Comparison of echocardiographic parameters during long and short interdialytic intervals in haemodialysis patients

Thesis

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List of Contents

List of Tables

Table No.	Title	Page No.

Table in Review

Table in Results

List of Figures

List of Figures Cont...

List of Abbreviations

Abb.	Full term
2D	Two dimensional
3D	Three dimensional
ACS	Acute coronary syndromes
ADMA	Asymmetric dimethyl arginine
BNP	Brain natriuretic peptide
BP	Blood pressure
Ca	Calcium
CHD	Coronary heart disease
CHF	Congestive heart failure
CMRI	Cardiac magnetic resonance imaging
CNHT	Canadian Normalization of Hemoglobin Trial
CRP	C-reactive protein
cTnT	Cardiac troponin T
CVA	Cerebrovascular accidents
CVDs	Cardiovascular diseases
DM	Diabetes mellitus
EBCT	Electron beam computed tomography
ED	Emergency department
EF	Ejection fraction
ENRAGE	Extracellular newly identified RAGE-binding protein
EOD	Every other day
ESRD	End stage renal Disease
FGF 23	Fibroblast growth factor 23
GDF-15	Growth differentiation factor-15
GFR	Glomerular filtration rate
GP	General population
HD	Haemodialysis

List of Abbreviations Cont...

Abb.	Full term
HNW	Hemodialysis Net Work
hs-CRP	High-sensitivity C-reactive protein
hsTnI	High-sensitivity troponin I
HTN	Hypertension
iPTH	Intact parathyroid hormone
IVC	Inferior vena cava
IVC	Inferior vena cava
LV	Left ventricular
LVH	Left ventricular hypertrophy
LVH	Left ventricular hypertrophy
mTOR	Mammalian target of rapamycin
MWF	Mondays, Wednesdays and Fridays
NFAT	Nuclear factor of activated T cells
NHT	Normal Hematocrit Trial
NO	Nitric oxide
NOS	NO synthase
NT-proBNP	N-terminal prohormone brain natriuretic peptide
P	Phosphate
PCWP	Pulmonary capillary wedge pressure
PTH	Parathormone
PTH	Parathyroid hormone
PTX3	Pentraxin 3
SBP	Systolic BP
SCD	Sudden cardiac death
TDI	Tissue Doppler imaging
TTS	Tuesdays, Thursdays and Saturdays
UF	Ultrafiltration
VSMC	Vascular smooth muscle cell

Abstract

Background: Cardiovascular disease is the leading cause of mortality in patients receiving haemodialysis (HD). Most HD patients follow the typical schedule of three sessions per week, and thus remain outside dialysis for two short intervals (~ 2 days in duration) and for a longer interval (~3 days) at the end of each week. There is a link between the long interdialytic interval and worsened cardiovascular outcomes but few studies have examined the underlying mechanisms

Objective: To compare changes in echocardiographic parameters during the 2- day (short) and 3-day (long) interdialytic intervals of prevalent HD patients.

Patients and Methods: The study involved 30 stable prevalent HD patients on thrice weekly regimen. Echocardiography was done before and after the short and long interdialytic interval to study left and right ventricle functions and inferior vena cava (IVC) diameter. Patients ages ranged between 28 and 75 years with mean age of 56.23±12.31 years (43.4% females and 56.7% males)

Results: Comparison of echocardiographic measurements was done before and after dialysis between the short (2-days) and long (3-day) interdialytic interval groups (Group 1 Vs Group 2). There were no statistically significant differences between left ventricular (LV) systolic and diastolic dimensions, septum affection, ejection fraction, or pulmonary artery pressure. There were statistically highly significant differences among left pulmonary capillary wedge pressure (PCWP), IVC diameter and interdialytic weight change after dialysis session between the short and the long interdialytic interval patients' groups. The intradialytic weight gain (2.45 ± 1.13 vs 1.19 ± 0.78 kg), IVC diameter (11 ± 2.98 vs 9.62 ± 2.32) and PCWP (11.13 ± 2.3 vs 10.13 ± 1.55) increase were higher during the 3-day versus the 2-day interval ($P < 0.001$).

Conclusion: IVC, PCWP and intradialytic weight increase was higher during the 3-day versus the 2-day interval in post dialysis comparison. IVC, PCWP and intradialytic weight gain reflect degree of volume overload and their increase especially after interdialytic interval call for need to evaluate timing and frequency of prescribed HD regimens for some HD patients>

keywords: Hemodialysis, Long Interdialytic Interval; Echocardiography .

INTRODUCTION

Cardiovascular disease is the leading cause of mortality in patients receiving haemodialysis (HD). Among these patients, serious arrhythmias and sudden cardiac arrests, rather than acute myocardial infarction or stroke, are the most frequent causes of cardiovascular death **(Bleyer et al., 2006 & Saran et al., 2016)**.

Most patients on maintenance HD follow the typical schedule of three sessions per week, and thus remain outside dialysis for two short intervals (~ 2 days in duration) and for a longer interval (~3 days) at the end of each week **(Foley et al., 2011; Georgianos et al., 2015; Banshodani et al., 2017).**

In recent years, large-scale population studies have shown that mortality and cardiovascular-related hospitalizations in haemodialysis are not evenly distributed throughout the days of the week; they commonly occur within the last hours of the long (3-day) intradialytic interval and the following dialysis session **(Foley et al., 2011; Zhang et al., 2012; Georgianos et al., 2015).** Thus, there has long been concern that the 2-day interdialytic interval may unnecessarily increase the risk of death **(Foley et al., 2011; Obokata et al., 2015; Banshodani et al., 2017).**

The clustering of death and cardiovascular events in the first week day suggest that extreme fluctuations in extracellular

volume, accumulation of potentially toxic uremic solutes during the long interval, and the hemodynamic stress of the first haemodialysis session of the week may be implicated in myocardial disease and risk of death in these patients **(Loutradis et al., 2018).**

Although this link between the long interval and worsened cardiovascular outcomes has attracted increasing attention, few studies have examined the underlying mechanisms **(Loutradis et al., 2018).**

The exact pathophysiologic mechanisms underlying changes in cardiac function and sizing during intra- and inter-dialytic intervals are also obscure. Several factors could be involved, such as volume overload, acid-base, and electrolyte shifts, as well as arterial and myocardial wall changes **(Georgianos et al., 2015; Obokata et al., 2015).**

Only a handful of studies have examined cardiac function changes during interdialytic intervals and just one compared changes in echocardiographic indices of left and right ventricle during the 3-day and the 2-day intradialytic interval **(Obokata et al., 2015; Tsilonis et al., 2016; Loutradis et al., 2018).**

End stage renal Disease (ESRD) patients on regular hemodialysis do have myriads of structural and functional cardiac abnormalities which include left ventricular hypertrophy (LVH), depressed left ventricular (LV) function,

variations in inferior vena cava (IVC) diameter, regional wall motion abnormality, pericardial effusion and valvular calcification **(Leskinen et al., 2009).**

AIM OF THE WORK

The aim of the study is to compare changes in echocardiographic parameters during the 2- day (short) and 3-day (long) interdialytic intervals of prevalent hemodialysis patients.

Chapter 1

CARDIOVASCULAR DISEASES IN HEMODIALYSIS PATIENTS

The number of patients with end stage renal disease (ESRD) is rapidly growing worldwide. Regular HD as a renal replacement therapy for those patients is associated with extremely high mortality rates, which are up to seven times greater than in the general population **(Collado et al., 2010).**

1. Prevalence of cardiovascular diseases in hemodialysis patients

Cardiovascular diseases (CVDs) are present since the early stages of CKD and reach around 30 to 44% of those beginning HD **(Renal Data System, USRDS 2013).**

CVDs are the major cause of death in HD patients accounting for 40% to 45% of all deaths **(Figure 1).** The specific causes of CV death in the HD population span quite a broad spectrum. The total mortality from specific CV causes in HD patients was divided as follows: 4.7% acute myocardial infarction (AMI), 4.8% congestive heart failure (CHF), 26.9% arrhythmia and sudden cardiac death (SCD), 3.1% cerebrovascular accidents (CVA), 0.3% pulmonary embolism (PE), 1.9% other cardiac causes and 0.9% other vascular causes **(Figure 2) (Renal Data System, USRDS 2013).**