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ORIGINAL ARTICLE

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Does imaging technology overcome problems of conventional postmortem examination?

A trial of computed tomography imaging for postmortem examination

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Abstract We used a mobile computed tomography (CT) unit for postmortem examinations of deceased subjects to see how many mistakes on cause-of-death diagnoses were made in Japan. In 5 of 20 cases, the cause of death determined by CT was different from the diagnosis made by superficial postmortem examination. In one case, the superficial examination suggested no trauma, whereas a subdural hematoma was found on cranial CT images. We concluded that postmortem examinations in Japan were not effective when screening for crimes or accidents. Using a mobile CT scanner in postmortem examination may be a viable method of screening for causes of deaths, although it cannot be used as a substitute for autopsy.

Keywords Postmortem examination · Computed tomography

Introduction

In Japan, unnatural deaths are reported to the police (as required) and are probed using guidelines for unnatural deaths [1]. However, the police and a local physician (usually a private practitioner) examine the dead body only superficially; only when a crime is suspected is a medico-legal autopsy performed. For example, in Chiba Prefecture, with a population of about six million, about 6,500 unnatural deaths are reported annually to the police. Autopsies are performed in only about 180 of those deaths wherein a crime is suspected because there is no funding from the government to support an infrastructure for medico-legal autopsies. Consequently, the autopsy rate in Japan is extremely low—as low as 1.38% [2]. Because of this, deaths by blunt trauma without surface injuries as well as poisoning cases may be overlooked. There is a report that blunt traumas, especially abdominal and spinal cord injuries, are missed; therefore, autopsies are needed to detect injuries that are not evident [3]. In the Japanese system, there is a possibility that many murders or accidents may be missed, and imaging may help to detect blunt traumas of the deceased.

There have been some reports on radiological imaging trials in the field of forensics. Imaging is useful in estimating age [4, 5], detecting foreign bodies [6, 7], and reaching difficult-to-reach areas, such as the upper neck, during autopsy [8]. There has been a study using computed tomography (CT) and magnetic resonance imaging in place of autopsies (called "Virtopsy") in Switzerland [8–10]. In Japan, a trial on postmortem ultrasound imaging [11] and CT imaging at a hospital for cardiopulmonary arrest [12] has been reported. However, we could not find any study in the literature reporting the usefulness of CT during postmortem examination.

In this study, we used CT scanning during postmortem examinations to investigate how many mistakes on cause-of-death diagnoses were made and to determine how helpful CT scanning could be during postmortem examinations.

Methods

This study was performed over five sequential days in January 2004 in Chiba Prefecture using a chartered mobile CT scanner in a van (Fig. 1) [13]. Among the unnatural deaths reported during this period, 20 cases were examined. After the usual postmortem examinations, CT examinations were performed with the mobile CT unit. CT scans of the head, thorax, abdomen, and, in some cases, the neck were performed. Section thickness varied from 5 to

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Fig. 1 The mobile CT unit used in this study

10 mm. All CT images were evaluated; the cause of death was diagnosed by forensic physicians and a radiologist.

Results

The cause of death determined by routine postmortem examination in each case is described in Table 1 and is compared to diagnoses made by CT imaging and by autopsy.

Of the three cases on which autopsies were performed, in only one case was the diagnosis by CT imaging the same as that by postmortem examination; in the other two cases, the CT images showed a cause of death that was different from that obtained by postmortem examination; thus, autopsies were performed to verify the results from the CT images.

From the 17 cases on which autopsies were not performed, the cause of death was not definitively diagnosed by CT in six cases, which showed only suggestions for the cause; the deceased subjects found in water showed tho-

Table 1 Cases on which CT imaging was performed

Case number	Age (years)	Sex	Autopsy	Diagnosis by postmortem examination	Diagnosis by CT imaging	Autopsy findings
1	89	M	+	Unknown	Subdural hematoma	Some abrasions and bruises on extremities, subdural hematoma
2	35	M	−	Unknown	Suspected ischemic cardiac failure	
3	73	M	−	Acute cardiac failure	Suspected ischemic cardiac failure	
4	65	M	−	Nontraumatic intracranial hemorrhage	Subarachnoid hemorrhage	
5	63	M	+	Head trauma	Liver contusion	Abrasions on the head without brain damage, liver contusion with 500-ml bleeding in the peritoneal cavity
6	88	M	−	Traumatic pneumothorax	Traumatic hemopneumothorax	
7	73	F	−	Drowning	Drowning suspected	
8	51	M	−	Acute cardiac failure	*Cardiac tamponade due to rupture of aortic aneurysm*	
9	56	M	−	Ischemic cardiac failure	*Subarachnoid hemorrhage*	
10	52	M	−	Nontraumatic intracranial hemorrhage	Intracerebral hemorrhage	
11	46	F	+	Nontraumatic intracranial hemorrhage	Intracerebral hemorrhage	No injury superficially, intracerebral hemorrhage due to rupture of right middle cerebral artery
12	–	M	−	Hanging	Hanging	
13	42	F	−	Congestive cardiac failure suspected	Lung edema	
14	55	F	−	Drowning	Drowning suspected	
15	58	M	−	Nontraumatic intracranial hemorrhage	*Subdural hematoma*	
16	77	M	−	Choked on food	Choked on food	
17	60	M	−	Heart stroke	Suspected ischemic cardiac failure	
18	59	M	−	Nontraumatic intracranial hemorrhage suspected	Intracerebral hemorrhage	
19	76	F	−	Acute cardiac failure	Suspected ischemic cardiac failure	
20	50	M	−	Suspected hypothermia	Unknown	

Underlined and italicized: the cause of death was different from that found by superficial examination
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M Male, *F* female

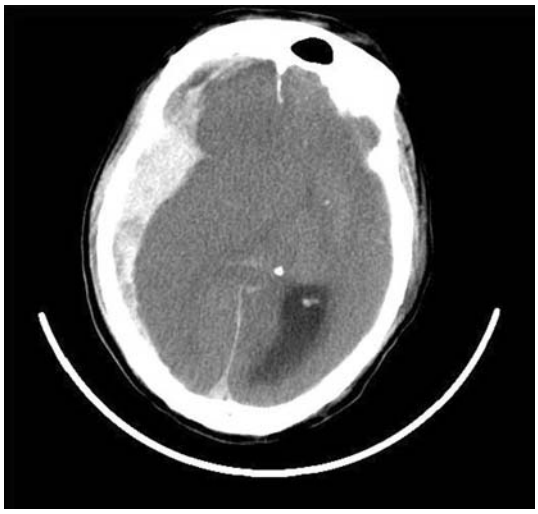

Fig. 2 Case 15. This CT image shows a subdural hematoma on the right side. A midline shift and lateral ventricular dilatation can be seen

racic effusion (n=2), and the others showed severe calcification of coronary arteries (n=4). In three cases, the diagnoses by postmortem examination were different from the definitive diagnoses by CT imaging.

In case 15, the deceased had been found dead in the kitchen without any signs of trauma to the skin. Judging from the bloody spinal cord fluid from this patient, the cause of death was first diagnosed as intracranial hemorrhage due to an internal cause. However, cranial CT images showed a right subdural hematoma (Fig. 2). We concluded that the deceased had fallen accidentally and then hit his head on the stove.

Discussion

This is perhaps the first known trial wherein CT imaging was performed during the postmortem examination and wherein the results were compared with those obtained by superficial postmortem examination. In this study, it was shown that about 25% (5 of 20) of the diagnoses made after the routine postmortem examination differed from those made by CT. From this sample, the rate of ambiguous diagnoses by CT was about 35% (6 of 17) and that by routine examination was about 60%. CT will help detect blunt trauma in corpses, improve the accuracy of postmortem examinations, and, finally, decrease the stress of local physicians and policemen. A mobile CT may also be beneficial in that scanning can be performed at or near the site of death. This is important because the autopsy rate declines when the distance between the place of death and the closest hospital or forensic institute increases [14].

However, autopsy is still the gold standard by which the cause of death is determined. In addition, imaging misinterpretations occur, so there is a danger of misinterpretation if an autopsy is not performed [15]. Imaging methods cannot detect death by poisoning, and an appropriate drug screening method, together with the imaging method, must be applied.

Imaging is a good method for screening and is a useful examination in combination with autopsy, but it cannot substitute for autopsy. Rather, the introduction of CT imaging will increase the number of autopsies because hidden deaths that occur from trauma will be brought to light. In the future, we hope that this method will take the place of conventional postmortem examination in Japan.

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