Ain Shams University
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Anesthesia and Intensive Care Department

Management of Acute Coronary Syndromes

An essay

Submitted for Partial Fulfillment of the M.Sc. Degree in

Intensive Care

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قسم التخدير والرعاية المركزة وعلاج الألم

Management of Acute Coronary Syndromes

معالجة المتلازمات الحادة للشريان التاجي

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رسالة مقدمة توطئة للحصول على درجة الماجستير في الرعاية المركزة

من الطبيب/ **عماد أحمد حمدان عبدالتواب**

بكالوريوس الطب والجراحة

تحت إشراف

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مدرس التخدير والرعاية المركزة وعلاج الألم
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List of Abbreviations

Abbreviation	Meaning
ACC	American College of Cardiology
ACE	Angiotensin-converting enzyme
ACS	Acute coronary syndrome
ACT	Activated clotting time
ADP	Adenosine diphosphate
AHA	American Heart Association
aPTT	Activated partial thromboplastin time
AMI	Acute Myocardial Infarction
ARB	Angiotensin receptor blocker
AV	Atrioventricular
BMI	Body mass index
BNP	Brain natriuretic peptide
CABG	Coronary bypass graft surgery
CAD	Coronary artery disease
CCS	Canadian Cardiovascular Society
CHD	Coronary heart disease
CHF	congestive heart failure
CK	Creatinine kinase
CK-BB	Creatinine kinase brain band
CK-MB	Creatinine kinase myocardial band
CK-MM	Creatinine kinase musle mass
COX	Cyclo-oxygenase
CRF	Chronic renal failure
CRP	C-reactive protein
CrCl	Creatinine clearance
CT	Computed tomography
cTnC	Cardiac troponin C
cTnT	Cardiac troponin T
cTnI	cardiac troponin I
DES	Drug-eluting stent
dl	decilitre
DTI	Direct thrombin inhibitor
e.g.	for example

List of Abbreviations (cont,)

Abbreviation	Meaning
ECG	Electrocardiogram
EDRF	Endothelium-derived relaxing factor
EF	Ejection fraction
ER	Emergency room
ESC	European Society of Cardiology
Factor- Xa	Activated factor-X
FDA	Food Drug Administration
GERD	Gastroesophgeal reflux disease
GFR	Glomerular filtration rate
GPIIb/IIIa inhibitors	Glypoprotein IIb/IIIa inhibitors
HB	Heart block
HBA1C	Haemoglobin A1 glycated
HDLc	High-density lipoprotein cholesterol
HIT	Heparin-induced thrombocytopenia
hsCRP	High-sensitive c-reactive protein
i.e.	that is
IMA	Ischemic modified albumin
IU	International units
IV	Intravenous
kg	kilogram
LBBB	Left-bundle branch block
LDLc	Low-density lipoprotein cholesterol
LMWH	Low molecular weight heparin
LV	Left ventricular
LVEF	Left ventricular ejection fraction
MB	Myocardial band
mg	milligram
MI	Myocardial infarction
mL	millilitre
mm	millimeter
MPO	Myeloperoxidase

List of Abbreviations (cont,)

Abbreviation	Meaning
MR	Mitral regurgitation
MRI	Magnetic resonance imaging
mV	millivolt
99mTc	Technetium-99m
NSAID	Non-steroidal anti-inflammatory drug
NSTEACS	Non-ST-elevation acute coronary syndromes
NSTEMI	Non-ST elevation myocardial infarction
NTG	Nitroglycerin
NT-proBNP	N-terminal pro-hormone brain natriuretic peptide
PAI-1	Plasminogin activator inhibitor-1
PAMI-II	Primary angioplasty in myocardial infarction-II
PCI	Percutaneous coronary intervention
PF4	Platelet factor 4
PIOPED	Prospective investigation of pulmonary embolism diagnosis
PTCA	Percutaneous transluminal coronary angioplasty
RBBB	Right bundle branch block
RI	Relative index
RUO	Right upper quadrant
RV	Right ventricle
SA	Sinuatrial
S1	First heart sound
S2	Second heart sound
S3	Third heart sound
S4	Fourth heart sound
SC	Subcutaneous
SMC	Smooth muscle cell
SPECT	Single-photon emission computed tomography
STEACS	ST-elevation-acute coronary syndrome
STEMI	ST-elevation myocardial infarction
TG	Triglyceride
TIMI	Thrombolysis in myocardial infarction
t-PA	Tissue plasminogen activator
UFH	Unfractionated heparin

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Introdution

Acute coronary syndromes (ACS) define a spectrum of clinical manifestations of acute coronary artery disease. These extend from acute myocardial infarction (AMI) through minimal myocardial injury to unstable angina. This spectrum shares common underlying pathophysiological mechanisms. The central features consist of fissuring or erosion of atheromatous plaque. The distinction between acute myocardial infarction and minimal myocardial injury is of immediate practical importance as emergency reperfusion treatment is indicated for acute infarction but not for the remainder of the acute coronary syndromes. **(Fox, 2000)**

The initial diagnosis of ACS is based on history, risk factors, and, to a lesser extent, electrocardiographic (ECG) findings. The symptoms are due to myocardial ischemia, the underlying cause of which is an imbalance between supply and demand of myocardial oxygen. Patients with ACS include those whose clinical presentations cover the following range of diagnoses: unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI). **(Fenton, 2007)**

When the only therapy for angina was nitroglycerin and limitation of activity, patients with newly diagnosed angina had a 40% incidence of myocardial infarction (MI) and a 17% mortality rate within 3 months. A recent study shows that the 30-day mortality rate from ACS has decreased as treatment has improved. This decrease in mortality rate is attributed to aspirin, glycoprotein (GP) IIb/IIIa blockers, and coronary revascularization via medical intervention or procedures. **(Watkins, 2005)**

Incidence is higher in males among all patients younger than 70 years. This is due to the cardio protective effect of estrogen in females. At 15 years post menopause, the incidence of angina occurs with equal frequency in both sexes. Evidence exists that females more often have coronary events without typical symptoms, which might explain the frequent failure to initially diagnose ACS in females. **(Fenton, 2007)**

ACS becomes progressively more common with increasing age, prior MI, diabetes, hypertension, and multiple-vessel or left-main stem disease. In persons aged 40-70 years, ACS is diagnosed more often in males than in females. In persons older than 70 years, men and women are affected equally. **(Gandhi, 1995; Fenton, 2007)**

Previously, the hazards of acute coronary syndromes (especially unstable angina or minimal myocardial injury) have been underestimated. This is mainly because of inconsistencies in diagnosis and the inclusion of patients with chest pain but without confirmatory evidence of an acute coronary syndrome. Recent data from large scale clinical trials, and from registry studies, demonstrate that patients can be identified on the basis of the clinical syndrome plus ECG and enzyme criteria. These tools should be available in all hospitals. **(Fox, 2000)**

The use of standard admission and discharge tools that reflect evidence based treatment can improve adherence to guide line recommendations. With these improvements in prevention and treatment, it may be possible to reduce mortality rates from ACS. **(Kleinschmidt, 2006)**

Pathophysiology of Acute Coronary Syndromes

Coronary circulation

The arterial supply of the heart is provided mainly by the right and left coronary arteries as shown in figure (1). They arise from the aorta immediately distal to the aortic valve from the right and left aortic sinuses, respectively. Initially, the two main arteries run in the atrioventricular groove on either side of the pulmonary trunk. They give off multiple, fine branches. **(Fuster *et al*., 2001)**

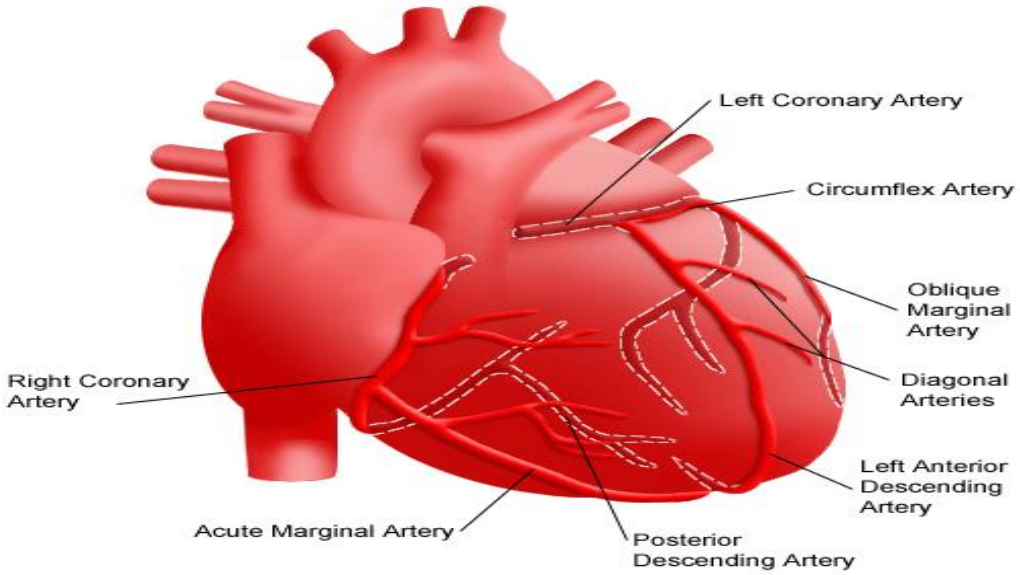

Figure (1): Coronary circulation. (Fuster *et al*., 2001)

The left coronary artery divides into two main branches include the circumflex artery and the anterior descending artery. The left coronary artery branches to supply the left atrium, left ventricle, interventricular septum - anterior section, sinuatrial (SA) node in 45% of the population, and atrioventricular (AV) node in 20% of the population. **(Erdmann, 2001)**

The right coronary artery gives off multiple small branches and several larger branches, typically a left atrial artery, conus artery, sinuatrial nodal artery, right atrial artery, right marginal artery during its course between right atrium and ventricle. Having reached the inferior surface of the heart within the groove, the right coronary artery gives off further branches include atrioventricular nodal artery and posterior interventricular artery. The right coronary artery terminates by anastomosing with the circumflex branch of the left coronary artery on the posterior surface of the heart near to the inferior margin of the left atrium. The right coronary artery and its branches supply the right atrium, right ventricle, part of the left ventricle, interventricular septum (posterior part), SA node in 55% of the population, and AV node in 80% of the population. **(Erdmann, 2001)**

On the superficial surface of the heart, there are several points of anastomosis between arterioles of the right and left coronary arteries e.g. between the anterior and posterior interventricular arteries in the posterior interventricular groove. Also, there are multiple anastomoses between both main arteries within the interventricular septum and both coronary arteries and pericardial arteries at the superior margin of the heart. However, over most of the heart each branch is effectively an end artery supplying a unique region of myocardium. In regions with relatively dense anastomoses, if there is rapid occlusion of vessels there may not be time for collateral channels to compensate resulting in ischaemia and infarction. **(Fuster *et al*., 2001)**

Histology of the Coronaries

Normal vessel wall components are arranged into three layers as shown in figure (2):

- **Intima**: This includes a single endothelial cell layer, and a subendothelial space. It is the layer that involved with atherosclerosis.
- **Media**: This includes a smooth muscle cell (SMC) layer. It is separated from other layers by internal and external elastic laminae.
- **Adventitia:** This includes a collagenous tissue with fibroblasts,

smooth muscle cells, and vascular supply. **(Kumar, 2004)**

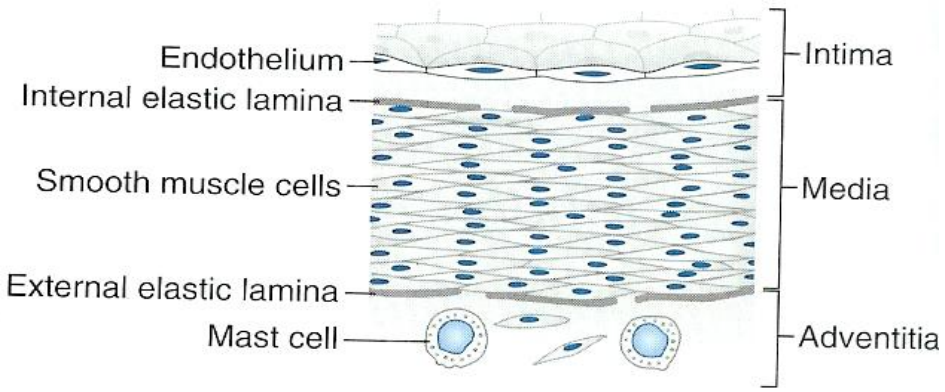

Figure (2): Normal vessel wall layers. (Kumar, 2004)

Normal endothelium is a single cell layer which acts as a permeability barrier. It controls the entry of lipoproteins, monocytes and other substances into the subendothelial space. Normal endothelium is metabolically active as it produces a number of substances such as growth factors, growth inhibitors, vasoactive substances and hemostasis factors, which regulate local inflammation and immunity. Normal endothelium maintains non-thrombogenic, and non-adhesive surface through producing a number of substances such as:

- Prostacyclin which is a vasodilator and inhibitor of platelet adhesion.
- Nitric oxide (formerly referred to as endothelium-derived relaxing factor or EDRF) which is a vasodilator, platelet inhibitor, and anti-inflammatory.
- Heparans (heparin-like substances) and tissue plasminogen activator (t-PA) agents which inhibit thrombosis, enhance fibrinolysis, and maintain a non- thrombogenic surface.
- Plasminogen activator inhibitor-1 (PAI-1) which inhibits fibrinolysis. **(Kumar, 2004)**

SMCs are normally found in the media with the following functions: contractile function; synthesis of extracellular matrix (collagen, elastin, proteoglycans); elaboration of cytokines, growth factors; and play a role in repair processes. **(Kumar, 2004)**