Learning objectives

1. To recognize and review radiologic signs associated with traumatic injuries

2. To describe cause of characteristic appearance in each sign

3. To emphasize importance of each sign in trauma patients
Background

Trauma accounts for majority of emergency department visits with various causes and whatever the cause it remains a significant cause of death in modern society. The high mortality with multitrauma makes CT an indispensible diagnostic tool in imaging of the severely injured patients. Quick and correct diagnosis of traumatic injuries is crucial in ensuring proper management and improving outcome of trauma patients.

In radiology literature, there are numerous radiological signs describing certain conditions. Familiarity with these signs provides radiologist more confidence while interpreting the images in an acute trauma setting. In this educational exhibit, several radiological signs encountered traumatic injuries are reviewed with relevant CT images.
Findings and procedure details

1. ICE CREAM CONE SIGN

Ice cream cone sign refers to the normal appearance of malleus and incus on an axial CT scan image of the temporal bone (Fig.1). The ball (scoop) of the ice cream is constructed by head of the malleus and the cone is constructed by body of the incus. In case of failure of this normal configuration, which represents disruption of the ossicle chain, middle ear injury with temporal bone basilar skull fracture should be suspected in a trauma setting. Traumatic ossicular lesion is usually associated with longitudinal fractures of the temporal bone extending into the middle ear along the tegmen tympani and is present approximately 20% of cases head trauma (1,2).

In addition, middle ear injury may also occur followed by blunt trauma to external auditory canal or penetrating trauma such as gunshot wound injury or barotrauma during exposure to a blast, air travel etc.

2. FLAT TIRE SIGN

Flat tire sign refers to a change in globe contour and an obvious loss of globe volume resembling flat tire (Fig.2). The sign indicates an open globe injury, which is a major cause of blindness. It has been reported 16% of major trauma patients had ocular or orbital trauma and of whom had ruptured globe had poor outcome (3,4). In blunt traumas rupture most common at the insertion of intraocular muscles where the sclera is thinnest (5).

3. HAMBURGER SIGN

Hamburger sign represents CT appearance of a normal facet joint (Fig.3). The superior articular process forms semicircular bun on top of the meat patty and the inferior articular process forms bun beneath the patty. When the facet joint dislocated hamburger seems to be reverse hamburger. Reverse hamburger or naked hamburger sign is characteristic of a flexion distraction injury.

4. SWISS CHEESE SIGN

Swiss cheese sign represents multiple small pneumatocele inside the contusion region, which is caused following pulmonary laceration. The appearance resembles Swiss cheese including multiple holes on X-ray or CT (Fig.4). These traumatic lung cysts are usually seen at subpleural location and beneath rib fractures (6).
5. **FALLEN LUNG SIGN**

Fallen lung sign describes that collapsed lung displaces toward the dependant portion of hemithorax (Fig.5). It indicates complete rupture or transection of mainstem bronchus and useful in cases of unexplained persistant pneumothorax. Since the hilar vascular structure remain in their normal locations collapsed lung falls into the posterior rather than central (7,8). Tracheabronchial system ruptures are difficult to diagnose in an acute trauma setting and usually the diagnosis is delayed. This sign seen both X-ray and CT is highly specific but rarely observed.

6. **COLLAR SIGN**

Diaphragmatic injury occurs in 0.16%-5% of blunt trauma cases. Imaging is essential in diagnosis of diaphragmatic injuries because the clinical diagnosis of traumatic diaphragm rupture is difficult, missed in up to 65% of patients. In the CT evaluation of diaphragm rupture some signs such as collar sign, dependant viscera sign, hump sign are used in addition to direct visualization of a diaphragm defect. Collar sign, also called to *hour glass sign*, is caused by herniated viscera with focal constriction at the point where it crosses the torn diaphragma (Fig.6). This appearance of herniated viscera mimics collar on coronal or sagittal CT images (9,10).

7. **DEPENDANT VISCERA SIGN**

Dependant viscera sign as mentioned above is one of CT findings of diaphragm rupture which means direct contact of herniated liver or stomach with the chest wall without intervening lung. In contrast to collar sign, dependant viscera sign is a nonspecific sign for diaphragm rupture.

8. **MOLAR TOOTH SIGN**

Molar tooth sign indicates extraperitoneal bladder rupture which is the most common type of bladder injury. Extravasated contrast in perivesical space surrounds the bladder in the shape of molar tooth on CT cystography (Fig7). This finding helps in differentiating extraperitoneal rupture from intraperitoneal rupture (11).

9. **FLAT IVC**
In trauma patients, flattening of inferior cava at multiple levels on CT is a strong indicator of hypovolemia or hypotension due to major hemorrhage (Fig.8). Some studies showed that the finding meant occult shock or severity of injury and early recognition may improve processes of care (12,13).

10. DOUBLE BRONCHIAL WALL SIGN

Double bronchial sign, a manifestation of pneumomediastinum, is caused by outlined major bronchus by air which allows clear depiction of the bronchial wall (Fig.9). The sign is created when air reside next to a major bronchus, which is diagnostic challenge to detect (14).
Fig. 1: ICE CREAM CONE SIGN Axial high-resolution CT scan of the temporal bone shows ice cream cone appearance of the incus and malleolus (arrow).

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
Fig. 2: FLAT TIRE SIGN Axial CT scan of orbita shows contour irregularity and obvious volume loss indicating open globe rupture on the right side.

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
Fig. 3: HAMBURGER SIGN Normal cervical facets on axial CT scan resembling hamburger bun (circle).

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
Fig. 4: SWISS CHEESE SIGN On axial CT images (a,b) pneumatoceles appear as holes(arrows) following blunt chest trauma.

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR

Fig. 5: FALLEN LUNG SIGN Axial CT scan shows a large pneumothorax and fallen lung(arrow).

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
Fig. 6: COLLAR SIGN Axial CT image (a) herniation of the stomach through the diaphragmatic defect (arrow. (b)Coronal CT image confirms herniation of the stomach into the thorax with collar sign at the point of the defect (arrows)

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR

Fig. 7: MOLAR TOOTH SIGN There is extravasation of contrast in the prevesicle space on CT cystogram. This has been referred to as molar tooth sign indicating extraperitoneal bladder rupture.

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
Fig. 8: FLAT IVC SIGN CT scan with IV contrast shows flattening of inferior cava (arrow)

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
**Fig. 9:** DOUBLE BRONCHIAL WALL SIGN Air in the mediastinum outlines posterior aspect of inferior wall of right main bronchus (arrow).

© hacettepe university department of radiology, hacettepe university, hacettepe university - Ankara/TR
Conclusion

Traumatic injuries are diagnostic challenge because they might lead to subtle changes and easily be missed. As reliable and easy method in interpreting images, using these signs might decrease missed injuries in an acute trauma setting.
References


