Introduction What are postmortem changes that can be visualized in postmortem images?

Grade of recommendations: C1

Different from antemortem images, many of the features of postmortem images are non-specific, including hypostasis and hyper-attenuation of structures such as the aortic walls and sinuses. These features are similar to those in antemortem images. However, they may be difficult to identify on postmortem images, and therefore care must be shown when reading postmortem images (see the chart for a summary). As the postmortem image findings change and become more pronounced with time, it is also important to take into account the time elapsed since death.

Explanation----------

As postmortem imaging is affected by postmortem changes, it differs from imaging performed in clinical settings [1]. Cardiopulmonary resuscitation also affects postmortem imaging. This makes it necessary to be careful not to mis-interpret postmortem images. It is necessary to establish "normal" postmortem image findings and features that could indicate the cause of death, and to organize this knowledge.

Postmortem changes [1,2]

Biological death is confirmed following the arrest of circulation, breathing, and brainstem functioning. In dead bodies (cadavers), postmortem changes due to the arrest of circulation vary according to the time elapsed since death. These occur in the same manner as those seen on the external surface of the body; they are influenced mainly by gravity and bacterial activity; and are affected by position, temperature, and the place where the dead body has been stored. Changes occurring within a few hours after death are termed early postmortem changes, and those occurring later are termed delayed postmortem changes. Early postmortem changes include falling body temperature, corneal opacity, livor mortis, and rigor mortis. Among these, livor mortis can be determined on images as hypostasis. Following the arrest of circulation, the blood in vessels and organs pools in the back and the lower parts of the body due to the effect of gravity. Hypostasis is depicted as areas of higher density than those seen in surrounding tissue, and is most commonly visualized in the area of the lungs and the intracranial sinuses. In contrast to this, delayed postmortem changes include autolysis, putrefaction, skeletonization, and mummification. During putrefaction, gas forms inside blood vessels, organs, and soft tissue by the action of bacteria. The ability of computed tomography to detect gas means that gas may sometimes appear as early as a few hours after death.

Postmortem image findings

Postmortem image findings comprise the antemortem clinical conditions causing death, those due to cardiopulmonary resuscitation, and postmortem changes. The changes due to cardiopulmonary resuscitation include those caused by chest compression (closed-chest cardiac massage), artificial respiration, and other treatments administered at cardiopulmonary arrest (CQ23-25). Typical postmortem changes that do not commonly appear in antemortem images are listed in the table below; these include hypostasis (CQ3) and gas from putrefaction. The changes are non-specific in postmortem images, and do not imply abnormal findings (figures) [1,2]. Even if the postmortem findings are similar to those in antemortem images, the underlying pathological mechanism and interpretation of the findings may be different [1]. It should be noted that here we discuss commonly occurring normal postmortem findings, rather than provide an exhaustive list.

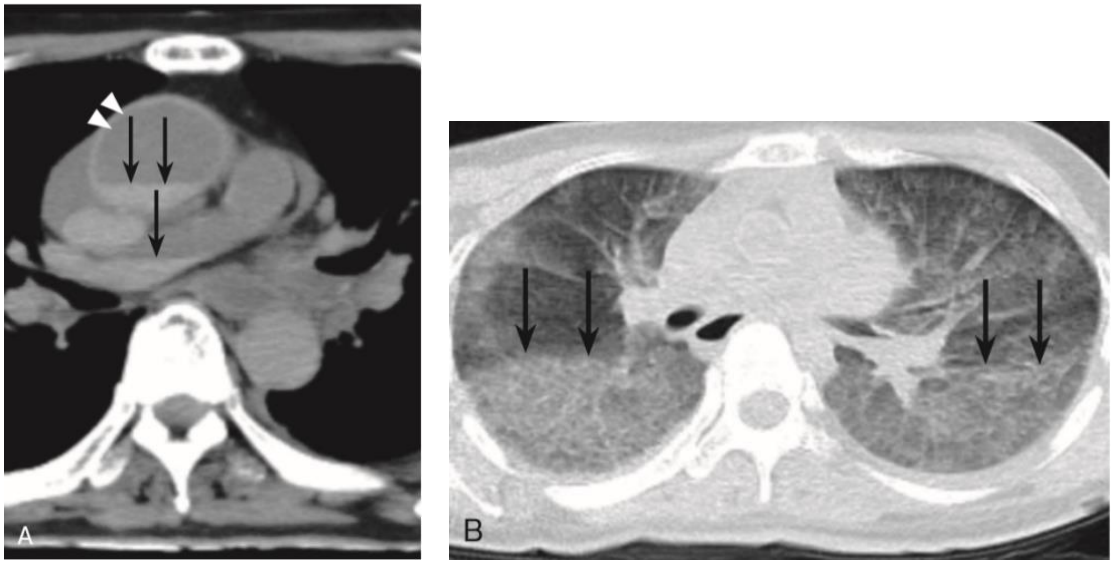
The longer time has passed, the stronger the postmortem changes appear (or disappear)

A study performed by computed tomography immediately after death and repeated at more than one day after death [3] found that the later images were influenced and modified by postmortem changes, and that these changes could cause misinterpretation. Images obtained immediately after death are only little influenced by postmortem changes, and are therefore suitable for determining the cause of death or the course of illnesses, while those obtained more than one day after death reflect the findings of an autopsy. It is necessary to have an understanding of the differences and characteristics of these features to enable the two phases of postmortem images to be utilized. Repeated scans at different time points after death and comparisons with an autopsy will enable improvements in our knowledge of postmortem changes and thus increase the accuracy of image interpretations.

As the postmortem changes change further over time, the time elapsed since death is an important factor that should be carefully considered when interpreting postmortem images.

Figures

Postmortem chest CT scans showing hyperattenuation of the aortic wall and hypostasis.



The wall of the enlarged ascending aorta shows high attenuation (△). There is a clear separation between areas of higher and lower attenuation, which form at a level perpendicular to gravity (→). The appearance of hypostasis is similar to that of erythrocyte sedimentation. (B)Attenuation of ground glass appearance is evident throughout the lung area, and is more prominent in the lower part of the body than on the ventral side (→). The appearance here is characteristic of hypostasis.

Table

Characteristic postmortem CT findings of a traumatic death (cited from references 1, 2; modified)

Chest	Abdomen
aortic dissection rupture of aortic aneurysms ischemic heart disease (pulmonary edema due to pumping dysfunction) pulmonary thromboembolism (enlargement of the hilar pulmonary artery)	rupture of aortic aneurysms intraperitoneal free gas (gastrointestinal perforation)
cardiovascular gas rib fractures	intrahepatovascular (portal and hepatic veins) gas dilation of the gastrointestinal tract
hypostasis (cardiovascular system, lungs) enlargement of the right side of the heart hyperattenuation of the aortic wall	intrahepatic gas
decomposition (intravascular gas)	decomposition (intravascular gas)

References

[1] Christe A et al: Clinical radiology and postmortem imaging (Virtopsy) are not the same: Specific and unspecific postmortem signs. Leg Med (Tokyo) 12: 215-222, 2010 (Level 5)

[2] Shiotani S et al: Autopsy imaging: postmortem findings are classified into cause of death, changes by cardiopulmonary resuscitation, and postmortem changes. Gazou Shindan 30: 106-120, 2010 (Level 5)

[3] Shiotani S et al: Postmortem pulmonary edema: a comparison between immediate and delayed postmortem computed tomography. Leg Med (Tokyo) 13: 151-155, 2011 (Level 5)