CQ46 Is postmortem CT Useful for Diagnosing Decompression Disorders?

Grades of recommendations:
B for evaluating the condition
C1 for determining the cause of death

Postmortem CT are useful in assessing the distribution of gas throughout the body, which is essential in the diagnosis of fatal decompression disorders. It is possible to assess gas findings that are often unproven by an autopsy. However, with gas findings it may be difficult to distinguish it from gas generated by other causes such as putrefaction. Therefore, it is desirable to record a CT image of the whole body as soon as possible after confirmation of death.

Explanation----------
Background

Decompression illness is divided into two categories: I. Decompression sickness (DCS): When a person suddenly rises during diving, components such as nitrogen dissolved in blood under the higher-pressure environment are bubbled into blood vessels and consequently cause various disorders. II. Arterial gas embolisms (AGE): Decompression causes alveolar damage, and alveolar gas flows into the blood causing embolisms. Various symptoms appear due to the generated gas obstructing flow in the small blood vessels, directly damaging the blood vessels, or it may be due to a secondary inflammatory reaction. In severe cases, disorders such as of the central nervous system and respiratory circulatory system may occur, resulting in shock, cardiac arrest, and death [1-4]. Clinically, a number of image findings have been reported; remission by hyperbaric oxygen therapy as well as fatal cases [5, 6]. In autopsy cases of fatal decompression disorders, pneumothorax, subcutaneous emphysema, and the presence of gas in the arteries are classically used as diagnostic criteria, and special procedures such as performing the autopsy in water are also performed to show the presence of the gas. However, in these cases the autopsy showed difficulties to accurately assess the gas distribution throughout the body [7].

In recent years, postmortem images have been introduced in the diagnosis of the cause of death, and postmortem CT are superior to autopsies regarding the diagnosis of decompression disorders. The advantage of postmortem CT lies in the superior visualization of gas over that in an autopsy [8]. However, evaluating the gas in postmortem CT is not straightforward because different types of gas are difficult to distinguish accurately from each other: gas generated by vaporization of dissolved gas in blood vessels after death in water (postmortem off-gassing), gas due to resuscitation, and gas due to decomposition [9]. Immediately after confirming death, a whole-body CT scan will contribute to an accurate evaluation of the condition in a specific case.

Postmortem CT findings characteristic of lethal decompression disorders

In a study of 18 cases of autopsies due to accidental death by diving, postmortem CT images were recorded within 72 hours of death in all cases. Two results are reported from this evaluation.

① The negative predictive value of decompression disorder is 100% and the positive predictive value is 70% when the cervical main artery is completely replaced with gas and further left ventricular gas is observed [9]. This is the most useful finding for the diagnosis of lethal decompression sickness in postmortem CT recorded within 24 hours of death [9].

② The classic triad of decompression sickness (pneumothorax, subcutaneous emphysema, and gas in the arteries) is nonspecific for the diagnosis of decompression sickness [9].

In addition, there are also 6 case reports of deaths occurring during diving. Postmortem CT and heart gas CO 2 concentrations were measured, and the cases of death by decompression disorders were considered to have a slightly higher CO 2 concentration than in the cases of other causes of death. This finding may be useful in diagnosing decompression disorders [10].

In addition, there are the following case reports: Besides the visualization of head gas in postmortem CT, X-rays showed gas in the right ventricle and gas in the pulmonary artery, which was useful for a diagnosis of decompression sickness [11]. Postmortem CT and postmortem MRI were superior to autopsy findings when assessing gas distribution in blood vessels in the parenchymal organs [8]. Postmortem CT were useful for assessing gas distribution and considering causes of death in cases of sudden death during diving (CQ7).

Literature search formula and literature selection (2019/7/26)

PubMed

#	Search formula	Number of documents
1	((((((((((postmortem) OR postmortem) OR "postmortem")) AND imaging)) OR (((((postmortem) OR postmortem) OR "postmortem")) AND CT)) OR (((((postmortem) ORpostmortem) OR "postmortem")) AND "computed tomography")) OR (((((postmortem) OR postmortem) OR "postmortem")) AND MR)) OR (((((postmortem) OR postmortem) OR "postmortem")) AND "magnetic resonance"))) OR (((((postmortem) OR postmortem) OR "postmortem")) AND MDCT)) OR ((MSCT) AND (((postmortem) OR postmortem) OR "postmortem"))	23,860
2	((decompression) AND ((disease) OR (illness)OR(sickness))	13,018
3	#1 and #2	41
4	Scuba diving fatalities	67

5	#1 and #4	4

Ichushi（Medical Journal）

#	Search formula	Number of documents
1	((死亡時画像/AL) and ((FT=Y) and AB=Y)) or (((死後検査/TH or autopsy/AL) and imaging/AL) and ((FT=Y) and AB=Y) and (減圧症 /AL)) or ((死後画像/AL) and ((FT=Y) and AB=Y))	181
2	(減圧症/AL)	1,561
3	#1 and #2	1

References

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[3] Doumoto E et al: Creation of a regenerative treatment manual for decompression sickness (decompression illness and arterial gas embolisms). The Japanese Journal of Hyperbaric Medicine 2001; 36: 1-17 (Japanese)

[4] Vann RD et al: Decompression illness. Lancet 2011; 377: 153-164

[5] Carson WK et al: The role of radiology in dive-related disorders. Mil Med 2005; 170: 57-62

[6] Tatuene JK et al: Neuroimaging of diving-related decompression illness: current knowledge and perspectives. AJNR 2014; 35: 2039-2044

[7] Lawrence C et al: Autopsy and the investigation of scuba diving fatalities. Diving Hyperb Med 2006; 36: 2-8

[8] Plattner T et al: Virtopsy-postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI) in a fatal scuba diving incident. J Forensic Sci 2003; 48: 1347-1355 (Level 5)

[9] Laurent PE et al:postmortem CT appearance of gas collections in fatal diving accidents. AJR 2014; 203: 468-475 (Level 4b)

[10] Varlet V et al: Understanding scuba diving fatalities: carbon dioxide concentrations in intra-cardiac gas. Diving Hyperb Med 2017; 47: 75-81 (Level 4b)

[11] Krantz P et al:postmortem computed tomography in a diving fatality. J Comput Assist Tomogr 1983; 7: 132-134 (Level 5)

[12] Dougherty S et al: Sudden death in a diver: a diagnostic conundrum. Wilderness Environ Med 2017; 28: 225-229 (Level 5)