

***Role of Multi Detector CT in Imaging Of chest
Trauma***

Essay

***Submitted for Partial Fulfillment of Master Degree in
Radio Diagnosis***

Presented By

Mohamed Shehata Goda

M.B., B.Ch.

Under Supervision Of

Dr. Mohamed Abdel Aziz Ali

Professor of Radiodiagnosis

Faculty of Medicine – Ain Shams University

Dr.Hossam Moussa Sakr

Lecturer of Radiodiagnosis

Faculty of Medicine – Ain Shams University

Faculty of Medicine

Ain Shams University

Acknowledgement

A word of thanks to ALLAH, the source of on knowledge, by whose abundant grace this work has come to fruition.

I would like to extend my deep gratitude and cordial thanks to everyone that helped, encouraged and believed in the value of this piece of work.

*Foremost, I would like to express my appreciation for **Prof. Dr. Mohamed Abdel Aziz Ali** , Professor of Diagnostic Radiology, Faculty of Medicine, Ain Shams University, for choosing this valuable topic and for his encouragement, support and kind advice that were of great value throughout the work.*

I am grateful to Dr.Hossam Moussa Sakr, Lecturer of Diagnostic Radiology, Faculty of Medicine, Ain Shams University, for his endless effort, continuous supervision and kind help.

At last, but definitely not the least, I would like to dedicate my work to the soul of my parents ,my wife and my sohila

Table of content

Acknowledgment	I
Table of content	II
List of abbreviations	III
List of figures	IV
Introduction	V
Review of lecture	VI
Chapter I	
Chapter I	
Chapter I	
Chapter I	
References	VII
Summary and conclusion	VIII
Arabic summary	IX

List of Abbreviations

2D, 3D	Two dimension, Three dimension
ARDS	Adult respiratory distress syndrome
BDR	blunt diaphragmatic rupture
CC	Costochondral cartilage
CAT	Computed axial tomography
CT	Computed tomography
CPR	Curved planner reformatting
DCT	number of detector computed tomography
FB	Foreign body
FOV	Field of view
HU	Hounsfield unite
IA	intercostal artery
IVC	inferior vena cava
LCC	left common carotid
LSC	left sub clavian
MDCT	multi detector computed tomography
MIP	Maximum intensity projection
MPR	multi planner reformatting
MRI	Magnetic resonant imaging
MSCT	multi slice computed tomography
STD	Scapula thoracic dissociation
STC	Shock Trauma Center
TIB	Tracheobroncheal injury
VB	Virtual bronchoscopy
VR	volume rendering
VRT	volume rendering technique

List of Figures

Figure	Title	Page
Figure (١)	The skeleton of the thorax: anterior aspect, showing muscle attachments	٥
Figure (٢)	Two ٣D CT images show some of the chest wall and structures within the mediastinum.	٦
Figure (٣)	Normal (A) posteroanterior and (B) lateral chest radiographs demonstrate the position of the anterior and posterior ribs	٧
Figure (٤)	Normal sternal anatomy. Coronal reformatted image from chest CT	٩
Figure (٥)	normal anatomy of the thoracic vertebral spine (A)axial cuts (B) vertebral column in mid sagittal plain	١١
Figure (٦)	Figure (٦) thoracic vetebrea	١٢
Figure (٧)	Two ٣D CT reconstructions are from axial CT data.	١٣
Figure (٨)	muscles of chest wall	١٤
Figure (٩)	Anatomy of the diaphragm as seen from below	١٥
Figure (١٠)	Radiologic anatomy of the diaphragm	٢٠
Figure (١١)	Schematic demonstration of the tracheobronchial tree	٢١
Figure (١٢)	Normal tracheal wall. Axial CT image at level of brachiocephalic vessels	٢٢
Figure (١٣)	Virtual bronchoscopy shows trachea bifurcating at the carina	٢٣
Figure (١٤)	Right sided bronchial anatomy	٢٦
Figure (١٥)	Virtual bronchoscopy shows RT main bronchus & its segmental branches	٢٧

Figure (١٦)	Left sided bronchial anatomy, illustrated using Boyden's numbering system	٢٨
Figure (١٧)	Virtual bronchoscopy shows LT main bronchus & its segmental branches	٢٩
Figure (١٨)	Three-dimensional volume-rendered (VR) image shows the anatomic segments of the thoracic aorta	٣٠
Figure (١٩)	Superior vena cava (SVC), right lateral volume-rendered view	٣٣
Figure (٢٠)	Normal subclavian and brachiocephalic veins, coronal volume-rendered view	٣٣
Figure (٢١)	Pulmonary veins, inferior volume-rendered view	٣٤
Figure (٢٢)	External ٣D rendering show normal tracheobronchial tree A) External surface rendering, B) Volume rendering were done in Kasr Alainy ٤ MDCT GE.	٤٢
Figure (٢٣)	Coronal MPR image of the left lung of a patient with bronchiectasis of the left lower lobe	٤٣
Figure (٢٤)	Coronal slab image of the thorax (slab thickness = ٢٠ mm) created with MinIP image	٤٩
Figure (٢٥)	Three-dimensional volume-rendered image of a duplicated inferior vena cava	٥٠
Figure (٢٦)	Volume rendering image of a patient with a right-sided aneurysmal descending thoracic aorta	٥١
Figure (٢٧)	Curved planar reformation. (a) Three-dimensional volume-rendered image shows the curved course of the right coronary artery. (b) Curved planar image of the right coronary artery shows a cross section of the vessel in its entirety	٥٢
Figure (٢٨)	Occult pneumothorax	٥٧
Figure (٢٩)	Tension pneumothorax. Chest radiograph shows a right pneumothorax.	٥٨
Figure (٣٠)	Tension pneumothorax. CT scan shows the right pneumothorax	٥٨
Figure (٣١)	Hemothorax in a ٢٢-year-old patient who was involved in a motor vehicle collision.(Chest X ray &CT chest)	٦٠

Figure (٣٢)	Active bleeding from intercostal artery. CT shows a large left extrapleural hematoma displacing the heart to the right	٦١
Figure (٣٣)	Tension hemothorax in a ٤٥-year-old woman who was involved in a motorcycle collision.	٦٢
Figure (٣٤)	Pulmonary contusion. Axial (a) and coronal reformatted (b) CT images	٦٤
Figure (٣٥)	Pulmonary lacerations (Chest X ray & CT chest)	٦٦
Figure (٣٦)	Traumatic lung herniation. (a) CT scan shows the herniation of lung tissue (arrowhead) through a fracture of the right third costochondral junction (arrow). (b) Three-dimensional CT image clearly depicts the lung herniation	٦٧
Figure (٣٧)	Bronchial laceration. Axial (a) and coronal reformatted (b) CT images	٦٨
Figure (٣٨)	Tracheal laceration. (a) Collimated chest radiograph shows pneumomediastinum (arrows). (b) CT scan shows a tear (black arrow) at the right posterolateral portion of the trachea, along with pneumomediastinum	٦٩
Figure (٣٩)	Rib fractures and flail chest.	٧١
Figure (٤٠)	. Sternal fracture in a ٧٢-year-old woman with severe osteoporosis, recently diagnosed breast cancer, and chest pain	٧٢
Figure (٤١)	Sternal fractures. (a) Axial CT scan (soft-tissue window) shows (b) Sagittal reformatted CT image (soft-tissue window)	٧٤
Figure (٤٢)	Sternoclavicular joint dislocation in a ٢١-year-old man who was admitted following a motor vehicle collision. (A) CT image (B) Three-dimensional oblique image of sternoclavicular joints	٧٥
Figure (٤٣)	Thoracoscaphular dissociation. (A) Admission chest radiograph in a patient who sustained blunt trauma (B) Three-dimensional rendering of injury from posterior view. (C) CT angiography showing occlusion of both axillary arteries.	٧٧
Figure (٤٤)	Sites of injuries. Drawing shows radial (A), transverse (B), and central (C) ruptures and a peripheral detachment (D).	٧٩
Figure (٤٥)	Left diaphragmatic tear in a ٢٤-year-old woman who was	٨٠

	injured in a motor vehicle accident	
Figure (٤٦)	Left diaphragmatic tear in a ٤٨-year-old man after a motor vehicle accident	٨٠
Figure (٤٧)	. Left diaphragmatic tear in a ٦٥-year-old patient after blunt trauma. S = stomach	٨٢
Figure (٤٨)	Right diaphragmatic tear in a ٤٦-year-old man who experienced multiple injuries in a motor vehicle accident	٨٣
Figure (٤٩)	Right diaphragmatic tear in a ٣٥-year-old man after a motor vehicle accident.	٨٤
Figure (٥٠)	Dependent viscera sign in a ٢٨-year-old pregnant woman after a motor vehicle accident.	٨٥
Figure (٥١)	Diaphragmatic defects in a ٦٨-year-old patient. CT scans (direct axial sections) show diaphragmatic defects	٨٥
Figure (٥٢)	Blunt cardiac injury. CT scan shows a traumatic hemopericardium	٨٦
Figure (٥٣)	Blunt cardiac injury. Axial (a) and coronal reformatted (b) CT images show a pericardial laceration	٨٧
Figure (٥٤)	٥٤ Traumatic pseudoaneurysm of the proximal descending thoracic aorta. Axial (a) and ٣D (b) CT images	٩٠
Figure (٥٥)	Distal descending thoracic aortic injury. Axial (a) and coronal reformatted (b) CT images	٩٢
Figure (٥٦)	Internal mammary artery injury	٩٣
Figure (٥٧)	Subclavian artery injury.	٩٤
Figure (٥٨)	Superior vena cava injury in blunt trauma. (A) Axial CT image (B) Vena cavagram (C) Appearance of injury after stent placement (arrows).	٩٥
Figure (٥٩)	Stab wound to left thoracoabdominal region with active bleeding in chest wall. Axial (A), coronal (B), and sagittal (C) multiplanar reformatted MDCT images show	١٠١
Figure (٦٠)	Wound track outlined by bullet fragments in a patient who has transmediastinal gunshot	١٠٢

Figure (٦١)	Subtle wound tract in a ٤٧-year-old woman who was stabbed in the juxtacardiac region of the left chest. (A and B) Axial MDCT images show entry site	١٠٣
Figure (٦٢)	Massive hemothorax in a young woman who was stabbed bilaterally in the lower chest. Coronal (A) and sagittal (B) three-dimensional images show a massive hemothorax	١٠٤
Figure (٦٣)	Pulmonary artery branch pseudoaneurysm in a ٣٧-year-old man who was stabbed in the right chest. Follow-up MDCT	١٠٥
Figure (٦٤)	Subclavian artery injury following a gunshot wound to the right thoracic inlet in an ١٨-year-old man	١٠٦
Figure (٦٥)	Pulmonary contusion and laceration following gunshot wound to right anterior thoracic inlet in an ١٨-year-old man.	١٠٩
Figure (٦٦)	Iatrogenic lung laceration	١١٠
Figure (٦٧)	Transmediastinal gunshot wound with major vascular injury. (A and B) Axial MDCT images	١١١
Figure (٦٨)	Transmediastinal stab wound with major vascular injury in a ٥٨-year-old man. Axial (A) and MPR (B) MDCT images	١١٢
Figure (٦٩)	Pericardial stab wound. Axial (A) and MPR (B) MDCT images	١١٢
Figure (٧٠)	٧٠ Pericardial tamponade in an ١٨-year-old man who was stabbed in the precordium. Coronal (A) and sagittal (B) three-dimensional MDCT images show a large amount of hemopericardium	١١٣
Figure (٧١)	Tracheal injury following a gunshot wound	١١٣
Figure (٧٢)	Transmediastinal gunshot wound with tracheal and esophageal injury	١١٤

List of tables

Table I	Lobes and Bronchopulmonary Segments of the Lung with Boyden's Schema for Numbering of Bronchi	۱۵
Table II	diaphragmatic openings	۲۲

Introduction

Trauma causes an estimated 10% of deaths world wide and is the third common cause of death after malignancy and vascular diseases. Blunt thoracic trauma causes 20% of trauma related deaths. Thoracic injuries caused by motor vehicles as crush 63% to 98% while only 10% to 14% are fall from a height (*Wong et al., 2005*)

Trauma is responsible for considerable morbidity and has a major socio-economic impact (*Wintermark , Schnyder, 2005*).

Radiologic imaging plays an important role in the diagnosis and management of blunt chest trauma (*Kaewlai et al., 2005* .)

In recent years, multidetector computed tomogram (MDCT) has begun to change the imaging approach in patient sustaining blunt or penetrating thoracic injury (*Magu et al., 2005 d*)

The speed and accuracy of CT in detecting multisystem injury has proven to be invaluable in the prompt diagnosis and triage of trauma patients (*Magu et al., 2005 d*)

The introduction of multi-detector row CT has offered a number of advantages in the work-up strategy of emergency patients when compared with single-section CT . The shorter scanning time permits better opacification of the blood vessels and improved contrast material enhancement of parenchymal organs. Furthermore, faster data acquisitions allow multiple consecutive CT examinations in the same patient in a shorter period of time (*Alkadhi et al., 2005*)

Studies have shown that CT may demonstrate significant disease (eg, thoracic aortic injury) in patients with normal initial radiographs.

Furthermore, CT has been credited with changing management in up to 30% of chest trauma patients with abnormal initial radiographs. CT is more accurate than radiography for the evaluation of pulmonary contusion, thereby allowing early prediction of respiratory compromise. It is also valuable in the diagnosis of fractures of the thoracic spine, especially at the cervicothoracic junction, which is difficult to evaluate with conventional radiography. (*Kaewlai et al., 2000*.)

Computed tomography (CT) is the imaging modality of choice in the assessment of patients with clinical or radiographic findings suggestive of aortic injury, bone fracture, or diaphragmatic tear following blunt chest trauma. Contrast material-enhanced spiral CT allows detection of both subtle and more obvious aortic tears (*Hise et al., 2004*.)

Optimal CT assessment requires careful attention to technique including the use of intravenous contrast material and multi-planar reconstruction images, as well as awareness of potential pitfalls.

INTRODUCTION

Introduction

Trauma causes an estimated 10% of deaths world wide and is the third common cause of death after malignancy and vascular diseases. Blunt thoracic trauma causes 20% of trauma related deaths. Thoracic injuries caused by motor vehicles as crush 62% to 98% while only 10% to 15% are fall from a height (*Wong et al., 2004*)

Trauma is responsible for considerable morbidity and has a major socio-economic impact (*Wintermark , Schnyder, 2000*).

Radiologic imaging plays an important role in the diagnosis and management of blunt chest trauma (*Kaewlai et al ., 2004*)

In recent years, multidetector computed tomogram (MDCT) has begun to change the imaging approach in patient sustaining blunt or penetrating thoracic injury (*Magu et al., 2004*)

The speed and accuracy of CT in detecting multisystem injury has proven to be invaluable in the prompt diagnosis and triage of trauma patients (*Magu et al., 2004*)

The introduction of multi-detector row CT has offered a number of advantages in the work-up strategy of emergency patients when compared with single-section CT . The shorter scanning time permits better opacification of the blood vessels and improved contrast material enhancement of parenchymal organs. Furthermore, faster data acquisitions allow multiple consecutive CT examinations in the same patient in a shorter period of time (*Alkadhi et al., 2004*)

Studies have shown that CT may demonstrate significant disease (eg, thoracic aortic injury) in patients with normal initial radiographs. Furthermore, CT has been credited with changing management in up to 20% of chest trauma patients with abnormal initial radiographs CT is

INTRODUCTION

more accurate than radiography for the evaluation of pulmonary contusion, thereby allowing early prediction of respiratory compromise . It is also valuable in the diagnosis of fractures of the thoracic spine, especially at the cervicothoracic junction, which is difficult to evaluate with conventional radiography. (*Kaewlai et al ., 2004*)

Computed tomography (CT) is the imaging modality of choice in the assessment of patients with clinical or radiographic findings suggestive of aortic injury, bone fracture, or diaphragmatic tear following blunt chest trauma. Contrast material-enhanced spiral CT allows detection of both subtle and more obvious aortic tears(*Hise et al., 1991*)

Optimal CT assessment require careful attention to technique including the use of intravenous contrast material and multi-planner reconstruction images, as well as awareness of potential pitfalls.

Chapter I