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ROLE OF ENDOVASCULAR INTERVENTIONAL RADIOLOGY IN CHRONIC KIDNEY DISEASE PATIENTS: SINGLE CENTRE EXPERIENCE

Radiology

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ABSTRACT

BACKGROUND AND AIMS: To study different vascular interventional procedures done in patients with chronic kidney disease (CKD) and End Stage Renal Disease (ESRD) patients and management of vascular pathologies using interventional procedures wherever applicable. **METHOD:** A retrospective study of CKD/ESRD patients referred to the department of Interventional Radiodiagnosis for undergoing hemodialysis related or renal diagnostic/therapeutic interventions during 12 months period. **RESULTS:** In our study of 60 patients following procedures were performed,16 patients underwent central venous angioplasty for central venous stenosis,10 patients underwent permcath insertion for hemodialysis,9 patients underwent fistulography/fistuloplasty,15 patients underwent renal artery angiography/angioplasty of the native and transplant kidney respectively,8 underwent embolization for post biopsy vascular complication and 2 patients underwent Trans jugular kidney biopsy. The individual most common procedure in our hospital was central venousplasty (16 patients), however combined most common procedure was for establishing dialysis access (19 patients, fistulography/fistuloplasty and permcath insertion) **CONCLUSIONS:** Interventional Radiology has a major role in management of CKD/ESRD patients as described in this study done in a tertiary care centre.

KEYWORDS

Chronic kidney disease, End Stage Renal Disease, Interventional Radiology

INTRODUCTION

Chronic kidney disease (CKD) is a major public health problem which is associated with high morbidity and mortality. Renal transplantation is the definitive treatment of patients with higher stages of CKD, but this option is not available to many patients because of the cost and complexity of the treatment. The majority of patients with End Stage Renal Disease (ESRD) who cannot undergo renal transplant are dependent on maintenance hemodialysis by surgically created access sites or via central venous access sites. Hemodialysis shunts are surgically created communications between arteries and veins. Majority of these dialysis related shunts generally fails within span of two years. Abnormal screening results have been attributed to the presence of venous stenosis in 80-90% of cases. These patients are hence referred for angiographic evaluation and/or therapy. So, in this study we would present patterns of dialysis-related interventions done at our institution. Technological progress in the fields of interventional radiology and device manufacturing has allowed a large segment of the dialysis population to be treated without the need for open surgery. Percutaneous procedures can salvage both fistulas and central veins without sacrificing venous outflow, thus prolonging the usage and overall life of the access. Along with such dialysis related interventions other vascular interventional procedures done in patients with CKD/ESRD like renal artery angioplasty, post renal biopsy vascular complication management and transplant related interventions are studied in this study.

MATERIALS AND METHODS

Study Design:

In this Retrospective Study, CKD/ESRD patients referred to the department of Interventional Radiodiagnosis for undergoing renal diagnostic/therapeutic interventions or hemodialysis related interventions during 12 months period were considered for the study. Patients considered for this study were diagnosed cases of CKD/ESRD requiring DSA/Endovascular Intervention for their management. Procedure was explained to them and consent was taken in the language they understand. Imaging examinations were performed in the digital subtraction angiography (DSA) suite, under local anaesthesia and aseptic precautions using a Siemens DSA fluoroscopy machine. Informed consent were obtained prior to all procedures. Portable Doppler machine was used for vascular access wherever required. Contrast was used in all patients for angiographic evaluation and endovascular interventional management was done as per the requirement and demand of the case.

RESULTS

Table 1: Distribution Of Patients As Per The Procedure Performed

Procedure performed	NO OF PATIENTS
Permcath insertion	10
Fistulography/fistuloplasty	9
Central venous plasty	16
Renal artery angioplasty(native)	10
Renal artery angioplasty(transplant)	5
Post renal biopsy vascular complication	8
Transjugular renal biopsy	2
Total	60

Table 2: Distribution Of The Stenosis As Per The Site In A Patient With Fistula (16 Stenotic Lesions Were Present In 9 Patients)

SITE OF STENOIS	NO OF STENOTIC LESIONS
Juxta-anastomotic site	6
Outflow vein	8
Inflow artery	2
Total	16

Table 3: Distribution Of The Stenosis/occlusion In The Central Venous System (20 Stenosis Were Present In 16 Patients)

Site of stenosis	No of stenotic lesions
Brachiocephalic vein	12
Subclavian vein	4
Superior vena cava	4
Total	20

Table 4: Distribution Of Interventions Done In Patient With Central Venous Stenosis

Intervention performed	No of stenosed segments	Percentage
High pressure balloon angioplasty	16	80
Stent plasty	2	10
Balloon angioplasty of the in- stent stenosis	1	5

Intervention not feasible	1	5

Table 5: Distribution Of Stenosis In The Native Renal Arteries (12 Stenotic Segments Were Present In 10 Patients.)

Site of stenosis	No of patients
Renal artery ostial lesions	6
Renal artery non-ostial lesions	4
Ileo-renal bypass stenosis	2

Table 6: Distribution Of Interventions Done In Patient With Native Renal Artery Stenosis

Intervention performed	No of stenoses segments	Percentage (%)
Balloon assisted stent angioplasty	7	58.3
Balloon angioplasty	3	25
No intervention done	2	16.6
Total	12	100

Table 7: Distribution Of Vascular Complications In Patients With Ckd Undergoing Dsa For Hematuria Post Renal Biopsy

Vascular complication	No of patients	Percentage (%)
Pseudoaneurysms	7	87.5
Arteriovenous fistula	1	12.5
Arterio-calyceal fistula	0	0
Total	8	100

DISCUSSION

This retrospective study was performed by selecting patients who underwent diagnostic or therapeutic endovascular interventions during the period of 12 months in the Department of Interventional Radiology, Bombay Hospital on 60 patients with chronic kidney disease with mean age of 50.02 years. In this study, we describe findings of Digital subtraction angiography and variety of different endovascular interventions which are performed in patients with CKD/ESRD whenever feasible. In the present study of 60 patients, maximum number of patients were between 51-75 years of age constituting 55% of all patients. There was also a predominance of male patients, with a male: female ratio of about 1.6:1. Of the 60 patients,35 patients were patients with end stage renal disease and were on maintainence hemodialysis ,19 patients were detected cases of chronic kidney disease and 6 patients were patients who underwent renal transplant.

In our study of 60 patients following procedures were performed,16 patients underwent central venous plasty for central venous stenosis,10 patients underwent permcath insertion for hemodialysis,9 patients underwent fistulography/fistuloplasty,15(10+5) patients renal artery angiography/angioplasty of the native and transplant kidney respectively,8 underwent embolization for post biopsy vascular complication and 2 patients underwent Transjugular kidney biopsy. The individual most common procedure in our hospital was central venous plasty (16 patients), however combined most common procedure was for establishing dialysis access (19 patients, fistulography/plasty and permcath insertion) which is similar to the study published by S Mammen et al in the year 2012. (1 and TABLE 1) 10 patients (7 males and 3 females) with mean age of 55.3 years underwent permcath insertion under fluoroscopy and ultrasound guidance. 9 patients were known case or newly diagnosed case of ESRD and 1 patient was a CKD patient with Acute kidney injury. Out of 10 patients, 6 patients had indication of failed AV fistula in bilateral upper limbs (60%), 3 patients were naïve ESRD with no h/o AV fistula (30%) and 1 patient underwent perm catheter insertion in view of delayed maturation of AV fistula (10%).

8 out of 10 patients, permanent catheter was inserted in the right IJV and remaining 2 were inserted in the left IJV. This result was similar to the studies performed by Noh HM et al in the year 1998 and Fry et al in the year 2008. Of the 2,1 patient had h/o chronic thrombosis and other had significantly thin right IJV. Technical success was 100 %.(2,3)

9 patients with ESRD underwent fistulography/plasty (3 female and 6 males) with mean age of 52 years, 5 of them had radio-cephalic fistula (55.5%) which was the most common fistula, similar result was also seen the study performed by Krishnaswamy Sampathkumar et al and R Hemachandra et al in the year 2015. (TABLE 6).9 patients with 16 stenotic segments,6/16(37.5%) showed juxta anastomotic stenosis/narrowing, 8/16(50%) showed outflow venous stenosis and inflow arterial mild stenosis noted in 2 segments (12.5%). (TABLE 2). These findings were consistent with study published by Grogan J et al in the year 2005.Balloon angioplasty was performed for 14/16 stenotic segments. Technical success was achieved in all the patients. (4,5,6)

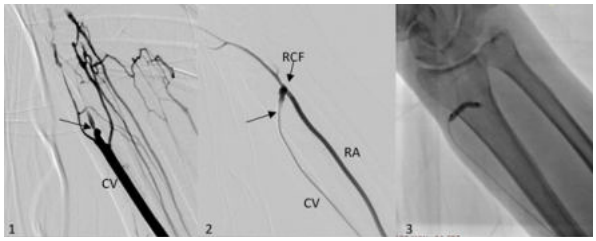
16 patients (11 males and 5 females) with mean age of 53.56 years and ESRD underwent endovascular intervention for central venous stenosis/occlusion. Most common presenting complaint was swelling of arm and neck which was seen in 13 of 16 patients, finding was similar to that of the study performed by Lumsden A B et al in the year 1997.20 stenotic/occluding lesions were seen in the central veins of which 12(60%) were in the brachiocephalic vein and 4(20%) each in the subclavian vein and the superior vena cava respectively(TABLE 3), similar to the publication work of Mukesh K Yadav et al in 2015. 14 lesions (70%) were stenotic type and 6(30%) occluding type. Of the 20 patients in 1 patient occlusion was not negotiable so procedure was abondaned.2 patients underwent stenting of the veins of which 1 patient had restenosis so reintervention in form of balloon plasty was performed after 7.5 months. In 16 patients Balloon angioplasty was performed. (TABLE 4) These findings are comparable to the study performed by Saleh M et al in 2017.15/16 patients responded to the intervention in the immediate postoperative period so clinical and technical success was around 93.75 percent. (7,8,9)

10 patients (6 males and 4 females) mean age 56.2 years and known case of chronic kidney disease underwent angiography/angioplasty for evaluation/treatment of renal artery stenosis.4 of these 10 patients (40%) showed improved serum creatinine and blood pressure post procedure and remaining 6 patients (60%) were stable clinically with no further decline in renal function.10 stenotic lesions were observed in the 8 patients, of which most number of lesions were ostial in origin similar results were noted in the study by Martin L. G et al .(TABLE 5).Of the 12, 7 stenotic lesions (50%) were managed by percutaneous balloon assisted stenting which was the most common procedure which was also consistent with the study published in the literature described previously (TABLE 6). Most of these lesions were due to atherosclerosis except 2 lesions managed by balloon angioplasty were secondary to underlying vasculitis. Of the 10, 6 patients (60%) showed similarity between ultrasound and angiography findings. Technical success was 100 percent. (10)

5 patients (4 males and 1 female) mean age of 36 years underwent angiography for evaluation of declining renal function/graft dysfunction post-transplant. All 5 patients showed narrowing/stenosis at the anastomotic sites in the angiography, consistent with the study performed by Andre Felipe Braga et al (11).

8 Patients (3 males and 5 females) mean age of 49.6 years underwent DSA for evaluation of post biopsy haematuria which was the most common complaint in all the patients.7 patients developed pseudoaneurysms (87.5%),1 developed AV-fistula (12.5%) and there was no evidence of arterio-calyceal fistula in any patients (0%).(TABLE 7) .All 7 patients presented with pseudoaneurysms in the lower polar branch of the renal artery. This was consistent with the study performed by Serkan Guneyli et al.1 of the 8 patients was a case of AV-fistula in a transplant kidney with graft rejection. Of the 8 patients,3 patients showed presence of extravasation (37.5%). All 8 cases were treated by super selective cannulation and embolization using coils with technical success of 100% similar to the study performed by Scwartz MJ et al. Of the 8 patients in 3 patients ultrasound findings were similar to DSA findings. (37.5%). (12,13)

2 Female patients underwent Trans jugular kidney biopsy with mean age of 47.5 patients. 1 patient had history of low platelet count and other had history of both low platelets and raised INR.Technical success was 100 percent with 1 of the 2 patients (50%) showing capsular perforation post procedure which did not require any other intervention. Overall, the findings were comparable to the study performed by Rathod Krantikumar R et al. (14)



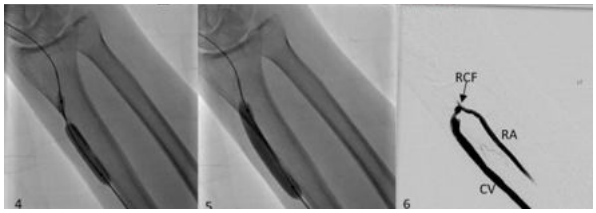


Figure 1: 1 Complete occlusion of the cephalic vein proximal to the radio cephalic fistula (black arrow) (RCF).2. Tip of the catheter at the anastomotic site negotiating the occlusion (black arrow).3,4 and 5) Balloon angioplasty of the stenotic cephalic vein and the anastomotic site using 3 x 40 mm balloon 6) Post angioplasty fistulogram.

Figure 2: 1. Brachial - cephalic fistula with stenosis at the outflow cephalic vein and at the venous side of the anastomotic site (arrows) 2. Balloon angioplasty of the cephalic vein and the anastomotic site using 4 x 40 mm balloon 3. Post fistuloplasty status showing patent AV fistula.

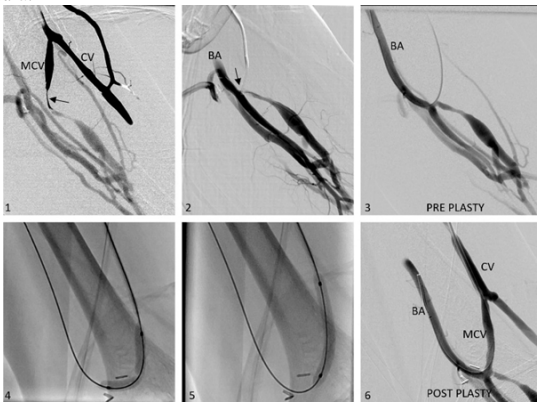
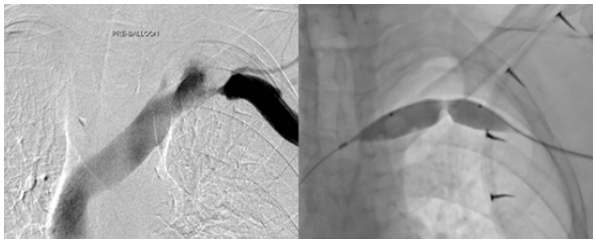


Figure 3: 1. Median cubital vein-Brachial artery fistula showing severe stenosis of the median cubital vein at the anastomotic site (arrow) 2,3. Tip of the catheter passing the stenosis and shoot taken, brachial artery visualised. 4,5. Balloon angioplasty of the anastomotic site. 6.Post fistuloplasty status, patent fistula.



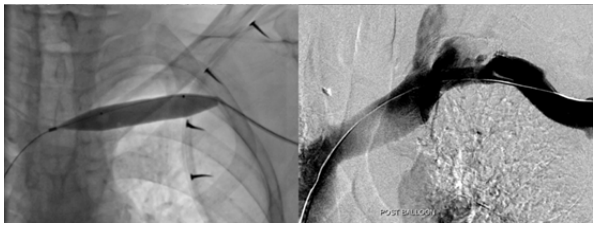


Figure 4: 61-year-old male presented with left upper limb swelling.1. Severe stenosis of the proximal left subclavian vein. 2,3. Venoplasty of the left subclavian vein performed using high pressure 14 x 40 mm balloon. 4. Post venoplasty status patent left subclavian vein.

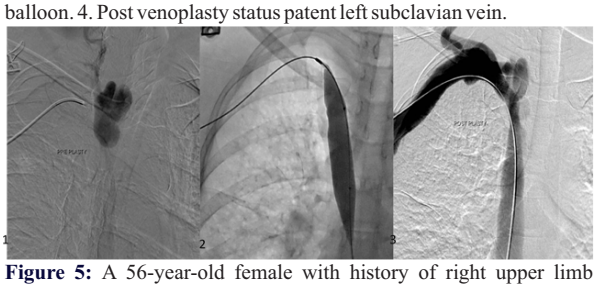


Figure 5: A 56-year-old female with history of right upper limb dialysis fistula presented with breathlessness and neck swelling.1. Occlusion of the superior vena cava (SVC). 2.Balloon angioplasty of the SVC using high pressure balloon 16 x 40 mm. 3. Post SVC plasty status.

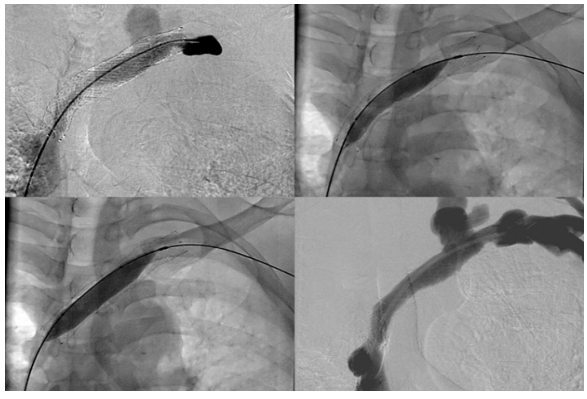


Figure 6: 34-year-old male with history of stenting of left BCV 8 months back presented with left upper limb swelling. 1.Restenosis within the stent in the left BCV. 2,3. Balloon angioplasty performed using 14 x 40 mm balloon. 4. Patent right BCV post procedure.

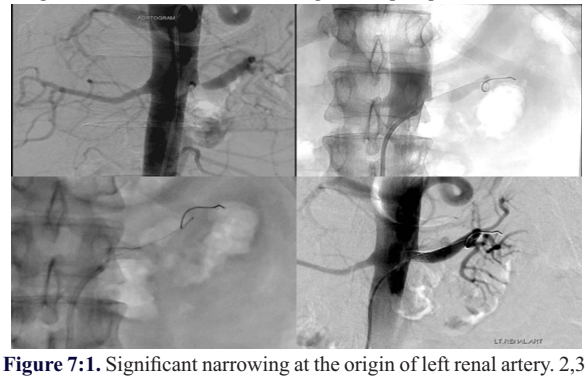


Figure 7:1. Significant narrowing at the origin of left renal artery. 2,3. 6x15mm balloon expandable stent was deployed.4. Post stenting status showing widely patent left renal artery.

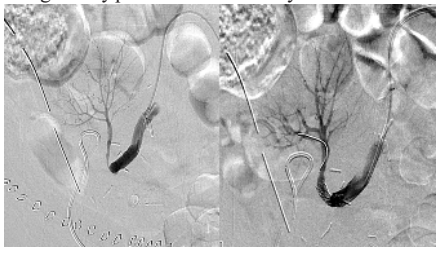


Figure 8: Status Post transplant Day 3. Persistent hypertension,

progressive decrease in urine output with creatinine reaching up to 3.7 suggestive of acute rejection. DSA performed showed anastomotic site stricture which was treated with Balloon mounted stent. Complete recanalization with good antegrade flow was achieved.

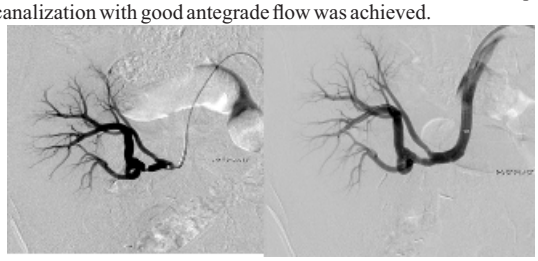


Figure 9 :35-year-old female with live Renal Transplant since 2 years showed rising trend of creatinine since 6 months. DSA showed short segment focal stenosis of the lower segmental artery which was treated with balloon mounted stent. Post stenting complete recanalization was seen with good antegrade flow.

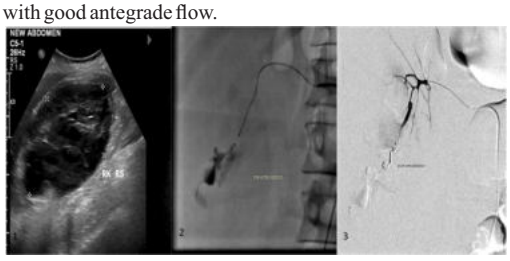


Figure 10: USG image of the right kidney showing a large perinephric hematoma measuring around 360cc. Right lower polar renal artery showing pseudoaneurysm with active extravasation. Super selective cannulation of feeding artery and embolization done with 18-2-2 microcoils.

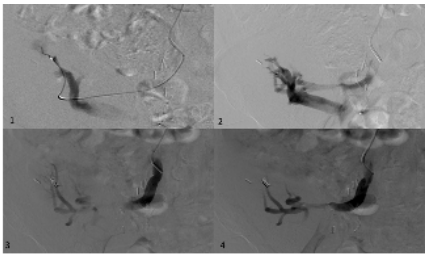


Figure 11: 1,2. Upper polar branch of the upper segmental artery showed presence of AV fistula. 3,4. Multiple coils were deployed by selective cannulation of the upper segmental branch. Peripheral pruning of the intra renal arterial branches, absence of nephrogram even on delayed phase.

FIGURE 12: Status post percutaneous transplant renal biopsy with contrast extravasation seen in the right external iliac artery. Tamponade given with 7X 40 mm balloon and later stent graft was deployed across the site of extravasation of size 7 x 40 mm.

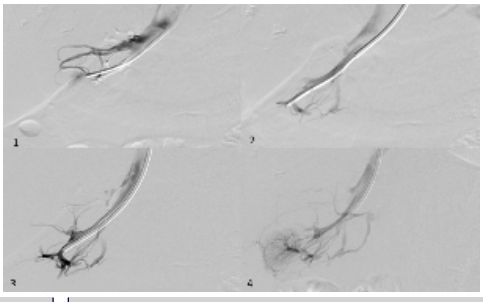


FIGURE 13: Sequential images in a patient undergoing transjugular renal biopsy. Right renal venogram with tip of vascular sheath in the proximal right renal vein through which catheter is wedged distally into the right lower pole renal cortical vein. Following the venogram, the sheath is advanced as distally as possible into the cortical vein to allow introduction of transjugular renal biopsy needle. Renal access and biopsy set needle was advanced through the sheath and placed distally into peripheral cortical vein and the biopsy was performed.4. Post biopsy check run.

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