Review of Complications of Vascular Access in Hemodialysis Patients

Essay
Submitted for Partial Fulfillment of Master Degree in General Surgery

Submitted by
Mohamed Mohamed Raafat Sayed Okelah

M.B., B. CH.
AIN SHAMS UNIVERSITY

Under the Supervision of
Prof. Dr. Ahmed Mahmoud Saad El-Deen
Professor of General & Vascular Surgery
Faculty of Medicine, Ain Shams University

Prof. Dr. Wagih Fawzy Abd El-Malik
Ass. Prof. of General & Vascular Surgery
Faculty of Medicine, Ain Shams University

Dr. Ahmed Farouk Mohamed
Ass. Prof. of General & Vascular Surgery
Faculty of Medicine, Ain Shams University

AIN SHAMS UNIVERSITY
2010

المضاعفات الناجمة عن جراحات منافذ الغسيل الكلوي الدموي في مرضى الفشل الكلوي المزمن

رسالة مقـدمة للحصول على درجة الماجستير فى الجراحة العامة

مـــن

الطبيب / محمد محمد رأفت سيد عقيلة

بكالوريوس الطب و الجراحة

كلية الطب- جامعة عين شمس

تحت إشراف

الأستاذ الدكتور/ أحمد محمود سعدالدين

أستاذ الجراحة العامة و جراحة الأوعية الدموية

كلية الطب- جامعة عين شمس

الأستاذ الدكتور/ وجيه فوزى عبدالملك

أستاذ مساعد الجراحة العامة و جراحة الأوعية الدموية

كلية الطب-جامعة عين شمس

الأستاذ الدكتور/ أحمد فاروق محمد

أستاذ مساعد الجراحة العامة و جراحة الأوعية الدموية

كلية الطب- جامعة عين شمس

جـــامعة عـين شـمـــس

2010

Acknowledgment

Thanks to Allah the almighty for allowing me to accomplish this study and hope that he makes it helpful and be of benefit to anyone who reads it.

My greatest thanks and gratitude would be to my professors supervising me. Prof. Ahmad Saad El Deen for being like a father to me, supplying me with the knowledge to follow into the right path. Prof. Wagih Fawzy for being supportive and always available to back me up with scientific data and clinical practice. Prof. Ahmad Farouk for always pushing me towards doing better and achieving my goals.

My thanks, love and a lifetime of gratitude to my mother who was an endless source of moral support, love and care. Many thanks I would like to express to my father who always made me seek perfection and told me that I should settle for nothing less than perfect.

The love of my life, my wife who was always beside me, always supportive in all possible means that she can and cherished me with care and concern. My lovely Jamila who ws an inspiration and a motive to move forwards.

Thanks to all my family members and to everyone to helped me with scientific, clinical psychological or technical support to accomplish this study.

THANK YOU ALL

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LIST OF ABBREVIATIONS

ARI: Access related ischemia

ASA: Acetyl Salycilic Acid

AAVS: American Association for Vascular Surgery

AV: Arteriovenous

AVF: Arteriovenous fistula

AVG: Arteriovenous graft

ANP: Atrial Natriuretic Peptide

BAL: Brachial artery ligation

BNP: Brain Natriuretic Peptide

CV: Central Vein

CVO: Central Venius Occlusion

CDC: Center for Disease Control and Prevention

CVS: Central Venous Stenosis

CAS: Cephalic arch stenosis

CDU: Colored Dupplex Ultrasound

CQI: Continious Quality Improvment

(CE)MRA: Contrast enhanced Magnetic Resonance Angiography

DOQI: Dialysis Outcome Quality Initiative

DSA: Digital Subtraction Angiography

DRIL: Distal Revascularization Interval Ligation

DU: Dupplex Ultrasound

DDAVP: 1-Deamino-8-Darginine Vasopressin

ESRD: End Stage Renal Disease

ePTFE: expanded Poly Tetra Fluro Ethelyene

FDA: Food and Drug adminstration

HD: Hemodialysis

IDDM: Insulin Dependent Diabetes Milletus

IJ: Internal Jugular

IMN: Ischemic Mono Neuropathy

LV: Left Ventricle

MRA: Magnetic Resonance Angiography

MT: Mechanical Thrombolysis

MDCT: ulti Detector Computed Tomography

NKF-DOQI: National Kidney Foundation Dialysis Outcome Quality Initiative

NH: Neointimal Huperplasia

NO: Nitric Oxide

PSV: Peak Systolic Velocity

PTA: Percutaneous Transluminal Angioplasty

PTS: Percutaneous Transluminal Stenting

PTVA: Percutaneous Transluminal Venous Angioplasty

PVR: Peripheral Vascular Resistance

PICC: eripherally Inserted Central Catheters

PMT: Pharmaco Mechanical Thrombosis

PPG: Photoplesythmography

PCB: Primary Cutting Balloon

PAI: Proximalization of Arterial Inflow

PE: ulmonary Embolism

PST: Pulse Spray Thrombosis

QA: Quality Assurance

SVS: Society for Vascular Surgery

SC: Sternoclavicular

SVC: Superior Vena Cava

SVO: Symptomatic Venous Obstruction

3D-Gd-MR: Three Dimensional Gadolinium Magnetic Resonance

t-PA: Tissue Plasminogen Activator

vWF: Von Willebrand Factor

WSS: Wall Shear Stress

Aim of the study

The aim of this study is to outline the possible complications in patients who had vascular access surgery for the purpose of hemodialysis, with emphasizing on the possible means of managing it.

Introduction

Magnitude of the problem in Egypt:

Reports have shown that unknown causes of ESRD in Egypt have reached 33.6% **(European Dialysis and Transplantation Association, 1987).**

Schistosomiasis, which is considered a common cause of renal failure in Egypt, is accused of being the cause of about 30% of chronic renal failure, most of which is due to obstructive uropathy and a small percentage is due to schistosomal nephritis **(El-Said et al., 1993).**

The prevalence of dialysis patients is presumed to have increased from 10 per million population (PMP) in 1974 to about 165 PMP in 1995 **(Barsoum et al., 1996.)** and up to 225 PMP in 1996 **(*Afifi et al., 1996).***

Hemodialysis vascular access requires repetitive reliable access to the circulation. This access to the circulation should meet three criteria. First, it should be suitable for repetitive circulatory access. Second, it should allow for a blood flow suitable to conduct modern high-efficiency dialysis. Third, the complication rate should be minimal. Currently there are three types of hemodialysis vascular access:

1) Native arteriovenous fistulas (radiocephalic, brachiocephalic, transposed brachiobasilic, brachiobasilic fistulae).
2) Arteriovenous (AV) grafts.
3) Central venous catheters. **(Schwab et al., 1999)**

Management of complications associated with arteriovenous (AV) access is an integral part of planning individual hemoaccess procedures. **(Padberg et al., 2008).**

A clinically significant bleeding tendency is a frequent complication of uremia, and its risk is assessed by template bleeding time. Hemorrhage into deep organs (subdural hematoma, arthrosis, gastrointestinal bleeding, and pericardial hemorrhage) and superficial bleeding (bruising, puncture sites, catheter entry sites) are both common.

Specifically, the vascular surgeon will encounter dysfunctional hemostasis in two common clinical situations. The first is intraoperative, characterized by diffuse oozing throughout the wound and prolonging both the dissection and closure. The second is after dialysis, characterized by a failure of hemostasis at the puncture sites in a reasonable time. This may manifest as external bleeding, hematoma, or pseudo aneurysm. **(Padberg et al., 2008).**

Infection is the second leading cause of failure of prosthetic AV accesses and autogenous AV accesses and is a frequent complication of AV access surgery requiring hospitalization. Infection ranks second to cardiovascular disease as a cause of death in hemodialysis patients. **(USRDS, 2007).**

Localized noninfectious fluid collections representing hematomas, seromas, lymphoceles, or lymphedema will occasionally complicate peripheral access sites. The initial presentation may be similar, but it is critically important to distinguish these from infection, abscess, or pseudo aneurysm because the implications for management vary significantly **(Padberg et al., 2008).**

An incidence of access-related pseudo aneurysms has been reported to be 0.049 to 0.1 per patient-year reported from two Dutch randomized trials, which probably underestimates this problem because it was limited to a single year of observation after construction of a new access **(Keuter et al., 2008).**

Symptoms of venous hypertension were recognized in its complete clinical form within a decade of the initial reports advocating AV access for hemodialysis. The most common manifestation of venous hypertension is regional edema, although other typical signs and symptoms such as pigmentation, induration, dermatosclerosis, and ulceration may be produced. The pathophysiology is straightforward but is frequently misunderstood or misdiagnosed. The essential concept pairs a functioning AV access, which increases arterial blood flow to an extremity, with an obstruction to venous outflow. **(Kerstein et al., 1976).**

Severe ischemic symptoms of arterial steal syndrome can be permanent and may be associated with constant pain, severe numbness, digital cyanosis or gangrene, finger contracture, or amputation of a digit, hand or forearm. Symptomatic arterial steal syndrome is uncommon, but usually requires surgical intervention.

Although symptomatic steal can occur with a forearm AV access, the incidence is low, ranging from 0.25% to 1.8%. **(Zibari et al., 1998).**

High output cardiac failure is a rare complication characterized by symptoms indistinguishable from cardiac failure. Because cardiac failure is very common in the dialysis-dependent population, differentiation is difficult. Autogenous AV access for maintenance hemodialysis was usually well tolerated, but high-output cardiac failure was reported within a decade of its introduction. **(Anderson et al., 1976).**

Anatomy of the relevant vessels used for vascular access in hemodialysis patients

Veins in the upper limb:

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)**