

RECENT LINES IN MANAGEMENT OF DIABETIC FOOT DISEASE

An essay
Submitted in partial fulfillment for the
Master degree in
General surgery

By
Ismail Mahmoud Serag El Din
(M.B. , BCH)

Supervised by
Prof. Dr. Alaa El Din Ismail
Professor of general surgery
Faculty of medicine, Ain shams university
MD, FRCS

Prof. Dr. Anas Hassan Mashaal
Lecturer of general surgery
Faculty of medicine, Ain Shams University

Prof. Dr. Yehia Galal Abo Sayed
Consultant of general surgery
Shebin El Kom Teaching Hospital

Ain Shams University
Faculty of medicine
2009

ACKNOWLEDGEMENT

*First of all, the great thanks to **ALLAH** who enabled us to complete this work hoping to provide a useful guide to the scope of the diabetic foot.*

*I would like to express my deep gratitude and appreciation to prof. **Dr. Alaa El Din Ismail** professor of general surgery faculty of medicine, ain shams university, for his kind supervision and support, without his continuous guidance and encouragement this essay would have never seen light.*

*I am just as much indebted to **Dr. Anas Hassan Mashaal** lecturer of general surgery faculty of medicine, ain shams university, every step and every detail in this work have been kindly assisted and supported by his effort and care.*

*A special measure of appreciation is extended for **Dr. Yehia Galal Abo Sayed** consultant of general surgery, shebin elkom teaching hospital. He offered me the utmost care, invaluable advice and unlimited support.*

Lastly, I am also indebted to everyone who assisted me in this work.

CONTENTS

SUBJECT	PAGE
Introduction.....	1
Aim of the Work.....	6
Chapter I: Anatomic Considerations.....	7
Chapter II: Pathophysiology Of Diabetic Foot Disease...	27
Chapter III: Diagnosis.....	52
Chapter IV: Lines Of Treatment.....	87
Summary.....	145
References	147
Arabic summary.....	172

LIST OF ABBREVIATIONS

1CPT	carboxyterminal telopeptide of type 1 collagen
ABI	ankle/brachial index
AFO	Ankle Foot Orthoses.
Ang-1	Angiopoetin-1.
BASIL	Bypass versus Angioplasty in Severe Ischemia of the Leg.
C.T	Computerized Tomography.
CROW	Charcot Restraint Orthotic Walkers .
DCCT	Diabetes Control and Complications Trial .
DFUs	Diabetic foot ulcers.
ECM	Extracellular matrix.
EGF	Epidermal growth factor.
EGFR	Epidermal growth factor Receptor.
eNOS	endothelial Nitric Oxide Synthase.
EPCs	Endothelial Progenitor Cells.
FDA	Food and Drug Administration.
FGF	Fibroblast Growth Factor.
HBO	Hyperbaric Oxygen Therapy.
IDSA	The Infectious Disease Society Of America.
LEA	Lower Extremity Amputations.
LJM	Limited Joint Mobility.
LOPS	Loss Of Protective Sensation.

MMPs	Matrix Metallo Proteinases.
MRA	Magnetic Resonance Angiography.
MRI	Magnetic Resonance Imaging.
MSC	Multipotent Stem Cells.
NO	Nitric Oxide.
P1CP	Procollagen Carboxyterminal Propeptide.
PAD	Peripheral Arterial Disease.
PDGF-BB	Platelet Derived Growth Factor BB.
PECAM-1/CD31	Platelet Endothelial Cell-Adhesion Molecule-1.
PEDIS	P (perfusion), E (extent/size), D (depth of tissue loss), I (infection) and S (sensation).
PET	Positive Emission Tomography.
PTB	Patellar Tendon-Bearing Brace.
PTIs	Pressure-Time Integrals.
PVR	Pulse Volume Recordings.
RCT	Randomized Controlled Trial.
SC	Stem Cells.
SDF-1 α	Stromal Cell-Derived Factor-1 α .
SPP	Skin Perfusion Pressure.
Tc-99 HMPAO	Technetium-99hexamethylpropylene-amineoxime.
Tc-99 M	Technetium-99 methylene diphosphonate .
TcPO ₂	Transcutaneous Oxygen Tension.
TGF-B	Transforming Growth Factor B.
UKPDS	United Kingdom Prospective Diabetes Study.
HSE	Human skin equivalent.

VE-cadherin	Vascular Endothelial Cadherin.
VEGF	Vascular Endothelial Growth Factor.
VEGFR2	Vascular Endothelial Growth Factor Receptor 2.
vWF	Von Willebrand Factor.
WBC	White Blood Cell Count.
WHO	World Health Organization.

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1	Classification of diabetes mellitus.	28
2	History items in diabetic foot disease.	66
3	Key components of the foot examination.	68
4	Radiographic Findings of Acute Osteomyelitis.	75
5	Compilation of Sensitivity and Specificity of Various Imaging Modalities in the Diagnosis of Osteomyelitis.	80
6	Wound Care Products.	137
7	Classifying diabetic foot infections.	142
8	Foot Infections.	143
9	Selected Antibiotic Regimens for Initial Empiric Therapy of Foot Infections in Patients With Diabetes Mellitus.	146

LIST OF FIGURES

Figure NO.	Title	Page NO.
1.	Arteries of lower limb.	7
2.	Popliteal artery.	8
3.	Posterior tibial artery .	9
4.	Posterior tibial artery .	10
5.	Anterior tibial artery.	11
6.	The dorsal artery of foot.	13
7.	Planter arteries of foot .	15
8.	Digital arteries of foot .	17
9.	Bones of foot.	19
10.	Bones of foot.	20
11.	Regions of foot.	21
12.	Fascia of dorsum of foot.	23
13.	Plantar fascia of foot.	24
14.	Prevalence of diabetes mellitus.	27
15.	The risk factors for ulceration.	37
16.	Diabetes mellitus is responsible for a variety of foot pathologies contributing to the complications of ulceration and amputation. Multiple pathologies may be implicated, from vascular disease to neuropathy to mechanical trauma.	47
17	The risk factors for amputation are multifactorial and similar to those for ulceration.	59
18	Osteomyelitis of the navicular bone on radiography.	75

19	Soft tissue air and deep ulcers on radiography.	76
20	Metatarsal osteonecrosis on CT.	78
21	Osteomyelitis of left ankle—delayed phase of a three-phase bone scan.	82
22	Osteomyelitis of left ankle—gallium scan.	85
23	Osteomyelitis—indium-labeled leukocyte scan.	87
24	Algorithm for assessing peripheral vascular disease in the patient with diabetes	97
25	Diabetic peripheral arterial disease pathway.	100
26	Diabetic neuroarthropathy may be classified according to the anatomic location of joint involvement.	111
27	Diabetic foot service.	119
28	This 60-year-old female with diabetes and a history of plantar callus presented with (A) ulceration sub 4th metatarsal head and (B) 4th left toe, and poor diabetic control. A severe foot infection was apparent and (C) radiographs showed erosive disorganization of the 4th MTP joint. The patient developed a foot infection secondary to the plantar callus that progressed to osteomyelitis of the 4th toe and 4th metatarsal. (D) She was	

	treated with parenteral antibiotics and ray resection.	154
29	Mechanisms of wound healing in healthy people versus people with diabetes.	165
30	Molecular basis of debridement.	169

AIM OF THE WORK

The aim of this work is to highlight the recent lines and modalities of management of diabetic foot disease trying to avoid or minimize the possibility of limb amputation offering a better quality of life for those patients.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disease. With pathological changes seen frequently in the peripheral vascular, nervous, skeletal and integumentary systems (thung p. et al., 1999).

WHO (world health organization) and the international working group on diabetic foot defines diabetic foot as the foot of diabetic patients with ulceration, infection, and/or destruction of the deep tissues associated with neurological abnormalities and various degrees of peripheral vascular disease in the lower limb.

Around the world at least 120 million people have diabetes and up to 10% will develop foot ulceration at some time, about 9% of national health service funds are spent dealing with diabetes, nearly halve of this is for hospitalization for complications, particularly of the diabetic foot. Throughout the developed world healthcare costs are incurred, but in the developing nations the scarcity of care means that most of the cost is social (Newrick p. 2000).

About 77% of individuals over 75 years of age undergoing amputation were unable to return to their own homes after surgery, and required additional financial support and social service (**Lavery et al, 1997**).

Diabetic patients have an increased propensity to develop a variety of fungal and bacterial skin and soft tissue infections. Foot infections are properly the commonest and most important of them, being responsible for more hospital days than any other complications of diabetes (**Ramsey et al., 1999**).

There are two main types of ulcers: neuropathic and ischemic, the vast majority of ulcers are either pure neuropathic or mixed neuroischaemic (**Katsilambros et al., 2007**).

The diagnosis of diabetic foot disease is multidisciplinary, including clinical history taking and thorough examination for gait, deformities, sensation, ulcers, fissures, corns, dryness, onychomycosis, infections, peripheral pulses and bruits. Also, different imaging techniques are of value ranging from plain x-rays, C.T (computerized tomography), MRI (magnetic resonance imaging), radioisotope scanning up to vascular

and hemodynamic studies such as duplex scanning, ankle brachial index, angiography and MRA (magnetic resonance angiography)(**Katsilambros et al.,2007**).

Meticulous attention to foot care and proper management of minor foot injuries are the key to preventing ulcer formation. Gentle cleansing with soap and water, followed by the application of topical moisturizers, helps to maintain healthy skin that can better resist breakdown and injury (**Lipsky et al., 2005**).

Wound management can be achieved by Aggressive surgical debridement and wound management, carefully chosen antimicrobial therapy, and modification of host factors (i.e., hyperglycemia). Also, improvement of limb vascularity through different vascular techniques as angioplasty, stenting or bypass surgery is all equally important for a successful outcome (**Perencevich et al., 2004**).

Some surgeons have proposed the advantages of plastic surgical flaps and skin grafts to expedite wound healing and provide for more durable soft tissue coverage.