

ROLE OF MULTISLICE CT SCAN IN PELVIC TRAUMA

Essay

Submitted for Fulfillment of the Master Degree in Radiology

By

Tamer Mohamed Khalil

M.B, B.Ch. (Cairo University)

Under Supervision of

Prof. Dr. Omar Moawayah Osman

Professor of Radiology

Faculty of Medicine – Cairo University

Dr. Suzan Mohamed Samy

Lecturer of Radiology

Faculty of Medicine – Cairo University

Faculty of Medicine

Cairo University

2010

Abstract

The CT scan has replaced conventional cystography as the most sensitive test for bladder perforation.

In cases of pelvic fractures, certain CT findings were seen with higher frequency in patients with associated urethral injury than in patients without urethral injury. However, these CT findings do not avoid the need for RUG, which must be performed in all such cases to confirm the diagnosis.

MDCT allows scanning with greater speed and narrower collimation compared with single-detector helical CT systems, which translates to larger volumes of coverage with improved spatial resolution and provides very high quality diagnostic images. MDCT allows complete investigation of visceral pelvic lesions and of associated thoracic, abdominal and even brain lesions.

Key Words:

ROLE OF MULTISLICE CT SCAN IN PELVIC TRAUMA

INTRODUCTION

The pelvis has important functions such as it transfers the body's weight to the lower extremities while standing, or to the ischial tuberosities while sitting, attachment points for numerous muscles that allow for the movements of the lower extremities and it houses and protects parts of the digestive, urinary and reproductive system (**Anderson 2000**).

The stability of the pelvis occurs because it is an intact bony ring with numerous ligaments. The hypogastric artery provides the main blood supply to the pelvis and the organs it contains. However, collateral circulation abounds, and the pelvis receives blood via numerous other sources (**Anderson 2000**).

Pelvic fractures account for 1-3% of all skeletal fractures (**Graf 2008**). Most pelvic fractures result from motor vehicle accidents, but severe complex pelvic fractures may also result from falls from buildings (**Dalal et al., 1989**). The pelvic ring is much more solid than many other bone structures, and high-energy trauma is required to disrupt this complex. Consequently, these fractures are rarely found in isolation, and patients with pelvic fractures often have multiple traumas (**Heetveld et al., 2004**).

Although pelvic x-ray is a routine part of the primary survey of polytraumatized patient according to advanced trauma life support guidelines, it can not provides soft tissue injures. So pelvic CT scan is the gold stander imaging technique in the diagnosis of pelvic fractures (**Hilty et al., 2008**).

MSCT combined with multi-planar reconstruction two-dimensional (MPR 2D) reformatted images or three-dimensional images (3D) images can provide important information that can change management in significant number of cases (**Falchi, 2004**).

Aim of work

The aim of work is to emphasize the role of CT scan in evaluating pelvic fractures & its related injury .

Acknowledgement

First and foremost, praise and thanks are to Allah, the most merciful and compassionate, who permitted the completion of this piece of work,

I am honored to have Prof. Dr. Omar Moawayah Osman, Prof. of Radiology, Faculty of Medicine, Cairo University, as a supervisor of this work, I am so grateful and most appreciative to his efforts. No words can express what I owe him for his endless patience and continuous advice and support.

I am deeply thankful to Dr. Suzan Mohamed Samy, Lecturer of Radiology, Faculty of Medicine, Cairo University, for her great help and effort to make this work possible.

Furthermore, I wish to express my thanks to all my professors, my senior staff members, my colleagues

Thanks for my Father who was very supportive, and encouraging. Thanks to my Mother

Finally, I would like to thank my wife who was supportive, cooperative, understanding and encouraging.

Tamer Khalil.

Table of Contents

Contents	Page
I- Review of Literature	1
Anatomy of the pelvis	1
Pelvic fracture	11
Imaging study of the pelvis	19
Plain radiography of the pelvis	19
CT scan of the pelvis	26
CT evaluation of urinary bladder	33
Classification of pelvic fractures	36
Classification of pelvic ring fractures	36
Burgess classification system	36
Tile classification system	46
Classification of acetabular fractures	60
CT based classification of acetabular fractures	68
Associated injuries with pelvic fractures	84
Visceral injuries	85
Urinary bladder injuries	85
Urethral injuries	86
Ureteral injuries	89
Vascular injuries	89
Peripheral nerve injuries	92
Other associated injuries	92
MSCT in imaging of trauma of the pelvis	93
The benefit of MSCT in the emergency room management of polytraumatized patient	103

MSCT in severely injured patients	105
MSCT and the detection of specific organ lesions	107
MSCT evaluation of active extravasation in blunt pelvic trauma patients	115
Use of CT in emergency care	117
Differentiation of bleeding from other high attenuation entities	118
Use of attenuation to determine bleeding source	121
Types of vessel injury	124
II Summary and Conclusion	129
III References	131
IV Arabic Summary	

List of Abbreviations

2D → two-dimensional

3D → three-dimensional

AO → (Arbeitsgemeinschaft für Osteosynthesefragen [Association for the Study of Internal Fixation])

AP → anterior posterior

APC → anterior posterior compression

CM → combined mechanical

CR → conventional X-ray

CT → computed tomography

DSA → digital subtraction angiography

FAST → focused assessment with Sonography for trauma

GU → genitourinary

IVC → inferior vena cava

kVp → kilo voltage peak

LC → lateral compression

mAS → milliamperere per second

MDCT → multidetector-row computed tomography

MPR → multiplanar reformation/reconstruction

MSCT → multislice (section) computed tomography

MVC → motor vehicle crash

RUG → retrograde urethrogram

SI → sacroiliac

UGD → urogenital diaphragm

VR → volume rendering

VS → vertical shear

List of Figures

Fig. No.		Page
1	Pelvic bone anatomy	1
2	Pelvic bone anatomy	3
3	Lateral view of acetabulum	5
4	Pelvic ligaments (anterior view)	6
5	Pelvic ligaments (posterior view)	6
6	Sacrum anterior and posterior view	8
7	Anatomy of pelvis and perineum	10
8	Lateral compression	12
9	Anterior posterior compression	13
10	Vertical shear	14
11	AP radiography of the pelvis	22
12	AP pelvis	23
13	Outlet view of the pelvis	24
14	Outlet view	25
15	Inlet view	26
16	Inlet view of the pelvis	26
17	Judet view of the pelvis	27
18	Normal CT pelvis	32
19	CT cystogram Sagittal view.	51
20	AP compression injury (AP view pelvis)	37
21	AP compression injury on CT pelvis	38
22	Lateral compression (AP view pelvis)	39
23	Lateral compression on CT pelvis	40
24	Lateral compression (AP pelvis)	41

25	Lateral compression on CT	41
26	Vertical shear AP radiography of the pelvis	43
27	Vertical shear on CT pelvis	43
28	Bilateral anterior inferior iliac spine avulsion fracture on AP the pelvis	44
29	Iliac wing fracture as seen on an anteroposterior radiograph of the pelvis.	45
30	Tile classification	47
30a	Lesion sparing (or with no displacement of posterior arch.	47
30b	Incomplete disruption of posterior arch, partially stable	47
30c	Complete disruption of posterior arch, unstable	47
31	Type-A1 fracture. Antero-posterior view. Fracture- avulsion of the right antero-inferior iliac spine	48
32	Type-A2.1 fracture. Isolated right iliac wing fracture	48
33	Type-A2.2 fracture. Antero-posterior view. Left unilateral pubic rami fractures	49
34	. Type-A2.3 fracture. Antero-posterior. Bilateral pubic rami fractures	50
35	Type-B1.1 fracture. Unilateral “open-book” injury	53
36	Type-B2.1 fracture.	54
37	Type-B2.3 fracture.	54
38	Type-B3 fracture	55
39	Type-C1.2 fracture	56

40	Type-C2. fracture	56
41	Type-C3. fracture	57
42	Acetabular fractures. Letournel's and Judet's classification.	61
43	Acetabular fracture classification system. Judet and colleagues	62
44	Anterior wall acetabular fracture. CT scan	64
45	Anterior column fracture with a posterior hemitransverse acetabular fracture, on CT scan	64
46	CT scan of a posterior wall acetabular fracture	65
47	Posterior column acetabular fracture. CT scan	65
48	CT scan of a transverse fracture with a posterior wall acetabular fracture	66
49	CT scan of T-shaped acetabular fracture	67
50	Two-column fracture of the acetabulum	67
51	Type 0: wall fractures in three patients	71
52	Type I: single-column fracture	72
53	Type IIA: two-column fracture without extension but with associated posterior wall fracture.	74
54	Type IIB: two-column fracture with superior extension to iliac wing	75
55	Type IIC: two-column acetabular fracture with inferior extension	76
56	Type IID: two-column acetabular fracture with superior and inferior extension.	77

57	Type III: floating acetabulum	79
58	CT scan of extraperitoneal bladder rupture	86
59	Type I urethral injury	88
60	Type II urethral injury	89
61	(a) Oblique plain radiograph showing posterior column fracture of the acetabulum. (b) Sagittal multislice CT (MSCT) reconstruction of the acetabulum showing the separated posterior column fragment. (c) Axial MSCT showing acetabular fracture (d) Radiolucent three-dimensional (3D) image of the pelvis in the sagittal plane showing fracture of the posterior column. (e) 3D image of the pelvis showing posterior column fracture.	100
62	(a) “Judet view” translucent three-dimensional (3D) image of the pelvis demonstrating bilateral sacral fractures, fractures of the right acetabulum posterior wall and fracture of the left pubic rami. (b) 3D image of the pelvis showing bilateral sacral fractures, bilateral pubic rami fractures and fracture of the right transverse process of L5 (c) Pelvic inlet 3D reconstruction to demonstrate the pelvic ring and to assess displacement of the fractured left hemipelvis	100
63	a Bilateral intracranial, subarachnoidal bleeding foci with coup and contre-coup lesions	108

	b. Fracture of the left orbita in the axial coronal view.	
64	a. Traumatic dissection of the descending thoracic aorta;	110
	b. Coronal reconstruction shows the extravasation of contrast material;	
	c. Situation after endovascular stent insertion	
65	Rupture of the spleen complicated by a large intraperitoneal haematoma	112
66	Fracture of the second cervical vertebra ; . Fracture morphology (Anderson type II lesion) can more appropriately be assessed on lateral reconstructions.	113
67	a. Fracture of the left acetabulum ;	114
	b. Coronal reconstructions demonstrate the extent of the both column injury.	
68	Retroperitoneal pseudoaneurysm	118
69	Bleeding into the extraperitoneal space of Retzius	123
70	Pelvic active extravasation	127
71	Sentinel clot and decreased vascular volume. Axial CT image shows hemoperitoneum surrounding the liver and spleen	128

List of Tables

Table No.		Page
1	Young-Burgess Classification System	45
2	Tile Classification System	57
3	Frequency of acetabular fracture types	70
4	Advantages and potential disadvantages of multislice CT	96
5	Scanning protocols for the bony pelvis	101
6	Reconstruction and imaging protocols	102
7	Standardized protocol for MS-CT imaging in polytrauma patients using a 4 slice-CT scanner	107
8	Characteristics That Distinguish Active Extravasation from Pseudoaneurysm	120
9	Attenuation Measurements of Hematoma and Other CT Findings in Vascular Trauma	121
10	Ideal Attenuation Measurements of Bleeding Vessels in Arterial Phase CT Images	123

Normal anatomy of the pelvis

The pelvis, so called from its resemblance to a basin, is a bony ring, interposed between the movable vertebrae of the vertebral column which it supports, and the lower limbs upon which it rest.(Gray, 1918)

The bony pelvis is composed of the sacrum, coccyx and two innominate bones. Each innominate bone includes the ilium, the ischium and the pubis which merge in to contribute the acetabulum. (Letournel, 1980).

The innominate or the hip bone is large, irregular, constricted centrally and expanded above and below, its lateral surface has a deep cup-shaped acetabulum, articulating with the femoral head, anterior-inferior to which is the large, oval or triangular obturator foramen. Above the acetabulum the bone widens into a plate with a sinuously curved iliac crest.

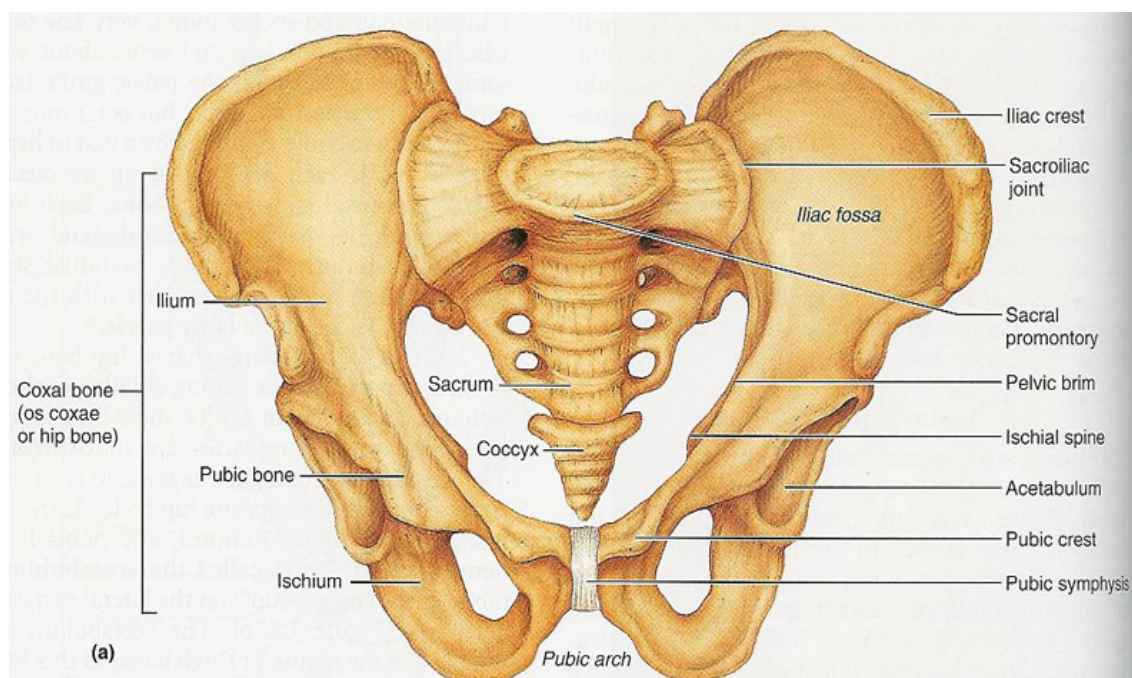


Figure (1):Pelvic bone anatomy.

(http://radiology.usc.edu/Presentations/SaddleProsthesis/PAGE2_ANAT_FINAL2.HTM)