

Prevalence of Right Ventricular Dysfunction in relation to Type of Vascular Access in Chronic Hemodialysis Patients: Monocentric Study

Mohamed Osama Mahmoud, Bichari Walid Ahmed, Rezk Khaled Mohamed and Abdel-Dayem Mohamed Mahmoud*

Department of Nephrology, Faculty of Medicine, Ain Shams University, Cairo, Egypt

*Corresponding Author: Abdel-Dayem Mohamed Mahmoud, E-mail: mohamednephro9856@yahoo.com

ABSTRACT

Background: chronic renal failure (CRF) is associated with significantly increased morbidity and mortality. Chronic renal failure affects almost every system of the body and results in various functional and structural abnormalities. Life-sustaining haemodialysis (HD) requires durable vascular access (VA) to the circulatory system. An arteriovenous fistula is currently considered the gold standard access for hemodialysis, as it has lower risk for infection, lower tendency to thrombotic occlusion, greater blood flow, reduced treatment time and is less expensive to maintain than alternative vascular access methodologies. Patients on hemodialysis have several risk factors for developing PH: LV systolic and diastolic dysfunction, volume overload, endothelial dysfunction and sleep-discorded breathing. **Aim of the Work:** The aim of the current study was the prevalence of right ventricular dysfunction in relation to type of the vascular access in chronic hemodialysis patients. **Patients and Methods:** this cross-sectional study was carried out on 100 subjects on regular hemodialysis more than six months duration, 62 males (62%) and 38 females (38%). The patients' age ranged between 24 and 76 years. They were selected from dialysis unit in Aswan health insurance hospital. All patients were subjected to the following: full history taking and clinical examination, vascular access examination (Types and patency), laboratory investigations. ECG for arrhythmias "AF, PVCs, Ischemic changes, LVH" and Echo parameters findings "RT. Vent. Systolic pressure, Rt. Vent. diastolic dysfunction, Rt. vent. dimensions, PHT & LVH). **Results:** percentage of right ventricular diastolic dysfunction was higher in patients of A-V fistula [47.5%] than [42.4 %] in cases of A-V graft and [33.3%] in patients with permanent catheter and there was significant statistical difference between right ventricular diastolic dysfunction and types of vascular access ($p=0.043$). The percentage of Rt. Ventricular diastolic dysfunction was higher in patients with low flux dialyzer membrane [83.3%] than in patients with high flux dialyzer [16.7%] but without significant statistical difference. There was no statistical difference between types of vascular access and attacks of recurrent of hypotension during dialysis session among chronic hemodialysis patients in the study. The percentage of Rt. Ventricular diastolic dysfunction was higher in patients with low flux dialyzer membrane [83.3%] than in patients with high flux dialyzer [16.7%] but without significant statistical difference. **Conclusion:** this study concluded a significant ventricular diastolic dysfunction in relation to type of vascular access in chronic hemodialysis patients. Vascular access type has a significant relationship to the incidence of pulmonary hypertension and Right ventricular systolic pressure (RVSP) in chronic hemodialysis patients.

Keywords: Rt.vent. dysfunction -AVF- hemodialysis-vascular access type- pulmonary Hypertension

INTRODUCTION

The number of patients with end-stage chronic kidney disease (CKD) requiring renal replacement therapy has increased progressively worldwide ⁽¹⁾. Permanent vascular access (VA) is the life-line for the majority of these patients when hemodialysis (HD) is the treatment of choice. Thus, the successful creation of permanent VA and the appropriate management to decrease the complications is mandatory, good functional access is also vital in order to deliver adequate HD therapy in end-stage renal disease (ESRD) patients, despite the advances that have taken place in the field of nephrology and particularly in dialysis, few things have changed in recent years with regards to VA, mainly the introduction of the polytetrafluoroethylene graft and the cuffed double lumen silicone catheter, However, the cost of VA

related care was found to be more than five-fold higher for patients with arteriovenous graft (AVG) compared to patients with a functioning arteriovenous fistula (AVF) ⁽²⁾. It seems that the native AVF still remains the first choice for VA, thereafter, VA still remains the base of the procedure and HD VA dysfunction is one of the most important causes of morbidity in this population ⁽³⁾. Patients with end-stage renal disease undergoing hemodialysis have high rates of morbidity and mortality. Cardiovascular disease accounts for almost half of this mortality, with the single most common cause being sudden cardiac death, early detection of abnormalities in cardiac structure and function may be important to allow timely and appropriate cardiac interventions ⁽⁴⁾. CVD complications are the major cause of mortality in CKD patients as compared with complications from chronic

kidney failure, while traditional CVD risk factors, including diabetes, hypertension, hyperlipidemia, obesity, physical inactivity, may be more prevalent among CKD patients, these factors seem to underestimate the accelerated cardiovascular disease in the CKD population, oxidative stress appears to play a central role in the development and progression of CVD and its complications ⁽⁵⁾. The prevalence of RV dysfunction further increased in patients with brachial AVF compared with the radial access (90.6% vs. 61.3%, $p < 0.001$). The risk of RV dysfunction was further enhanced in patients with brachial AVF compared to those with the radial fistulas. End-stage renal disease and arteriovenous fistula are associated with right ventricular dysfunction with significantly lower RV ejection fraction by using conventional Doppler echocardiography, subclinical RV dysfunction- as estimated by TDI is highly prevalent among ESRD patients even before starting dialysis therapy and pulmonary hypertension is not significantly associated with RV dysfunction in these patients ⁽⁶⁾.

AIM OF THE WORK

The aim of the current study was the prevalence of right ventricular dysfunction in relation to type of the vascular access in chronic hemodialysis patients.

PATIENTS AND METHODS

The study was approved by the Ethics Committee in Aswan health insurance hospital. All study participants proved written consent at the time of study. None of the participants suffered from cardiac diseases, connective tissue diseases, chest diseases, malignancy, long standing infection or (history of athero-embolic disease, peptic ulcer, peripheral vascular diseases). This cross-sectional study was carried out on 100 subjects on regular hemodialysis more than six months duration, 62 males (62%) and 38 females (38%). The patients' age ranged between 24 and 76 years (Mean \pm SD; 53.92 \pm 11.27). They were selected from dialysis unit in Aswan health insurance hospital. These patients with different permanent vascular accesses (AVFs, AV grafts and permanent catheters). RV mass was measured by echocardiography and ECG was done and the study included the relation between types of vascular accesses to right ventricular diastolic dysfunction, RVSP, cardiac valves and pulmonary hypertension. The study also included the relation between right ventricle diastolic dysfunction to types of dialyzer. The relation between types of vascular accesses to recurrent attacks of hypotension and degree

of ultrafiltration of dialysis session was included also in this study. **All patients were subjected to the following:** 1. Full history taking and clinical examination. 2. Vascular access examination (Types and patency) 3. Laboratory investigations, including: complete blood picture, ESR and C-reactive protein (CRP), serum creatinine, BUN, Na, K, Ca, Po₄, liver functions (SGPT&SGOT), pTH and iron profile (S.ferritin, TIBC & TSAT). 4. ECG and Echocardiography were done. (ECG for arrhythmias "AF, PVCs, Ischemic changes, LVH" and Echo parameters findings "RT. Vent. Systolic pressure, Rt. Vent. diastolic dysfunction, Rt. vent. dimensions, PHT & LVH). **Statistical methodology:** Data were analyzed using the Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as a mean \pm standard deviation (SD). Qualitative data were expressed as frequency and percentage.

RESULTS

Table (1): Blood pressure distribution in study group

| Blood pressure | Range | Mean \pm SD |
|----------------|--------|----------------------|
| Systolic | 90-200 | [136.30 \pm 25.45] |
| Diastolic | 30-110 | [83.30 \pm 15.11] |

This table showing Blood pressure distribution in the study group, the mean \pm SD of systolic blood pressure was [136.30 \pm 25.45] while the mean \pm SD of diastolic blood pressure was [83.30 \pm 15.11].

Table (2): Laboratory data, description of the study group (N=100).

| Laboratory data | Mean \pm SD |
|-------------------------------|----------------------|
| S.Creat | [8.04 \pm 1.82] |
| Bl. Urea | [130.85 \pm 31.73] |
| SGOT | [53.77 \pm 12.46] |
| SGPT | [50.51 \pm 11.97] |
| CRP [Negative/ Positive] | |
| ESR | |
| 2 nd hr | [35.97 \pm 7.59] |
| 1 st hr | [120.93 \pm 28.79] |
| HBG (gm/dl) | [8.96 \pm 1.61] |
| RBCS (x10 ⁶) | [3.55 \pm 0.56] |
| WBCS (x10 ³) | [21.97 \pm 4.62] |
| Platelets (x10 ³) | [290.26 \pm 71.87] |
| Ca X P | [57.71 \pm 13.27] |
| Phosp (mg/dl) | [8.54 \pm 1.58] |
| Ca Total (mg/dl) | [8.46 \pm 0.68] |
| K (mmol/l) | [4.92 \pm 0.78] |
| Na (mEq/L) | [133.56 \pm 3.95] |

Table showing laboratory data, description of the study group, renal function, liver functions were impaired, ESR was elevated in 1st and 2nd hour, in CRP, the percentage of negative "89%" was higher than positive "11%" in the study group. Other laboratory parameters were variable in the study group.

Table (3): Echo parameters distribution of the study group.

| Echo parameters | Total (N=100) |
|------------------------------------|---------------|
| Pulmonary artery pressure | |
| Pulmonary HTN | 42(42%) |
| Lt. ventricle hypertrophy | 37(37%) |
| Dilated left atrium | 1(1%) |
| LVH + Hypertensive heart disease | 1(1%) |
| Rt ventricle hypertrophy | 10(10%) |
| Tricuspid regurge | 1(1%) |
| Cardiac valves | |
| Aortic + Mitral regurge | 1(1%) |
| Aortic regurge | 5(4%) |
| Aortic regurge + Tricuspid regurge | 2(1%) |
| Aortic stenosis | 3(3%) |
| Mitral & Tricuspid regurge | 5(1%) |
| Mitral + Aortic regurge | 1(1%) |
| Mitral regurge | 8(7%) |
| Mitral stenosis | 2(2%) |
| Tricuspid + Aortic regurge | 1(1%) |
| Tricuspid regurge | 51(49%) |
| EF% | |
| Range | 53-75 |
| Mean±SD | [61.15 ±64] |

Table showing Echo parameters distribution of the study group, pulmonary Hypertension represented "42%" in the study group, left ventricular hypertrophy represented "37%" in the study, right ventricular hypertrophy represented "10%" in the study, while Tricuspid regurge represented "51%" in the study, EF ranged (53-75%) in the study group.

Table (4): Others laboratory distribution of the study group.

| Other laboratory | Total (N=100) |
|--------------------|-----------------|
| PTH (pg/ml) | |
| Range | 12.7-2190 |
| Mean±SD | [698.98±545.10] |
| TIBC | |
| Range | 103-314 |
| Mean±SD | [191.87±42.34] |
| TSAT | |
| Range | 15-30 |
| Mean±SD | [23.97±4.25] |
| S.ferritin | |
| Range | 35-353 |
| Mean±SD | [188.38±83.06] |

Table showing others laboratory distribution of the study group, Iron profile & PTH serum levels were variable in the study group. Mean±SD of PTH were [698.98±545.10] while Mean ±SD of iron profiles (TIBC, TSAT and S.ferritin) were [191.87±42.34, 23.97±4.25& 188.38±83.06] respectively.

DISCUSSION

The present study was carried out on 100 subjects on regular hemodialysis more than six months duration, 62 males (62%) and 38 females (38%). The patients' age ranged between 24 and 76 years (Mean±SD; 53.92±11.27). They were selected from dialysis unit in Aswan health insurance hospital. Our results showed a significant statistical difference between type of vascular access and Right ventricular dysfunction (RVD) among hemodialysis patients where AVF represented (47.5%) among chronic hemodialysis patients with right ventricular dysfunction (RVD) (P=0.043) Likely to our results, **Montaz *et al.*** ⁽⁷⁾ concluded a significant statistical difference between the Right ventricular dysfunction (RVD) and the type of vascular access in hemodialysis patients (p<0.005). **Paneni *et al.*** ⁽⁸⁾ investigated the impact of different dialysis treatments on RV function showed that HD increases the risk of RVD particularly in the presence of AVF which match with our results in the study. Similarly **López-Quijano *et al.*** ⁽⁹⁾ found the right ventricular systolic function had been poorer in hemodialysis patients and was a significant statistical differences between RVD and types of AVF among hemodialysis patients (p=0.004). Our results didn't match to results by **Loaiza *et al.*** ⁽¹⁰⁾ concluded that no relationship was found between the fistula (location and type) and changes in the cardiovascular system included Rt. Ventricle function. Our results found a significant statistical difference between RVDD and pulmonary hypertension and RVSP. In agreement to our results **Kariyawasam *et al.*** ⁽¹¹⁾ found a significant statistical difference between types of VA and RVSP and Pulmonary hypertension in the intermediate term (mean 504 days) after AV fistula placement for chronic hemodialysis in a retrospective longitudinal study in a cohort of (105) chronic regular hemodialysis patients which aimed to evaluate changes in PAP and RVSP following AVF placement. Our results found a highly significant statistical difference

between RVD dysfunction and pulmonary hypertension ($p < 0.001$) but found no significant statistical difference between RVD dysfunction and LVH. Similarly to our result *Haddad et al.*⁽¹²⁾ found good relationship between pulmonary hypertension and RVD dysfunction and pulmonary hypertension was associated with reduced right ventricular output. *Zhao et al.*⁽¹³⁾ concluded that pulmonary hypertension was extraordinary common and was significantly associated with RVD among hemodialysis patients. Our results showed a significant statistical difference in relation of types of vascular access to aortic regurgite, mitral regurgite, tricuspid regurgite, pulmonary hypertension and RVSP. In agreement to our results, *Stinebaugh et al.*⁽¹⁴⁾ showed high prevalence of mitral, tricuspid, and aortic regurgitation was observed in dialysis patients, mitral regurgitation was the most commonest in the study was conducted on (75) patients with on chronic regular hemodialysis patients with vascular access. Unlikely to our results, *Alhamad et al.*⁽¹⁵⁾ found no significant statistical difference in relation of types of vascular access [(Graft/ Fistula and catheters)] to pulmonary hypertension and RVSP in chronic regular hemodialysis patients ($p = 0.746$ & 0.751) respectively in a prospective, descriptive clinical study was conducted on (55) patients on chronic regular hemodialysis patients which aimed to examine the clinical characters of patients with pulmonary hypertension [PH] who were receiving hemodialysis (HD). Our results revealed a high significant statistical differences in relation right ventricular dysfunction (RVD) to duration of hemodialysis within years whereas longer duration of hemodialysis in years was associated with increased prevalence of right ventricular dysfunction (RVD) among chronic hemodialysis patients ($p < 0.001$). Likely to our results, *Shin et al.*⁽¹⁶⁾ revealed a high significant statistical difference relation of ventricular dysfunction (RVD) to duration of hemodialysis in years ($p = 0.009$) in study was conducted on 120 chronic hemodialysis patients which aimed to assess the effects of longer duration of hemodialysis on right ventricular function in Korean single center study.

CONCLUSION

This study concluded a significant ventricular diastolic dysfunction in relation to type of vascular access in chronic hemodialysis patients.

Vascular access type has a significant relationship to the incidence of pulmonary hypertension and Right ventricular systolic pressure (RVSP) in chronic hemodialysis patients.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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