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Prevalence and Pattern of Cardiovascular Diseases among ESRD Patients undergoing Short Term and Long Term Hemodialysis

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ABSTRACT

Background: Cardiovascular diseases (CVD) are the major causes of mortality and morbidity among End Stage Renal Disease (ESRD) patient undergoing hemodialysis (HD). The cardiovascular diseases in dialysis patient is related to chronic volume overload, anemia, inflammation, oxidant stress, homocysteine and other aspects of the uremic milieu. The duration of ESRD undergoing dialysis is related to the severity of cardiovascular diseases. The main objective of this study is to know the pattern of cardiovascular disease among the ESRD patient undergoing dialysis.

Methods: This is a comparative study done at Collage of Medical Sciences Bharatpur, Nepal from 1st June 2020 to 30th July 2020. This study included total number of 300 dialysis patients divided into two groups; 150 patients undergoing dialysis for less than one year and rest undergoing dialysis for more than one year. Patients with primary heart disease were excluded from study. Patients were evaluated with demographic data, clinical history, and physical examination with focus on cardiovascular system, lab investigations, electrocardiography (ECG) and echocardiogram variables. The pattern of cardiovascular diseases was compared among patients undergoing short term and long term hemodialysis.

Results: In this study concentric or eccentric LVH was found in 60 %(n=90) of patients with short-term hemodialysis and 75 %(n=112) of patients with long-term hemodialysis. 30 %(n=45) of patients with short-term hemodialysis had degenerative/atherosclerotic valvular heart disease while the number was 35%(n=52) in patients undergoing long-term hemodialysis. Pericardial effusion was present in 9 %(n=13) of short-term hemodialysis patient and in 5%(n=7) of long-term hemodialysis patient. 18%(n=27) of short-term hemodialysis patient had systolic dysfunction while such change was present in 27%(n=40) of long-term hemodialysis patient. Diastolic dysfunction was present in 35%(n=52) of short-term hemodialysis patient and 49%(n=73) of long-term hemodialysis patient. Pulmonary Artery Hypertension (PAH) was present in 20%(n=30) of short term hemodialysis patient and 32%(n=48) of long term hemodialysis patient. Atrial fibrillation was present in 7 % (n=10) of short-term hemodialysis patient and 5%(n=7) of long term hemodialysis patients.

Conclusions: Variety of cardiovascular diseases are common in ESRD patient undergoing hemodialysis. CVD is more prevalent in patient undergoing hemodialysis for long term.

Keywords: cardiovascular diseases; end stage renal disease; hemodialysis.

INTRODUCTION

Dr. Bright first reported the relationship between CKD and CVD in 1836.[1] Besides traditional risk factors, CKD can be considered as an independent risk factor for CVD as renal function impairment can increase CVD risk by 2 to 4 folds.[2] Mortality rate in patient with both CVD and CKD (50-70%) is higher than in patient CVD and normal kidney functions (22-27%).[3] As an independent risk factor CKD accounts for more CVD mortality as compared other traditional CVD risk factors like Diabetes and Hypertension.[4]

End-stage renal disease patients are high risk population for cardiovascular diseases which amounts for major cause of death in these population. ESRD also complicates the management of cardiovascular diseases by influencing both medical and interventional management options of CVD worsening both prognosis and outcome.[5] The mortality in ESRD patients is higher by 30% as compared to general population and renal impairment is being considered as an independent and strong risk factor for CVD. In United States 63% of ESRD patients have CVD while the prevalence of CVD is 5.8% in general public without ESRD. Prevalence of CVD is increased with the severity of ESRD.[6] Mortality in ESRD undergoing dialysis is 20 fold higher than in general population without renal impairment. This substantial relationship between CKD and CVD can be attributed to unique clustering of CVD risk factors in CKD patients. These risk factors are usually classified as modifiable risk factors (including Diabetes, Hypertension,

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Dyslipidemias, smoking), non-modifiable risk factors (Age, Sex, Genetics) and CKD specific risk factors (anemia, high volume state, proteinuria, inflammatory state, oxidative stress).[7] The prevalence and pattern of cardiovascular diseases can be related to the duration of ESRD on maintenance hemodialysis.

Over the last few decades there have been remarkable progress in the treatment modality of CVD in the general population, it is not clear whether these management results in similar benefits for ESRD patients. Due to the differences in the prevalence, treatment options, pathophysiology and mortality of CVD in ERSD patients, generalization of data from patients without kidney disease should not be done among patients with both CVD and CKD.[8]

Estimates of the incidence of ESRD in Nepal are difficult to ascertain. There is currently no renal registry. Global and South Asian (i.e., Indian) predictions are used to estimate incidence. Published estimates on the incidence of ESRD within India range from 100 to 200 per million populations.[9] The incidence of ESRD patients receiving hemodialysis is increasing over time. Free Hemodialysis for ESRD patient in Nepal has increased the assess to Hemodialysis for ESRD patients however the prevalence of CVD in these patients remains to be estimated in Nepal. The objective of this study was to evaluate the pattern of cardiovascular disease among the ESRD patient undergoing short term hemodialysis and long term hemodialysis.

METHOD

This is a cross-sectional study conducted in Department of Cardiology and Department of Nephrology Department/Collage of Medical Sciences, Bharatpur, Nepal from 1st March to 30st May 2020. Total 300 patients (150 patients undergoing short term hemodialysis and remaining 150 undergoing long term hemodialysis) were taken in the study.

Operational Definitions

1. Cardiovascular Diseases: Variables in CVD were evaluated by ECG and Echocardiogram. Atrial fibrillation was determined in ECG by the absence of p waves and irregular rhythm. Other variables were determined by echocardiography. They included Left ventricular hypertrophy (Interventricular septum and/or left ventricular posterior wall diameter >11 mm), ischemic heart disease (presence of regional wall motion abnormalities), valvular heart disease (degenerative or atherosclerotic valvular changes), pericarditis (pericardial thickening and/or effusion), left ventricular systolic dysfunction (Left ventricular ejection fraction <50 %), left ventricular diastolic dysfunction (E/A ratio <1), and pulmonary artery hypertension (PAH) (Tricuspid regurgitation pressure gradient/TRPG >35 mmHg)
2. ESRD: All the patient undergoing maintenance hemodialysis.
3. Short term maintenance hemodialysis: Hemodialysis for less than one year
4. Long term maintenance hemodialysis: Hemodialysis for more than one year.

Sampling Technique

Non-Probability consecutive sampling technique was used. An online sample size calculator by survey systems (http://www.surveysystem.com/sscalc.htm) was used to determine sample size.

Sample Selection

Inclusion Criteria: Adult Patient aged more than 18 years undergoing maintenance hemodialysis.
Exclusion Criteria: 1. Patient with primary diseases of heart including Rheumatic Heart Disease, congenital heart disease, history of acute coronary syndromes etc. 2. Patient with previous heart surgeries 3. Patient refusal. 4. Age less than 18 years.

Statistical Analysis

The collected data was analyzed using SPSS (Statistical Package for social sciences release 20.0; SPSS, Inc; Chicago, IL) system for Windows. Mean ± SD (Standard deviation) is used to express continuous variables and categorical variables were presented as frequencies and percentages. Atrial fibrillation, left ventricular hypertrophy, Ischemic Heart Disease, left ventricular systolic dysfunction, left ventricular diastolic dysfunction, Pericardial Disease, Valvular Heart Disease and Pulmonary Arterial Hypertension were used as dependent variables for short term and long term hemodialysis. P values <0.05 were considered statistically significant.

RESULTS

This study revealed, 202 patients (67%) undergoing hemodialysis had concentric or eccentric LVH. LVH is more common in patients undergoing hemodialysis for long term (75%) than in patients undergoing hemodialysis for short term (60%). Only two patients were found to have regional wall motion abnormality with hypokinetic anterior wall and posterior wall respectively. Both were in long term hemodialysis group with moderate left ventricular systolic dysfunction (left ventricular ejection fraction 35 to 45 %) identified as ischemic cardiomyopathy. These patients had no history of treatment for acute coronary syndromes.

30%(n=45) of patients with short-term hemodialysis had degenerative/atherosclerotic valvular heart disease while the number was 35% (n=52) in patients undergoing long-term hemodialysis mostly involving aortic and mitral valve. Pericardial effusion was present in 9 % (n=13) of short-term hemodialysis patient and in 5 %(n=7) of long-term hemodialysis patient, none of the patient had evidence of cardiac tamponade.

Table 1. Cardiac diseases among patients ESRD patients undergoing HD.

Variables	Frequency (n=300)	Percentage (%)
LVH	202	67
PAH	78	26
Pericarditis	20	6
LV systolic dysfunction	67	22
LV diastolic dysfunction	125	41
Valvular heart disease	97	32
Cardiac dysrrhythmias	17	5
Ischemic heart disease	2	0.6

18%(n=27) of short-term hemodialysis patient had systolic dysfunction while such change was present in 27%(n=40) of long-term hemodialysis patient. Systolic dysfunction in this category was accounted as left ventricular ejection fraction less than 50% with global left ventricular (LV) hypokinesia with or without dilated LV. Diastolic dysfunction was present in 35%(n=52) of short-term hemodialysis patient and 49%(n=73) of long-term hemodialysis patient. Pulmonary Artery Hypertension (PAH) was present in 20%(n=30) of short term hemodialysis patient and 32%(n=48) of long term hemodialysis patient. Atrial fibrillation was present in 7 %(n=10) of short-term hemodialysis patient and 5%(n=7) of long term hemodialysis patients.

Table 2. Variation of frequency of cardiac diseases across short term and long term hemodialysis. (N=150)

Variables	Short Term He-modialysis	Long Term Hemodialysis
LVH *n* (%)	90(60)	112(74)
IHD *n* (%)	0(0.00)	2(1)
VHD *n* (%)	45(30)	52(34)
Pericarditis *n* (%)	13(8)	7(4)
LVSD *n* (%)	27(18)	40(26)
LVDD *n* (%)	52(34)	73(48)
Arrhythmias *n* (%)	10(3)	7(4)
PAH n(%)	30(20)	48(32)

LVH-left ventricular hypertrophy, LV-left ventricle, PAH-pulmonary artery hypertension, LVH-left ventricular hypertrophy, IHD-ischemic heart disease, VHD-valvular heart disease, LVSD-left ventricular systolic dysfunction, LVDD-left ventricular diastolic dysfunction, PAH-Pulmonary Artery Hypertension

DISCUSSION

Two hundred two patients accounting 67% of the total study population had eccentric/concentric LVH. This percentage is lower as compared to other studies, for example, one in Nigeria where 95% of patients with ESRD had LVH.[5] Similarly It was present in 82% of Albanian ESRD patients.[10] Pericardial effusion in ESRD patients is mostly due to uremia and low serum albumen. It was less common in this study affecting 6% of study population. Rostand et al. found a similar proportion of pericardial effusion among ESRD patients which amounted to 6-10%. Uremic pericarditis can be attributed to missing the scheduled or recommended HD due to various reasons.[11]

The most common type of arrhythmia present in ESRD is Atrial Fibrillation. In this study 5% of patients had Atrial Fibrillation. In USA it was found that 21 % of ESRD patients had Atrial Fibrillation.[7] In a study done in Pakistan Mukhtar et. al found that about 56 % of patients undergoing HD had pulmonary artery hypertension. However in this study only 26% of patients undergoing HD had pulmonary artery hypertension.[12]

Straumann found that hemodynamically significant aortic and mitral valve changes is positively correlated with the duration of hemodialysis. The degenerative and atherosclerotic valvular changes increased with the duration of hemodialysis and also due to alteration in calcium metabolism caused by increased level of alkaline phosphatase in ESRD patients.[13] In this study also valvular heart disease is more common among patients undergoing hemodialysis for long term.

In a study done by Zoccali et. al in 2004, it was reported that 26% (n=262) of asymptomatic hemodialysis patients had LV systolic dysfunction with LV ejection fraction less than 48%.[14] In this study also 22% of patient LV systolic dysfunction with global LV hypokinesia. The regional wall motion abnormality in a certain part of LV was not included in this category.

In this study we found that CVD is very common in ESRD patient undergoing hemodialysis. LVH is the most common CVD among ESRD patients. LVH was present even in normotensive ESRD patients but was more common in hypertensive patients. With the progression in the duration of hemodialysis, the frequency and severity of cardiovascular diseases increased among ESRD patients. So the spectrum and prevalence of CVD is positively correlated with the duration of hemodialysis.

CONCLUSIONS

The burden of CVD among ESRD is remarkably high and provide the peculiar challenge in the management while contributing as the major cause of

death. The duration of ESRD and hemodialysis is directly associated with the severity and likelihood of getting CVD. Further study is required to elaborate the pathogenesis of CVD in ESRD patients thereby helping in prevention and management of CVD among ESRD patients.

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