

Extracorporeal Ultrafiltration in Advanced Decompensated Heart Failure

A study
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسببائك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

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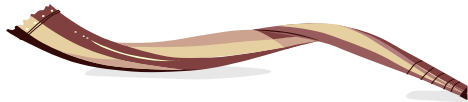
First of all, great thanks to God who enabled us to complete this work.

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List of Abbreviations

Abbreviation	Meaning
AA₁RA	Adenosine A ₁ Receptor Antagonist
ABG	Arterial Blood Gases
ACC	American College of Cardiology
ACEIs	Angiotensin Converting Enzyme Inhibitors
ADHF	Acute Decompensated Heart Failure
AF	Atrial Fibrillation
AHA	American Heart Association
AHFS	Acute Heart Failure Syndrome
ANP	Atrial Natriuretic Peptide
APD	Automatic Peritoneal Dialysis
ARBs	Angiotensin Receptor Blockers
ARVC	Arrhythmogenic Right Ventricular Cardiomyopathy
AST	ASpartate amino-Traansfer
BIVAD	BIVentricular Assisted Device
BNP	Brain Natriuretic Peptide
BP	Blood Pressure
BUN	Blood Urea Nitrogen
CABG	Coronary Artery Bypass Graft
CAD	Coronary Artery Disease
CAPD	Continuous Ambulatory Peritoneal Dialysis
CAVH	Continuous Arterio Venous Hemodialysis

Abbreviation	Meaning
CBC	Complete Blood Count
CHF	Congestive Heart Failure
COP	Cardiac Out Put
CRRT	Continuous Renal Replacement Therapy
CRT	Cardiac Resynchronization Therapy
CVVHD	Continuous Veno-Venous HemoDiafiltration
DCM	Dilated CardioMyopathy
EDPVC	End Diastolic Pressure Volume Curve
EF	Ejection Fraction
EPA	EicosaPentaenoic Acid
ERNA	Equilibrium RadioNuclid Angiography
ESC	European Society of Cardiology
ESRD	End Stage Renal Disease
ET-1	EndoThelin-1
FRF	Filter Replacement Fluid
GFR	Glomerular Filtration Rate
HCCT	HypocalCemic Citrate Toxicity
HCM	Hypertrophic CardioMyopathy
HD	HemoDialysis
HF	Heart Failure
HFNEF	Heart Failure with Normal Ejection Fraction
IABP	Intra Aortic Balloon counter-Pulsation
ICD	Implantable Cardioverter Defibrillator
IHD	Ischemic Heart Disease

Abbreviation	Meaning
IV	Intra Venous
LBBB	Left Bundle Branch Block
LV	Left Ventricle
LVAD	Left Ventricular Assisted Device
LVEF	Left Ventricular Ejection Fraction
LVH	Left Ventricular Hypertrophy
MCS	Mechanical Circulatory Support
MI	Myocardial Infarction
MRA	Mineralocorticoid Receptor Antagonist
MUGA	Radionuclide Multiple Gated Acquisition
NSAID	Non-Steroidal Anti-Inflammatory Drug
NT-ANP	N-Terminal Atrial Natriuretic Peptide
NT-BNP	N-Terminal Brain Natriuretic Peptide
PASP	Pulmonary Artery Systolic Pressure
PCI	Percutaneous Coronary Intervention
PCWP	Pulmonary Capillary Wedge Pressure
PD	Peritoneal Dialysis
PUFA	Poly Unsaturated Fatty Acids
PVC	Pressure Volume Curve
RAAS	Renin Angiotensin Aldosterone System
RCM	Restrictive CardioMyopathy
RRT	Renal Replacement Therapy
RV	Right Ventricle
RVAD	Right Ventricular Assisted Device

Abbreviation	Meaning
SLEDD	Sustained Low Efficacy Daily Dialysis
SPECT	Single Photon Emission Computed Tomography
STEMI	ST-Elevation Myocardial Infarction
TNF-α	Tumor Necrotizing Factor- α
TSH	Thyroid Stimulating Hormone
UF	Ultra-Filtration
V/Q	Ventilation Perfusion ratio
VAD	Ventricular Assisted Device
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

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Introduction

Heart failure (HF) is defined as the state in which an abnormal cardiac function is responsible for the inability of the heart to pump an adequate volume of blood to meet the requirements of the peripheral tissues. However, many patients do have structural cardiac alterations that impair systolic or diastolic function, but do not have clinical signs of heart failure (*McMurray and Pfeffer, 2005*).

Heart failure is the leading cause of hospitalization in people older than 65 year. In developed countries, the mean age of patients with heart failure is 75 years old. In developing countries, two to three percent of the population suffers from heart failure, but in those 70 to 80 years old, it occurs in 20-30 percent (*Neubaure, 2007*).

Management of heart failure includes life style modification, medical treatment like nitroglycerins, diuretics, treatment of predisposing factors, inotropes. Sometimes the case severity would only respond to ultrafiltration (UF) (*Nieminen et al., 2005*).

Ultrafiltration is a process that involves the mechanical removal of fluid from the blood by generating connective

gradient across the filter membrane (*Fiaccadori et al., 2011*). Compared with conventional diuretic therapy, ultrafiltration is associated with greater weight loss and fewer rehospitalisation in patients admitted with decompensated heart failure (*Bart et al., 2005*).

There is also data showing that UF leads to less neurohormonal activation and that there is a sustained benefit to UF that persists after the acute therapy (*Costanzo et al., 2007*).

Aim of the Work

This work aims to discuss management of heart failure and focuses mainly on the role of extracorporeal ultrafiltration in treatment of decompensated heart failure refractory to conventional diuretic therapy.

Pathophysiology of Heart Failure

Definition:

Heart failure (HF) is a pathophysiological state in which the heart fails to pump blood at a rate adequate for satisfying the requirements of the tissue or it is able to do this only with an elevated diastolic filling pressure (*Bursi et al., 2006*).

Epidemiology:

Heart failure is a worldwide problem. The most common cause of heart failure in the developed countries is ischemic cardiomyopathy (ICM). However in the developing countries which become more urbanized and have a more sedentary lifestyle, there has also been an increase in diabetes, hypertension and obesity resulting in an increasing rate of heart failure (*Stewart et al., 2008*).

The following trends in developing countries are apparent:

Causes tend to be largely nonischemic, patients present at younger age and isolated right side heart failure tends to be more prominent (*Damasceno et al., 2007*).

Types of heart failure:

- **Acute and chronic heart failure:**

In acute HF the underlying condition develops rapidly resulting in rapid onset of signs and symptoms in the form of severe inadequate tissue perfusion and severe congestion which need urgent hospitalization.

In chronic HF underlying condition develops slowly, compensatory mechanisms will have time to develop and the patient will be able to tolerate the reduction of cardiac output (*Georghiade and Pang 2009*).

- **Low-output and high-output heart failure:**

Low-output failure associated with peripheral vasoconstriction and the patient is cold. It represents most cases of HF.

High-output failure associated with peripheral vasodilatation and the patient is warm with flushed skin. It is present only with a hyperkinetic circulatory state (*Anand and Florea 2001*).

- **Right and left sided heart failure:**

Accumulation of fluid in left side of the heart even with small amount gives rise to pulmonary venous congestion with its subsequent manifestations.