Multi-slice computed tomography analysis of bullet trajectory in forensic investigation.

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Aims and objectives

Purpose:

In forensic investigation of death by suspected projectile injuries, judgment of the bullet's entry, exit, location, path and associated tissue damage is of great importance. For example, the course of a bullet through the body can give clues as to how the victim was shot. The current study sought to illustrate the non-invasive characterization of gunshot wound tracks using postmortem multi-slice computed tomography (MSCT) prior to forensic autopsy. We obtained MSCT images in two cases of gunshot wounds in order to determine the bullet's path in the body.

Methods and materials

Cases:

Two cases were examined; one is an accident due to shotgun shooting (Case1), and the other is suicide using a handgun (Case2). Case1 was a man in his seventies found dead in the forest. The wounds were formed at the right side of the chest. According to police investigation, he went into the forest for bird hunting. The colleague alleged he used the gun as a stick when walking. Case2 was a man in his fifties, and he was found dead in his car. The police found a handgun close by the body, and gunshot injuries were confirmed on both temporal regions.

Methods:

Postmortem MSCT scanning for pre-autopsy screening was performed with 8-row MSCT (Aquilion; Toshiba Medical Systems, Tokyo, Japan) using a collimation of 1.0-2.0 mm and a beam pitch of 0.875. Images were reconstructed with a soft tissue, lung, and bone kernels. The images were viewed and analyzed with a combination of axial slices, multi-planar reconstructions (MPR) and 3D reconstructions by a 3D image workstation (ziostation2; Ziosoft, Tokyo, Japan) then compared with forensic autopsy findings.

Results:

Results:

On Case1, postmortem thoracoabdominal MSCT imaging was visualized that an entrance wound on skin surface of the right front chest as a big hole of defective soft
tissue without satellite pellet holes (Fig.1a, 1b). It also demonstrated multiple rib fractures, lung injury in this area, and the presence of approximately 200 shotgun pellets in the body (Fig.1c-f). There was no exit wound hole on the back. It was considered that the small area of pellets distribution and the shape of the entrance wound hole was produced by a contact range shotgun discharge (1).

On Case2, postmortem head MSCT imaging indicated the inward beveled entrance wound and the outward beveled exit wound (Fig.2a-f) (2). It also showed bullet track through the brain and skull fractures along the trajectory path (Fig.3a, 3b). There was no bullet in the cranial cavity, resulting perforating wound. Severe damage of the brain tissue along the trajectory path was confirmed in the near-axial cut surface of formalin fixed brain (Fig.3c).

**Images for this section:**

**Fig. 1:** Figure 1. Shotgun injury on the right side of the thorax in Case1. a. Photograph of the victim's right chest shows entrance wound (black arrow) without satellite pellet holes. There is some red colored abrasion of wound edge. b. Volume-rendering (VR) 3D breast computed tomography (CT) image enhanced skin shows clearly an entrance wound hole (black arrow). c. VR 3D breast CT image enhanced bone shows the right 2nd through 4th ribs fractures and defects (arrows). d. Axial multi-planar reconstruction (MPR) image at the level of 6th thoracic vertebra with bone window shows that the defect of right front soft
tissue through the pleural cavity (arrows) and remained some pellets in the right lung and soft tissue of right back. e. Sagittal MPR image at the level of entrance wound with bone window also shows that the defect of right front soft tissue (arrows) and the distribution of remained some pellets in soft tissue of right back. f. VR 3D breast CT image reveals the spread wide pattern of multiple shotgun pellets, compared with the diameter of entrance wound hole.

Fig. 2: Figure 2. The head of the body in Case2. a. The deep lacerations of the scalp on the right temporal region (entrance wounds). b. VR image of victim's skull viewing from right back shows extensive fractures directed forehead and vertex. c. Maximum Intensity Projection (MIP) image of the right temporal region shows inward skull fractures. d. The exit wound on the left temporal area. e. VR image of victim's skull viewing from left front shows fractures directed forehead and vertex. f. MIP image of the left temporal area shows outward skull fractures (arrow).
Fig. 3: Figure 3. CT images of the head and photograph of the formalin fixed brain in Case 2. a. MIP coronal image of hematoma and bone fragments along the trajectory path. b. MPR brain image shows a clear bullet track through the brain from the right to left temporal regions. c. Near-axial cut surface of the formalin fixed brain shows a severe damage along bullet track direction (arrow).
Conclusion

Conclusion:

MSCT imaging revealed the depth and direction of projectile in the body died by firearms prior to the forensic autopsy. Therefore, the major task of MSCT imaging is the reconstruction of the events that produced firearm injuries. Thus, MSCT can provide a guide for gunshot wounds, and has the potential to enhance forensic investigations.

Personal information

References
