CQ01 What are the findings of postmortem changes in the morphology and attenuation/signal changes on postmortem CT/MRI?

Grade of recommendations: C2

Postmortem changes in the brain may include swelling and loss of differentiation between gray/white matter on postmortem CT. The heart tends to be larger and the cardiac wall tends to thicker and show higher densities. In addition, the aorta tends towards reduced vascular diameters and thicker walls. Dilation of the right atrium, right ventricle, and superior vena cava is also simply observed. Further the volume of the postmortem CT adrenal gland, kidneys, and spleen has been reported to be reduced.

Explanation----------

Postmortem changes to the brain

There is a case report of a reduction in contrast between white matter and gray matter on when compared with antemortem CT. Gray matter density directly after death on the postmortem CT is lower than on the antemortem CT images [1]. It is thought that the reason for the obscure differentiation between gray/white matter may be caused by decreased fluid attenuation of gray matter due to increased water content arising from cellular edema, and/or increased ischemic pressure due to ischemia or increased white matter attenuation due to the stopped blood flow.

The following reports of morphological changes in the brain on postmortem CT have been reported in a study of cases of sudden death, brain swelling was not clearly determined on the CT recorded immediately after death [1]. In the examination of postmortem CT of in-hospital death cases, brain swelling was also observed in a somewhat large number of cases [2]. There was no correlation between brain swelling and postmortem elapsed time, and it was not possible to distinguish whether cerebral swelling actually occurred during or after the death.

Postmortem changes of the heart

After death, the heart tends to expand [3]. The cardiothoracic ratio has been reported to be increased in postmortem CT compared to that in antemortem CT. Particularly, dilation is present in the right atrium and right ventricle [4], the myocardial wall has contracted more strongly, the cardiac wall thickness is increased [5], and the CT attenuation slightly increased [6]. This is believed to be due to postmortem rigidity.

Postmortem changes of the aorta and central veins

Postmortem CT show that the density of the aortic wall is increased [7]. In addition, the aortic wall tends to be thicker than the antemortem CT in the same case [8], and the aortic vessel diameter tends

to decrease in the postmortem CT [9]. Collapse and flattening of the aorta may occur further away from the abdominal aorta, and the flattening tendency is conspicuous in the elderly. One reason is thought to be the less elastic fibers in the media than in younger persons [9]. Further, after death, the internal pressure follows the mean circulatory filling pressure, and the superior vena cava tends to dilate, similar to the situation in the right atrium described above [4]. Changes in the inferior vena cava are not clearly noticeable [10].

Postmortem changes of the upper abdominal organs

There is research of the adrenal glands, kidneys, and spleen comparing with ante- and postmortem CT for the same case. The volume of the adrenal gland tends to decrease on postmortem CT, and it is considered that the lipoid decrease in the cells may be reflected pathologically [11]. The volume of the kidneys and spleen is also smaller on postmortem CT [12, 13]. The volume of the spleen has been reported as markedly reduced in corpses involving bleeding [12]. It has also been reported that spleen attenuation increased in postmortem CT compared with antemortem CT [13].

Column----------

Postmortem CT findings of the brain are characterized by a possible decrease in parenchymal attenuation and a narrowing of the sulci as in hypoxic encephalopathy, but this is not always the case. It is necessary to note that changes in the morphology and attenuation in the brain on postmortem CT differ from case to case, due to various confounding factors such as the postmortem elapsed time to the scanning of the postmortem CT, antemortem pathology, and the state of death.

Postmortem MRI can also be expected to show morphological changes as seen on postmortem CT, but there is an insufficient number of studies about this. In addition, the signal intensity of MRI is considered to be affected by environmental factors such as the temperature at which the deceased has been placed, and it is considered that there are visual variations additional to the attenuation of CT.

Literature search formula and literature selection (2019/6/7)

PubMed

#	Search formula	Number of documents
1	((((((((((postmortem) OR post-mortem) OR "post mortem")) AND imaging)) OR (((((postmortem) OR post-mortem) OR "post mortem")) AND CT)) OR (((((postmortem) OR post-mortem) OR "post mortem")) AND "computed tomography")) OR (((((postmortem) OR post-mortem) OR "post mortem")) AND MR)) OR (((((postmortem) OR post-mortem) OR "post mortem")) AND	23,704

	"magnetic resonance"))) OR (((((postmortem) OR post-mortem) OR "post mortem")) AND MDCT)) OR ((MSCT) AND (((postmortem) OR post-mortem) OR "post mortem")))	
2	(change) AND #1	809

Ichushi（Medical journal）

#	Search formula	Number of documents
1	(死後 CT/AL or 死後 MRI/AL or (死亡時画像診断/TH or 死亡時画像診断/AL) or (死亡時画像診断/TH or オートプシーイメージング/AL)) and (LA=日 本語,英語 and PT=会議録除く)	529
2	(変化) and #1	101

References

[1] Takahashi N et al: Quantitative analysis of brain edema and swelling on early postmortem computed tomography: comparison with antemortem computed tomography. Jpn J Radiol 2010; 28: 349-354 (Level 4b)

[2] Shirota G et al: Brain swelling and loss of gray and white matter differentiation in human postmortem cases by computed tomography. PLoS One 2015; 10: e0143848 (Level 4b)

[3] Okuma H et al: Comparison of the cardiothoracic ratio between postmortem and antemortem computed tomography. Leg Med 2017; 24: 86-91 (Level 4b)

[4] Shiotani S et al: Dilatation of the heart on postmortem computed tomography (PMCT): comparison with live CT. Radiat Med 2003; 21: 29-35 (Level 5)

[5] Okuma H et al: Heart wall is thicker on postmortem computed tomography than on antemortem computed tomography: the first longitudinal study. PLoS One 2013; 8: e76026 (Level 4b)

[6] Okuma H et al: Comparison of attenuation of striated muscle between postmortem and antemortem computed tomography: results of a longitudinal study. PLoS One 2014; 9: e111457 (Level 4b)

[7] Shiotani S et al: Hyperattenuating aortic wall on postmortem computed tomography (PMCT). Radiat Med 2002; 20: 201-206 (Level 5)

[8] Okuma H et al: Greater thickness of the aortic wall on postmortem computed tomography compared with antemortem computed tomography: the first longitudinal study. Int J Legal Med 2014; 128: 987993 (Level 4b)

[9] Takahashi N et al: Changes in aortic shape and diameters after death: comparison of early postmortem computed tomography with antemortem computed tomography. Forensic Sci Int 2013; 225: 27-31 (Level 4b)

[10] Hyodoh H et al: Vascular measurement changes observed using postmortem computed tomography. Jpn J Radiol 2012; 30: 840-845 (Level 4b)

[11] Ishida M et al: Early postmortem volume reduction of adrenal gland: initial longitudinal computed tomographic study. Radiol Med 2015; 120: 662-669 (Level 4b)

[12] Takahashi N et al: Postmortem volume change of the spleen and kidney on early postmortem computed tomography: comparison with antemortem computed tomography. Jpn J Radiol 2019; 37: 534542(Level 4b)

[13] Okuma H et al: Comparison of volume and attenuation of the spleen between postmortem and antemortem computed tomography. Int J Legal Med 2016; 130: 1081-1087 (Level 4b)