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Prevalence of Access Recirculation in Prevalent Arterio-Venous (A-V) Fistula Hemodialysis Patients and its Effect on Hemodialysis Adequacy

Thesis

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List of Abbreviations

Abb.	Full term
ALB	Albumin
AV	Arterio- venous.
AVFs	Arterio- venous fistulas.
AVGs	Arterio- venous grafts.
BFR	Blood flow rate.
BP	Blood pressure.
BUN	Blood urea nitrogen.
Ca	Calcium.
cAMP	Cyclic adenosine monophosphate.
CBC	Complete blood count.
CKD	Chronic kidney disease.
Co2	Carbon dioxide.
Colest	Cholesterol.
CVD	Cardiovascular disease.
DDS	Dialysis disequilibrium syndrome.
DM	Diabetes Mellitus.
ESRD	End stage Renel disease.
GFR	Glomerular filtration rate.
GN	Glomerulonephritis.
HB	Hemoglobin.
HD	Hemodialysis.
HIV	Human immune deficiency virus.
IDH	Intradialytic hypotension.
K	Potassium
K	Potassium.
L	Liter.

List of Abbreviations Cont...

Abb.	Full term
MAP	Mean arterial pressure
Na	Sodium.
Na/ K ATPase	Sodium/ potassium adenosine triphosphatase.
nPCR	Normalized protein catabolic rate.
PCKD	Polycystic kidney disease.
PD	Peritoneal dialysis.
PD	Peritoneal dialysis.
Pmp	Per million population.
Po_4	Phosphorus.
PTFE	Poly tetrafluoroethylene.
PTH	Parathyroid hormone.
RMP	Resting membrane potential.
RRT	Renal replacement therapy.
sp.Kt/V	Single- pool Kt/V.
st.Kt/V	Standard Kt/V.
TC	Tunnelled hemodialysis catheter.
TMP	Transmembrane pressure.
UF	Ultrafiltration.
UFR	Ultrafiltration rate.
URR	Urea reduction ratio.
USA	United States of America.
USRDS	United States Renal Data System.

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INTRODUCTION

End stage renal disease (ESRD) is one of the most common life-threatening diseases. The number of patients accepted for renal replacement therapy including hemodialysis (HD), peritoneal dialysis, and kidney transplantation in developed and developing countries increases each year and imposes a major social and economic burden on these communities ***(USRDS, 2003).***

Some factors affect on the survival of ESRD patients include inadequate dialysis, method of renal replacement therapy, etiology of renal failure and the presence of comorbid disease ***(Goodkin et al., 2003).***

It is well established that one of causes of inadequate dialysis in HD patients is arterio-venous (A-V) fistula access recirculation (AR). In addition, screening for recirculation may be used as a surveillance technique for the early detection of fistula stenosis, the correction of which may prevent thrombosis ***(Miskulin et al., 2003).***

Hemodialysis access recirculation is diagnosed when dialyzed blood returning through the venous side reenters the dialyzer through the arterial needle, rather than returning to the systemic circulation and as a result, the efficiency of HD is reduced ***(Berkoben et al., 2011).***

The Diagnosis of arterio-venous (A-V) fistula access recirculation (AR) could be done through two methods Non Urea based method (Ultrasound dilution Transonic Hemodialysis Monitor—USM) or Dilution techniques, utilizing the dilution of serum potassium (K), glucose, hematocrit (Hct) and hemoglobin (Hb) have been recently described ***(Basile et al., 2003).***

Assessment of access recirculation (AR) is crucial to dialysis efficiency and there is thus a need for a method yielding a highly accurate, fast, easy and economical measurement that can be applied in any busy dialysis clinic. So the Non urea based methods are good method & avoid problems with cardiopulmonary recirculation, but they require expensive specialized devices, which limit their applicability.

In Dilutional -based method, the degree of access recirculation is measured by comparing the basal and arterial k concentration from the following formula:

Percent recirculation = **100 x [1 - arterial K+/basal K+].**

Potassium based dilutional method, similar to other dilutional methods, is not influenced by cardiopulmonary recirculation or veno-venous disequilibrium and is fast and accurate. Moreover it is very simple, economical, and can easily be performed in any dialysis unit ***(Tessitore et al., 2001).***

The potassium based method showed: sensitivity (100 %); specificity (95%); predictive value, positive (91%); predictive value, negative (100%). In addition, the potassium based method appears to be more reliable than the two-needle urea based method ***(Brancaccio et al., 2001).***

AIM OF THE STUDY

The study is an epidemiological study investigating the prevalence of arterio-venous (A-V) fistula access recirculation (AR) and its effect on adequacy of hemodialysis in patients using AVF as a vascular access.

Chapter 1

HEMODIALYSIS

History of dialysis:

In 1854, Thomas Graham was the first to use the term `dialysis`. He demonstrated that 'crystalloids', but not 'colloids', diffused down a concentration gradient across a semi-permeable membrane separating two solutions. In 1913, Abel Rowntree and Turner, wrote the first article on the technique of haemodialysis (HD), named the artificial kidney ***(Smith & Thomas, 2002).***

The main aim was the removal of salicylates. The removal of fluid and toxins that accumulated due to kidney disease was not at this time considered. However, difficulties in dialysis construction and anticoagulation control prevented further developments for about 7 years. In 1920, Georg Haas, performed the first dialysis on a human uremic patient. Hand-made colloidion membranes were used. Haas used multiple dialyzers to increase the surface area of blood exposed to the dialysis fluid, but the arterial pressure of the blood was insufficient to propel the blood through the entire extracorporeal circuit. He therefore introduced a pump into the circuit ***(Smith & Thomas, 2002).***

Willem Kolff built a rotating drum dialyzer, which provided sufficient surface area for human HD. After the war in

1945, Kolff's technique was widely used, particularly in Sweden and the United States of America (USA). The treatment was mainly used for acute renal failure when kidney function could be expected to return to normal, following a short period of dialysis treatment. It was just a bridging dialysis. However vascular access limited dialysis to patients with acute renal failure who only needed renal replacement therapy for a short period of time ***(Smith & Thomas, 2002).***

There after, the rotating drum dialyzer was modified by Dr. Carl Walter, and Edward Olson, to create a new version of the Kolff device. Jack Leonards and Leonard Skeggs produced a plate dialyzer, which permitted a reduction in the priming volume and allowed negative pressure to be used to remove fluid from the patient's system. Larger dialyzers followed, which necessitated the introduction of a blood pump ***(Smith & Thomas, 2002).***

In 1950, Fredrik Kiil developed a parallel plate dialyzer with a large surface area (1 m2), requiring a low priming volume. In 1960, Richard Stewart produced the true forerunner of today's capillary flow dialyzer. It was a hollow-fibre dialyzer with a low priming volume and minimal resistance to flow ***(Smith & Thomas, 2002).***