CQ23 Are all high densities in the cranium hemorrhages?

Grade of recommendations: C2

A postmortem CT may show a high attenuation area similar to hemorrhages due to postmortem changes and pathological conditions other than hemorrhages, making a careful evaluation necessary. Postmortem hypostasis causes high attenuation in the dorsal venous sinus. In cases with diffuse brain swelling and cerebral edema, there are cases where the sulci and cisterns of the brain exhibit a high attenuation (pseudo-subarachnoid hemorrhage: pseudo-SAH). There are also reports of cases in which an artificial object specific to the corpse exhibited an absorption value that mimicked hemorrhages. It is necessary to distinguish between these high attenuation areas and true bleeding.

Explanation----------

Background

The usefulness of head CT for interpretations of intracranial hemorrhages is clinically established. Intracranial acute to subacute hemorrhages are visualized as a high attenuation area, but postmortem CT show a high attenuation area due to normal postmortem changes and other pathological conditions other than hemorrhages. In interpretations of postmortem CT the postmortem changes should be distinguished from true intracranial hemorrhages.

High intracranial absorption as postmortem changes

It is generally known that postmortem CT show high attenuation values in the blood vessels on the gravity side and a high attenuation in the venous sinus, especially the dorsal side of the superior sagittal sinus in the skull, due to hypostasis [1-5] (CQ1). According to a study on normal postmortem changes in postmortem images in in-hospital death cases, high attenuation of the superior sagittal sinus due to hypostasis had occurred in 96% of cases [6]. In a comparative study of 50 cases in which CT images of the head were scanned before and after death, the CT numbers in the posterior superior sagittal sinus were significantly higher in the postmortem CT than in antemortem CT. In the same study, an increase in the attenuation of the superior sagittal sinus was strongly present in cases where the blood flow in the heart and large blood vessels was very large [4]. A study on a pediatric case which showed high attenuation in the cerebellar tent in postmortem CT, no subdural or subarachnoid hemorrhages were identified in the autopsy. In that study the autopsy showed the high attenuation area on postmortem CT corresponding to a cerebellar tent itself, with congestion [7].

Pseudo-SAH due to cerebral edema

High attenuation areas may appear in the sulci and cisterns in pathological conditions causing

cerebral edemas and swelling such as hypoxic-ischemic encephalopathy and acute cerebral infarctions, which are known as pseudo-SAH [8-12]. In a quantitative study of 168 pathological autopsy cases of in-hospital deaths, the diagnostic determination of subarachnoid hemorrhages (SAH) by postmortem CT was 95.2% in sensitivity and 94.6% in specificity. Eight of 28 cases suspected of SAH by postmortem CT were shown to be pseudo-SAH by the autopsy. This study suggests that true SAH rather than pseudo-SAH should be suspected when the following findings are obvious: asymmetry of SAH signs, acute/subacute intraventricular, and intraparenchymal hemorrhages, and thick SAH signs [11].

Artifacts in head CT

Similar to antemortem clinical head CT, CT-specific artifacts can be confused with bleeding. A study on the diagnostic usefulness of extra-parenchymal hemorrhages on postmortem CT reported that false-positive findings of epidural/subdural hemorrhage/hematomas and subarachnoid hemorrhage occurred under the following conditions: edge gradient effect due to pneumocephalus, metal artifact due to dental treatment, and beam hardening artifacts [13].

Epidural blood retention in burned corpses (CQ43)

In severely burned corpses, it is known that the venous sinus ruptures, caused by contraction of the dura due to increased temperatures in the skull, resulting in epidural blood pooling (so-called “heat hematoma”) [14], and it is necessary to distinguish this from true epidural hemorrhages due to trauma.

Other high attenuation value structures

As with clinical CT, differentiating between intracranial calcified lesions (tumors, ectopic calcification, and others) and bleeding may be difficult in postmortem CT diagnoses. A case of a calcifying meningioma confused with a hemorrhage was reported in a fatal case caused by traffic injuries [15]. As an artificial structure of high attenuation peculiar to cadavers, a case in which a superabsorbent polymer used in postmortem procedures to prevent leakage of cranial contents was reported to have migrated into the ventricles and was visualized as a high attenuation lesion mimicking a hemorrhage in postmortem CT [16]. In addition, there is a report of a case where postmortem CT of death from a traffic injury showed multiple high attenuation areas in the subarachnoid space, which was confirmed by autopsy and X-ray fluorescence analysis as residual oily contrast agents used for myelography [17]. Myelography with oily contrast agents has not been performed after the early 1980s, but caution is required in cases in which myelography had been performed before that.

Literature search formula and literature selection (2019/5/12)

PubMed (2000-2019)

#	Search formula	Number of documents
1	(("postmortem" or "post-mortem" or "post mortem" or "forensic" or "pre-autopsy" or "autopsy") and ("CT" or "computed tomography" or "MDCT" or "MSCT" or "neuroimaging"))or "minimally invasive autopsy" or "virtopsy" or "autopsy imaging"	6,875
2	“cerebral” or “intracranial” or “cranial” or “brain” or “head”	1,379,348
3	“hyperattenuation” or “high attenuation” or “hyperdense” or “high density”	62,956
4	“hematoma” or “bleeding” or “hemorrhage”	250,867
5	(#1 and #2 and #3) or (#1 and #2 and 4)	332

Ichushi（Medical Journal）

#	Search formula	Number of documents
1	(死後CT or 死亡時画像診断 orオートプシーイメージング)and(LA=日本語, 英語 PT= 会議録除く)	516
2	(頭部 or 頭蓋内 or 脳)and(LA= 日本語, 英語 PT= 会議録除く)	439,002
3	(出血 or 血腫)and(LA= 日本語, 英語 PT= 会議録除く)	160,665
4	#1 and #2 and #3	59

From other than search formula

[3, 12-14]

References

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[2] Yen K et al: Postmortem forensic neuroimaging: correlation of MSCT and MRI findings with autopsy results. Forensic Sci Int 2007; 173: 21-35 (Level 4b)

[3] Levy AD et al: Postmortem imaging: MDCT features of postmortem change and decomposition. Am J Forensic Med Pathol 2010; 31:12-17 (Level 5)

[4] Takahashi N et al: Quantitative analysis of intracranial hypostasis: comparison of early postmortem and antemortem CT findings. AJR 2010; 195: W388-393 (Level 4b)

[5] Christe A et al: Clinical radiology and postmortem imaging (virtopsy) are not the same: specific and unspecific postmortem signs. Leg Med 2010; 12: 215-222 (Level 5)

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[10] Misra V et al: Pseudo-subarachnoid hemorrhage in a patient with acute cerebellar infarction. Neurol Res 2008; 30: 813-815 (Level 5)

[11] Shirota G et al: The pseudo-SAH sign: an imaging pitfall in postmortem computed tomography. Int J Leg Med 2017; 131: 1647-1653 (Level 4b)

[12] Yuzawa H et al: Pseudo-subarachnoid hemorrhage found in patients with postresuscitation encephalopathy: characteristics of CT findings and clinical importance. AJNR 2008; 29: 1544-1549 (Level 4b)

[13] Anon J et al: Traumatic extra-axial hemorrhage: correlation of postmortem MSCT, MRI, and forensicpathological findings. J Magn Reson Imaging 2008; 28: 823-836 (Level 4b)

[14] Coty JB et al: Burned bodies: post-mortem computed tomography, an essential tool for modern forensic medicine. Insights Imaging 2018; 9: 731-743 (Level 5)

[15] Qian H et al: Subtentorial meningioma misdiagnosed as cerebral hemorrhage in postmortem computed tomography imaging: a case report. Am J Forensic Med Pathol 2017; 38: 103-106 (Level 5)

[16] Kanazawa A et al: New pitfalls of high-density postmortem computed tomography. Leg Med 2014; 16: 297-299 (Level 5)

[17] Tanaka N et al: A case of prolonged retention of oil-based contrast agent. The Japanese journal of forensic pathology 2017; 23: 29-32 (Level 5) (Japanese)