Study of the difference of B-type natriuretic peptide (BNP) between pre and post haemodialysis using a low versus a high flux membrane

Thesis

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BY

Roaa Abd Alglil Abohamr

M.B.B.CH.

Faculty of Medicine – Ain Shams University

Under supervision of

Prof. Dr. Hesham Mohamed Elsayed

Professor of Internal Medicine and Nephrology

Faculty of Medicine – Ain Shams University

Dr. Amr Mohamed Mohab

Lecturer of Internal Medicine and Nephrology

Faculty of Medicine – Ain Shams University

Faculty of Medicine
Ain Shams University
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List of Abbreviations

AVF	Arteriovenous fistula
AVG	Arteriovenous graft
BIS	Bioimpedance spectroscopy
BNP	Brain-type natriuretic peptide
BUN	Blood urea nitrogen
cGMP	Cyclic guanosine monophosphate
CKD	Chronic kidney disease
CTR	Cardiothoracic ratio
CV	Cardiovascular
CVP	Central venous pressure
DRA	Dialysis-related amyloidosis
EABV	Effective arterial blood volume
ED	Emergency department
ESRD	End‑stage renal disease
FEUN	Fractional excretion of urea
GFR	Glomerular filtration rate
HD	Hemodialysis
HeRO	Hemodialysis reliable outflow
IL	Interleukin
IVC	Inferior vena cava
MPO	Membrane Permeability Outcome
NKF	National Kidney Foundation
NP	Natriuretic peptide
NPR	Natriuretic peptide receptor
NPs	Natriuretic peptides
NYHA	New York Heart Association
PBUT	Protein-bound uraemic toxins
RAAS	Renin–angiotensin–aldosterone system
RRT	Renal replacement therapy
SNS	Sympathetic nervous system
TNF	Tumour necrosis factor
VPW	Vascular pedicle width
VS	Volume status

ABSTRACT

Background: The maintenance of optimum fluid balance in patient's on haemodialysis (HD) is a key therapeutic goal, and plays a major role in determining morbidity and mortality**. Aim of the work:** examine the extent of clearance of the cardiac BNP in hemodialysis using a low-flux versus a high-flux membranes and its correlation to volume status. **Patients and methods:** 48 patients end stage renal disease (ESRD) maintained on regular hemodialysis (24 patients were maintained on a high flux membrane and 24 patients maintained on a low flux) in Hemodialysis unit in Nasr city insurance hospital and Shiekh Zaid specialized hospital, over a period from April to December 2016. Full history and clinical examination were done. Blood Urea, creatinine, potassium, serum Sodium, uric acid, calcium, phosphorus, albumin, PTH, CBC, iron profile, HCV Ab, HBs Ag and BNP pre and post dialysis were measured. **Results**: significant lower BNP pre and post dialysis in patients maintained on a high flux membrane compared to those maintained on a low flux membrane. Blood urea, serum creatinine and PTH were singificantly lower in high flux group, IDWG was positive correlated in high flux group. **Conclusion**: There were a significant lower blood urea, serum creatinine and serum PTH in patients on a high flux membrane (group II) compared to those on a low flux membrane (group I). On the other hand, there was no significant differences between them as regards to other laboratory investigation.BNP was significantly lower in high flux group (both pre & post dialysis) than low flux group and Clearance of BNP was signifantly higher with using high flux.

keywords: bnp, hd, high flux membrane, low flux membrane.

INTRODUCTION

Chronic kidney disease (CKD), with end‑stage renal disease (ESRD) as its final phase, has emerged as one of the most challenging healthcare issues in developed countries. Each year about 440 000 individuals are introduced to renal replacement therapy (RRT) worldwide ***(Ortiz, et al., 2014).***

Cardiovascular (CV) risk in this group is significantly higher compared with their sex- and age‑matched healthy counterparts, and CV disease, the leading cause of death, accounts for nearly 50% of all deaths ***(Hoppe , et al., 2017).***

The maintenance of optimum fluid balance in patients on haemodialysis (HD) is a key therapeutic goal, and plays a major role in determining morbidity and mortality. Clinical assessment remains the main arbiter of volume status though relatively insensitive. Other measures may be helpful, the most well explored of these being bioimpedance methodologies. Blood levels of a biomarker of fluid status would be of huge benefit ***(Sivalingam, et al., 2015).***

Natriuretic peptides play a major role in salt and water homeostasis, protecting the cardiovascular system from the effects of volume overload. ANP (28 amino acids) and BNP (32 amino acids) share a common 17-amino-acid ring structure. Both peptides are released primarily from the heart and act in various tissues inducing vasodilatation, natriuresis and diuresis ***(Sivalingam, et al., 2015).***

ANP is predominantly synthesised in the atria and BNP in the ventricles, though both can be synthesised in either chamber

under pathological conditions. ANP is stored in atrial granules and released even with minor increases in volume whilst BNP, which only has minimal storage in granules, is synthesised and secreted in bursts. ANP is stored as pre-proANP, which is then cleaved to proANP and then finally to the inactive NT proANP and the biologically active ANP.

Both ANP and BNP have been investigated as markers of hydration in dialysis patients.

Both can be used as sensitive biomarkers of cardiac dysfunction and well-characterized commercial assays have recently become available. In acute coronary syndromes increased concentrations are strong predictors of recurring myocardial infarction, heart failure, and death. In acute dyspnea, high BNP and NT-proBNP point to a cardiac rather than a pulmonary origin of the symptoms. BNP and NT-proBNP help in the assessment of the severity of ventricular dysfunction and heart failure and as a prognostic predictor, regardless of the primary cause of the condition. They can be used to guide the therapy of heart failure and left ventricular dysfunction. BNP and NT-proBNP work better when they are used for specific clinical purposes, rather than for screening in the general population. Their main strength is the excellent negative predictive value with regard to left ventricular dysfunction and heart failure. BNP and NT-proBNP are nonspecific biomarkers of cardiac dysfunction. Specific diagnostic tools, such as echocardiography, are required to define the actual abnormality ***(Vuolteenaho et al.,2005)***

AIM OF THE WORK

The aim of this study was to compare clearance of cardiac BNP using low-flux membranes versus high-flux membranes and its correlation to volume status.

HEMODIALYSIS

Hemodialysis (HD) is the routine renal replacement therapy for patients who have reached end-stage renal disease. The goals of HD are straightforward and include restoring the body's intracellular and extracellular fluid environment and accomplishing solute balance by either removal from the blood into the dialysate or from the dialysate into the blood ***(Ikizler &Schulman, 2005).***

Hemodialysis can be an outpatient or inpatient therapy. Less frequently hemodialysis is done at home ***(Galla et al., 2000).***

Principle:

The principle of hemodialysis is the same as other methods of dialysis; it involves diffusion of solutes across a semipermeable membrane. Hemodialysis utilizes counter current flow, where the dialysate is flowing in the opposite direction to blood flow in the extracororeal circuit. Counter-current flow maintains the concentration gradient across the membrane at a maximum and increases the efficiency of the dialysis ***(Pendse et al., 2007)***

The dialysis solution that is used is a sterilized solution of mineral ions. Urea and other waste products, potassium, and phosphate diffuse into the dialysis solution. However, concentrations of sodium and chloride are similar to those of normal plasma to prevent loss. Sodium bicarbonate is added in a higher concentration than plasma to correct blood acidity. A small amount of glucose is also commonly used ***(Ikizler & Schulman, 2005).***

Initiation of Dialysis:

The decision to initiate dialysis in a patient with CKD involves the consideration of subjective and objective parameters by the physician and the patient. These parameters are often modulated by the patient's perception of his or her quality of life and by possible anxiety about starting new therapy that is technologically complex ***(Pendse et al., 2007).***

There are a number of clinical indications to initiate dialysis in patients with CKD according to ***(K/DOQI, 2006)***. These include:

- Pericarditis or pleuritis (urgent indication).
- Progressive uremic encephalopathy or neuropathy, with signs such as confusion, asterixis, myoclonus, wrist or foot drop, or, in severe cases, seizures (urgent indication).
- A clinically significant bleeding diathesis attributable to uremia (urgent indication).
- Fluid overload refractory to diuretics.
- Hypertension poorly responsive to antihypertensive medications.
- Persistent metabolic disturbances that are refractory to medical therapy; these include hyperkalemia, metabolic acidosis, hypercalcemia, hypocalcemia, and hyperphosphatemia.
- Persistent nausea and vomiting.
- Weight loss or signs of malnutrition.

However, these indications are potentially life-threatening and the patient is generally known to have advanced CKD. As a result, most nephrologists agree that delaying initiation of dialysis until one or more of these complications is present may put the patient at unnecessary jeopardy ***(Tang et al., 2007).***

Non Renal Indications of Hemodialysis:

- Systemic inflammatory response syndrome and sepsis
- Removal of inflammatory mediators with hemofiltration
- Acute respiratory distress syndrome
- Cardiopulmonary bypass
- Congestive heart failure
- Inborn errors of metabolism
- Lactic acidosis
- Crush Injury
- Tumor lysis syndrome
- Poisonings
- Salicylates
- Barbiturates
- Theiphylline
- Lithium
- Methanol
- Metformin
- Valporic acid