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THE EFFICACY OF AN IMPROVISED ENDO-VASCULAR THROMBOLYTIC TECHNIQUE FOR THE TREATMENT OF THROMBOSED ARTERIO-VENOUS FISTULAS IN HEMODIALYSIS PATIENTS

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ABSTRACT

Arterio-venous fistulas can occasionally develop thrombosis requiring endo-vascular thrombolysis. As an alternative to expensive balloon angioplasty, we have been using an improvised technique, which includes ultrasound-guided instillation of thrombolytic agents through multiple punctures, followed by thrombo-aspiration and maceration.

Objectives: To study the immediate clinical success, patency rates at 3 and 6 months and complications following an improvised endo-vascular technique for the treatment of thrombosed native Arterio-Venous fistulas.

Methods: A retrospective observational study was done on 25 patients with thrombosed Arterio-Venous fistulas who underwent this improvised endo-vascular technique in Pushpagiri Medical College Hospital from 1st January 2018 to 30th June 2020 and all relevant data were collected. The outcome variables included immediate clinical success, primary and secondary patency rates and complications related to the procedure. A Kaplan-Meier analysis was done for patency rates at 3 and 6 months.

Results: Immediate clinical success of this technique was 17 (68%). The primary and secondary patency rates at three months were 15 (60%) and 13 (40%) respectively. Complications included bleeding from puncture site and systemic bleeding in 1 (4%) patient each.

Conclusion: This affordable endo-vascular thrombolytic technique, which eliminates the need of balloon angioplasty, has shown reasonable success in restoring and maintaining fistula patency, and thus turns out to be a promising alternative in a resource-limited setting.

Key words: Improvised Endo-vascular Thrombolytic Technique, Primary patency rate, Secondary patency rate, Thrombosed Arterio-Venous Fistulas

INTRODUCTION

The National Kidney Foundation's Kidney Disease Outcomes Quality Initiative has recommended that native AVF be preferred over other forms of vascular access. However, both native AV fistula as well as synthetic A-V graft can develop thrombosis, though the latter is much more prone to it [1]. Thrombosis is often caused either by associated vascular stenosis, which usually develops on the venous side of the fistula or by venous thrombosis that occurs else where in the same extremity [2].

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Up until recently, surgical repair remained the main stay of treatment for thrombosed AV fistulas. However, surgical thrombectomy with revision has a poor outcome with reported success rates ranging from 28% to 73% [3]. Recently, percutaneous treatment for salvage of thrombosed native AVFs is performed which includes thrombo-aspiration, balloon maceration of the clot and mechanical

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thrombectomy. Reported technical success rates of these techniques vary in a range from 73% to 100%. The most common thrombolytic drugs used are urokinase and recombinant tissue plasminogen activator (rt-PA) [4].

Though these endo-vascular techniques are highly effective, they are also very expensive. The high cost comes from the need of real time radiological monitoring in a Cath lab, as well as the cost of the consumables like percutaneous catheter and appropriately sized balloons for angioplasty. In a country where the vast majority of the people are paying for medical expenses from their own pockets, this poses a serious challenge. It is not surprising that many such patients opt for the surgical creation of a fresh vascular access, rather than going for expensive endo-vascular procedures. The fresh vascular access is often created on the other limb, which limits the options for future long-term vascular access, in case they also fail.

A more affordable interventional technique with comparable effectiveness will be of immense help to these patients in avoiding unnecessary surgical procedures and preserving their other vascular access optionsin the long run. Given these circumstances, the department of nephrology at Pushpagiri Medical College Hospital decided to offer these patients an improvised, and far less expensive, endo-vascular technique to salvage those thrombosed fistulas. This new technique, which is in use in our hospital since 2018, involves ultrasound-guided canulation of the thrombosed segment of the vein at multiple levels, local instillation of a thrombolytic agent-either streptokinase or urokinase, and dislodgement of the thrombus using a combination of mechanical breakage and intermittent aspirations. The whole procedure is done in a minor operation theatre. Patient is put on systemic anticoagulation for the next 24 hours following the procedure and closely monitored for complications. The present study was undertaken to find out the efficacy of this improvised thrombolytic therapy in terms of the immediate clinical success of the technique, primary and secondary patency rates, and complications associated with the procedure.

MATERIALS AND METHODS

A retrospective observational study of all patients who underwent the improvised endo-vascular technique for thrombosed Arterio-Venous fistulas in Pushpagiri Medical College Hospital from 1st January 2018 to 30th June 2020 was done after obtaining ethical committee permission.

Inclusion criteria

- All hemodialysis patients above 18 years who underwent the improvised endo-vascular thrombolytic technique for treatment of thrombosed arterio-venous fistula.

Exclusion criteria

- Patients who were lost to follow up following the procedure.
- Thrombosis of synthetic arterio-venous graft
- Patients who had primary failure of arterio-venous fistula
- Patients who had prior history of surgical or endo-vascular interventions in the same arterio-venous fistula

Analysis

Hospital records of all those patients who satisfy the inclusion and exclusion criteria were studied and baseline demographics including comorbid conditions were recorded. Other data that were collected include cause of End Stage Renal Disease, year of initiation of dialysis, type of arterio-venous fistula, history of previous thrombosis of arterio-venous fistulas, time interval between the surgical creation of fistula and thrombosis, type of thrombolytic agent used, and time interval between the diagnosis of

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thrombosis and thrombolytic. The outcomes of interest were immediate clinical success, primary patency rate, secondary patency rate and complications associated with the procedure. The following standard definitions were used to objectively measure the outcomes.

Clinical success: Defined as resumption of normal dialysis through the recanalized A-V fistula for at least one session.

Primary patency rate: Defined as the percentage of patent fistulas after intervention until the next access thrombosis or re-intervention.

Secondary patency rate: Defined as the percentage of patent fistulas after intervention until the access is surgically revised or abandoned.

Statistics

Statistical analyses was performed using Statistical Package for the Social Sciences (SPSS) 17.0 statistical software. The data are presented as mean standard deviation or the percentage. The outcomes including clinical success rates, primary and secondary patency rates, and complications are determined by frequency.

RESULTS

A total of 25 patients satisfied the inclusion and exclusion criteria of this study, which included 17 (68%) males and 8 (32%) females. The co-morbidities found in these patients were diabetes 14 (56%), Coronary Artery Disease 7 (28%), Cerebrovascular disease 1 (4%) and hypertension 25 (100%). Causes of End Stage kidney disease were diabetic nephropathy 15 (60%), chronic glomerulonephritis 8 (32%), autosomal dominant polycystic kidney disease 1 (4%) and unknown etiology 1 (4%). 12 (48%) patients were taking dialysis at a frequency of three sessions per week while the remaining 13 (52%) were taking two sessions per week. 17 (68%) patients were using a radio-cephalic fistula while 8 (32%) were usinga brachio-cephalic fistula.

The time interval between surgical creation of arterio-venous fistula and development of thrombosis was between 2 to 5 years for 12 (48%) patients, 1-2 years for 7 (28%) patients, less than 1 year for 5 (20%) patients and more than 5 years for 1 (4%). The time interval between the diagnosis of arterio-venous fistula thrombosis and endo-vascular intervention was less than 24 hours in 8 (32%) patients, 24 to 48 hours in 2 (8%) patients, 48 to 72 hours in 1 (4%) patient, 72 to 96 hours in 8 (32%) patients and more than 96 hours in 6 (24%) patients **(Table 1)**.

17(68%) patients had immediate clinical success following this improvised thrombolytic technique and were able to continue hemodialysis through the re-canalize arterio-venous fistula. One patient who had an initial successful thrombolysis died after two months, hence was lost to subsequent follow up. Of the remaining successfully thrombolysed patients, both the primary and secondary patency rates at three months were 15 (60%) and the corresponding rates at 6 months were 13 (40%) respectively **(Table 2)**. Life table of the proportion of patients who developed subsequent fistula failure is given in **Table 3** and hazard rates in **Table 4**. Kaplan-Meier curve for primary and secondary patency rates after restoration of flow in the arterio-venous fistula is shown in **(Figure 1)**. As far as complications are concerned, 1 (4%) patient developed significant bleeding from the local puncture site, while another patient developed systemic bleeding. No patient developed hypotension, arrythmia or allergy to the thrombolytic agent.

Table 1: Time intervals from creation of arterio-venous fistula to development of thrombosis and

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from thrombosis to intervention

Time interval between creation of arterio-venous fistula and development of thrombosis		
Time interval	**Number**	**Percentage (%)**
Less than 1 year	5	20
1-2 years	7	28
2-5 years	12	48
More than 5 years	1	4
Time interval between arterio-venous fistula thrombosis and endovascular intervention		
Less than 24 hours	8	32
24-48 hours	2	8
48-72 hours	1	4

Table 2: Primary and secondary patency rates following successful thrombolysis

Month Frequency	Primary patency rate		Secondary patency rate	
	Number	Percentage (%)	Number	Percentage (%)
At 3 months	15	60	15	60
At 6 months	13	40	13	40

Table 3: Proportion of cases who developed arterio-venous fistula failure after initial successful thrombolysis

Interval Start Time	Number Entering Interval	Number Withdrawing during Interval	Number Exposed to Risk	Number of Terminal Events	Proportion Terminating
0	25	0	25	8	0.32
3	17	1	16.5	1	0.06
6	15	13	8.5	2	0.24

a. The median survival time is 6.00

Cumulative Proportion Surviving at End of Interval: The proportion of cases surviving (remain patent /success) from the start of the table (0) to the end of the interval (6)

Probability Density: An estimate of the probability of experiencing the terminal event (failure) during the interval.

Hazard Rate: An estimate of experiencing the terminal event (failure) during the interval, conditional upon surviving to the start of the interval.

Table 4: Hazard rate of arterio-venous fistula failure after initial successful thrombolysis

Interval Start Time	Proportion Surviving	Cumulative Proportion Surviving at End of Interval	Std. Error of Cumulative Proportion Surviving at End of Interval	Probability Density	Std. Error of Probability Density	Hazard Rate

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0	0.68	0.68	0.09	0.107	0.031	0.13
3	0.94	0.64	0.1	0.014	0.013	0.02
6	0.76	0.49	0.12	0	0	0

a. The median survival time is 6.00

Cumulative Proportion Surviving at End of Interval: The proportion of cases surviving (remain patent /success) from the start of the table (0) to the end of the interval (6)
Probability Density: An estimate of the probability of experiencing the terminal event (failure) during the interval.
Hazard Rate: An estimate of experiencing the terminal event (failure) during the interval, conditional upon surviving to the start of the interval.

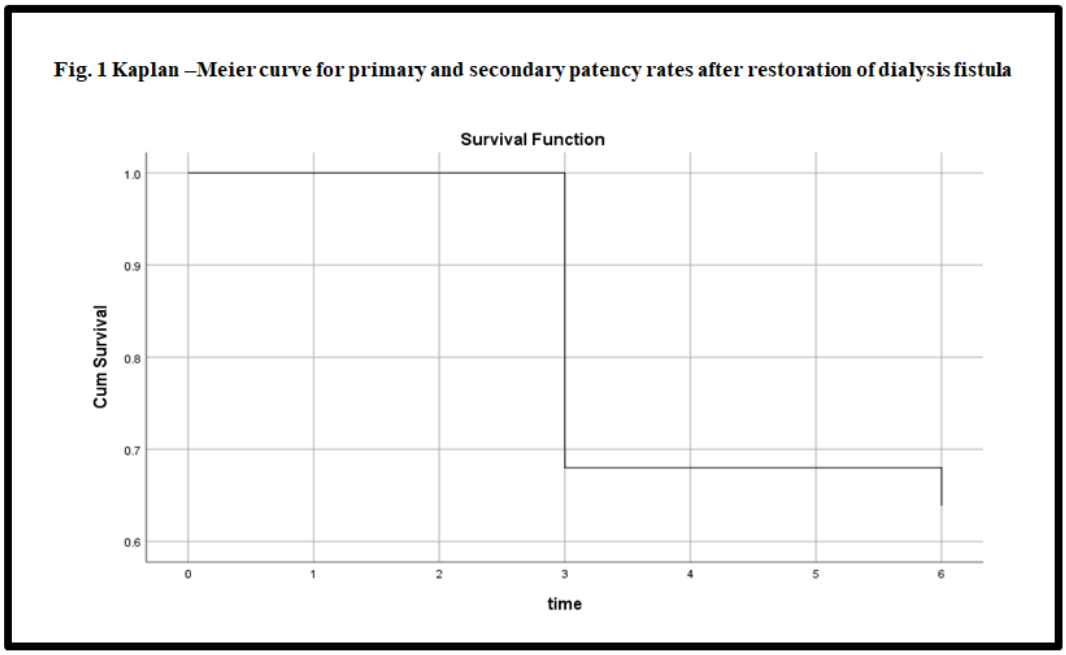

Figure 1: Kaplan-Meter curve for primary and secondary patency rates after restoration of dialysis fistula

DISCUSSION

In the past, dysfunctional arterio-venous fistulas were preserved by surgical methods. Today, the vast majority of dysfunctional fistulas are getting treated by interventional approaches. Percutaneous recanalization of arterio-venous fistulas can be achieved with local instillation of various thrombolytic drugs or percutaneous catheter-based balloon angioplasty or a combination of both. The success rates of these techniques are reported to be quite high in the range of 73% to 100%.
A study by Cho et al. used the pulse-spray technique with injection of urokinase for thrombolysis of the thrombosed arterio-venous fistulas. The results showed 75% technical and clinical success rates with primary and secondary patency rates of 64% and 71% at 6 months and 55% and 63% rates at 12 months, respectively. Another study by Rajan et al., who also used a similar technique, reported a 77% technical success rate with primary and secondary patency rates of 28% and 44% at 6 months and 24% and 44% rates at 12 months, respectively. Another study from Thailand by Boonsrirat et al showed an 85.7%

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technical and clinical success rates using a similar technique. The primary and secondary patency rates were 67% and 75% at 6 months and 50% and 67% at 12 months respectively [5-7].

All the above studies used a combination of local instillation of thrombolytic agents, mechanical thrombectomy and balloon angioplasty to achieve these excellent results. Unfortunately, these methods work out to be prohibitively expensive in a resource-limited setting. The costs come from the need of real-time radiological monitoring in a Cath-lab and the use of expensive consumables like the percutaneous catheter and balloon. Because of the costs involved, many of our patients refuse endo-vascular procedures, and instead opt for the surgical creation of a new vascular access, often in the opposite limb. Not only this is an avoidable surgical procedure, but also it uses up their limited resources for future vascular accesses, in case there are multiple access failures in the long-run. It was in this context that we started offering such patients our affordable improvised endo-vascular thrombolytic technique. By using ultrasound guidance and by eliminating balloon angioplasty we were able to significantly reduce the costs of our procedure. Despite these limitations, we could still achieve a re-canalisation rate of 68 percent with our technique. 60 percent of those fistulas remained patent at the end of 3 months and 40 percent at the end of 6 months. Apart from minor bleeding, this improvised procedure was not associated with any significant complications.

CONCLUSION

This study proves that the improvised endo-vascular technique we used to treat thrombosed arterio-venous fistulas achieved clinically acceptable success rates in terms of immediate re-canalisation as well as patency at 3 and 6 months. The fact that we could eliminate the need of balloon angioplasty and real-time radiological monitoring ensured that this success was achieved at a fraction of cost to that of conventional endo-vascular techniques. Thus, this improvised technique turns out as a promising alternative to more expensive interventions in a resource-limited sitting.

REFERENCES

1. Çildağ BM, Köseoğlu KÖ. Percutaneous treatment of thrombosed hemodialysis arteriovenous fistulas: Use of thromboaspiration and balloon angioplasty. Clujul Medical. 2017;90(1):66.
2. Boonsrirat U, Hongsakul K. Pharmacomechanical thrombolysis for the treatment of thrombosed native arteriovenous fistula: a single-center experience. Polish journal of radiology. 2014;79:363.
3. Burger H, Kluchert BA, Kootstra G, Kitslaar PJ, Ubbink DT. Survival of arteriovenous fistulas and shunts for haemodialysis. The European journal of surgery= Acta chirurgica. 1995 May 1;161(5):327-34.
4. Cho SK, Han H, Kim SS, Lee JY, Shin SW, Do YS, Park KB, Choo SW, Choo IW. Percutaneous treatment of failed native dialysis fistulas: use of pulse-spray pharmacomechanical thrombolysis as the primary mode of therapy. Korean journal of radiology. 2006 Jul;7(3):180.
5. Cho SK, Han H, Kim SS, Lee JY, Shin SW, Do YS, Park KB, Choo SW, Choo IW. Percutaneous treatment of failed native dialysis fistulas: use of pulse-spray pharmacomechanical thrombolysis as the primary mode of therapy. Korean journal of radiology. 2006 Jul;7(3):180.
6. Rajan DK, Clark TW, Simons ME, Kachura JR, Sniderman K. Procedural success and patency after percutaneous treatment of thrombosed autogenous arteriovenous dialysis fistulas. Journal of vascular and interventional radiology. 2002 Dec 1;13(12):1211-8.
7. Boonsrirat U, Hongsakul K. Pharmacomechanical thrombolysis for the treatment of thrombosed native arteriovenous fistula: a single-center experience. Polish journal of radiology. 2014;79:363.

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