

CQ08 Are postmortem images useful in the external examination of the body?

Grade of recommendations: C1

Using postmortem images before an autopsy makes it possible to identify abnormalities that cannot be identified by external examination alone, and it may be possible to identify findings that are directly linked to the cause of death. In addition, even if there is no clear finding to determine the cause of death, the findings of postmortem images allow an objective evaluation of an absence of abnormalities, and the postmortem interval can be estimated. When interpreting images, it is necessary to understand that there are causes of death that cannot be identified by postmortem images. The interpreting physicians should be familiar with postmortem images to avoid misinterpretations, such as determining postmortem changes as pathological abnormalities.

Explanation-----

Background

The external examination of the body is a medical procedure which physicians perform to estimate the cause of death, the manner of death, or the postmortem interval of the body.

The autopsy rate of unnatural deaths in Japan is about 10%, extremely low compared to other developed countries [1, 2]. In addition, an autopsy is rarely performed when a police officer or physician determines that the cause of death is natural and that there is no suspicion of this [1]. However, postmortem images can help detect specific conditions, such as overlooked injuries that cannot be identified solely by crime scene investigations or an external examination of the body. Some specific CT findings can help determine the cause of death and the manner of death [1]. There are also studies on estimation of postmortem intervals using postmortem images [3, 4].

Diagnostic rate of cause of deaths by postmortem imaging

A study comparing postmortem image findings with autopsy findings reported trauma as the cause of death in more than 80% of diagnosed trauma deaths [2]. Approximately 30 to 80% of natural deaths can be diagnosed [2, 5, 7]. Images can be used for screening purposes if an autopsy cannot be performed [5]. For natural deaths, hemorrhagic diseases (cerebral hemorrhage, subarachnoid hemorrhage, aortic dissection, aortic aneurysm rupture, and others) [2] and respiratory failure as a direct cause of death (ARDS, DAD, pneumonia, airway obstruction, and others) [6, 7] can be diagnosed. It is sometimes difficult to tell whether bleeding is natural or due to trauma in CT images [1]. Image interpretation should be performed by a doctor with forensic knowledge [1].

Preventing errors in determinations of involvement of external factors

A study on postmortem CT images of 80 cases that were found not to be suspicious (diagnosed as natural deaths) by police inspectors showed 10 cases where death was associated with external factors [1]. This shows that postmortem CT images can be used to prevent overlooked cases where suspicion that they may have involved external factors remains [1].

Postmortem CT images are also useful for diagnosing the cause and manner of death of suspected suicide cases [8]. In drug overdose cases, postmortem CT scans can be used as a screening tool for diagnosing the cause and manner of death. In non-suspicious cases with no unexpected findings and negative external examinations, a basal radio-opaque layer in the stomach of >100 HU is strongly suggestive of an intentional drug overdose [9-11].

Postmortem CT images can also help identify overlooked cases of asphyxia by choking since images enable determination of laryngeal foreign elements that are invisible to external examinations [4-6]. It is also possible to identify foreign substances (objects), including what may have been inserted postmortem in the larynx or pharynx and which cannot be identified by the external examination [12, 14-16].

Avoiding autopsies in the cases of infectious diseases

Some studies report that rapid toxicological tests and care in scanning and interpreting postmortem CT scans can reduce the number of autopsies helping to avoid infection from cases of high-risk infectious diseases such as HIV or HCV positive cases [16].

Combination with other examinations

Although the rate of diagnosis of causes of death with CT scans alone is low [1], a combination of plain CT scans, postmortem CT angiography, and biopsies, presents a minimally invasive approach that has delivered noteworthy results [17, 18]. Such minimally invasive approaches have led to a correct diagnosis of the cause of death in 90% of the studied cases [17]. Clinical notes will also help to ensure that a postmortem examination provides the most accurate and comprehensive information regarding a cause of death [19, 20].

Pathologies that are easily overlooked or undiagnosable on CT

Postmortem image findings were not helpful in reaching a definitive diagnosis of ischemic cardiac disease, chemical addiction, metabolic disorders, and inflammatory entities [1]. Further, CT scans may also miss cervical spine injuries, cardiac ruptures, injuries to hollow organs, diaphragmatic injuries, and hemomediastinum [1]. There are some important autopsy findings which have not been identified with CT-scanning, including non-calcified severe coronary atherosclerosis, coronary thrombosis, pulmonary embolisms, bronchiectasis, emphysema, liver or spleen contusions, severe aspiration/boluses, micronodular cirrhosis, fractures of the cranial base, chronic gastrointestinal

ulceration, and others [21]. There have been unexpected microscopic findings at autopsies, including microscopic occulted cancers, chronic lymphatic leukemia, disseminated sarcoidosis, bronchopneumonia, and pulmonary tuberculosis [21]. However, it must be borne in mind that MRI is effective for the diagnosis of cardiomyopathy [22].

Important CT findings that tend to be missed by autopsies

Important CT findings overlooked at autopsies are fractures (of the extremities, pelvis, and facial skeleton), pneumothorax, bone metastases, hydrothorax with cardiac compression, and subcutaneous emphysema [19].

Estimating the postmortem interval

There are some reports that examined whether postmortem CT findings could be used to estimate the postmortem interval (PMI). The aortic wall becomes thicker and the outer diameter narrows as PMI becomes longer [3, 23]. In addition, the Hounsfield Unit number of cerebrospinal fluid and vitreous humor increases with the PMI [4, 24].

Literature search formula and literature selection

PubMed (2019/8/27)

#	Search formula	Number of documents
1	(postmortem MRI) AND screening	3,657
2	(postmortem MRI) AND (postmortem interval)	126
3	(postmortem MRI) AND (estimate cause of death)	1
4	(((((postmortem MRI) AND causes of death) AND autopsy) AND English[Language]) AND ("2006/1/1"[Date - Publication] : "present"[Date - Publication]))) AND (external examination)	7
5	(postmortem CT) AND screening	2,829
6	(postmortem CT) AND (postmortem interval)	120
7	(postmortem CT) AND (estimate cause of death)	10
8	(((((postmortem CT) AND causes of death) AND autopsy) AND English[Language]) AND ("2006/1/1"[Date - Publication] : "present"[Date - Publication]))) AND (external examination)	14

Ichusi (Medical journal) (2019/8/29)

#	Search formula	Number of documents
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1	(死後 CT)OR(死後 MRI)OR(死後画像)	280
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From other than search formula

[1, 2, 12-14,18, 20, 22]

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