Endovascular therapy for central venous obstruction as a consequence of prolonged hemodialysis

Terapia endovascular para la obstrucción venosa central como consecuencia de hemodiálisis prolongada

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Abstract

Background: Central Venous Disease (CVD) in hemodialysis patients, resulting from stenosis in primary veins, affects 25-40% of this population, majorly due to prolonged central venous catheter use and high-flow AVF conditions. Such obstructions lead to complications like access site dysfunction and symptoms including localized swelling. While surgical and endovascular treatments are available, the optimal method for addressing CVD remains contentious. The article describes our experience with endovascular (balloon angioplasty) therapy of central venous blockage and hypertension in hemodialysis patients with AVF. **Method:** Prospective 12-month research with varying follow-up of 20 chronic renal failure patients on regular hemodialysis with venous hypertension (ipsilateral limb edema) between July 2022 and July 2023. Age (years), gender, AVF type, approach, site of occlusion, outcomes, post-op therapy, complications, recovery time (months), and recurrences are recorded for all patients. **Results:** The mean age of patients was 42 ± 12 years, with most aged 40-49. While 55% had successful operations without complications, 54.5% experienced recurrence post-success. Factors like age, gender, and AVF type didn't significantly affect outcomes. Conclusion: Our study highlights the recurrent obstructions post-AVF operations. Antiplatelet and anticoagulant therapy's effectiveness post-surgery needs evaluation. Other determinants for recurrent obstructions should be further explored.

Keywords: Endovascular, therapy, central venous obstruction, consequence, prolonged hemodialysis.

Resumen

Antecedentes: La enfermedad venosa central (ECV) en pacientes en hemodiálisis, resultante de estenosis en venas primarias, afecta entre el 25 y el 40% de esta población, principalmente debido al uso prolongado de catéter venoso central y condiciones de FAV de alto flujo. Estas obstrucciones provocan complicaciones como disfunción del sitio de acceso y síntomas que incluyen hinchazón localizada. Si bien existen tratamientos quirúrgicos y endovasculares, el método óptimo para abordar la ECV sigue siendo polémico. El artículo describe nuestra experiencia con la terapia endovascular (angioplastia con balón) de la obstrucción venosa central y la hipertensión en pacientes en hemodiálisis con FAV. **Método:** Investigación prospectiva de 12 meses con seguimiento variable de 20 pacientes con insuficiencia renal crónica en hemodiálisis regular con hipertensión venosa (edema de extremidad ipsilateral) entre julio de 2022 y julio de 2023. Edad (años), sexo, tipo de FAV, abordaje, sitio de Se registran para todos los pacientes la oclusión, los resultados, la terapia posoperatoria, las complicaciones, el tiempo de recuperación (meses) y las recurrencias. **Resultados:** La edad media de los pacientes fue de 42 ± 12 años, la mayoría entre 40 y 49 años. Mientras que el 55% tuvo operaciones exitosas y sin complicaciones, el 54,5% experimentó recurrencia después del éxito. Factores como la edad, el sexo y el tipo de FAV no afectaron significativamente los resultados. **Conclusión:** Nuestro estudio destaca las obstrucciones recurrentes post-operaciones de FAV. Es necesario evaluar la eficacia de la terapia antiplaquetaria y anticoagulante después de la cirugía. Se deben explorar más a fondo otros determinantes de las obstrucciones recurrentes.

Palabras clave: Endovascular, terapia, obstrucción venosa central, consecuencia, hemodiálisis prolongada.

Introduction

Central venous stenosis and obstruction pose significant challenges for patients who require long-term hemodialysis, leading to complications associated with dysfunction of the access site. Such conditions, termed Central Venous Disease (CVD), are characterized by a stenosis of 50% or more in the internal jugular, subclavian, or axillary veins[1]. Studies suggest that the prevalence of central venous stenosis in this population lies between 25-40%[2,3]. The predominant factors contributing to central venous stenosis among hemodialysis patients include extended use of central venous catheters and the high-flow conditions associated with arteriovenous fistula (AVF) or graft. These factors promote venous intimal hyperplasia leading to stenosis[2,4]. The clinical manifestations of central venous stenosis encompass swelling of the arm or neck on the affected side, increased venous pressure during hemodialysis sessions, and the failure of the hemodialysis access. Therapeutic interventions aim at alleviating symptoms for patients while ensuring the AVF remains functional[5]. While both surgical and endovascular procedures are available to treat central venous stenosis, the best method remains a topic of discussion. Open surgical interventions of the central veins have demonstrated promising primary patency rates of 80-90% within the first year[6], but they are also associated with considerable post-surgical complications and mortality risks. Conversely, endovascular approaches are increasingly recognized as the preferred modality for treating central venous stenosis[7-9]. Among the endovascular techniques available are percutaneous transluminal angioplasty (PTA) and the placement of either bare metal stents or covered stents. However, there is ongoing debate regarding the superior endovascular treatment, as both angioplasty and primary stent placement show comparable outcomes[10-12]. Guided by the recommendations from the National Kidney Foundation Disease Outcomes Quality Initiative[13], angioplasty, either with or without stent insertion, is promoted as the favored treatment for CVD. The aim of study is to describe our experience in the endovascular (balloon angioplasty) treatment of central venous obstruction and venous hypertension in hemodialysis patient with AVF.

Methods

Prospective study, duration of study 12 month and follow up was variable, 20 Patient of chronic renal failure on regular hemodialysis complaining from venous hypertension (ipsilateral limb swelling) between July 2022 and July 2023 in Al_shaheed ghazi Al hariri teaching hospital. We did not make any image study before endovascular intervention. All patients take the following data: Age groups (years), gender, Types of AVF, Approach, Site of occlusion, Outcomes, any treatment after operation, complications, duration of recovery (months) and any Recurrences occur. SPSS 22 was used to conduct statistical analysis on categorical data, using frequency and percentage, and mean, median, and standard deviation on continuous data. Chi-square is used to evaluate the relationship between categorical variables. A significant P-value is less than or equal to 0.05.

Results

Cross sectional study of Mean age of patients 42 ± 12 years old. Most age group of patients 40-49 years old, 55% of patients have Left Cephalobrachial AVF type, 70% of patients are males, 65% of patients have CFV AND AVF and left innominate vein, 55% of patients have success operation, 100% of patients have no complications, 30% of successful operation have recurrent, 55% of patients put on Aspirin and apixaban 2.5m after operation, 90% of patients have duration of recovery less than 12 months. As shown in table 1.

Table 1: Distribution of patients according to the variables of the study.

variables		frequency	percentage
	20-29	3	15.0
Age groups (years)	30-39	3	15.0
	40-49	6	30.0
	50-59	5	25.0
	≥60	3	15.0
Types of AVF	Left Basilobrachial	2	10.0
	Left Cephalobrachial	11	55.0
	Right Cephalobrachial	7	35.0
Gender	Females	6	30.0
	males	14	70.0
Approach	CFV AND AVF	13	65.0
	through AVF	7	35.0
Site of occlusion	left innominate vein	13	65.0
	right innominate vein	7	35.0
Outcomes	failed	9	45.0
	success	11	55.0
Treatment	apixaban tab 2.5 x2	9	45.0
	Aspirin and apixaban 2.5m	11	55.0
Complication	nill	20	100.0
Duration (months)	≤12	18	90.0
	>12	2	10.0
	Failed	9	45.0
Recurrences	not occurred	5	25.0
	Occurred	6	30.0

As shown in table 2; there is significant association between Success of operation and recurrent of obstruction, 54.5% of recurrent occur after successful operation. Also all successful operation patients (100%) put on Aspirin and apixaban 2.5m after it. No any significant association between outcome Age groups (years), gender, Types of AVF, Approach, Site of occlusion, complications, duration of recovery (months).

Table 2: association between outcome and variables of study.

Variables			Outcome	P-value
		Failed	*Success*	
	20-29	3	0	
Age groups		33.3%	0.0%	
(years)	*30-39*	1	2	
		11.1%	18.2%	
	40-49	2	4	0.35
		22.2%	36.4%	
	50-59	2	3	
		22.2%	27.3%	
	60	1	2	
		11.1%	18.2%	
	Total	9	11	
		100.0%	100.0%	
	Left basil brachial	2	0	
Types of		22.2%	0.0%	
AVF	*Left cephalic brachial*	4	7	0.24
		44.4%	63.6%	
	Right cephalic brachial	3	4	
		33.3%	36.4%	
	Total	9	11	
		100.0%	100.0%	
Approach	*CFV AND AVF*	6	7	
		66.7%	63.6%	
	through AVF	3	4	1.000
		33.3%	36.4%	
	Total	9	11	
		100.0%	100.0%	
	left innominate vein	6	7	
Occlusion		66.7%	63.6%	1.000
site	*right innominate vein*	3	4	
		33.3%	36.4%	
	Total	9	11	
		100.0%	100.0%	
	apixaban tab 2.5 x2	9	0	
Treatment		100.0%	0.0%	**0.0001**
	Aspirin and apixaban	0	11	
	2.5m	0.0%	100.0%	
	Total	9	11	
		100.0%	100.0%	
	Females	3	3	
Gender		33.3%	27.3%	
	Males	6	8	1.000
		66.7%	72.7%	
	Total	9	11	
		100.0%	100.0%	
	≤12	7	11	
Duration in		77.8%	100.0%	
(Months)	*>12*	2	0	1.8
		22.2%	0.0%	
	Total	9	11	
		100.0%	100.0%	
	Failed	9	0	
Recurrence		100.0%	0.0%	
	Not occurred	0	5	**0.0001**
		0.0%	45.5%	
	Occurred	0	6	
		0.0%	54.5%	
	Total	9	11	
		100.0%	100.0%	

P-value ≤ 0.05 (significant).

Discussion

In recent years, there has been a significant increase in complications associated with dialysis access due to the growing number of patients with endstage renal disease and their longer surviva CVD is a prevalent condition among hemodialysis patients. Two main contributors to the development of cardiovascular disease are venous trauma caused by cannulation of central veins and hemodynamic stress caused by elevated flow at the AVF access site[3]. Currently, endovascular therapy is the preferred option for CVD. Endovascular techniques include balloon angioplasty, stenting, and, more recently, cutting balloon angioplasty. The best management approach remains unclear. Some recommend primary stenting for CVD therapy[9], while others recommend balloon angioplasty and reserve stenting for treatment failure or restenosis[10]. The average age of the patients in this cross-sectional study was 42 ± 12 years, with the predominant age group being 40-49 years old. This is consistent with previous studies that have reported a similar age range for patients undergoing hemodialysis procedures[14]. Interestingly, a significant majority (70%) of the participants were males. This gender disparity in our study population is noteworthy and aligns with prior research that has shown a male predominance in certain vascular conditions[15]. The type of arteriovenous fistula (AVF) also revealed specific trends. Over half (55%) of the patients had a Left Cephalobrachial AVF. AVFs are considered the gold standard for providing vascular access in hemodialysis due to their longevity and lower complication rates compared to other access types[16]. The left-sided preference for AVF placement has been previously documented, often attributed to ease of surgical procedure and subsequent management[17]. The study results are encouraging when we consider the success rates of operations. A notable 55% of patients had a successful operation, and impressively, all (100%) reported no post-operative complications. The absence of complications in our cohort is remarkable and suggests a high level of proficiency and care in the surgical and post-operative management of these patients. Nonetheless, it's worth noting that 30% of those with successful operations experienced recurrence. Recurrence after AVF surgery has been a challenge in the field, with previous studies also reporting similar findings[18]. More than half (55%) of the patients were administered a combination of Aspirin and apixaban (2.5mg) post-operation. The use of antiplatelet and anticoagulant therapy, such as Aspirin and apixaban, respectively, is a common practice to prevent thrombosis and maintain the patency of the AVF[19]. Lastly, the recovery duration post-operation for most patients was promising. A significant 90% reported a recovery time of less than 12 months. Swift recovery is crucial to ensure that patients can return to their routine hemodialysis schedules, minimizing disruptions to their renal

care[20]. In our study, there was a marked association between the success of the operation and the recurrence of obstruction. Specifically, 54.5% of cases that experienced recurrence had initially undergone a successful operation. This finding underscores the complexity and challenges in ensuring the long-term patency of vascular access after an initially successful procedure. Similar observations have been reported by other researchers, noting that even after a seemingly effective surgical intervention, various pathophysiological processes can still lead to recurrent obstructions[21]. Interestingly, all patients (100%) who had a successful operation were subsequently prescribed a combination of Aspirin and apixaban (2.5mg). The universal prescription of this therapeutic combination after successful operations suggests a standard protocol or clinical practice aimed at preventing thrombosis and ensuring the sustained functionality of the AVF[22]. However, given the high recurrence rate observed, it might be pertinent to review the effectiveness of this therapeutic regimen in the context of long-term AVF patency. In contrast, there were no significant associations observed between the outcome and other variables such as age groups, gender, types of AVF, surgical approach, site of occlusion, complications, and duration of recovery. The absence of associations with these factors indicates that they may not play a determinant role in the outcome of the operation or the subsequent recurrence of obstructions in this study cohort. This is consistent with some studies which have found that demographic factors, for instance, may not directly impact surgical outcomes or recurrence rates[23]. However, other research has sometimes shown variations, emphasizing the multifactorial nature of AVF outcomes and the importance of considering individual patient characteristics and clinical contexts[24]. Our research was limited. A first non-randomized retrospective research was conducted. Secondly, the patient count was low with poor follow-up. Patency rates were unable to be determined. We have merely presented our early experience, and more extensive research with bigger sample sizes are required to evaluate long-term results in the Indian community.

Conclusions

In summary, our study emphasizes the challenges of managing recurrent obstructions following successful AVF operations. The universal adoption of antiplatelet and anticoagulant therapy post-operation requires further assessment to gauge its efficacy in preventing recurrences. The lack of significant associations with various other patient and procedural factors suggests the need to explore other potential determinants or mechanisms behind recurrent obstructions in this patient population.

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