

# Comparative Analysis Of Vascular Access For Haemodialysis In End-Stage Renal Disease In A Developing And Developed Country.

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## Abstract

Background: End Stage Renal disease (ESRD) is an important and growing medical problem all over the world especially in developing countries. Securing adequate vascular access is an essential part of managing affected patients. Objectives: To compare vascular access routes for haemodialysis in a developed and developing country setting. Method: Case notes were studied for information on age, gender, vascular access routes at University of Nigeria teaching hospital (UNTH) from January to July 2000. Operation lists and case notes used at Texas Heart Institute (THI) from October 2005 to March 2006 were reviewed to provide the above information. The findings were compared. Result: One hundred and fifty nine and Ninety four patients at THI and UNTH respectively were studied. There was similar gender pattern among patients seen at both institutions. The mean age in years of patients with ESRD requiring haemodialysis was lower at UNTH ( $44.6 \pm 17.1$  as against  $56.2 \pm 14.8$  in THI),  $p < 0.001$ . Direct femoral vein cannulation was the main vascular access route in UNTH (93.6%), whereas left hand arteriovenous graft (AVG) was the commonest route at THI (34.6%). Conclusion: We conclude that the prevalent vascular routes differ in these two centers with THI having a well established renal replacement protocol. The important challenges at UNTH include inadequate manpower, general poverty of the patients, lack of vascular access creation materials and unavailability of organized health policy for patients with ESRD in Nigeria. These problems are common in most developing countries.

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## INTRODUCTION

End Stage Renal Disease (ESRD) is a significant and growing medical problem in the United States of America<sup>1</sup> and indeed all over the world, especially in the developing countries such as Nigeria<sup>2</sup>. Securing vascular access is an essential part of any haemodialysis (HD) programme. In December 31, 1999, the point prevalence of patients with ESRD receiving HD was 209,637 and this number increased by approximately 4.2% per year between 1995 and 1999<sup>3</sup>. The first arteriovenous fistula (AVF) constructed for haemodialysis access was created by Kenneth Apple in February 1965 at the Bronx Veterans Administration Hospital in collaboration with James Cimino, and Nephrologists Michael Brescia and Baruch Hurwich<sup>4</sup>. Before this, dialysis access was possible only by direct needle cannulation of large vessels or by a Scribner external

vascular shunt.

End stage renal failure patients requiring long term haemodialysis need a durable vascular access. Various types are available. This study compares what obtains in a typical Nigerian setting, a resource challenged environment with that of an institution in the United States of America.

## METHODS

This study was a comparative retrospective one examining the route of vascular access for chronic haemodialysis in the University of Nigeria Teaching Hospital (UNTH), Enugu and Texas Heart Institute (THI), Houston, USA. One of the authors was on a one year clinical cardiovascular surgery fellowship at the THI. This offered the opportunity to obtain data from THI. From UNTH relevant information which included age, gender, vascular access type and vessels used were obtained from the case notes of the patients involved in the study. The period studied at THI was from October 2005 to March 2006, while at UNTH, January to July 2000. Acute

cases that required emergency dialysis through any available access route were not included in this study. THI was using cannulation of left subclavian, right internal jugular or femoral vein as the case may be for these cases.

Data analysis was done using the statistical package for social sciences (SPSS) version 17.0. Comparison of proportions was done using the chi-square test( $\chi^2$ ). Continuous variables were compared using the Analysis of Variance (ANOVA). P value <0.05 was considered statistically significant.

## RESULTS

Within the period of study, a total of 159 and 94 patients with ESRD were seen at THI and UNTH respectively.

The mean age of patients with ESRD undergoing haemodialysis was significantly higher in THI than UNTH ( $56.2 \pm 14.8$  and  $44.6 \pm 17.1$ ,  $p < 0.001$ ). The age range was 18 – 88 years in Texas and 13 – 83 years in Enugu. There was no gender difference between patients seen at both centers (Table I).

**Figure 1**

Table I. Characteristics of study population

Characteristics	UNTH	THI	F	p
Number	94	159		
Mean Age(years)	$44.6 \pm 17.1$	$56.2 \pm 14.8$	32.9	<0.001
Age range(years)	13 - 83	18 - 88		
Gender (Number, %)				
Female	34(36.2)	70(44.0)	$\chi^2 = 0.24$	0.14
Male	60(63.8)	89(56.0)		

Right femoral vein cannulation was the commonest type of vascular access route in Enugu, Nigeria (93.6%) while left hand Arteriovenous Graft (AVG) was the commonest vascular access route in Texas (34.6%), Tables IIA and B.

**Figure 2**

Table II. Vascular Access Types. II A. UNTH, ENUGU NIGERIA

Access Type	Number (%)
Right Femoral Vein Cannulation	88(93.6)
Left Femoral Vein Cannulation	2(2.1)
Bilateral Femoral Vein Cannulation	2(2.1)
Left Arm Fistula	2(2.1)
Total	94(100)

**Figure 3**

Table IIB. TEXAS HEART INSTITUTE (THI), HOUSTON, USA.

Access Type	Number (%)
Left hand graft	55(34.6)
Left hand fistula	32(20.1)
Right hand graft	14(18.8)
Right hand fistula	11(6.9)
Left femoral graft	8(5.0)
Right femoral graft	2(1.3)
Unclassified(missing data)	37(23.3)
Total	159(100)

Out of the 159 patients who had vascular access within the stated period at THI, 27(17%) had revision of their vascular access for various reasons. Left hand graft and right hand fistula were the commonest revision sites each accounting for 18.5% respectively, (Table III).

**Figure 4**

Table III. Vascular Access for Revised Cases (THI).

Access Type	Number (%)
Left hand graft	5(18.5)
Right hand fistula	5(18.5)
Left hand fistula	4(14.8)
Left femoral graft	2(7.4)
Unavailable(missing) data	9(33.3)

Plain revision of the vascular access was the commonest procedure for the revised cases accounting for 77.8%, followed by ligation procedure which accounted for 14.8%. Exploration/revision and revision/thrombectomy accounted for 3.7% respectively of revision procedures, (Table IV).

**Figure 5**

Table IV. Procedure for revised cases.

Procedure	Number (%)
Revision	21(77.8)
Ligation	4(14.8)
Exploration/Revision	1(3.7)
Revision/Thrombectomy	1(3.7)
Total	27(100)

## DISCUSSION

End stage renal disease (ESRD) remains a significant and growing medical problem all over the world. Before the advent of dialysis, the prognosis was uniformly poor. Invention of dialysis therapy has changed the history of this disease. Securing vascular access is an essential part of any haemodialysis programme. Before the landmark publication of Brescia et al<sup>5</sup> in 1966, dialysis access was possible only

by direct needle cannulation of large vessels or by Scribner external vascular shunt. During the following decades, various vascular access procedures have been used, such as variations of more proximal and complex fistulas, snuff-box fistulas, trans-positions, vascular grafts ( both synthetic and biologic) implantable access devices, shunts, catheters, and more.<sup>6-8</sup>

In this study for chronic haemodialysis in these two centers, the utilization of access routes were compared. More people utilized these facilities in a developed country setting (Texas, USA). The underdeveloped country setting ( Enugu, Nigeria) still depend more on direct femoral vein cannulation while in the developed country setting, grafts and fistulas are more commonly used.

There are several reasons for these discrepancies in the utilization of vascular access route in the developing world like Nigeria. There is a dearth of appropriate technology and materials for vascular surgery. Poverty, ignorance, and relative high cost of treatment are also additional factors. Where manpower and other materials are available, poor quality vessels in limbs make surgery difficulty resulting in high failure rates. Most of the vessels were destroyed due to repeated venipuncture prior to surgery.

Unites States of America (USA) has a renal data system that shows situation report of the disease<sup>9</sup>. This data shows in atlas form as well as in writing what need to be known thereby keeping the country aware of what is happening. There is nothing like that in Nigeria and most countries in sub-Saharan Africa. Our government is yet to buy the idea of including treatment of ESRD in the National Health Insurance Scheme or set up a committee to study the prevalence of ESRD among our population of over 150 million people.

The patients with ESRD in Enugu, Nigeria were younger at presentation. This is likely due to aetiological factors such as infective processes leading to chronic glomerulonephritis. These are important causes of ESRD<sup>2, 10, 11</sup> in developing world than in the United States where diseases like diabetes mellitus is the commonest cause.<sup>12</sup> It is also known that life expectancy is shorter in developing countries.

With the availability of advanced technology, guided venous cannulation under fluoroscopy has become the order of the day in developed countries<sup>13</sup>. Fluoroscopy during and after catheter placement allows accurate placement of the catheter

tip and ensures that the catheter is not kinked. Ultrasound guidance is the standard of care for all haemodialysis catheter insertions, but this is not so in Nigeria. The radiology unit in our hospital needs to be involved. Ultrasound –guided catheter placement in the internal jugular vein increased success rate, decreased complication rates and reduced catheter associated infections<sup>13</sup>. More arteriovenous graft (AVG) and arteriovenous fistula (AVF) were done in a developed country setting (Texas, USA). This is because there is a good and well organized haemodialysis programme already integrated into the health system of the country. The cost of providing this treatment is high, but health insurance scheme which is hardly available or functional or comprehensive enough in developing countries, help to relieve the patients the financial burden in developed countries. The minimum wage in Nigeria is \$100, while the cost of haemodialysis in Nigeria is between \$100 to \$200. The cost implication for the average patient with ESRD becomes very clear.

In both centers, more males were undergoing haemodialysis treatment although this is not statistically significant. The reason for this is not easily known. Could it be that more males are utilizing haemodialysis services or does it have to do with cultural orientation? There could be individual patient factors (such as morbidity), physician based factors, and patient factors that have to do with traits and cultural factors<sup>14</sup>. Coordinated effort is needed to handle this issue.

Direct venous cannulation of the right femoral vein was the commonest vascular access route in Enugu, Nigeria. It can be used for emergency haemodialysis but it is not suitable for chronic haemodialysis. The complications of haematoma and pseudoaneurysms are high with direct venous cannulation. Double lumen catheterization of the internal jugular or subclavian vein was the procedure of choice in Texas during emergency situations and before the maturation of AVF or AVG. it is most times introduced under fluoroscopic guide. Chan et al<sup>15</sup> has reviewed catheter use and provided comprehensive update of tunneled haemodialysis catheters, their necessity and pitfalls, and novel direction for future investigations.

Left upper limb access routes which were either grafts or fistulae form the main sites for haemodialysis access in Texas. This is most likely because of the dominant nature of the right upper limb. Use of the left upper limb leaves the patient with a non-restricted functional upper limb. In Enugu, Nigeria, these routes were hardly utilized. Current

guidelines recommend native AVF as the vascular access of choice for haemodialysis on account of the lower incidence of complications<sup>16</sup>. The fistula access, while at times less successful in the immediate short term, is always the preferred long-term access type because of its greater longevity, fewer interventions for maintenance, and lower infection rates.

Grafts and fistulas could develop problems needing revision. In the Texas situation, 18.5% of left hand graft and right hand fistula cases respectively were revised, while 14.8% of left hand fistulas needed revision. Early failure of AVF occurs mainly in forearm sites among women and diabetic patients. Surgical expertise has also a significant influence<sup>17</sup>. The probability of primary failure is strongly related to the centre of access creation, suggesting an important role for the vascular surgeon's skills and decisions<sup>18</sup>.

AV fistula surgery requires use of size 6-0 or 7-0 prolene suture and surgical loop for clearer vision. This loop has never been used at UNTH; Enugu before this study and as a result of this and other technical problems, the outcome for AVF has not been good. The surgeon should focus on sites distally on the extremity; reserving proximal sites for potential future access insertions should initial access site fail<sup>16</sup>. Arterio-venous grafts have some advantages in the guideline. Synthetic materials were used throughout in all the cases at THI. While the majority of past experience with prosthetic grafts has been with the use of Polytetrafluoroethylene (PTFE), other prosthetics (e.g. polyurethane) and biological conduits (bovine) have been used recently with similar outcomes. The choice of synthetic or biological material should be based on the surgeon's experience and preference. The choice of synthetic or biological conduits should consider local experience, technical details, and cost.

## **CONCLUSION**

This study demonstrated that younger patients were affected by ESRD in Enugu, Nigeria compared to Texas, USA. The most common access route in Enugu for haemodialysis was repeated femoral vein cannulation which is not only crude but also not a permanent measure. This is likely to be the situation in most poor resource environment. Poverty, unavailability of comprehensive health insurance package, unavailability of vascular access creation materials and adequately trained doctors to perform the required surgery are important factors determining the vascular access route.

This calls for government, institutional, pharmaceutical and people with philanthropic disposition to come to the rescue in these resource challenged environments where the incidence of chronic kidney disease is rising dangerously.

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