

CQ40 What are useful findings in postmortem images to determine starvation and hypnutrition?

Grades of recommendations:

C2 for evaluating the condition

D for determining the cause of death

Postmortem CT in starvation cases has reported a decrease in cardiovascular volume and a decrease in lung absorption, but there are no typical findings of starvation in postmortem images. Postmortem images may show findings that may be caused by undernutrition.

Explanation-----

Background

In addition to hunger caused by directly non-human-induced causes like wars and disasters, hunger caused by human-induced causes like abuse and neglect of infants and the elderly is a forensic problem [1]. An autopsy of starvation death in children would show the following findings: extremely low body weight, decreased subcutaneous fat volume, decreased amount of fat around organs, and decreased weight of organs except for the brain [2]. Other characteristic findings include loss of buccal fat, empty stomach/small intestine, and dry solid stool in the colon. Foreign objects in the colon suggest that the person tried to eat a nearby object before death [2].

Image findings on clinical hunger and undernutrition

Structural changes in the lungs and changes in fat on CT have been reported in patients with anorexia nervosa, a condition similar to starvation. It is considered that patients with anorexia nervosa have low lung absorption, high gas volume relative to lung tissue weight, and long-term malnutrition causes loss of lung tissue compared to that of a normal control group [3]. Similarly, there is a report that the treatment of spontaneous pneumomediastinum was delayed in young female patients with anorexia nervosa [4].

It has been reported that the CT attenuation of abdominal subcutaneous fat, visceral fat, and thigh subcutaneous fat increases and the attenuation difference between fat and parenchyma disappears in patients with anorexia nervosa compared to normal controls [5]. In addition, abdominal fat and muscle mass decrease, and bone density is decreased [6]. In in vivo MRI, it was reported that the orbital fat signal in T1-weighted images was reduced [7], and the lower the body mass index value, the lower the signal in T1-weighted images in the order: bone marrow fat, subcutaneous fat, and orbital fat. [8].

Findings of starvation and undernutrition in postmortem images

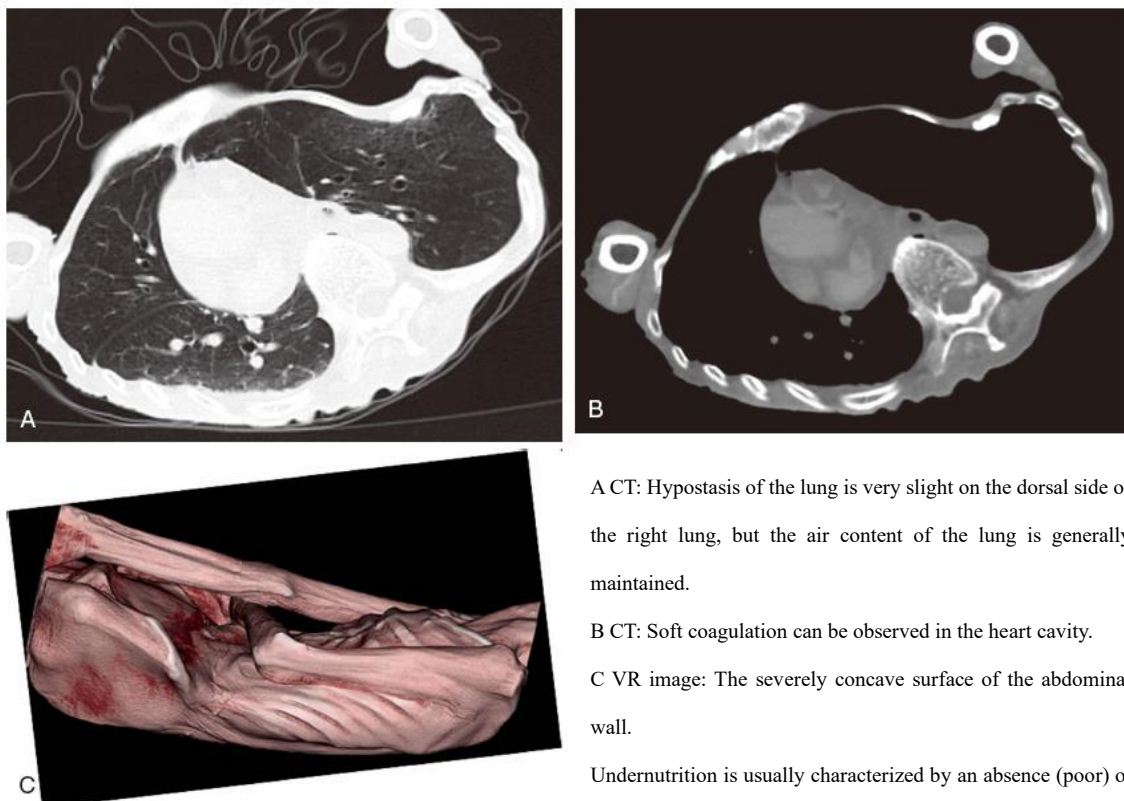
Very few reports directly referred to hunger or undernutrition in postmortem images, only one case report and one cohort study were found.

In the case report of a middle-aged woman who died suddenly after hospitalization due to malnutrition, the autopsy showed dilation of the stomach and duodenum, but there was no structural abnormality, and postmortem CT were examined after the autopsy. As a result, the superior mesenteric artery compressed the duodenum on the postmortem CT, and the cause of death was diagnosed as superior mesenteric artery syndrome, also known as Wilkie syndrome [9].

On a postmortem CT study of starvation, alcohol-related sudden death, and ischemic heart disease, a significantly greater cardiothoracic ratio and inferior vena cava area has been demonstrated in ischemic heart disease compared with starvation and alcohol-related sudden death. Pulmonary absorption values were significantly higher in ischemic diseases and lowest in starvation, with significant differences. It is considered that this is due to dehydration on starvation [10].

Combined with clinical studies, changes in lung and fat may occur in postmortem images of starvation and undernutrition, but it is expected to be difficult to evaluate due to postmortem changes.

Figure Female in the 70s, hypo-nutrition (2 days after death)



A CT: Hypostasis of the lung is very slight on the dorsal side of the right lung, but the air content of the lung is generally maintained.

B CT: Soft coagulation can be observed in the heart cavity.

C VR image: The severely concave surface of the abdominal wall.

Undernutrition is usually characterized by an absence (poor) of lung hypostasis, which is seen as postmortem changes.

Since the process leading to death is slow, it is often observed that blood clots are formed in blood vessels.

Literature search formula and literature selection (2019/3/28)

PubMed

#	Search formula	Number of documents
1	("computed tomography") OR "magnetic resonance imaging"	674,740
2	postmortem	119,456
3	(((hunger) OR starvation) OR malnutrition) OR undernourishment) OR nervosa	198,858
4	#1 AND #2 AND #3	38

Ichushi (Medical Journal)

#	Search formula	Number of documents
1	(死後/AL)and((FT=Y)PT= 原著論文, 会議録除く CK= ヒト)	4,573
2	(死亡時/AL)and((FT=Y)PT= 原著論文, 会議録除く CK= ヒト)	678
3	((画像診断/TH or 画像診断/AL))and((FT=Y)PT= 会議録除く CK= ヒト)	266,892
4	((X 線 CT/TH or X 線 CT/AL))and((FT=Y)PT= 会議録除く CK= ヒト)	102,448
5	((MRI/TH or MRI/AL))and((FT=Y)PT= 原著論文, 会議録除く CK= ヒト)	85,771
6	#1 or #2	5,044
7	#3 or #4 or #5	277,138
8	#6 and #7	1,225
9	(餓死/AL)and((FT=Y)CK= ヒト)	9
10	((飢餓/TH or 飢餓/AL))and((FT=Y)CK= ヒト)	478
11	((栄養失調/TH or 低栄養/AL))and((FT=Y)CK= ヒト)	11,094
12	#9 or #10 or #11	11,331
13	#8 and #12	3

From other than search formula

[4, 5, 6, 7, 8]

References

- [1] Fukunaga T: Death from starvation. Edited by Ishizu H et al.; Standard Forensic Medicine 7th Edition, p128-130, Igaku-Shoin, 2013 (level 6) (Japanese)
- [2] Madea B et al: Forensic aspects of starvation. Forensic Sci Med Pathol 2016; 12: 276-298 (Level

6)

- [3] Coxson HO et al: Early emphysema in patients with anorexia nervosa. *Am J Respir Crit Care Med* 2004; 170: 748-752 (Level 4b)
- [4] Kuroiwa M et al: Spontaneous pneumomediastinum in young women: comparison between anorexia nervosa and nonanorexic patients. *J Gen Fam Med* 2017; 18: 268-270 (Level 5)
- [5] Gill CM et al: Fat attenuation at CT in anorexia nervosa. *Radiology* 2016; 279: 151-157 (Level 4b)
- [6] Tabari A et al: Anorexia nervosa: analysis of trabecular texture with CT. *Radiology* 2017; 283: 178-185 (Level 4b)
- [7] Demaerel P et al: MRI demonstration of orbital lipolysis in anorexia nervosa. *Eur Radiol* 2002; 12 Suppl 3: S4-6 (Level 5)
- [8] Okamoto K et al: Change in signal intensity on MRI of fat in the head of markedly emaciated patients. *Neuroradiology* 2001; 43: 134-138 (Level 4b)
- [9] Baber YF et al: Sudden death due to undiagnosed Wilkie syndrome. *Am J Forensic Med Pathol* 2016; 37: 54-56 (Level 5)
- [10] Suzuki H et al: Postmortem computed tomography findings associated with sudden death in alcoholics. *Nihon Arukoru Yakubutsu Igakkai Zasshi* 2016; 51: 283-292 (Level 4b)