# INTRODUCTION

Estimated prevalence of end-stage renal disease in Egypt is 225 per million populations. Most patients were undergoing intermittent haemodialysis treatment (97.1%), while minorities (2.9%) were treated by peritoneal dialysis; the rate of renal transplantation was 32 per 1000 dialysis patients per year ***(Afifi and Karim, 1999).***

The arteriovenous fistula is the preferred access for heamodialysis. However, the arteriovenous fistula failure has become more common over the last three decades as more patients are older, and have diabetes or vascular disease ***(Martin et al., 2008).***

Fifteen percent of hospitalizations of patients with end-stage renal disease are caused by vascular access complications. This makes it a major cost as well as a health issue. Measures to improve the longevity of vascular accesses are needed. Preoperative evaluation to select the most appropriate site and type of access could play a role. Access surveillance to predict and prevent access failure and consequently to correct the lesion is likely to prevent access thrombosis or loss ***(Jean et al., 2008).***

During the late 1970s, diabetic patients with end-stage renal disease were increasingly accepted for maintenance chronic heamodialysis. At that time the strategies for creating vascular access in diabetic patients

wear not different from those in non –diabetic patient: priority was given to an anastomosis located at the wrist, despite occasional technical problems in suturing vein to a calcified artery. This strategy, well established and accepted in non-diabetic patients, caused a high failure rate, especially early thromboses and low arteriovenous fistula blood flow ***(Klaus, 2000).***

We have had good success with the upper arm cephalic vein–brachial artery autogenous fistula. The upper arm cephalic vein is frequently not subjected to multiple intravenous lines and blood draw attempts as are the forearm veins and offers an excellent autogenous conduit for access ***(Mendelssohn et al., 2006).***

Early problems after primary arteriovenous fistula placement are often related to surgical technical factors and include thrombosis, postoperative bleeding, infection, hand ischemia ("steal") and paresthesia from peripheral nerve injury during anesthesia or surgery. Late complications are usually related to dialysis practice and needle puncture technique. The most common are vascular stenosis at various levels, thrombosis, usually starting at a stenosis site, infection/inflammation usually in association with thrombosis, false aneurysm at the anastomosis site, infiltrating hematoma after dialysis needle puncture, true aneurysm along the vein and venous hypertension in the hand ***(Ingemar, 2002).***

Early detection of dialysis access dysfunction and timely intervention is likely to result in prolongation of access function. Several strategies are available for the diagnosis of failing access. Doppler ultrasound has the distinct advantage of evaluating both anatomic and flow characteristics. Meaningful ultrasound information requires skilled technicians and presence of the surgeon to direct and interpret images. While static venous pressure monitoring is easy, it does not represent intra-access pressure only. The evolving technology of access flow measurement has important prognostic implications to predict failure as well as evaluate the outcome of intervention ***(Ohira et al., 2006).***

# AIM OF THE STUDY

The aim of our work is to compare between radio-cephalic arterio venous fistula versus brachio-cephalic arterio venous fistula in end-stage renal disease patients with diabetes regarding primary patency.

# Chapter I

# ANATOMY OF THE RELEVANT VESSELS USED FOR VASCULAR ACCESS IN HEMODIALYSIS PATIENTS

The following table outlines veins of the upper limb. The veins that are most commonly used for vascular access are the Axillary, Basilic, and Cephalic veins. Both of the Basilic and Cephalic veins could either be used for native arteriovenous fistula or with synthetic grafts. These veins are anastmosed with the Brachial artery or the ulnar artery incase of the Basilic vein and both the Radial artery (distal arteriovenous fistula) and the Brachial artery (proximal arteriovenous fistula) in case of the Cephalic vein. The Cephalic and Basilic veins derive their names from their position during the embryonic life, were the Cephalic vein is towards the fetal head and thus the name *Cephalic*, while the Basilic vein is away from the head and thus the name *Basilic*. The Axillary vein is used for anastmoses with the Brachial artery via a synthetic graft incase of Brachioaxillary graft. The Cephalic vein could be used for anastmoses with the Brachial artery via a synthetic graft in case of a Brachiocephalic graft (Forearm loop graft) ***(Montreuil, 2007).***

## **Table (1):** Veins of the upper limb

| Selected Veins of the Upper Limb - Listed Alphabetically | | | | |
|---|---|---|---|---|
| **Vein** | **Tributaries** | **Drains Into** | **Regions Drained** | **Notes** |
| Axillary v. | Basilic and brachial veins | Subclavian v., which is its driect continuation | Upper limb | Originates at the lower margin of teres major muscle and terminates at lateral margin of first rib |
| Basilic v. | medial end of the dorsal venous arch of the hand; superficial veins of the forearm; median cubital v. | it unites with the brachial vein(s) to form the axillary v. | superficial parts of the medial side of the hand and medial side of the forearm | basilic v. communicates with deep veins of the forearm through perforating veins, especially in the cubital region |
| Brachiocephalic v. | formed by the union of the subclavian v. and the internal jugular v.; tributaries: vertebral v., thymic v., inferior thyroid v., internal thoracic v., 1st posterior intercostal v., left superior intercostal v. (to the left brachiocephalic v.) | the left and right brachiocephalic v. unite to form the superior vena cava | head; neck; upper limb; anterior chest wall | at its origin, the left brachiocephalic v. receives the thoracic duct; at its origin, the right brachiocephalic v. receives the right lymphatic duct |
| Cephalic v. | lateral side of the dorsal venous arch of the hand; superficial veins of the forearm | axillary vein | superficial parts of the lateral hand and lateral forearm | median cubital vein usually shunts some of the blood collected by the cephalic v. to the basilic v. |
| Median cubital v. | Cephalic | Basilica | superficial part of the hand and forearm | a median antebrachial vein occurs occasionally and, when present, it may drain into the median cubital vein |

***(Thomas and Jaye, 1995).***

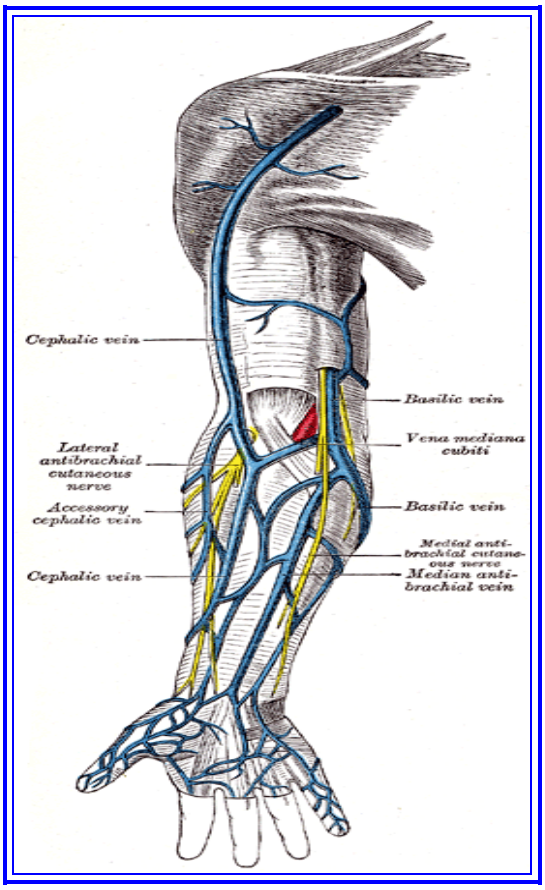


**Figure (1):** Venous anatomy of the right upper extremity ***(Moore and Agur, 2007).***

## Arteries in the upper limb:

The arteries of the upper limb are outlined in the following table, of these arteries the most commonly used are the Radial and Brachial artery.

**Table (2):** Selected Arteries of the Upper Limb - Listed Alphabetically

| Artery | Source | Branches | Supply to | Notes |
|---|---|---|---|---|
| axillary | subclavian a. (axillary a. is the continuation of the subclavian lateral to the 1st rib) | 1st part: superior thoracic a.; 2nd part: thoracoacromial a., lateral thoracic a.; 3rd part: anterior humeral circumflex a., posterior humeral circumflex a., subscapular a. | pectoral region, shoulder region and upper limb | pectoralis minor m. crosses anterior to the axillary artery and is used to delineate the 3 parts mentioned at left |
| brachial | axillary a. (brachial a. is the continuation of the axillary a. distal to the teres major m.) | deep brachial a., superior ulnar collateral a., nutrient a., inferior ulnar collateral a.; terminal branches are the radial a. and the ulnar a. | arm, forearm and hand | brachial a. normally terminates at the level of the elbow, but high branching may occur |
| radial | brachial a. | radial recurrent a., palmar carpal br., superficial palmar br., dorsal carpal br., 1st dorsal metacarpal a., princeps pollicis a., radialis indicis a., deep palmar arterial arch | posterior elbow, posterior forearm, posterior hand, deep portion of palmar side of the hand, thumb | radial a. provides the majority of blood supply to the deep palmar arterial arch; normally it arises at the level of the elbow but may high branching of the brachial a. may result in the radial a. arising as proximal as the axilla |
| subclavian | brachiocephalic a. (right), aortic arch (left) | 1st part: vertebral a., thyrocervical trunk, internal thoracic a.; 2nd part: costocervical trunk; 3rd part: dorsal scapular a. (70%) | neck, brain, spinal cord, thyroid gland, larynx, shoulder, chest muscles, upper limb | subclavian a. is continuous with the axillary a., the name change occurs at the lateral border of the first rib; anterior scalene muscle passes anterior to the subclavian a., dividing it into 3 parts |
| ulnar | brachial a. | anterior ulnar recurrent a., posterior ulnar recurrent a., common interosseous a., palmar carpal br., dorsal carpal br., deep palmar br., superficial palmar arterial arch | medial side of the anterior forearm, posterior forearm, superficial palm, fingers | ulnar a. supplies the majority of blood to the superficial palmar arterial arch; it normally arises at the level of the elbow, but high branching of the brachial a. may cause the ulnar a. to arise as far proximally as the axilla |

***(Thomas and Jaye, 1995).***

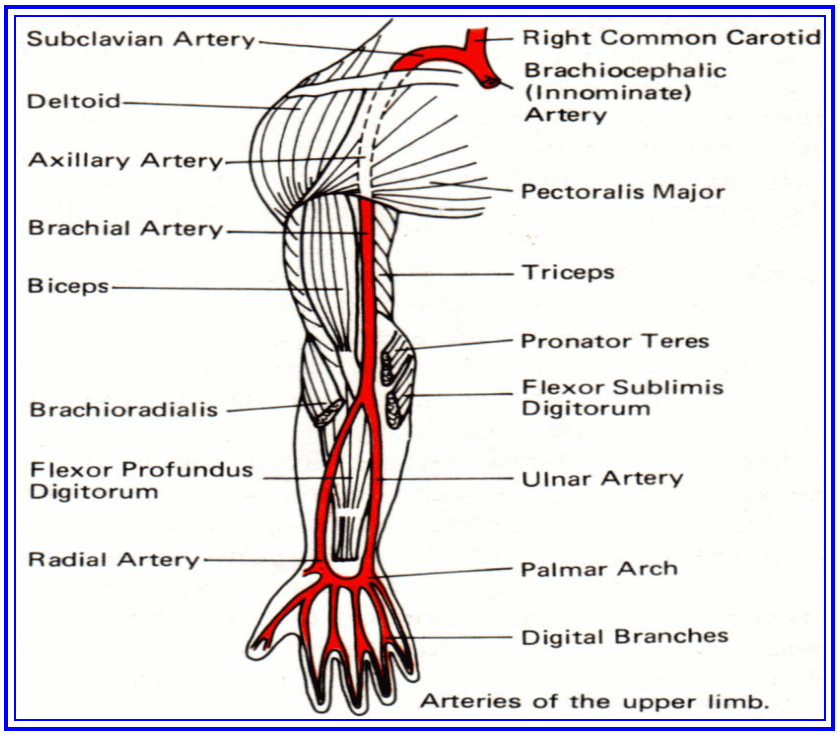


**Figure (2):** Arterial anatomy of the right upper extremity ***(Moore and Agur, 2007).***

# Chapter II

# ARTERIAL AND VENOUS PATHOLOGY IN DIABETIC PATIENTS

## Introduction

Macrovascular disease is the leading cause of mortality and morbidity in diabetes. The study of factors that may uniquely contribute to the accelerated development of atherosclerosis in diabetes has been an ongoing process for several years. However, the concepts behind both the pathogenic mechanisms of atherosclerosis and the trigger mechanisms that lead to acute clinical events have drastically changed in the last two decades. It is now fully accepted that arteriosclerosis is a chronic inflammatory process and not a degenerative process that inevitably progresses with age. Also accepted is the fact that plaque rupture or erosion not the degree of vessel obstruction is responsible for the majority of acute cardiovascular events. Diabetes most likely contributes to and enhances the chronic inflammatory process characteristic of arteriosclerosis. In recent years, mechanisms that lead to plaque formation and to plaque erosion or rupture and the key event that precedes both, endothelial dysfunction, are being actively studied ***(Moreno et al., 2000).***

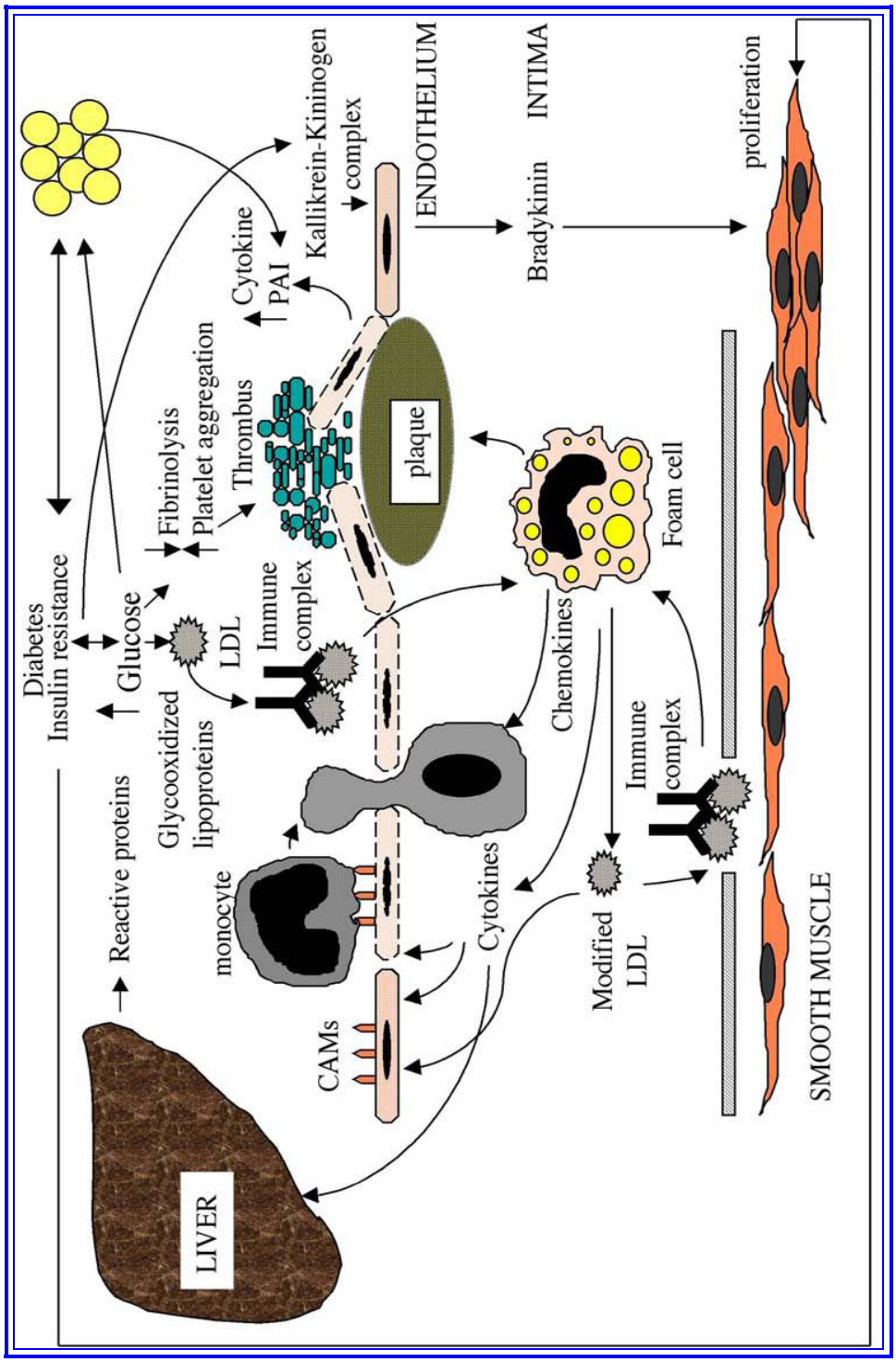
Diabetes
Insulin resistance
Glucose
Reactive proteins
Glycooxidized lipoproteins
LDL
Immune complex
Fibrinolysis
Platelet aggregation
Thrombus
Cytokine
PAI
Kallikrein-Kininogen complex
ENDOTHELIUM
INTIMA
Bradykinin
proliferation
plaque
Foam cell
Chemokines
monocyte
Cytokines
CAMs
Modified LDL
Immune complex
LIVER
SMOOTH MUSCLE

**Figure (3):** Diagrammatic representation of the possible pathogenic mechanisms for the development of atherosclerosis in diabetes. Increased levels of glucose lead to decreased production of prostacyclin stimulating factor (PSF), reduced nitric oxide activity, increased bradykinin in an injured endothelium and to multiple changes in lipoprotein metabolism and in cell–lipoprotein interactions. These changes contribute to the accelerated development of atherosclerosis in diabetic patients by reducing vasodilatation of the endothelium and, in the case of bradykinin promoting vasoconstriction and smooth muscle cell proliferation. Increased plasma glucose levels promotes also nonenzymatic glycation of lipoproteins and enhance their susceptibility to oxidative modification. These modified lipoproteins decrease fibrinolysis and increase platelet aggregation, which contributes to increased thrombosis. Modified lipoproteins may also stimulate the expression of cell adhesion molecules (CAMs). Monocyte adhesion to the endothelial cell layer and migration of these cells to the subendothelial space follow the expression of these molecules. Furthermore modified lipoproteins lead to a decrease in the release of nitric oxide by the endothelium and therefore to impaired vasodilatation. Glycated oxidized lipoproteins in the intimal layer may be further modified by oxidative processes that result in the formation of glycoxidized lipoproteins that, in turn, stimulate the immune system to form antibodies. The resulting immune complexes are taken up by macrophages, and they stimulate the formation of cholesteryl esterladen cells (foam cells) and the release of cytokines. Cytokines released during these processes will elicit release of reactive proteins by the liver (C-reactive protein) besides further injuring the endothelium and, thus, exacerbate the cycle ***(Virella et al., 2002).***

Diabetes accelerates the development of atherosclerosis and thrombosis. Special emphasis will be placed on endothelial dysfunction, on abnormalities in platelet function, coagulation and fibrinolysis, and on qualitative and quantitative abnormalities of lipoproteins and their role in foam cell formation and in eliciting a humoral response with formation of antibodies and immune complexes ***(Virella et al., 2002).***

## Endothelial Dysfunction

The endothelium participates in a number of important homeostatic and cellular functions that are essential to preserve its functional integrity. Loss of functional integrity of the endothelium is responsible, not only for cell adhesion, the initial step in the atherosclerotic process, but also for the triggering of its final step: the formation of thrombi, which leads to vessel occlusion and to acute ischemic events ***(Rajavashisth et al., 1990).***

### *Nitric Oxide*

NO is synthesized from L-arginine by NO synthase (NOS) and it is an anti thrombotic product of the endothelial cells. NO has been shown not only to mediate vasodilation but also to inhibit platelet aggregation and adhesion, prevent monocyte adherence to the endothelium, and prolong bleeding time. It has also been found to be responsible for reducing plasma fibrinogen levels and to

reduce platelet activation. Reduced NO bioavailability leads to impaired vasodilation, to abnormalities in the above functions and, as a consequence, enhances thrombotic events in humans .Impairment of NO-mediated vasodilation has been shown in both type 1 and type 2 diabetes and it may contribute to the accelerated development of macrovascular disease in diabetes ***(Bhatia et al., 2003).***

### *Insulin*

Several clinical trials clearly show that increased levels of insulin are frequently associated with increased risk for macrovascular disease and that led to the concept that administration of exogenous insulin would contribute to or enhance the development of macrovascular complications in diabetes ***(Bhatia et al., 2003).***

### *Prostaglandins*

#### *Prostacyclin*

Prostacyclin (PGI2) is synthesized mainly by vascular endothelial cells and it is a potent vasodilator and an inhibitor of platelet adhesion and aggregation . studies have shown that the synthesis of PGI2 by the vasculature of diabetic patients is reduced ***(Christopher et al., 2002).***

### *Thromboxane*

The endothelium secrets not only vasorelaxing agents, but also vasoconstricting agents. Thromboxane A2, is one of the best studied vasoconstrictors and it is the physiological counteracting mediator for NO. Both thromboxane A2 and its precursor, prostaglandin H2, are synthesized by both platelets and vessel wall tissues. Thus, it is obvious that the increased activation of platelets in diabetics contributes to the formation of thromboxane A2 and prostaglandin H2 in this disease state ***(Christopher et al., 2002).***

### *The Kallikrein/Kinin Pathway*

Bradykinin is generated by kallikreins from their precursor kininogens and it is a potent vasodilator that increases vascular permeability and plays a primary role in inflammation ***(Christopher et al., 2000***).

### *The Lipoxygenase Pathway*

Several lines of evidence support the concept that lipoxygenases (LOs) and their products play an important role in the pathogenesis of arteriosclerosis ***(Natarajan et al., 2003).***