

**PREDICTION OF VASCULAR ACCESS  
MALFUNCTION IN CHRONIC RENAL FAILURE  
PATIENTS ON MAINTENANCE  
HEMODIALYSIS**

Thesis submitted in partial fulfillment of  
Master degree in Pediatrics

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**Cairo  
1998**



TO MY  
Parents



## ACKNOWLEDGMENT

First of all I must thank GOD and express my endless gratitude to his grace that enabled me to accomplish this work successfully.

Then I have to thank Assistant Professor Mohamed Salah El Dia Fahoom, beside his scientific remarks which are always precise and hitting the target, he has a genius personal attitude that always impresses me and all those who deal with him. Working under his supervision is all at once both pleasurable and educational.

Also I like to be grateful to Lecturer Dr. Ashraf Abdel Bahy Salama, for his sincere involvement in this work. I always felt that he is so clever with his experienced scientific hints, so faithful with his care for every detail, and so proficient for his intent of perfection.

Many thanks to Assistant Professor Dr. Hanaa Mohamed El Sayed Affifi, as she competently handled the laboratory tasks, the most difficult part of this work, upon which we built all the results and the conclusion. She was always helpful, sincere, persevering and meticulous.

I don't forget to extend my thanks to the all staff of the Pediatric Dialysis Unit- Ain Shams University Hospital for the effort and time they gave to me during collection and preparation of samples.

Also I don't forget to extend my thanks to my colleges in Air Forces Hospital both military staff and civilian staff for the saving time to me.

Finally, I am so grateful to the children attending the unit, either for HD or conservative management. I hope that this article would share in improving the quality of their lives, until God with his mercy and influential will grants them permanent cure.

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## **LIST OF ABBREVIATIONS**

<b>ARF</b>	<b>Acute Renal Failure</b>
<b>AV</b>	<b>Arteriovenous</b>
<b>AVF</b>	<b>Arteriovenous Fistula</b>
<b>BSF-2</b>	<b>B Cell Stimulating Factor-2</b>
<b>CRF</b>	<b>Chronic Renal Failure</b>
<b>ESRD</b>	<b>End Stage Renal Disease</b>
<b>HD</b>	<b>Hemodialysis</b>
<b>ICAM-1</b>	<b>Intercellular Adhesion Molecule-1</b>
<b>IL-1</b>	<b>Interleukin-1</b>
<b>IL-6</b>	<b>Interleukin-6</b>
<b>IVUS</b>	<b>Intravascular Ultrasound</b>
<b>MCP-1</b>	<b>Monocyte Chemoattractant Protein-1</b>
<b>PBMC</b>	<b>Peripheral Blood Mononuclear Cells</b>
<b>PDGF</b>	<b>Platelet Derived Growth Factor</b>
<b>PTFE</b>	<b>Polytetrafluoroethylene</b>
<b>TM</b>	<b>Thrombomodulin</b>
<b>TNF<math>\alpha</math></b>	<b>Tumor Necrosis Factor alpha</b>
<b>VCAM-1</b>	<b>Vascular Adhesion Molecule-1</b>
<b>VSMC</b>	<b>Vascular Smooth Muscle Cells</b>

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## INTRODUCTION

Vascular access dysfunction is an important cause of morbidity for dialysis patients and a major contributor to HD cost (*De Marchi et al., 1996*). Thrombosis is a leading cause of vascular access failure, and usually results from stenotic lesions in the venous outflow system. This kind of lesions predisposes to changes in both the vessel's wall and the blood flow (*Owen et al., 1993*).

Interleukin-6 was found to have an important role in regulating the proliferation of vascular smooth muscle cells which has the key role in the pathogenesis of the access stenosis. So, estimation of serum IL-6 may help in early detection of vascular access stenosis (*De Marchi et al., 1996*). Doppler ultrasound is a new non invasive technique that allows imaging of flow through the vascular access and detection of stenosis that predisposes later on to thrombotic occlusion of the access (*Raja, 1994*).

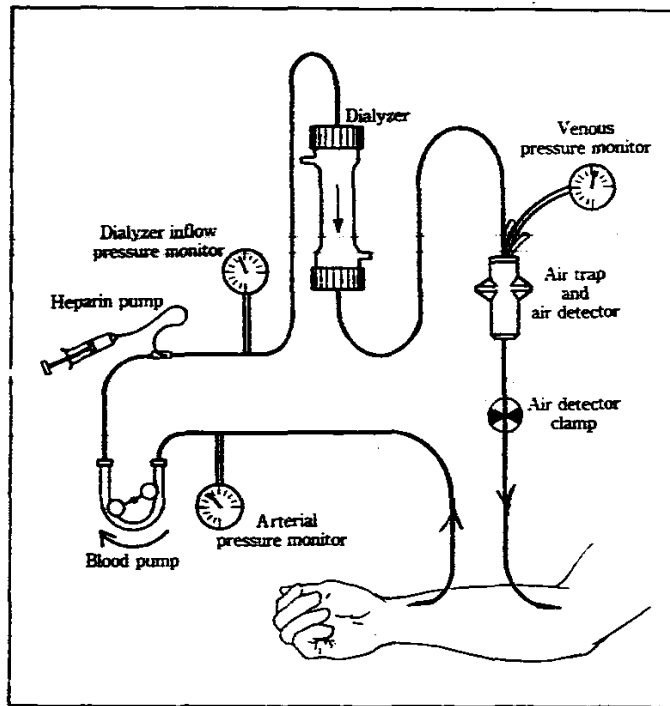
## AIM OF THE WORK

This study aimed at speculation of a suitable tool that may help in the early detection of vascular access malfunction in pediatric patients with CRF on regular HD.

# Reviews of Literature

## **VASCULAR ACCESS In HEMODIALYSIS**

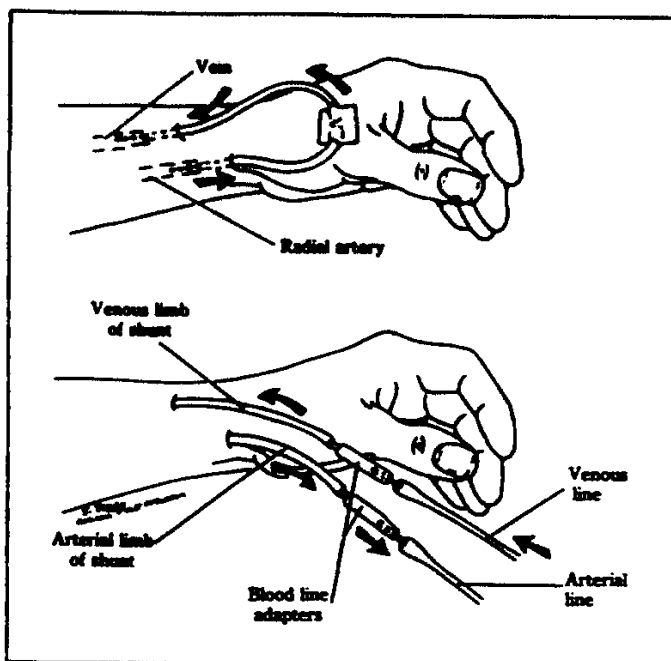
Hemodialysis (HD) is of the modalities of therapy for patients with renal failure. It uses extracorporeal perfusion to transfer fluids and solutes by diffusion and ultrafiltration between blood and dialysate. This is accomplished by allowing blood and dialysate to flow by each other separated by a semipermeable membrane. Solute are primarily removed from the blood by diffusion occurring along a concentration gradient. Continual flow of blood and dialysate regenerates this concentration gradient, permitting maximal removal of solutes. Fluid is removed by ultrafiltration across the semipermeable membrane. Ultrafiltration occurs because a transmembrane hydrostatic pressure gradient is created from the blood to the dialysate compartment. This hydrostatic pressure gradient is a result of both venous outflow resistance from the dialyzer and negative pressure exerted on the dialysate compartment (*Evan et al., 1995*). HD process needs suitable dialyzer, machine, and good vascular access to the patient's circulation. The principal of blood circuit in hemodialysis could be simplified as in Figure(1).



Figure(1): The Blood Circuit in Hemodialysis .

Chronic HD requires repeated reliable access to the systemic circulation (*Schwab et al., 1997*). Vascular access failure is a significant source of morbidity in chronic HD patients (*Feldman et al., 1993*). HD access failure continues to be the most frequent cause of hospitalization in end stage renal disease (ESRD) patients (*Schwab et al., 1997*). In some centers it accounts for the largest number of hospital days (*Mayers et al., 1992*).

The first technical advance in establishing repeated vascular access was the development of Quinton - Scribner shunt in 1960 (Quinton *et al.*, 1960). It is an external arteriovenous shunt. It consists of two hard plastic cylinders (vessel tips). One vessel tip is implanted into an extremity artery and the other into a nearby vein. The opposite vessel tip ends are connected to pieces of silicone elastomer tubing. After implantation, the two silicone tubes are connected with each other to establish the external shunt (Figure 2). The Scribner shunt is now largely obsolete (Michael *et al.*, 1996).



Figure(2): Quinton-Scribner Shunt.

The subsequent development of the internal fistula made chronic HD possible and easier. Later on improvements in vascular accesses, such as the polytetrafluoroethylene (PTFE) graft, expanded the availability of HD. With the increasing survival of the HD population, it has become evident that patients who survived 10 or more years on HD had significantly fewer vascular access than those who survived less than 10 years (*Fan and Schwab, 1992*).

### **Ideal Vascular Access**

Ideally, access to the systemic circulation should accommodate a flow rate adequate for the HD prescription, remain usable for a long period of time, and have a low complication rate. No access meets all these criteria (*Schwab et al., 1997*). Native arteriovenous fistula (AVF) comes closest, but even it is associated with complications. As the number of patients undergoing dialysis for ESRD has grown, the use of native AVFs has declined and the use of synthetic arteriovenous (AV) graft for permanent vascular access has increased (*Albers, 1994*). Unfortunately, patency rates for AV grafts are inferior to those of native AVFs, and complication rates are at least three fold greater (*Feldman et al., 1996*).