# Role of Doppler Ultrasonography in Surveillance of Vascular Access and Assessment of the Shunt in Hemodialysis Patients

## Essay

**Submitted for partial fulfillment of Master degree in Radiodiagnosis**

Submitted by

**Sara Mohammad Shehatah Mohammad El Geneidy**
(M. B. B. Ch)
Ain Shams University

Under supervision of

**Prof. Dr. Sameh Abd El-Wahab**
Professor of Radiodiagnosis
Faculty of Medicine, Ain Shams University

**Dr. Ahmed Basiouny**
Lecturer of Radiodiagnosis
Faculty of Medicine, Ain Shams University

**Faculty of medicine**
**Ain Shams University**
**2016**


سورة البقرة الآية: ٣٢


وأنزل الله عليك
الكتاب والحكمة
وعلَّمَكَ مَا لَمْ تَكُنْ
تَعْلَمُ وكَانَ فَضْلُ
اللَّهِ عَلَيْكَ عَظِيماً
صدق الله العظيم
سورة النساء الآية (١١٣)

# Acknowledgments

*First and foremost, I feel always indebted to* Allah*, The Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound gratitude to* **Prof. Dr. Sameh Abd El-Wahab,** *Professor of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for his guidance, kind supervision, valuable advice, and continuous encouragement, which made possible the completion of this work. I really have the honor to complete this work under his supervision.*

*I am also delighted to express my deepest gratitude and thanks to* **Dr. Ahmed Basiouny,** *Lecturer of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for his kind care, continuous supervision, valuable help and great assistance throughout this work.*

*I would like to express my hearty thanks to all my* ***Family*** *for their support till this work was completed.*

Sara Mohammad Shehata

# List of Contents

# List of Abbreviations

| *Abbr.* | *Full-term* |
|---|---|
| **AKF** | : Acute kidney failure |
| **AVF** | : Arteriovenous fistula |
| **BA** | : Brachial artery |
| **CDS** | : Color Doppler sonography |
| **CKF** | : Chronic kidney failure |
| **CVC** | : Central venous catheter |
| **DSA** | : Digital subtraction angiography |
| **DUS** | : Doppler ultrasound |
| **ESKD** | : End-stage kidney disease |
| **GFR** | Glomerular filtration rate |
| **HD** | : Hemodialysis |
| **IJV** | : Internal jugular vein |
| **LSA** | : Left subclavian artery |
| **PD** | : Peritoneal dialysis |
| **PTFE** | : Polytetrafluoroethylene |
| **RI** | : Resistance index |
| **RSA** | : Right subclavian artery |

# List of Tables

# List of Figures

# Introduction

Arteriovenous fistula (AVF) is the most widely used means of vascular access for long-term hemodialysis (HD) in patients with end-stage renal disease. Satisfactory function of these artificial shunts is essential for adequate hemodialysis ***(Lindert et al., 2012).***

Preoperative evaluation of upper extremity veins and arteries with duplex ultrasound is a useful adjunct to physical examination, especially for those patients who are obese, have had multiple previous access surgeries or otherwise are difficult to examine well, or for those in whom arterial or venous disease is suspected ***(Ferring et al., 2010).***

Although access is the lifeline for the hemodialysis patient, its creation and maintenance is a difficult undertaking. After creation of the access, prolonged functional patency may prove elusive due to the development of stenotic lesions leading to thrombosis or failure to mature ***(Kumbar & Karim, 2012).***

The complication rate related to permanent HD vascular access remains high and accessrelated problems are responsible for 50% of the hospitalization of dialysis patients. Most of these complications are related to the thrice-weekly trauma to the graft inflicted by large core

needles required for hemodyalisis treatment.[1] Because potential sites for vascular access are limited, extending the life of an existing fistula or graft is of great benefit. Thus, early detection, localization, and characterization of lesions that compromise hemodyalisis are extremely important because they may allow correction before failure of the access ***(Middleton et al., 2009).***

Traditional methods of graft surveillance include: clinical examination, venous line pressure measurements during dialysis, urea or tracer recirculation measurement, duplex ultrasonography and angiography. The frequency of occurrence of recurring access problems mandates a method of examination that is accurate, noninvasive, and can be repeated as often as needed to evaluate the morphology and function of the fistulas. Color Doppler sonography (CDS) has established itself in recent years as the procedure of first choice for the evaluation of HD access problems ***(Elsharawy & Moghazy, 2006).***

Duplex ultrasound imaging lends itself well to the evaluation of hemodialysis access as grafts and fistulas are superficial structures. This modality allows identification and localization of abnormalities, which may potentially threaten access function and patency. Identification and correction of access abnormalities at early stages may improve longevity

and function as blood flow <500/cc/min or stenosis >50% identified on duplex exam has been correlated with access thrombosis within 6 months ***(Strauch et al., 2012).***

Duplex sonography and flow volume measurements have been used for graft surveillance for the prediction of graft failure. According to reports in the literature, the mean flow rates range from 500 to 1000 mL/min. An excessive fistula flow rate is often suspected when clinical problems such as cardiac failure, recurrent swelling of the access arm, or steal syndrome arise. Excessive fistula flow may, in some cases, necessitate surgical reduction of the anastomotic orifice or closure of the anastomosis with creation of a new fistula. In patients with proximal venous stenoses, fistula flow is an important factor in the development of venous congestive symptoms such as edema, pain, and atrophic skin changes ***(Paun et al., 2010).***

# Aim of the Work

To emphasize the role of duplex ultrasonography in evaluation and surveillance of vascular access and assessment of the shunt in hemodialysis patients.

# Chapter (1)
# Vascular Access for Hemodialysis

## 1. Introduction

Patients with acute kidney failure (AKF) and chronic kidney failure (CKF) require an appropriate vascular access for hemodialysis ***(Ortega et al., 2005).***

Vascular access is needed to allow blood flow through an extracorporeal circulation system with a blood pump connected to a hemodialysis monitor driving the blood through a dialysis filter (dialysator). Satisfactory levels of blood flow range between 300 and 400 mL/min.

The need for vascular access in patients with kidney failure may be temporary or permanent ***(NKF-K/DOQUI, 2000).***

## 2. Temporary hemodialysis vascular access

Temporary hemodialysis access is required in patients scheduled to start hemodialysis treatment in several days to six months. It is mostly needed in patients with AKF of various etiology ***(Weijmer & ter Wee, 2004).***

For that purpose, a hemodialysis catheter is introduced percutaneously into one of the large central veins (the internal