End-stage renal disease patients developed left ventricular hypertrophy, Gezira State- Sudan

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Abstract

Background: Left ventricular hypertrophy is the strongest independent predictor of cardiovascular death, and it is worsening in association with SCD. According to studies from the main international registers, cardiac disease is the leading cause of unexpected mortality in dialysis patients. Several studies have found that the prevalence of LVH is high among patients on maintenance haemodialysis, and that numerous risk factors linked with it, such as anaemia, hypertension, and volume overload, are common in these patients. Many clinical and nephrologist researchers are focusing their attention on the processes and factors that are present in these patients in order to prevent and regress the development of LVH.

Aim: The purpose of this study is to investigate the prevalence of left ventricular hypertrophy and associated risk factors among patients receiving routine haemodialysis at Gezira Hospital for Renal Disease and Surgery.

Method: This was a cross-sectional research with 70 patients receiving routine haemodialysis. Personal and clinical information was collected. The measurements included blood pressure, ECG, and echocardiogram. The concentration of haemoglobin was determined.

Result: Patients in the study ranged in age from 20 to 80 years old. Male made up 57 % (n=40). 75% of the individuals had LVH, with 68% undergoing echocardiography and just 7% receiving an ECG diagnosis. LVH affected 30 of the 40 male patients and 15 of the 30 female patients. Anaemia was detected in 44 (88%) of the 48 LVH patients with Hb12 gm/dl. In 74 % of the patients, systemic hypertension (BP>140/90mmHg) was present, and it was identified in 42 of the 48 patients with LVH. According to the evaluation, volume overload was evident in 63 % of the patients (32 out of 48 patients with LVH). The Chi-square test was performed to determine the frequency and distribution of study participants based on several characteristics (age, gender, anaemia, volume overload, HTN, and dialysis duration) and LVH; the link between age and LVH, HTN and LVH, and DOD and LVH was statistically significant. P-values of 0.001, 0.013, and 0.005 were all significant.

Conclusion: We concluded that LVH is common among haemodialysis patients, and that there is a link between age, HTN, and DOD and LVH in this study.

INTRODUCTION

When kidney function declines and renal replacement therapy is required, the heart and vascular tree undergo major structural and functional changes, and the prevalence of cardiovascular disease is higher than in the general population (Usrds, 2017), with 40 % of all deaths in patients with end-stage renal disease (ESRD) due to cardiac causes (Steddon, S, 2014). Left ventricular hypertrophy (LVH) is a typical indication of cardiac structural disease in ESRD patients, defined as an increase in left ventricular mass (LVM) due to increased...
wall thickness. Anaemia, hypertension, hyervolemia, and mineral metabolism problems are all linked to a loss in renal function, which increases the risk of LVH (McCullough et al., 2016). The researchers discovered that the strongest independent predictor of cardiovascular mortality in patients with chronic kidney disease is LVH (Shlipak et al., 2005), and that worsening of it is associated with SCD in haemodialysis patients (Kim H et al., 2015), which is a major cause of mortality in these patients (Paoletti et al., 2004). In individuals with chronic kidney disease (CKD), the prevalence of LVH is around 40%, and it increases with CKD progression until it reaches 75% in ESRD patients (McCullough et al., 2016).

Chronic kidney disease CKD is defined as kidney damage or a GFR of less than 60 mL/min/1.73 m² for at least 3 months and is divided into five stages (‘K/DOQI clinical practice recommendations for chronic kidney disease: evaluation, classification, and stratification, 2002). Left ventricular hypertrophy LVH, reduced LV function, regional wall motion abnormality, pericardial effusion, and valvular calcification are among the anatomical and functional cardiac abnormalities seen in ESRD patients. LVH is a common complication in ESRD patients and is a preventable risk factor (Charytan, 2014). HTN, vascular calcification (Nitta et al., 2004), anaemia, and volume overload (Vaiininen et al., 2017) are all risk factors for LVH in ESRD patients. The prevention or regression of LVH was achieved with early and effective management of these risk factors (Kim et al., 2015; Erdan et al., 2018).

LVH was caused by a variety of pathophysiologic variables in CKD and ESRD patients, who were categorized into three groups (Ritz and Wanner, 2008):

Afterload: an increase in systemic arterial resistance, raised arterial blood pressure, and impaired large-vessel compliance, which necessitates a rise in intra cavity pressure during ventricular contraction (Mominadam et al., 2008).

Preload: a condition caused by intravascular volume expansion (salt and fluid loading), anaemia, and an AV fistula (Di Lullo, et al., 2011; Cuadrado et al., 2004).

Not related to afterload or preload.

Arterial hypertension and poor control of blood pressure is the most common cause of chronic pressure overload of the left ventricle and cardiac adaptation in response to chronic pressure overload is LVH (Sweety et al., 2014).

Renal dysfunction and poor cardiovascular prognosis are linked to the coexistence of anaemia and LVH (Chang et al., 2014). Non-hemodynamic and hemodynamic adaptations are used in anaemic persons to maintain adequate tissue oxygenation. Increases in erythropoietin synthesis and intra-erythrocytic concentrations of 2,3-diphosphoglycerate (2,3-DPG) lower the affinity between oxygen and haemoglobin, resulting in a shift to the right of the oxygen haemoglobin dissociation curve (Oski et al., 1971).

When compared to conventional haemodialysis, short haemodialysis reduces LVH due to proper fluid control (Ayus et al., 2005), and intensive HD (McCullough et al., 2016). While frequent haemodialysis resulted in LVH regression (Trinh and Chan, 2016;Chan et al., 2018). In comparison to traditional haemodialysis, the improved clinical outcomes resulted in a higher frequency of vascular access procedures complications (Slinin et al., 2015).

Despite the numerous research that have been conducted to improve the quality of haemodialysis, it remains a complex procedure that necessitates a coordinated effort from your entire health-care team, including your nephrologist, dialysis nurse, dialysis technician, nutritionist, and social worker.

Diagnosis of LVH is by:

ECG: This is the first non-invasive test, although it is less sensitive in diagnosing LVH (Vanezis and Bhopal, 2008), and there are various criteria for diagnosing LVH:

Lim lead voltage criteria: R in a VL > 11 mm, R in a VL > 13 mm if left axis deviation is present, and S in L III > 15 mm if left axis deviation is present. >25 mm R in LI + S in LIII

Sokolow-Lyon criteria for chest lead: S in V1 + R in V5 or V6 >35 mm (Sokolow and Lyon, 1949).

Romhilt-Estes criteria: deep S in V1/V2 and tall R in V5/ V6, with the aggregate of both exceeding 7 large squares or one of them exceeding 5 large squares (Romhilt and Estes, 1968).

Echocardiography: is a more sensitive and specific method of diagnosing LVH than an ECG. ECG criteria must account for ethnicity in people of African descent (Vanezis and Bhopal, 2008), and they must be correct in patients with HTN to rule out LVH (Pewsner et al., 2007). Left ventricular mass (using the Troy formula according to the American Society of Echocardiography ASE recommendation):= 1.05 (LVEDD+HVS +PW)3 LVEDD3.

The LVMI is calculated by dividing the LVH mass by the body surface area. LVH was characterized as an LVMI of greater than 150 g per m². (from the Framingham Heart Study) (Armstrong and colleagues, 2014).

1. MRI: is the gold standard for assessing left ventricular mass, cavity volume, and pattern of LVH, whereas M-mode echocardiography (ECHO) overestimates LV mass in haemodialysis patients when compared to CMRI (Ebeid et
2. **ESRD**: but they are not commonly utilized due to cost and lack of availability. In practice, echocardiography is a good all-around instrument that is well-suited to long-term research studies.

    Sudden cardiac death is the most prevalent cause of mortality in dialysis, accounting for 40% of deaths, most of which occur in the first three months of dialysis due to difficulty adapting to the cardiovascular stress that is characteristic of dialysis. And it could be due to LVH after a period of acclimatization. LVH is becoming more common among ESRD patients, particularly those on haemodialysis. It is also one of the most common causes of mortality among such patients. Many risk factors for LVH in such people could be treated to reduce the prevalence or regress LVH, and thus the risk of death. As it stands, diagnosis is not difficult and can be accomplished using less invasive techniques such as echocardiography and ECG.

### MATERIALS AND METHODS

#### Study area:*

The study was conducted in Gezira hospital for renal disease and surgery- Gezira State- Wad Madani Central Sudan, which service the Gezira and whole nearby areas.

#### Study design:*

In Gezira hospital for renal disease and surgery, a descriptive, cross-sectional study was done among haemodialysis patients.

#### Study population:*

The study comprised 70 patients on daily haemodialysis, both male and female, ranging in age from 20 to 80 years. Each of the patients in this study dialyzed twice a week at the Gezira hospital for renal disease and surgery. Time and duration of dialysis, symptoms of volume overload, blood pressure, and lower limb oedema were among the personal, demographic, and clinical data obtained. The concentration of haemoglobin was determined. In patients with patent arterio-venous fistulae, blood pressure was monitored in the contralateral arm with a mercury sphygmomanometer. Standard limb and chest leads were used, with a paper speed of 25mm/s and a gain of 10mm/mV (or 5mm/mV). Sum of S wave in lead V1 and R wave in lead V5 or V6 35mm and/or R wave in lead aVL 11mm was classified as Sokolow-Lyon LVH. A physician performed the ECG interpretations. IVS, LVPW, LVEDD, and LVESD were measured using M-mode echocardiography and 2-dimensional ultrasonography.

#### Haemodialysis:

The blood is filtered and cleaned out of the body, then reintroduced to the body in this operation, three times a week, for 4-5 hours. which has been used to treat advanced and permanent kidney failure.

#### Inclusion criteria:*

All patients who receive regular haemodialysis are eligible.

#### Exclusion criteria:*

Patients with established congenital heart disease or a history of heart disease, diabetics, and hypertensive patients prior to dialysis are also excluded.

#### Data analysis:*

The data were analysed using statistical package of social science (SPSS) version 24.

#### Ethical consideration:*

All participants in this study were fully told about the study's goal and were promised that any personal information regarding their health status would be kept private.

#### Ethical clearance:

Ethical clearance was acquired from the Gezira university faculty of medicine's ethical committee. Permission to conduct research in the Gezira hospital for renal disease and surgery from the director.

### RESULTS

This study included 70 patients on regular haemodialysis in Gezira hospital for renal disease and surgery, including 40 males and 30 females ranging in age from 20 to 80 years. The Chi-square test was performed to determine the frequency and distribution of research participants based on various characteristics. At 0.05, the P-value is considered significant.

#### Table 1: General characteristic of study group

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#### Table 2: Relationship between different variables and LVH

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<td>20</td>
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There is a significant relationship between duration of hemodialysis and LVH P value (0.005)
total haemoglobin level was not reached in patients with a better outcome (Regidor, 2006), while a higher haemoglobin level of 12-13 mg/dl in ESRD patients is related with a P-value of 0.512. Many studies have found that a haemoglobin level of 12-13 mg/dl in ESRD patients is related with a better outcome (Regidor, 2006), while a higher haemoglobin level is associated with a higher risk of mortality and arteriovenous access thrombosis (Phrommintikul et al., 2007). The goal haemoglobin level was not reached in the majority of patients due to poor management, blood loss in the dialyzer, and repeated blood sampling, however the basic underlying issue is erythropoietin insufficiency. Sweety et al. (2014) found an association between anaemia and LVH. Anaemic patients have insufficient tissue oxygenation, which is compensated for by increasing blood volume, resulting in an increase in left ventricular mass and assuming an eccentric geometry LVH (Metivier et al., 2000). This finding was consistent with our finding of blood volume in 42 of LVH patients, which was confirmed also by Nasri and Baradaran, 2005. Moreover, their study was confirmed our findings that 40 participants with hypertension had a significant connection between HTN and LVH with P-value of 0.013. Because volume overload is the most common cause of hypertension in ESRD patients (Bellizzi et al., 2006), insufficient clearance of this excess fluid leads to resistant hypertension (Fishbane, et al., 1996). The target blood pressure for adults with CKD is 130/80 mmHg, and for hypertensive individuals without target organ damage is 140/90 mmHg (Chobanian et al., 2003). However, this aim is not met in most patients, resulting in chronic pressure overload of the left ventricle and LVH.

When it comes to volume overload, 15% extracellular volume overload equates to around 2.5 litres of extra fluid in an HD patient (Wabel and colleagues, 2008). As a result, total fluid evacuation during dialysis may not be completed, and normal fluid status may not be achieved even immediately after dialysis. We discovered that 62% of patients were overloaded based on clinical assessment and the presence of lower limb oedema, and that 32 out of 48 patients had LVH (presence of lower limb oedema and shortness of breath does not mean haemodialysis patients have LVH), but there was no significant relationship between volume overload and LVH P-value 0.238. While Unver et al. found a substantial positive link between hypervolemia and LVH in a study of 97 patients on regular haemodialysis (Unver et al., 2015), and that the presence of lower limb oedema and shortness of breath does not mean that haemodialysis patients had LVH. Observational studies have shown that more frequent or longer haemodialysis sessions are associated with proper fluid management and a lower prevalence of LVH (Ly and Chan, 2006). However, another study found that more frequency and longer dialysis did not improve clinical outcome (Slinin et al., 2015).

Significant connection between haemodialysis duration and LVH was found in this study, with P-value of 0.005. Because all patients in this trial have just two-four hrs. sessions per week, they will not achieve their dry weight and will stay hypovolemic even after dialysis, as their intera-dialytic weight gain will be more than 3 kg between sessions. Foley et al. (2010) investigated whether the incidence of LVH correlates with the length of dialysis in

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596 incident haemodialysis patients with no prior history of heart disease. According to the study, 62% of the patients had an elevated LV mass volume index, and 49% of them developed overt LV failure.

CONCLUSION

We concluded that LVH is common among haemodialysis patients, and that there is a link between age, HTN, and DOD and LVH in this study.

RECOMMENDATION: Follow up with a nephrologist and a nutritionist on a regular basis to ensure adequate anaemia management during the pre-dialysis phase and after the start of haemodialysis, as well as blood pressure control and proper volume management.

• Before starting haemodialysis, all ESRD patients must have an echocardiogram to see if they have LVH and be treated as high-risk patients.

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References


