Cardella CJ. Ten years of experience with vascular complications in renal transplantation. *J Urol*. 1982; 128:689-692.
 8. Akcetin Z, Schrott KM. Renal transplant artery thrombosis. *Turkish Journal of Urology*, 1996, 370-374.
 9. Fervenza FC, Lafayette RA, Alfrey EJ, Petersen J. Renal artery stenosis in kidney transplants. *Am J Kidney Dis*. 1998; 31:142-148.
 10. Wei K, Le E, Bin JP, Coggins M, Thorpe J, Kaul S. Quantification of renal blood flow with contrast-enhanced ultrasound. *J Am Coll Cardiol*. 2001; 37(4):1135-40.
 11. Patil AB, Ramesh D, Desai SC, Mylarappa P, Guttikonda SH, Puvvada S. Transplant renal artery stenosis: The impact of endovascular management and their outcomes. *Indian j urol*. 2016; 32(4):288-292.
 12. Giustacchini P, Pisanti F, Citterio F, De Gaetano AM, Castagneto M. Renal vein thrombosis after renal transplantation: an important cause of graft loss. *Transplant Proc*. 2002; 34(6):2126-7.
 13. Obed A, Uihlein DC, Zorger N. Severe renal vein stenosis of a kidney transplant with beneficial clinical course after successful percutaneous stenting. *Am J Trans*. 2008; 8:2173-2176.
 14. Lucewicz A, Isaacs A, Allen RD, Lam VW, Angelides S, Pleass HC. Torsion of intraperitoneal kidney transplant. *ANZ J Surg*. 2012; 82(5):299-302.
 15. Koo CK, Rodger S, Baxter GM. Extra-renal pseudo aneurysm: An uncommon complication following renal transplantation. *Clin Radiol*. 1999; 54:755-8.