A STUDY OF FLOW AND SITE OF ARTERIOVENOUS FISTULA ON LEFT VENTRICULAR FUNCTIONS AND DIAYSIS ADEQUACY INHAEMODIALYSIS PATIENTS
Al Sayed M Rashed and Mohamed A. Shazly
Departments of Internal Medicine and Radiodiagnosis, Al-Hussien University Hospital, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

ABSTRACT
Background: Congestive heart failure (CHF) is common among patients with haemodialysis (HD). Patients with chronic kidney disease (CKD), HD and CKD have a worse prognosis. As hemodynamic stability is a target for managing patients with end stage renal disease (ESRD) as well as with CHF. Creation of AVFs was noted to be associated with an apparent increase in cardiac output (CO), AVF leads to shunting of blood from high resistance arterial system to low resistance venous system with subsequent increase in venous return and CO. Aim of the study: to evaluate the effect of AVFs site and flow on left ventricular functions and also on HD adequacy. Patients and Methods: 80 patients with chronic renal failure (CRF) on regular HD via native AVF at dialysis unit of Al-Hussien University Hospital. They were divided into two groups: Group I with high flow AVF and Group II with normal flow fistula. Also Group I was subdivide into Groups IA and IB according to AVF sites. All patients were subjected to full history taking, clinical examination, complete blood count, blood urea, serum creatinine, serum calcium, serum phosphorus, fasting blood glucose, lipid profile, aspartate transaminase, alanine transaminase, urea reduction ratio (URR), online ktV, Duplex ultrasound of AVF and two dimensional M-mode echocardiography. Results: As regard echocardiographic parameters there were statistically significant increase in mean stroke volume (153.30 ± 27.87 vs 78.38 ± 8.2), left ventricular mass (LVM) (255.65 ± 68.73 vs 206.97 ± 18.91), left ventricular mass index (LVMPI) (174.87 ± 27.08 vs 137.53 ± 12.94) in group I than group II; but there were significant decrease in ejection fraction (EF) (50.21% ± 6.12% vs 56.87% ± 3.75%), fraction shortening (FS) (35.06 ± 11.68% vs 28.7 ± 11.9%) in Group I than Group II respectively. The comparison showed highly significant increase in LVM, LVMPI, EF and FS in group IA than IB, the results revealed positive correlation between access blood flow and LVMPI, also there was a positive correlation between access blood flow and stroke volume. Regarding URR, there were no statistically significant differences between group 1 (1A: 61.5 ± 15.2, 1B: 63.1 ± 10.4) and group 2 (57.1 ± 11.6), finally there were significant differences between group 1 (A, B) and group 2 regarding kTV (1.2 ± 15.2, 1.22 ± 0.3, 1.01 ± 0.2) respectively. Conclusion: High flow and upper arm AVFs (Proximal one) have greater risk for developing high CO failure inspite of increased dialysis adequacy with high flow fistula.

Keywords: AVFFlow, site, Ventricular, Dialysis adequacy.

Correspondence: ALSayed M Rashed, MD.
Lecturer of internal medicine, ALAzharUniversity, Cairo, Egypt.

Mail: drsayedaswad@gmail.com.
Cellular: 00201003360943.

INTRODUCTION
Previous studies investigated the effect of AVFs on echocardiographic changes (Iwashima et al., 2002 and Ori et al., 1996). These studies showed an increase in left ventricular end diastolic dimension (LVEDD), contractility, stroke volume and CO with in 7-10 days after the surgical construction of AVF (Savage et al., 2002). Diastolic filling parameters (E to A ratio) were also impaired indicative of worsening diastolic functions, the creation of an AVF increases CO by 15-20%, and diastolic pressure by 5-10% (London et al., 2002 and De Lima et al., 1999).

Dialysis delivery should be adequate not only to improve quality of life but also to prolong survival. An ideal vascular access delivers blood flow rate that is sufficient for dialysis prescription, has along life use, and low rate of complications such as infections, stenosis, and aneurysmal dilatation. Working AVF must have blood flow greater than 600 ml quality of life when adjusted for life expectancy has defined as kTV of 1.3 as the optimal cost-effective dialysis. Routine screening for early detection of dysfunctioning AVF using non invasive methods including clinical assessment, and device based surveillance relying on access flow (aa) venous pressure ratio measurements and by duplex ultrasound (Tessitore N et al., 2014).
AIM OF THE STUDY
To evaluate the effect of AVF creation (site and flow) on LV functions and also on dialysis adequacy.

PATIENTS AND METHODS
The present study was a cross-sectional study conducted on 80 patients with chronic kidney disease stage V maintained on regular haemodialysis 4 hours thrice weekly through AVF using Fresenius machines(4008B,4008S) with volumetric controlled ultrafiltration by polysulfone dialyzer1.3.1.4.1.6 , 1.8m surface area and dialysate solution is bicarbonate for all patients with Na+140mEq/L,K+2mEq/L,Ca++1.75mEq/L,Mg ++ 0.5mEq/L,CL 109.5 mEq/L,HCO3 35 mEq/L,ch3cooH 3mEq/L , the blood pump was kept between250-400ml/min with dialysate flow between 500-800ml/min and the anticoagulation was 2500 IU as bolus followed by 500-1000 IU/hr.

They were all dialyzed through a native AVF at the dialysis unit of Al-Hussein University Hospital. Patients were dialyzed via temporarily or permanent catheters, patients dialyzed via graft, ischemic heart disease, rheumatic heart disease and core pulmanalewere excluded from the study and there diaysis prescription,; the study was started by dividing the patients into two groups:

Group I: which included patients with AVF flow more than 1200 (ml/min) which considered high flow fistula.

Group II: which included patients with AVF flow from 600 (ml/min) to 1200 (ml/min) which was considered normal flow fistula.

Group I was subdivided into upper fistula (GIA) and lower fistula (GIB) according to AVF site. Each patient was subjected to the following: clinical history stressing on patient’s age, sex, underlying etiology of chronic kidney disease and haemodialysis duration. Venous blood was drawn to determine complete blood count (CBC), fasting blood sugar, S. creatinine, blood urea, lipid profile, serum calcium and phosphorous.

Dialysis adequacy(UUR and Kt/V):online measurement of ionic dialysance using a biosensor in the dialysate flow path produces a continuous measure of Kt/V(based on the predicted V),Essentially ,the dialysate conductivity is measured at the inlet and outlet, which produces a measure on ion flux during diaysis,which correlates with urea clearance this monitor is present in the new dialysis machines.

At the beginning of the study duplex ultrasound was done to all patient, screening the fistula from the bronchial artery in the mid arm via anastomosis and upward to the upper arm.

The flow measurement of the feeding artery was taken (2) cm above the fistula. For evaluating the access flow, the diameter and cross-sectional area of the feeding artery were determined by a B-mode sonography in a transverse plan from the inner edge to the inner edge and tracing the luminal outline. At the same site, Doppler spectra were obtained in a longitudinal plane with an angle maintained as far as possible at ≤ 60 (45-65) for calculation of time average velocity (TAV).

Access flow wave determined by equipment software using the formula below:

\[ \text{Flow volume (ml/min)} = \text{TAV (cm / sec)} \times \pi r^2 \]

To reduce errors to an acceptable level, we carried out measurements twice ad used the mean results, if the second measurement varied by > 10%, a third measurement was performed and the mean of the two closest measurements were taken.

The access blood flow was done to all patients by a single radiologist who was blinded to the patient’s data. To determine the effect of high flow of AVF on the heart conventional echocardiography (two-dimensional M-mode) was done to measure the following parameters: Ejection fraction (EF), fraction shortening (FS), left ventricular mass (LVM), left ventricular mass index (LVMI), stroke volume (SV), relative wall thickness (RWT), left ventricular end diastolic dimension (LVEDd), left ventricular end systolic dimension (LVEsd).

Statistical analysis:
The collected data were organized, tabulated and statistical analysis using statistical package for social science (SPSS) for Windows, version 16 [SPSS inc., USA]. Numerical data were expressed as relative frequency and percentage t test was used to compare 2 independent groups of numerical data. Chi square test was used to compare categorical groups of data. A P. value was considered to be non-significant if > 0.05, significant if ≤ 0.05 and highly significant if < 0.01.
RESULTS

Clinical and biochemical parameters, as well as significant differences between studied groups were presented in Table 1.

There were no statistically significant differences between group I with high flow fistula and group II with normal flow fistula regarding age, duration of HD, FBs, Hb, ALT, AST, B. urea, S. creatinine, T, cholesterol, S. calcium and S. phosphorus.

Left ventricular parameters were shown in Table 2.

There were highly statistically significant decrease of EF, stroke volume and FS in group I than group II (P < 0.01, P < 0.01, P < 0.01). LVM and LVMI were higher in group I than group II which were highly statistically significant (P < 0.01, P < 0.01) respectively. But there were no statistically significant differences between both groups as regarding LVEDd, LVEd and RWT (P > 0.05, P > 0.05, P > 0.05) respectively.

Echocardiographic parameters of both group IA and group IB were shown in Table 3.

There was highly statistically significant increase of LVM and LVMI in group IA than group IB (P < 0.01, P < 0.01) respectively. There were also significant increase of EF and FS in group IA than IB which were statistically significant (P < 0.05, P < 0.05) respectively.

But there were no statistically significant differences between group IA and IB regarding stroke volume, LVESDd, LVEDd and RWT (P > 0.05, P > 0.05, P > 0.05) respectively.

There were significant decrease in ejection fraction (EF) (50.21% ± 6.12% versus 56.87% ± 3.75%), fraction shortening (FS) (35.06 ± 11.68% versus 28.7 ±11.9%) in group I than group II respectively.

Table (4) showed that there were no statistically significant differences between group (1, 2) regarding URR, also it showed that there was statistically significant differences between both groups regarding Kt/V.

Our results showed positive correlation between AVF blood flow and LVM I, also there was a positive correlation between AVF blood flow and SV as shown in figure 1 and 2.

Table 1: Clinical and laboratory data of group I and group II.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean± SD</th>
<th>T</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Group I</td>
<td>Group II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49.48±1.703</td>
<td>51.25±7.36</td>
<td>0.8</td>
<td>&gt;0.05</td>
<td>N.S</td>
</tr>
<tr>
<td>Duration of dialysis (years)</td>
<td>7.91±2.610</td>
<td>6.41±2.68</td>
<td>1.9</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>S. phosphorus (mg/dl)</td>
<td>4.14±0.75</td>
<td>4.54±0.69</td>
<td>1.6</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>S. calcium (mg/dl)</td>
<td>9.44±1.76</td>
<td>8.83±0.93</td>
<td>1.5</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>S. cholesterol (mg/dl)</td>
<td>135.30±43.07</td>
<td>157.91±45.96</td>
<td>1.8</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>S. Triglyceride (mg/dl)</td>
<td>124±45.41</td>
<td>123.13±57.13</td>
<td>0.06</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>S. creatinine (mg/dl)</td>
<td>9.43±3.31</td>
<td>9.27±3.42</td>
<td>0.19</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>B. Urea (mg/dl)</td>
<td>145.39±35.26</td>
<td>148.94±55.77</td>
<td>0.28</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>AST (iu/dl)</td>
<td>20.87±8.58</td>
<td>24.06±19.18</td>
<td>0.74</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>ALT (iu/dl)</td>
<td>21.91±11.47</td>
<td>21.78±23.83</td>
<td>0.02</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Haemoglobin (g/dl)</td>
<td>8.8±1.753</td>
<td>7.67±2.62</td>
<td>1.4</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>FBS (mg/dl)</td>
<td>107.03±52.45</td>
<td>97.41±37.29</td>
<td>0.79</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

AST = aspartate transaminase, ALT = alanine transaminase, FBs = Fasting blood sugar, N.S = nonsignificant
Table (2): Left ventricular echocardiographic parameters of group I and group II.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean±SD</th>
<th>T</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I</td>
<td>Group II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ejection fraction (EF%)</td>
<td>50.21±6.12%</td>
<td>56.87±3.75%</td>
<td>4.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fractional shortening (FS%)</td>
<td>35.06±11.68%</td>
<td>28.7±11.9%</td>
<td>4.1</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Stroke volume (ml)</td>
<td>153.30±27.87</td>
<td>78.38±8.2</td>
<td>14.4</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>LVEDd (cm)</td>
<td>4.69±0.61</td>
<td>5.21±0.93</td>
<td>2.3</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>LVSDd (cm)</td>
<td>1.04±0.22</td>
<td>3.87±15.9</td>
<td>0.84</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>RWT (cm)</td>
<td>0.39±0.06</td>
<td>0.41±0.12</td>
<td>0.67</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>LVM (gm)</td>
<td>255.65±68.73</td>
<td>206.97±18.91</td>
<td>3.8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>LVMI (gm/m²)</td>
<td>174.87±27.08</td>
<td>137.53±12.94</td>
<td>6.8</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

LVEDd = left ventricular end-diastolic dimension (cm), LVESDd = left ventricular end-systolic dimension (cm), RWT = relative wall thickness (cm), LVM = left ventricular mass (gm), LVMI = left ventricular mass index (gm/m²), S = significant, N.S = non-significant, HS = highly significant.

Table (3): Echocardiographic parameters of group IA and group IB.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean±SD</th>
<th>T</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group IA</td>
<td>Group IB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ejection fraction (EF%)</td>
<td>57.5±5.3</td>
<td>54.3±4.4</td>
<td>3.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Fractional shortening (FS%)</td>
<td>31.2±14.1</td>
<td>27.2±12.2</td>
<td>3.01</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Stroke volume (ml)</td>
<td>167.9±27.4</td>
<td>139.3±23.2</td>
<td>2.6</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>LVEDd (cm)</td>
<td>4.7±0.61</td>
<td>4.6±0.60</td>
<td>0.55</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>LVSDd (cm)</td>
<td>1.08±0.26</td>
<td>0.98±0.06</td>
<td>1.1</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>RWT (cm)</td>
<td>0.4±0.07</td>
<td>0.34±0.13</td>
<td>1.1</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>LVM (gm)</td>
<td>304.6±27.1</td>
<td>197±48.0</td>
<td>3.8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>LVMI (gm/m²)</td>
<td>193.9±20.4</td>
<td>149±13.1</td>
<td>6.8</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

LVEDd = left ventricular end-diastolic dimension (cm), LVESDd = left ventricular end-systolic dimension (cm), RWT = relative wall thickness (cm), LVM = left ventricular mass/gm, LVMI = left ventricular mass index (gm/m²), S = significant, N.S = non-significant, HS = highly significant.

Table (4): Comparison between group IA, group IB and group II as regards to URR% and Kt/V.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean±SD</th>
<th>ANOVA</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group IA</td>
<td>Group IB</td>
<td>Group II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N=23)</td>
<td>(N=20)</td>
<td>(N=37)</td>
<td></td>
</tr>
<tr>
<td>URR%</td>
<td>61.5±15.2</td>
<td>63.1±10.4</td>
<td>57.1±11.6</td>
<td>1.260</td>
</tr>
<tr>
<td>Kt/V</td>
<td>1.2±0.3</td>
<td>1.22±0.3</td>
<td>1.01±0.2</td>
<td>3.190</td>
</tr>
</tbody>
</table>

URR% = urea reduction ratio; Kt/V: dialysis adequacy.
Figure (1): Correlation between AVF blood flow and LVMI. There was highly significant positive correlation between blood flow and LVMI.

Figure (2): Correlation between AVF blood flow and stroke volume. There was highly significant positive correlation between the two parameters.

DISCUSSION

The presence of an AVF lowers systemic vascular resistance resulting in an increase in stroke volume (SV) and CO in order to maintain blood pressure (Girred et al., 1996).

This study was conducted to find the effect of the flow and site of AVFs in our patients on cardiac functions and dialysis adequacy.

In our study we found that the high flow fistula cause increase in SV, LVM and LVMI with normal RWT (eccentric hypertrophy).

Basile et al. (2008) reported that the creation of an AVF exerted on cardiac function. Furthermore it causes long-term volume overload characterized by increased SV, LVM and LVMI and the resulting LVH is predominantly eccentric.

Basile et al. (2008) reported that the creation of an AVF exerted on cardiac function. Furthermore it causes long-term volume overload characterized by increased SV, LVM and LVMI and the resulting LVH is predominantly eccentric.

Also MacRae et al., (2006) reported that patients with high-flow AVFs most likely have a greater risk of developing high-output cardiac failure and are also likely to have greater increases in left ventricular end-diastolic volume (LVEDV).

However the same author reported that, the only way to determine if AVF creation produces LVH in HD patients is with a prospective randomized study comparing a central venous catheter with an AVF, and examining the serial changes in left ventricular dimensions and thickness. Due to the increased morbidity and mortality associated with catheters, this is unlikely to occur.

Chemla et al., (2007), monitored the effect of surgical access flow reduction on cardiac output in a group of high access flow patients. Only accesses with flow volume exceeding 1600 ml/min were included. Cardiac output decreased significantly after the surgery together with the access flow.

However Movelli et al., (2010), reported that on post transplantation period after AV fistula closure showed an increase in left ventricular ejection fraction, decrease in left ventricular mass, and mass index, and more favorable shift of cardiac geometry toward normal.

Our results can be explained as creation of AVF result in increased cardiac output, decreased peripheral resistance, increased sympathetic activity resulting in an increase in myocardial contractility, heart rate, stroke volume and increased in pulmonary flow.

Also Unger et al., (2004), showed regression of LVH following AVF closure in renal transplant patients.
Some suggest that cardiac decompensation due to AVFs is likely to only occur in patients with underlying cardiac disease (London et al., 2002). Engelberts et al. (1995), documented that High-output heart failure is a rather uncommon complication which can easily be overseen.

The other relevant finding of this study is that in patients with upper arm fistula there is highly statistically significant increase in LVM, LVMI and decrease in EF compared with lower arm fistula.

This results can be explained as lower arm AVFs are usually positioned in a type of patient with a different phenotype from those who get an upper arm AVFs (among them, usually there are less diabetics, younger people with fewer vascular diseases and cardiac dysfunctions).

In the present study we found a high statistically significant differences between G1(A,B) and G2 regarding kt\textsubscript{V} (p-value was 0.002), but there were no statistically differences between all groups in URR (p-value was 0.213).

K\textsubscript{V} is a measurement of dialysis adequacy (k is dialyzerblood water urea clearance L/h, T is dialysis session length per hour, v is distribution volume of urea per liter. KDOQI guide lines 2015 recommended asingle pool KT\textsubscript{V} of 1.4 per HD session for patients treated thrice weekly with a minimum delivered spK\textsubscript{T} of 1.2, as noticed in this study k\textsubscript{TV} was higher in g1(A,B) with high flow fistula (mean k\textsubscript{TV} was 1.2 0.3, 1.22 0.3) for GA and GB respectively which was reached minimum target for HD pts according to KDOQI 2015. The explanation of these low normal results could be various aetiologieste.g stenosis of AVF, low blood pump, premature termination of the HD session, use low dialyzer surface area and finally some overweight pts. Low flow fistula (G2) did not reach the minimum target k\textsubscript{TV} but if we correct these factors that affect k\textsubscript{TV} we can get a better results (e.g increase duration of HD session, increase blood pump of the machine).

Unfortunately, URR was not reach the target according to KDOQI 2015 and it could be explained by the previous factors affecting k\textsubscript{TV} plus blood urea generated during HD session.

Our message taken from that study is: the upper AVFs should be placed as distal as possible and the lower arm fistula is safe regarding to Lt ventricular functions and cardiovascular outcomes inspite of being low in dialysis adequacy but it can be overcome by improvement of other parameters that affect dialysis adequacy.

CONCLUSION

High flow AVFs >1200 ml/min and upper arm fistulas (proximal one) have greater risk for developing high cardiac output failure more than lower arm AVFs, inspite of increased dialysis adequacy with high flow AVFs.

REFERENCES


Lee H, Manns B, Taub K et al. (2002): Cost analysis of ongoing care of patients with end-stage renal disease: the impact of


دراسة مكان وعدل سرٌان الوصلّة الورديّة الشريانيّة على وظائف القلب وكفاءة الاستصفاء الدموي
في مرضي الفشل الكلوي المزمن

 السيد محمد راشد1  ومحمد أحمد شاذلى3

قسم الباطنة العامة و/و الأشعة التشريحيّة، مستشفى الحسين الجامعي، كلية الطب للبنين – جامعة الأزهر – القاهرة

انتشرت أعراض القلب بين مرضى الفشل الكلوي يعتبر من أهم المشكلات التي تواجه هؤلاء المرضى وهي تعد من أبرز أسباب الوفاة بين هؤلاء المرضى وقد يجري هذا البحث لدراسة تأثير الوصلّة الورديّة الشريانيّة التي يتم من خلالها الاستصفاء الدموي.

وجوانب القد: أجريت هذه الدراسة على 80 مريض تم تقسيمهم على حسب ضغط الدم بالوصلّة الورديّة الوريديّة إلى مجموعتين كالآتي:

المجموعة الأولى: تشتمل على مجموعة المرضى أصحاب الوصلّة الورديّة الشريانيّة الوريديّة تراكمية من 1200مل/الدقيقة.

المجموعة الثانية: تشتمل على مجموعة المرضى أصحاب الوصلّة ذات التدفق الأعلى 600_1200مل/الدقيقة.

ثم بعد ذلك تم تقسيم المجموعة الأولى إلى مجموعتين على حسب مكان الوصلّة.

وقد تم عمل الآتي:

1- اخذ التاريخ المرضي وأجراء فحص أكليبيكي شامل لكل مريض.
2- عمل التحاليل الاتية للمرضي(صورة دم كاملة - سكر صائم - كرياتين ووريديا - دهون ثلاثية وكولسترول كالميوم وفصور).
3- تقييم وظائف القلب باستعمال الاكيو وقياس معدل ضغط الدم في الوصلّة الورديّة الشريانيّة باستعمال الدوبلكس.
4- قياس كفاءة الاستصفاء الدموي و عمل نقص النيتروجين بعثة عملية الاستصفاء الدموي.

وقد أظهرت نتائج الدراسة أن زيادة تدفق الوصلّة الورديّة الشريانيّة على النيتروجين يؤدي إلى اضطراب وظائف القلب مثل زيادته فجأة من القلب وتومتر كتلة البطين الأيسر وهذا يجعل المريض أكثر عرضة لفشل القلب على التدفق. وأيضاً أظهرت النتائج أن مكان الوصلّة يؤثر على القلب حيث أن الوصلّة في أعلى الذراع كانت أكثر تأثيراً على القلب من الوصلّة في أسفل الذراع.

فلكاء الاستصفاء الدموي أعلى في المجموعة الأولى ذات التدفق الأعلى عن في المجموعة الثانية ذات التدفق الأقل.

وقد أوصت الدراسة بالآتي:

الوصلّة الورديّة الوريديّة هو أفضل مكان للاستصفاء الدموي، ينبغي أن تكون هي الاختيار الأول للمريض ذاك ينبغي أن يكون مكان الوصلّة في أسفل الذراع لأن ذلك أكثر حفاظاً على سلامة القلب.