# Diagnosis of abdominal trauma using MDCT reformations: findings and pitfalls

**Essay**

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**By**

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# Introduction

The prompt detection and accurate localization of abdominal injuries are difficult. Some diagnostic modalities, including laboratory tests, plain radiography, ultrasound, laparotomy and diagnostic peritoneal lavage (DPL) were used to evaluate patients with blunt abdominal trauma, with various advantages and pitfalls. (1 and 2)

Computed tomography (CT) has taken the lead to be the primary modality used in the emergency evaluation of patients with abdominal trauma in many institutions. (3)

The recent proliferation of multi–detector row computed tomography (MDCT) has led to an increase in the creation and interpretation of images in planes other than the axial images traditionally viewed with CT. Powerful three-dimensional (3D) applications improve the utility of detailed CT data but also create confusion among radiologists, technologists, and referring clinicians when trying to describe a particular method or type of image. (4 -6)

Designing examination protocols using MDCT that optimize data quality and radiation dose to the patient requires familiarity with the concepts of beam collimation and section collimation as they apply to MDCT. A basic understanding of the time-limited nature of projection data and the need for thin-section axial reconstruction for 3D applications is necessary to use the available data effectively in clinical practice concerning abdominal trauma.(7-9)

The use of MDCT with its high capabilities using 2D and 3D reformations in evaluation of cases of abdominal trauma has solved many issues which have not previously solved using traditional imaging facilities. Concerning hemoperitoneum, which can be caused by injury of solid organ particularly the liver or the spleen or injury of a vessel- which is uncommon but highly lethal crises that makes exsanguinating hemorrhage is the most important cause of early death ,MDCT has represented signs and findings such as sentinel clot,

active arterial extravasation, and mesenteric fluid with its high sensitivity for detection of even small effusions of blood in the peritoneal cavity that enable the radiologist to locate sources of intraperitoneal hemorrhage and help direct management. (1 and 5)

As regard MDCT pitfalls when it is used in imaging of abdominal trauma patient, For example concerning diaphragmatic injury, Diaphragmatic eventration may mimic diaphragmatic paralysis, and diaphragmatic hernias may mimic diaphragmatic rupture, and vice versa. The exact incidence of false-positive and false-negative findings with CT is unknown, though one would expect that the incidence with multi section CT is lower than that of conventional CT. Another example of pitfalls is concerning bowel and mesenteric injury. Specific reasons of pitfalls include an often chaotic trauma setting that may cause findings to be overlooked or misinterpreted and the presence of other injuries that may distract the observer. Large patients and metallic monitoring or support devices can cause significant artifact which may distract the attention to findings which should not be overlooked. (1, 4 and 5)

# Aim of work

The aim of this essay is to clarify the role of MDCT in the diagnosis of abdominal trauma using reformatted reconstructed images and to high lighten the pitfalls in abdominal trauma diagnosis.

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# List of abbreviations

| | |
|---|---|
| 3D | Three dimensional |
| AAST | American association for the surgery of trauma |
| AIP | Average intensity projection |
| CT | Computed tomography |
| CTA | Computed tomographic angiography |
| CTDI | Computed tomography dose index |
| CTU | Computed tomographic urography |
| DPL | Diagnostic peritoneal lavage |
| FAST | Focused assessment with sonography for trauma |
| GIT | Gastro intestinal tract |
| HRCT | High resolution computed tomography |
| HU | Hounsfield unit |
| ICU | Intensive care unit |
| IVC | Inferior vena cava |
| MDCT | Multi-detector computed tomography |
| Min IP | Minimum intensity projection |
| MIP | Maximum intensity projection |
| MPR | Multi planar reformation |
| PACS | Picture archiving and communication system |
| SSD | Shaded surface display |
| UPJ | Uretero- pelvic junction |

# Abstract

## Diagnosis of abdominal trauma using MDCT reformations: findings and pitfalls

MDCT is considered as one of the most important imaging modalities used in diagnosis of abdominal trauma including various abdominal contents which are: abdominal organs, bowel and mesentery, peritoneum, diaphragm and abdominal vasculature. MDCT with its 3D application and multiplanar reformations has a great accuracy and speed in diagnosis of abdominal trauma cases. MDCT examination may face some pitfalls that should be known not to affect the interpretation and consequently the management.



Key words: MDCT - Abdominal trauma - MDCT findings - MDCT pitfalls.

# Chapter 1

# Overview of Abdominal trauma

Trauma is one of the leading causes of death all over the world .the abdomen is one of the most common sites of the body vulnerable to be injured either due to blunt or penetrating injury. The care of the trauma patient is demanding and requires speed and efficiency. Evaluating patients who have sustained blunt or penetrating abdominal trauma remains one of the most challenging and resource-intensive aspects of acute trauma care. (1)

Missed intra-abdominal injuries and concealed hemorrhage are frequent causes of increased morbidity and mortality, especially in patients who survive the initial phase after an injury. (1)

Physical examination findings are notoriously unreliable for several reasons; a few examples are the presence of distracting injuries, an altered mental state, and drug and alcohol intoxication in the patient. Coordinating trauma resuscitation demands a thorough understanding of the pathophysiology of trauma and shock, excellent clinical and diagnostic acumen, skill with complex procedures, compassion, and the ability to think rationally in critical situations. (2)

## A- Blunt abdominal trauma:

It usually results from motor vehicle collisions, assaults, recreational accidents, or falls. The most commonly injured organs are the spleen, liver, retroperitoneum, small bowel, kidneys, bladder, colorectum, diaphragm, and pancreas. Men tend to be affected slightly more often than women. (3)

### Pathophysiology

Vehicular trauma is by far the leading cause of blunt abdominal trauma in the civilian population. Auto-to-auto and auto-to-pedestrian collisions have been cited as causes in 50-75% of cases. Rare causes of blunt abdominal injuries include iatrogenic trauma during cardiopulmonary resuscitation and manual thrusts to clear an airway. (1)

Intra-abdominal injuries secondary to blunt force are attributed to collisions between the injured person and the external environment and to acceleration or deceleration forces acting on the person's internal organs. Blunt force injuries to the abdomen can generally be explained by 3 mechanisms. (4)

The first is when rapid deceleration causes differential movement among adjacent structures. As a result, shear forces are created and cause hollow, solid, visceral organs and vascular pedicles to tear, especially at relatively fixed points of attachment. For example, the distal aorta is attached to the

thoracic spine and decelerates much more quickly than the relatively mobile aortic arch. As a result, shear forces in the aorta may cause it to rupture. Similar situations can occur at the renal pedicles and at the cervicothoracic junction of the spinal cord. (1)

The second is when intra-abdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid viscera (eg, spleen, liver, and kidneys) are especially vulnerable. (3)

The third is external compression forces that result in a sudden and dramatic rise in intra-abdominal pressure and culminate in rupture of a hollow viscus organ. (3)

## Imaging Studies

- The most important initial concern in the evaluation of a patient with blunt abdominal trauma is an assessment of hemodynamic stability. In the hemodynamically unstable patient, a rapid evaluation must be made regarding the presence of hemoperitoneum. This can be accomplished using DPL (diagnostic peritoneal lavage) or the FAST (focused assessment with sonography for trauma) scan. Radiographic studies of the abdomen are indicated in stable patients when the physical examination findings are inconclusive. (2)

- A-Plain radiography
    - Although the overall value of plain films in the evaluation of patients with blunt abdominal trauma is limited, they can demonstrate numerous findings. The chest radiography may aid in the diagnosis of abdominal injuries such as ruptured hemidiaphragm (eg, a nasogastric tube seen in the chest) or pneumoperitoneum. The pelvic or chest radiography can demonstrate fractures of the thoracolumbar spine. The presence of transverse fractures of the vertebral bodies, ie, Chance fractures, suggests a higher likelihood of blunt injuries to the bowel. In addition, free intraperitoneal air, or trapped retroperitoneal air from duodenal perforation, may be seen. (4)
- B-FAST examination
    - The use of diagnostic ultrasonography to evaluate a patient with blunt trauma for abdominal injuries has been advocated since the 1970s.Bedside ultrasonography is a rapid, portable, noninvasive, and accurate examination that can be performed by emergency clinicians and trauma surgeons to detect hemoperitoneum. In fact, in many medical centers, the FAST examination has virtually replaced DPL as the procedure of choice in the evaluation of hemodynamically unstable trauma patients. (1)