UPDATE ON DIAGNOSIS AND MANAGEMENT OF PULMONARY EMBOLISM

Essay
Submitted by

USAMA NABIL YOUSEF ZAKI

M.B.B.Ch
For partial fulfillment of the Master Degree in
Intensive care

Supervised By

Prof. Dr. MOSTAFA KAMEL FOUAD SALEH
Professor of Anesthesia and Intensive care
Faculty of Medicine
Ain Shams University

Dr. HAZEM MOHAMED ABDELRAHMAN FAWZY
Assistant professor of Anesthesia and Intensive care
Faculty of Medicine
Ain Shams University

Dr. MOHAMED YOUSEF MOHAMED ABOELMAGD
Lecturer of Anesthesia and intensive care
Faculty of Medicine
Ain Shams University

2012

الحديث فى تشخيص وعلاج الجلطة الرئوية

رسالة تمهيدية مقدمة من الطبيب

أسامة نبيل يوسف زكى

بكالوريوس الطب والجراحة

توطئة للحصول على درجة الماجستير فى الرعاية المركزة

تحت اشراف

الأستاذ الدكتور/ مصطفى كامل فؤاد صالح

أستاذ التخدير والرعاية المركزة

كلية الطب – جامعة عين شمس

الدكتور/ حازم محمد عبد الرحمن فوزى

أستاذ مساعد التخدير والرعاية المركزة

كلية الطب – جامعة عين شمس

الدكتور/ محمد يوسف محمد أبو المجد

مدرس التخدير والرعاية المركزة

كلية الطب – جامعة عين شمس

2012

List of Abbreviation

ABG	: Arterial Blood Gas
ACCP	: American College of Chest Physicians
ACEP	: American College of Emergency Physicians
APC	: Activated Protein C
APS	: Antiphospholipid Syndrome
APTT	: Activated Partial Thromboplastin Time
AST	: Aspartate Aminotransferase
AT	: Antithrombin
ATS	: American Thoracic Society
BMI	: Body Mass Index
BNP	: Brain Natriuretic Peptide
BTS	: British Thoracic Society
CDT	: Catheter-Directed Thrombolysis
CLD	: Chronic Liver Disease
COPD	: Chronic Obstructive Pulmonary Disease
CPTP	: Clinical Pretest Probability
Crcl	: Creatinine Clearance
CTEPH	: Chronic Thromboembolic Pulmonary Hypertension

CT-PA Angiography	: Computed Tomography- Pulmonary
CUS	: Compression Ultrasonography
CVC_S	: Central Venous Catheters
DVT	: Deep Venous Thrombosis
ECG	: Electrocardiogram
ELISA	: Enzyme-Linked Immunosorbent Assay
ESC	: European Society Of Cardiology
ESR	: Erythrocyte Sedimentation Rate
ETCO2	: End-Tidal CO2 Pressure
GCS	: Graduated Compression Stockings
H-FABP	: Heart Type Fatty Acid Binding Protein
HIT	: Heparin-Induced Thrombocytopenia
HITT Thrombosis	: Heparin-Induced Thrombocytopenia with
HRT	: Hormone Replacement Therapy
Icus	: Intensive Care Units
INR	: International Normalized Ratio
IPC	: Intermittent Pneumatic Compression
IV	: Intravenous
IVC	: Inferior Vena Cava
IXa	: Active Factor 9

LDH	: Lactate Dehydrogenase
LMWH	: Low Molecular Weight Heparin
MAP	: Mean Arterial Pressure
MDCT	: Multidetector Computed Tomography
MI	: Myocardial Infarction
MRA	: Magnetic Resonance Angiography
MVS	: Micro Vesicles
NPV	: Negative Predictive Value
NT-proBNP	: N-Terminal Pro-Brain Natriuretic Peptide
PCO_2	: Partial CO2 Pressure in Blood
PE	: Pulmonary Embolism
PESI	: Pulmonary Embolism Severity Index
PIOPED	: Prospective Investigation of Pulmonary Embolism Diagnosis
PO_2	: Partial O2 Pressure in Blood
PS	: Protein S
PSGL-1	: P-Selectin Glycoprotein Ligand-1
RHD	: Right Heart Dysfunction
RNA	: Ribonucleic Acid
RT	: Renal Transplantation
RV	: Right Ventricle
SBP	: Systolic Blood Pressure

SC	: Subcutaneous
SK	: Streptokinase
SPECT Tomography	: Single Photon Emission Computed
SPESI Index	: Simplified Pulmonary Embolism Severity
Tc	: Technetium
TEE	: Transesophageal Echocardiography
TF	: Tissue Factor
TPA	: Tissue Plasminogen Activator
UFH	: Unfractionated Heparin
UK	: Urokinase
V/Q	: Ventilation-Perfusion Ratio
V_a	: Active Factor 5
V_E	: Minute Ventilatory Gas Volume
VFP	: Venous Foot Pumps
VIII a	: Active Factor 8
VTE	: Venous Thromboembolism
VWF	: Von Willebrand Factor
Xa	: Active Factor 10

List of Tables

Table No.	Title	Page
Table 1.1	Risk factors for venous thromboembolism	5
Table 2.1	ESC classification of pulmonary embolism	44
Table 2.2	Wells score rule	47
Table 2.3	Revised Geneva Score	48
Table 4.1	Risk stratification according to expected pulmonary embolism-related early mortality rate	141
Table 4.2	Original and simplified pulmonary embolism severity index scores	152

List of Figures

Figure No.	Title	Page
figure 1.1	pathophysiology of pulmonary embolism	30
Figure 2.1	Chest x-ray shows radiological signs of PE	63
Figure 2.2	diagnostic approaches for suspected high risk PE	65
Figure 2.3	diagnostic approaches for suspected non-high risk PE	67
Figure 3.1	Types of IVC filters	121

Contents

- **Introduction**
- **Chapter I: Pathophysiology of thromboembolism**.
- **Chapter II: Diagnostic approach of pulmonary embolism**.
- **Chapter III: Treatment strategies of pulmonary embolism**.
- **Chapter IV: Prognostic assessment.**
- **Summary**.
- **References**.
- **Arabic Summary**.

Acknowledgment

For **ALLAH** the merciful, the compassionate, I kneel to express my gratitude for all the countless gifts I have been offered, including those who gave their hands to enable me to fulfill this work.

I would like to express my deep thanks, gratitude and appreciation to **Prof. Dr. Mostafa Kamel Fouad Saleh**, Professor of Anesthesia and Intensive care Faculty of Medicine Ain Shams University; for his extensive help, kind supervision and the continuous encouragement throughout the course of this work.

Many great thanks and appreciation are also owed to **Dr. Hazem Mohamed Abdelrahman Fawzy**, Assistant professor of Anesthesia and Intensive care Faculty of Medicine Ain Shams University for his great help, sincere cooperation and fruitful support during the conduction of this work.

Also, I must thank **Dr. Mohamed Yousef Mohamed Aboelmagd**, Lecturer of Anesthesia and intensive care Faculty of Medicine Ain Shams University for his great support and active participation. He kindly offered his remarkable experience during this work.

Lastly, my great thanks to everyone who participated in one way or another in making this work possible.

Aim of the Work

The aim of the work is to highlight recent updates in pulmonary embolism in the ICU as regards; risk factors, diagnosis, management, and outcome.

Introduction

Pulmonary embolism is a relatively common cardiovascular emergency and the third most common cause of death from cardiovascular disease after heart attack and stroke. ***(Goldhaber SZ, et al; 2012)***

Pulmonary embolism (PE) and deep vein thrombosis are two elements of the same pathophysiologic process referred to as venous thromboembolism. ***(Key NS, et al; 2010)***

A pulmonary embolism most commonly results from deep vein thrombosis (a blood clot in the deep veins of the legs or pelvis) that breaks off and migrates to the lung. ***(Banovac F, et al; 2010)***

The causes of venous thrombosis can be divided into two groups: hereditary and acquired causes. ***(Lijfering WM, et al; 2010)***

PE is a difficult diagnosis that may be missed because of non-specific clinical presentation. However, early diagnosis is fundamental, since immediate treatment is highly effective. ***(Roy PM, et al; 2006)***

Depending on the clinical presentation, initial therapy is primarily aimed either at life-saving restoration of flow through occluded pulmonary arteries or at the prevention of potentially fatal early recurrences. Both initial treatment and the long-term anticoagulation that is required for secondary prevention must be justified in each patient by the results of an appropriately validated diagnostic strategy. ***(Roy PM, et al; 2006)***

Chapter I

Pathophysiology of venous thromboembolism

Virchow's triad

A major theory delineating the pathogenesis of venous thromboembolism (VTE), often called Virchow's triad proposes that VTE occurs as a result of:

- Alterations in blood flow (stasis).
- Alterations in the constituents of the blood (inherited or acquired hypercoagulable states).
- Vascular endothelial injury. ***(Bagot CN, et al; 2008)***

Risk factors for venous thromboembolism

VTE is currently regarded as the result of the interaction between patient-related and setting-related risk factors.

Patient-related predisposing factors are usually permanent whereas setting-related predisposing factors are more often temporary.

Patient-related predisposing factors include age, history of previous VTE, active cancer, neurological disease with extremity paresis, medical disorders causing prolonged bed rest, such as heart or acute respiratory failure, and congenital or acquired thrombophilia, hormone replacement therapy and oral contraceptive therapy. ***(Alikhan R, et al; 2004)***

The causes of venous thrombosis can be divided into two groups: inherited and acquired causes. *(Table 1.1)* ***(Lijfering WM, et al; 2010)***

Inherited Thrombophilia

Inherited thrombophilia is a genetic tendency to venous thromboembolism. ***(Dahlbäck B; 2008)***