

## Alternative Grafts for Brachioaxillary Hemodialysis access: Saphenous Vein Versus Synthetic Graft (Comparative Study)

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### Abstract

Many chronic renal patients lack autologous veins in the upper limbs suitable for construction of arteriovenous fistulas for hemodialysis. Alternative fistula options for these patients should be evaluated and compared. The point of this examination is to analyze incredible saphenous unite and polytetrafluoroethylene(PTFE) joins utilized for brachio-axillary access in hemodialysis patients as far as their patency and confusions rates. The investigation was an imminent randomized controlled examination included 60 patients with a clinical analysis of end-stage renal disappointment (ESRF) requiring hemodialysis. Thirty patients were worked upon by saphenous join for brachio-axillary shunt while the other thirty patients were worked upon by manufactured unite (PTFE) for brachio-axillary shunt. Patients remembered for this investigation were between the ages of 18 and 80 years. They were conceded or alluded to the general medical procedure office, vascular unit, with a conclusion of (ESRF) requiring hemodialysis. Patients were missing appropriate venous framework for characteristic AVFs in both upper appendages, or bombed recently done AVFs.; Enrollment of qualified patients was between March 2018 and February 2019. Follow up was intended for first, sixth and twelfth months term. The patients were randomized into 2 gatherings Group (I); by utilizing incredible saphenous vein as a brachioaxillary dialysis get to and Group (II); by utilizing PTFE unite as a brachioaxillary dialysis get to.

**Keywords:** Arteriovenous fistula, Renal dialysis, Saphenous vein, Polytetrafluoroethylene.

### 1. Introduction

An expanding number of patients with ceaseless kidney ailment relies upon hemodialysis and support of useful vascular access is a deciding variable of effective haemodialysis [1]. Optimal access with an autologous arteriovenous fistula (AVF) offers a sheltered way to deal with the patient, gives proper flow to hemodialysis, is related with low paces of inconveniences and mortality and includes lower costs [2].

The best option access for upper appendages is a radiocephalic AVF, in light of the fact that these are handily developed and have been related with scarcely any inconveniences, while brachiocephalic AVFs and different autologous veins are acceptable auxiliary decisions [3].

Be that as it may, in numerous patients it is difficult to utilize upper-appendage autologous veins for a few reasons, including singular anomalies of arteriovenous life structures, disappointment of past transposition fistulae, degenerative procedures coming about because of the basic illness, exorbitant past punctures of these veins and atherosclerotic procedures innate to diabetes or propelled age [4].

Elective strategies utilizing focal venous catheters have been created for circumstances in which autologous AVF is outlandish. In any case, notwithstanding the significant expenses engaged with keeping up these kinds of access, they are likewise connected with high paces of entanglements, bringing about continuous emergency clinic affirmations and extra bleakness among patients with ceaseless kidney ailment who require hemodialysis [5].

Other elective methods incorporate natural or prosthetic unions. The most well-known areas utilized for this system is the upper arm crossing over the brachial course to the axillary vein. Unions situated in the crotch circled between the shallow femoral conduit and proximal saphenous vein are exceptionally hazardous; as contamination is a typical inconvenience around there and

in the event that it happens it can truly imperil the appendage and the life of the patient too [6].

Both extraordinary saphenous vein (GSV) and extended polytetrafluoroethylene (PTFE) joins were proposed as alternatives and showed great transient outcomes as far as patency. Be that as it may, both were related with significant complexities (disease, apoplexy, seroma development, aneurysm and blood vessel ischemia) and not inconsistent impediments brought about by apoplexy as well as myointimal hyperplasia, prompting exorbitant dismalness and raised expenses [7].

Extraordinary saphenous vein join could be the best option in those patients with devoured or unacceptable upper appendage veins particularly in creating nations with restricted flexibility of PTFE because of monetary reasons and high pace of disease [8].

### 2. Patients & methods

An expanding number of patients with constant kidney illness relies upon hemodialysis and support of utilitarian vascular access is a deciding component of fruitful haemodialysis [1]. Optimal access with an autologous arteriovenous fistula (AVF) offers a protected way to deal with the patient, gives proper flow to hemodialysis, is related with low paces of inconveniences and mortality and includes lower costs [2].

The best option access for upper appendages is a radiocephalic AVF, on the grounds that these are effortlessly developed and have been related with not many entanglements, while brachiocephalic AVFs and different autologous veins are acceptable auxiliary decisions [3].

Be that as it may, in numerous patients it is difficult to utilize upper-appendage autologous veins for a few reasons, including singular irregularities of arteriovenous life systems, disappointment of past transposition fistulae, degenerative procedures coming about because of the fundamental illness, exorbitant past punctures of these

veins and atherosclerotic procedures innate to diabetes or propelled age [4].

Elective strategies utilizing focal venous catheters have been produced for circumstances in which autologous AVF is outlandish. Nonetheless, notwithstanding the significant expenses engaged with keeping up these kinds of access, they are likewise connected with high paces of entanglements, bringing about regular medical clinic confirmations and extra dreariness among patients with incessant kidney malady who require hemodialysis [5].

Other elective procedures incorporate natural or prosthetic unions. The most well-known areas utilized for this methodology is the upper arm crossing over the brachial supply route to the axillary vein. Unions situated in the crotch circled between the shallow femoral corridor and proximal saphenous vein are hazardous; as contamination is a typical inconvenience around there and in the event that it happens it can truly jeopardize the appendage and the life of the patient also [6].

Both extraordinary saphenous vein (GSV) and extended polytetrafluoroethylene (PTFE) unites were proposed as choices and displayed great momentary outcomes as far as patency. Be that as it may, both were related with significant difficulties (contamination,

apoplexy, seroma development, aneurysm and blood vessel ischemia) and not inconsistent impediments brought about by apoplexy as well as myointimal hyperplasia, prompting unreasonable dreariness and raised expenses [7].

Extraordinary saphenous vein join could be the best option in those patients with devoured or unacceptable upper appendage veins particularly in creating nations with restricted gracefulness of PTFE because of monetary reasons and high pace of disease [8].

#### Statistical analysis

The collected data were tabulated and analyzed using SPSS version 19 software (SpssInc, Chicago, ILL Company). Categorical data were presented as number and percentages, Chi square ( $\chi^2$ ) and Fisher's exact tests were used to analyze them. Quantitative data were tested for normality using Shapiro-Wilks test assuming normality at  $P > 0.05$ . Normally distributed variables were expressed as mean  $\pm$  standard deviation and analyzed by Student "t" test for 2 independent groups, while non parametric data were presented as median and inter-quartile range (IQR), and analyzed by Mann Whitney U (ZMWU) test.  $P \leq 0.05$  was considered significant,  $P$  value  $> 0.05$  is non significant (NS),  $P \leq 0.001$  is highly significant (HS).



**Fig (1)** GSV harvesting



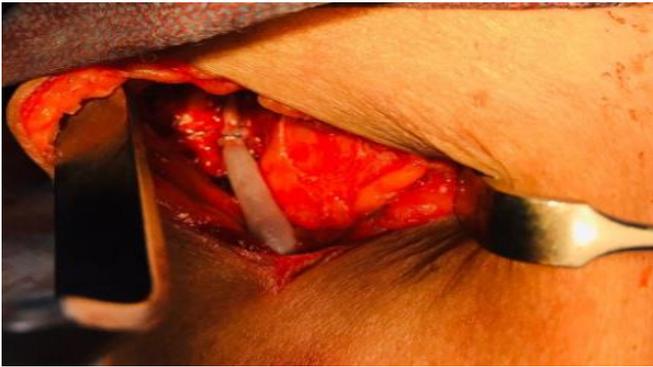
**Fig (2)** Brachial artery exposure above cubital fossa



**Fig (3)** axillary vein exposure and cannulation



**Fig (4)** GSV anastomosed to brachial



**Fig (5)** GSV anastomosed to axillary vein



**Fig (6)** PTFE graft tunneled and appear through the 2 incisions



**Fig (7)** PTFE graft anastomosed to axillary vein



**Fig (8)** PTFE graft anastomosed to brachial artery

### 3. Results

The current prospective randomized controlled study included 60 patients with a clinical diagnosis of end-stage renal failure (ESRF) requiring hemodialysis and randomization was done by card test and was single-blinded. Thirty patients were operated upon by saphenous graft for brachio-axillary shunt (group I) while the other thirty patients were operated upon by synthetic graft (PTFE) for brachio-axillary shunt (group II).

As regard Age, all patients had Age range from  $(50.8 \pm 2.5)$  in group I and  $(52.1 \pm 3.2)$  in group I. Other sociodemographic data can be showed in Table (1).

Four patients of group (I) and 3 of group (II) were given ASA score 4 and the rest of patients were given ASA score 3. There was no significant difference could be detected between both groups with P-Value  $>0.05$ . In group (I), local anaesthesia as only type of anaesthesia was used in 10(33.3%) patients, local and spinal anaesthesia are used in 14(46.7%) patients, supraclavicular block with spinal anaesthesia are used in 6(20%) patients. In group (II), local anaesthesia as only type of anaesthesia was used in 22(73.3%) patients, supraclavicular block is used in 8(26.7%) patients. There was significant difference in type of anaesthesia could be detected between both groups with P-Value  $>0.05$ .

Mean total operation time was  $120.7 \pm 9.51$  minutes and  $91.0 \pm 2.04$  minutes for the saphenous and synthetic group respectively that showed significant statistical difference (p value  $<0.001$ ). The time for graft maturation was within a mean interval of  $39.9 \pm 7.71$  days and  $14.0 \pm 2.04$  days after the intervention for the saphenous and synthetic group respectively that showed significant statistical difference (p value  $<0.001$ ). Median blood loss was 200 ml and 125 ml in saphenous and synthetic group respectively which is statistically significant (p value  $<0.001$ ). There was no significant difference could be detected between both groups in hospital stay with P-Value  $>0.05$ .

As regard complications, in group (I) graft thrombosis in group (I) occurred in eight cases (26.6%) within 1-month, surgical thrombectomy was done for seven cases and regained patency in one case and failed in six cases and 1 case refused the procedure. Further thrombosis in four cases (13.3%) at 6 months follow up had occurred for which surgical thrombectomy was done and regained patency in 1 case only. At 12 months follow up further thrombosis has occurred in three cases (10%) in which failed the trial of surgical thrombectomy.

On the other hand, in group (II) graft thrombosis had occurred in three cases (10%) within 1 month, for which thrombectomy was done and regained patency in one case

,three cases of further thrombosis within 6 months with failure of trial of thrombectomy to regain patency(one case associated with pseudoaneurysm and infection so graft is removed) and another three cases at 12 months follow up and thrombectomy was successful in two out of the three cases.

Postoperative Hematoma (within 1st month) occurred in three (10%) cases in group I and two cases (6.7%) in group II and all of them were grade 2 and treated conservatively except a case in group I which needed open drainage (grade 3). Puncture site hematomas occurred in group I in three cases (10%) in 6 months (2 of them grade 1 and treated conservatively and a case of grade 4 hematoma associated with pseudoaneurysm and required ligation of the fistula)and then in two cases(grade 1) (6.7%) at 12 months compared to 4(13.3%)(3 of them grade 1 and a case of grade 4 associated with infection which caused loss of the graft) and two(6.7%)(case of grade 1 and another of grade 4 associated with infection and caused loss of the graft) cases in group II at 6 and 12 months respectively with no statistical difference (P value >0.05).Postoperative seroma occurred in four(13.3%) and five(16.7%) cases in group I and II respectively.

Two cases of infection in group 1 required ligation of the graft(grade 2) (1 at 1 month and the other at 12 months) and 3 cases of GSV harvesting(grade 1) wound infection has required antibiotics and dressing , on the other hand three cases of graft infection(grade 2)(1 at 1 month , 1 at 6 months and the last one at 12 month follow up)are observed in group 2 and required graft removal and three cases of superficial wound infection(grade 1) treated by antibiotics and daily dressing. A case of venous aneurysm occurred in group (I) after 5 months which required surgical revision with use of interposition graft.

Three cases with pseudoaneurysm were observed in group 1 at 1 month follow up,two cases of pseudoaneurysm development associated with infection and bleeding had occurred at 6 and 12 months follow up which required ligation of fistula. In group II pseudoaneurysm in a case in the 1st month postoperatively with no intervention needed, while other two cases at 6 and 12 months follow up had needed removal of the graft due to pseudoaneurysm associated with infection and recurrent bleeding.

Steal is observed in two cases of group 1, and three cases in group II .Venous hypertension in a case of group 1 and two cases in group II is observed postoperatively as upper limb edema during and after dialysis but resolved spontaneously, except a case in group II needed PTA due to central venous stenosis and. Ischemic monomelic neuropathy has occurred in a case of saphenous group and required immediate ligation of the fistula.

Primary patency rate is higher in group II as it was 86.7%,76.7 and 63.3% at 1, 6 and 12 months in comparison to 66.7%, 53.3% and 40% in group I however it isn't statistically significant.

Assisted primary patency rate is also higher in group II as it was 86.7%,76.7 and 70% at 1, 6 and 12 months in group II in comparison to 66.7%, 53.3% and 40% in group I however it isn't statistically significant in 1 and 6 months follow up but significant in 12 months follow up (P value< 0.05).

Secondary patency rate is higher in group II as it was 90%,80 and 73.3%at 1, 6 and 12 months in group II in comparison to 70%, 60% and 46.7% in group I however it isn't statistically significant at 1 and 6 months follow up but significant at 12 months follow up (P value< 0.05). arter

**Table (1)** show sociodemographic data and ASA score of studied groupsVariable

		Group I (n=30)		Group II (n=30)		St."t"	P
Age (ys)	Mean±SD	50.8±2.5		52.1±3.2		1.8	0.077 (NS)
	Range	47-55		48-61			
Gender		No.	%	No.	%	$\chi^2$	P
	Male	18	60.0	17	56.7		
	Female	12	40.0	13	43.3		
<b>Table (1) Continue</b>							
Clinical data		No.	%	No.	%	$\chi^2$	P
DM		5	16.7	7	23.3	0.42	0.52 (NS)
HTN		8	26.7	6	20.0	0.37	0.54 (NS)
IHD		3	10.0	4	13.3	FET	1.0 (NS)
Smoking		5	16.7	6	20.0	0.11	0.74 (NS)
ASA score	3	26	86.7	27	90.0	FET	1.0 (NS)
	4	4	13.3	3	10.0		

**Table (2)** Comparison between the studied groups regarding time taken for graft maturation, operative time, blood loss, and hospital stay.

Variable	Group I (n=30)			Group II (n=30)			St. 't'	P
	Mean	± SD	Range	Mean	± SD	Range		
Hospital stay (days)	1.0	1-2	1-3	1.0	1-1	1-2	1.0	0.32 (NS)
Time for graft maturation (days)	39.9	7.91	27-53	14.0	2.04	10-18	17.3	<0.001 (HS)

Table (2) Continue

Operative time (min.)	120.7	9.51	100-140	91.0	10.07	75-110	11.7	<0.001 (HS)
	Median	IQR	Range	Median	IQR	Range	Z <sub>MWU</sub> test	P
Blood loss (ml)	200.0	150-250	100-300	125.0	100-150	100-250	4.45	<0.001 (HS)

Table (3) comparison between the studied groups regarding graft thrombosis.

Variable	Group I (n=30)		Group II (n=30)		$\chi^2$	P
	No.	%	No.	%		
Thrombosis at 1 m	8	26.7	3	10.0	2.78	0.095 (NS)
Further thrombosis at 6 m	4	13.3	3	10.0	FET	1.0 (NS)
Further thrombosis at 12 m	3	10.0	3	10.0	FET	1.0 (NS)

Table (4) Comparison between the studied groups regarding access failure and patency rates 1ry, assisted 1ry, 2ry).

Variable	Group I (n=30)		Group II (n=30)		X <sup>2</sup>	P	
	No.	%	No.	%			
Access failure	At 1 m	9	30.0	3	10.0	3.75	0.053 (NS)
	At 6 m	12	40.0	6	20.0	2.85	0.091 (NS)
	At 12 m	15	50.0	8	26.7	3.46	0.063 (NS)
Primary patency	At 1 m	20	66.7	26	86.7	3.35	0.067 (NS)
	At 6 m	16	53.3	23	76.7	3.59	0.058 (NS)
	At 12 m	12	40.0	19	63.3	3.27	0.071 (NS)
Assisted primary patency	At 1 m	20	66.7	26	86.7	3.35	0.067 (NS)
	At 6 m	16	53.3	23	76.7	3.59	0.058 (NS)
	At 12 m	13	43.3	21	70.0	4.34	0.037 (S)
Secondary patency	At 1 m	21	70.0	27	90.0	3.75	0.053 (NS)
	At 6 m	18	60.0	24	80.0	2.85	0.091 (NS)
	At 12 m	14	46.7	22	73.3	4.44	0.035 (S)

#### 4. Discussion

Simple access to the vascular framework is fundamental in patients with End Stage Renal Disease (ESRD) who need long haul haemodialysis [9]. The accessibility of dialysis and long haul endurance of patients with ESRD has significantly expanded. Patients who require long haul hemodialysis additionally need long haul vascular access. The essential utilization of autologous AVF is suggested by the NKF-DOQI practice rules [10]. The highest quality level in VA remains the local distal or proximal fistula, with or without veins transposition. The fundamental variables considered for the decision of a vascular access are the ability to accomplish a long patency time and shirking of confusions, for example, diseases, apoplexy and pseudoaneurysm arrangement [11].

Using the GSV as a unite between the supply route and vein has been stimulated in 1973 by Adar et. al utilizing cadaveric saphenous veins, in spite of the fact that he accomplished a sensible patency rate (as high as 70% following 1 year contrasted with essential patency of 80% at end of 1 year in our investigation), the unions would in general create aneurysm because of unite immunogenicity and join degeneration [12]. and this

inconvenience was excluded from our examination since we utilized autogenous saphenous vein.

In 1974 Haimov et al, used the autogenous saphenous vein unite in examination with the ox-like heterograft and found that the cow-like heterograft was exorbitant, had propensity to join degeneration and aneurysm arrangement, and higher disease hazard in correlation with autogenous saphenous join [13] and this outcome about contamination rate matches with the outcomes in our investigation where there was just two instances of contamination (2 out of 30) in the saphenous gathering (6.6%) in light of the fact that we utilized autogenous saphenous vein contrasted with 2 instances of disease (2 out of 20 cases in the autogenous gathering of Haimov et al study (10%)).

Ramacciotti et al. depicted the consequences of brachioaxillary AVF with SV joins in nine patients and contrasted them and results for 10 patients who got PTFE unites. The SV unites showed better patency rates and lower entanglement rates and disease was just seen with PTFE joins. Likewise, the creators expressed that utilizing reversed SV includes more noteworthy specialized trouble, despite the great present moment and long haul results and the nonappearance of disease [14]. However, in our investigation better patency rates and

lower inconvenience rates were seen with the manufactured join gathering.

Likewise, in the current examination, the ideal opportunity for join development was inside a mean time frame 7.71 days and  $14.0 \pm 2.04$  days after the mediation for the saphenous and manufactured gathering separately, it was longer than Schild et al [15].,concentrate in which all patients had the option to cannulate the engineered unite inside 72 hrs postoperative , however coordinating with different investigations suggested that most polytetrafluoroethylene unites develop 2-3 weeks before use [16].

Essential patency rate is fundamentally influenced in smokers in bunch II as patency rate in non-smokers was 95.8 % at multi month and 75% at a year while it was half and 16.7% in smokers at 1 and a year. This matches with Monroy-Cuadros et al. concentrate in which smokers were 3.7 occasions bound to encounter essential utilitarian patency disappointment [22]. The immediate connect to AVF disappointment was first depicted by Wetzig et al, [18] who announced an altogether higher occurrence of ahead of schedule and late fistula disappointment in patients who were cigarette smokers, discoveries that have since been affirmed by different examinations [17,19].

Patients matured more youthful and more seasoned than 50 years, in our investigation had no noteworthy contrast could be distinguished in patency rates in the two gatherings with P-Value  $>0.05$ .In Cinat et al. study ,more established patients ( $>60$  years old) had a measurably huge increment in essential patency rate at 1 year contrasted and more youthful patients (60 years or less), with unite endurance of 56% versus 29% ( $p < 0.05$ )(20)and this discovering underpins information announced in an enormous review audit by Kennedy et al. where old patients additionally had improved unite patency. The component for this is muddled. Maybe more youthful patients with beginning stage renal disappointment have increasingly forceful vascular and fundamental sickness inclining them to early unite apoplexy and diminished join patency [21].

Mean all out activity time in our investigation was  $120.7 \pm 9.51$  minutes and  $91.0 \pm 2.04$  minutes for the saphenous and engineered bunch individually that indicated critical factual contrast ( $p$  esteem  $<0.001$ ) and this matches with Oto et al. concentrate in which the all out working time of the SV bunch was altogether longer than that of the PTFE gathering ( $108.2 \pm 7.3$  versus  $73.1 \pm 3.1$  min,  $p < 0.0001$ ) [22].

Schneider et al. depicted 309 instances of AVF made utilizing a wide range of benefactor conduits and receptor veins in upper appendages with rationed SV unites, demonstrating that essential and auxiliary patency rates were like those revealed in the writing on prosthetic unions [23]. In a gathering of 70 patients whose AVF included various locales in upper appendages and utilized monitored SV or prosthetic unions (Gore-Tex), Mousavi et al. watched no distinctions in useful standards, patency rates, or event of apoplexy yet they reported an essentially higher recurrence of disease in patients

rewarded with prosthetic grafts [24] which coordinate with our investigation as 3 unions (10%) has been tainted , however in our examination , there is a contrast between the two gatherings regarding patency and join apoplexy .

In our investigation, essential, helped essential and optional patency is higher in manufactured gathering than saphenous gathering. Essential patency rates were 86.7%,76.7% and 63.3% at 1, 6 and a year in manufactured gathering contrasted with 66.7%,53.3% and 40% in saphenous gathering. Helped essential patency rate is likewise higher in engineered bunch as it was 86.7%,76.7 and 70%at 1, 6 and a year in manufactured gathering in contrast with 66.7%, 53.3% and 40% in saphenous gathering. Auxiliary patency rate is higher in manufactured gathering as it was 90%.80 and 73.3%at 1, 6 and a year in engineered bunch in contrast with 70%, 60% and 46.7% in saphenous group.In differentiate Uzun et al.(25)study has indicated that saphenous vein intervention (SVI) bunch fistula disappointment was seen in 5 of 29 patients (17.2%). Essential patency rate was 93% in twelfth month and 82% in 24th month. In PTFE gathering, arteriovenous fistula disappointment was seen in 13 of the 25 patients (52%). Essential patency rate was 88% in twelfth month and 56% in 24th month. As indicated by the Kaplan-Meier strategy, mean time of essential patency was fundamentally higher in SVI bunch when contrasted with PTFE gathering [25].

In our examination, in gathering (I) join apoplexy in gathering (I) happened in eight cases (26.6%) inside 1-month, further apoplexy in 4 cases (13.3%) at a half year development ,at a year follow up further apoplexy has happened in three cases (10%) with complete 15 cases(50%) of unite apoplexy in 1 year follow up.In gathering (II) unite apoplexy had happened in three cases (10%) inside multi month ,three instances of further apoplexy inside a half year and another three cases at a year catch up with an absolute 9 cases (30%).SV join apoplexy matches with Bosman et al [26]. concentrate in which SV join apoplexy has happened in 56% in one year , yet PTFE unite apoplexy in our examination is less as apoplexy has happened in Bosman et al, concentrate in 53%.

It is notable that contamination is essentially less successive (2%-3%) in AVFs made utilizing autologous veins, while PTFE joins are related with confusion paces of 11% to 35% in hemodialysis AVFs [27]. In our examination the pace of join contamination in the engineered bunch was 10% (3 out of 30 cases) and this rate matches with the pace of disease in the prosthetic unite in numerous investigations that ranges from 10% to 20% [28,29] ,while join contamination in saphenous bunch was 6.66%(2 out of 30 cases). Bonnaud et al. revealed a 12% genuine disease rate with PTFE joins contrasted with a 2% rate with SV unites [30]. It is significant that arteriovenous join diseases can result from a few hazard factors. In hemodialysis patients, an immunological state including debilitated neutrophils, renal brokenness with uremia and proceeded with utilization of the AVF, giving expected access to microscopic organisms, are extremely significant hazard

factors for joint disease. Stoutness, diabetes, hyperalbuminemia, and lacking individual cleanliness are likewise chance variables for disease [31].

In our examination our choice to utilize saphenous vein as a unite between brachial conduit and axillary vein for angioaccess depended on numerous variables, for example, the unmistakable perception that autogenous AVF had substantially less complexities than after engineered join [32], the way that a significant number of the Egyptian patients live in open country (for the most part causing relative high danger of contamination), restricted flexibility of PTFE (in light of its relative significant expense) and awful notoriety of the lower appendages as a site of unite for hemodialysis because of high danger of disease and ischemia and hazard on life of both the appendage and even life.

### 5. Conclusion

The ideal answer for hemodialysis patients with two-sided depleted or unacceptable upper appendage shallow veins incorporating basilic vein in Egypt stays unclear because of relative significant expense of extended polytetrafluoro-ethylene (PTFE) and high defenselessness to contamination because of aseptic conditions during haemodialysis and terrible patient cleanliness. Brachio-Axillary translocated extraordinary saphenous vein could be an appealing thought as an option in contrast to manufactured join yet with lower patency rate and higher pace of confusions, so it ought to be saved as the last choice in upper appendage hemodialysis access before utilizing lower appendage, focal venous access as HERO gadget or peritoneal dialysis.

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