CQ34 What are useful findings on postmortem images to assess blunt trauma?

Grade of recommendations: C1

If a blunt trauma is the cause of bone fracture, organ damage, organ deformation/deviation, or ectopic liquid/gas, this can be identified by postmortem CT. Since some fatal damage may be difficult to identify by postmortem CT, the images must be interpreted with care.

Explanation----------

Definition of trauma

Trauma (injury) can be explained as damage to the human body due to the exposure to mechanical force. A weapon is defined as an object which produces an injury. The mechanism of the injury is explained as how the injury has been produced, and injuries caused by a blunt object are termed blunt trauma. Trauma caused by a high-energy impact involved in the trauma such as road traffic accidents or falls are also included in the broad sense of blunt trauma.

Blunt trauma

Determining the occurrence of blunt trauma by postmortem images is extremely important from a forensic perspective. Postmortem CT scans should be actively involved in trauma cases for the potential to add positive findings to an autopsy [1]. Postmortem CT have been reported to provide high diagnostic rates for cause of death in trauma death cases. Postmortem CT offer a substitute when an autopsy is not possible [1] or it can obviate the need for an autopsy [2].

Useful CT findings to diagnose injuries

It is known that positive agreement rates for antemortem and postmortem CT findings are high since CT scan findings of injuries are less affected by the postmortem interval [3].

Findings of damage in the body effected by an external force : fractures of bones, contusions of organs, deformities or translocation of organs/bones

Plain X-rays [4] and CT images are useful in diagnosing fractures of bones [1], but humeral fractures are likely to be missed when they are outside the parameters of the scan (upper extremity and below the knees) [5]. In addition, there are many kinds of organ damage that cannot be detected by an X-ray examination [4], making CT and MRI useful [1]. The most injured organ in blunt abdominal trauma is the liver [6, 7], however even fatal liver laceration may be missed on CT [8, 9]. Injuries which are difficult to detect by CT scans are bleeding in soft tissue, splenic laceration, thyroid contusion, mesenteric lacerations, and others [5, 10]. Injuries to soft tissue can be detected by postmortem MRI

scans as they can visualize tissue hemorrhages clearly [11].

Presence of ectopic liquids/gas/fat translocated by external forces: blood (bleeding), gas, embolisms

Hemopericardium can be identified as a rupture of the heart due to blunt trauma to the chest [12]. The following can also be observed after blunt trauma to the chest: focal pericardial dimpling and discontinuities, pneumopericardium, interposition of a lung: between aorta and pulmonary artery heart and diaphragm, or right atrium and right ventricular outflow tract. Characteristic changes for a cardiac herniation include: signs of "empty pericardial sac", air outlining empty pleuropericardium as a result of cardiac luxation into the hemithorax [13]. A triple-layered structure, which is a distinct fat level on top of sedimented layers of corpuscular blood particles and serum, is seen in the large blood vessels after fracture of the femur as a result of fat embolisms [14].

An autopsy may sometimes miss gas in the abdominal cavity, subcutaneous emphysema, or intramuscular hemorrhages, which can be identified with postmortem CT [8,10]. Injury on the aorta is often overlooked by CT and MRI but can be diagnosed by postmortem CT angiography 1).

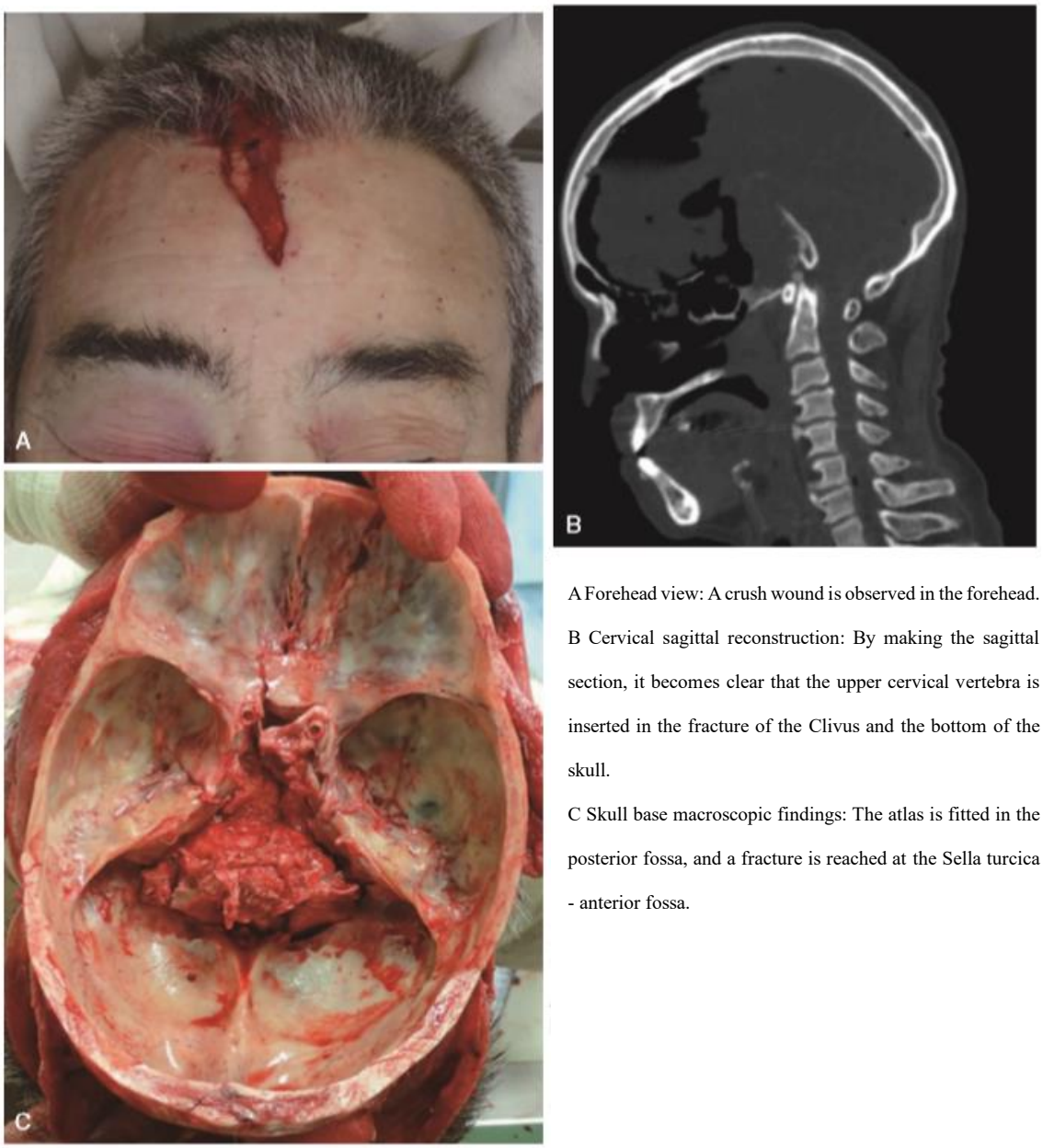
Traumatic head/brain injuries

The head and brain are essential for life support and present unique anatomical structures. Due to their characteristics, head/brain injuries may suffer from various forms of damage not occurring to other organs. Typical blunt trauma to the head include skull fracture, epidural hematomas, subdural hematomas, subarachnoid hemorrhages, and cerebral contusion. Most injuries in brain parenchymal lesions can be diagnosed by CT and MRI, but compared to an autopsy only less detailed findings can be obtained [1, 15]. Large intracranial hemorrhages and subdural hematomas in a putrefied body may be identified by CT [16], while small hemorrhages may be missed [1].

High energy trauma (road traffic accidents and falls)

In car-to-pedestrian collisions, it is best to combine postmortem image inspection and autopsy to give well-founded answers to questions pertaining to both collision reconstruction and cause of death [17]. In cases of motorcycle accident fatalities, an analysis of postmortem CT images should always be performed since it provides important information for forensic investigations especially in the patterns of fractures [18]. In a small light airplane crash, the injury pattern analysis including 3D reconstruction of postmortem CT was helpful to determine who controlled the airplane at the time of the accident [19]. In the case of traffic accidents when the manner of death is clear based on the case circumstances, postmortem images may replace an autopsy to diagnose the exact cause of death [20].

Figure Male in the 60s, with skull base fracture, was found lying right under stairs (2 days after death)



A Forehead view: A crush wound is observed in the forehead.

B Cervical sagittal reconstruction: By making the sagittal section, it becomes clear that the upper cervical vertebra is inserted in the fracture of the Clivus and the bottom of the skull.

C Skull base macroscopic findings: The atlas is fitted in the posterior fossa, and a fracture is reached at the Sella turcica - anterior fossa.

Literature search formula and literature selection (2019/8/27)

PubMed

#	Search formula	Number of documents
1	Search (postmortem CT) OR (postmortem computed tomography)	7,637
2	Search (causes of death) AND (autopsy)	10,851
3	Search (#1) AND (#2)AND English[Language] Filters : published in the last	141

	10 years AND (injury)	
4	#3 AND (trauma)	130

Ichushi（Medical Journal）

#	Search formula	Number of documents
1	Search (postmortem MRI) OR (postmortem magnetic resonance)	6,315
2	Search (causes of death) AND (autopsy)	10,851
3	Search (#1) AND (#2)AND English[Language] Filters : published in the last 10 years AND (injury)	265
4	#3 AND (trauma)	45

From other than search formula

[5, 6, 10, 13, 20]

References

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[12] Ebert LC et al: Fatal left ventricular rupture and pericardial tamponade following a horse kick to the chest. Am J Forensic Med Pathol 2012; 33: 167-169 (Level 5)

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[16] Sano R et al: Use of postmortem computed tomography to reveal acute subdural hematoma in a severely decomposed body with advanced skeletonization. Leg Med 2013; 15: 32-34 (Level 5)

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