Usefulness of computed tomography in non-traumatic patients with cardiopulmonary arrest

Poster No.: C-0576
Congress: ECR 2013
Type: Scientific Exhibit
Authors: M. Ochi\textsuperscript{1}, J. Murakami\textsuperscript{2}, S. Sunami\textsuperscript{1}, S. Oguri\textsuperscript{1}, K. Ochiai\textsuperscript{1}, T. Fukuya\textsuperscript{1}, T. Kuroiwa\textsuperscript{1}, A. Nakatsuka\textsuperscript{1}, K. Ayukawa\textsuperscript{1}; \textsuperscript{1}Iizuka/JP, \textsuperscript{2}lizuka/JP
Keywords: Forensics, Diagnostic procedure, CT, Forensic / Necropsy studies, Emergency
DOI: 10.1594/ecr2013/C-0576

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

In the case of non-traumatic patients who have already presented with cardiopulmonary arrest at the time of their emergency-room entry, the clinical information tends to be deficient, and determining the etiology is difficult. Also, it is required as an information source in postmortem examinations performed not only by health professionals but police officials. For this reason, in our hospital, in order to determine the pathogenesis of a case, it is common to perform a CT examination. There are some previous reports of CT in non-traumatic cardiopulmonary-arrest cases [1-8]. Takahashi N et.al. [1], in 2012, described the fatal findings in 494 cases of clinically diagnosed non-traumatic death that were enrolled retrospectively. Fatal findings were made in 188 subjects (38.1%), including 122 with definite (24.7%) and 66 with possible fatal findings (13.4%). On the other hand, Roberts IS et. al. [2], in 2012, assessed 182 unselected cases and found that the major discrepancy rate between cause of death as identified by radiology and by autopsy was 32% for CT. Given this background, we also retrospectively examined the usefulness of CT examination over the past one year.
Methods and Materials

We performed CT examination on the cardiopulmonary-arrest patients in all cases except that the clear traumata and the etiology comprehend. We also performed thoracoabdominal CT if head CT was performed first and no responsible focus was found. We performed contrast CT for some of examples of cardiorespiratory revivification success. The subjects included a total of 94 non-traumatic patients, 12 of whom were resuscitated (13%) and 82 of whom died (87%; autopsy performed in four patients (4%)). These patients were drawn from among the 121 patients undergoing CT out of the 210 patients who had cardiopulmonary arrest upon arriving at the outpatient emergency department of our hospital. These patients were classified based on the usefulness of CT as follows: Group A, patients for whom the culprit lesion was visualized and a definitive diagnosis was obtained; Group B, patients for whom a suspected diagnosis was obtained for the culprit lesion; Group C, patients for whom the culprit lesion was not visualized and only other information such as findings for other lesions was obtained; and Group D, patients with no abnormalities on imaging for whom no additional information was obtained.
Results

**Group A:** Subarachnoid hemorrhage was found in 8 patients (34.8%, resuscitation was achieved in 2); hematencephalon was found in 7 patients (30.4%, resuscitation was achieved in 7); ruptured aortic aneurysm was found in 5 patients (21.7%, resuscitation was achieved in 0); and dissection of the aorta was found in 3 patients (13%, resuscitation was achieved in 0). The resuscitation success rate was 7%, and there was no case that underwent a postmortem examination. The total number of cases in Group A was 23 (24.2%).

**Group B:** Cardiac-tamponade was found in 2 patients (28.6%, postmortem examination 1) (Fig 1a-c); suspected gastric tumor was found in 1 patient (14.3%, postmortem examination 1) (Fig 2a,b); suspected hemopneumothorax was found in 1 patient (14.3%); suspected drowning was found in 1; suspected congestive heart failure was found in 1. The resuscitation success rate was 0%, and there were 2 cases that underwent a postmortem examination. The total number of cases in Group B was 7 (7.4%).

**Group C:** Post-death changes and changes due to cardiorespiratory resuscitation occurred in 25 cases (64.5%, postmortem-examination 1) (Table 1). Cardiomegaly was found in three cases (7.7%), lung tumor/pneumonitis suspicion in three (7.7%), coronary-artery calcification in two (5.1%), suspected acute pancreatitis in one (2.6%), ovarian cyst in one (2.6%), hydrocephaly in one (2.6%), and multiple cerebral infarction in one (2.6%). The resuscitation success rate was 2.6%. There were two cases in which a postmortem examination was done. The 25 cases of post-death changes and changes due to cardiorespiratory resuscitation were these cases. Hypoxia encephalopathy was found in 17 cases (68%), a diffuse lung ground-glass pattern in 10 (40%), portal venous gas in three (12%), vessel distortion/prostration in two (8%), intravascular gas in two (8%), lung consolidation in four (16%), esophagus/gastric dilatation in three (12%), and subcutaneous/mediastinal emphysema in two (8%). The total number of cases in Group C was 39 (41.4%).

**Group D:** Severe arrhythmia was found in seven (26.9%, resuscitation 1), acute heart failure in four (15.4%, resuscitation 1), suffocation in three (11.5%, resuscitation 3), ictus epilepticus in one (3.8%), hyperkalemia in one (3.8%, resuscitation 1), infant burst expiration syndrome in one (3.8%), juvenile Alzheimer's disease in one (3.8%, resuscitation 1), acute alcoholism in one (3.8%), aortostenosis in one (3.8%), acute respiratory failure in one (3.8%), and the diagnosis was unknown in five (3.8%, resuscitation 2). The total number (resuscitation coefficient) of cases in group D was 26 (34.6%).
Fig. 1: (a) 72 year-old-man Hemorrhagic pericardial effusion is recognized in unenhanced CT (arrow), but no finding of dissection of the descending aorta is made. (b) In pathology, a cardiac ventricle rupture is found (arrow), and we had a final diagnosis of a myocardial infarction accompanied by cardiorrhesis.

© Diagnostic Radiology Department, Iizuka Hospital - Iizuka/JP
Fig. 2: (a) 71-year-old man. A tumor is shown (arrow) close to the stomach in an unenhanced CT. (b) The pathological diagnosis was a gastrointestinal stromal tumor (arrow) (a hemorrhagic GIST).

© Diagnostic Radiology Department, Iizuka Hospital - Iizuka/JP
CT findings considered to be based on post-death changes / resuscitation

- Hypoxic encephalopathy
- Diffuse pulmonary ground-glass pattern
- Portal venous gas
- Great-vessel distortion/prostration
- Intravascular gas
- Pulmonary consolidation (aspiration suspicion)
- Esophageal/gastric dilatation
- Subcutaneous/mediastinal emphysema
- Postmortem hypostasis

Table 1

© Diagnostic Radiology Department, Iizuka Hospital - Iizuka/JP
Conclusion

There have been several previous reports of CT in non-traumatic cardiopulmonary-arrest cases [1-8]. Takahashi N et al. [1], in 2012, described the fatal findings in 494 cases of clinically diagnosed non-traumatic death that were enrolled retrospectively. The fatal findings were detected in 188 subjects (38.1%), including 122 definite (24.7%) and 66 possible findings (13.4%). The definite findings included 21 cases of intracranial vascular lesions, 84 with intra-thoracic hemorrhage, 13 with retroperitoneal hemorrhage and 4 with esophagogastric hemorrhage. We found the reason for the definitive diagnosis in 24.4% of non-traumatic cardiopulmonary-arrest patients of CT enactment, and found the reason for the suspected diagnosis in 7.3%. Subarachnoid hemorrhage occurred in eight (34.8%), hematencephalon in seven (30.4%), ruptured aortic aneurysm in five (21.7%), and dissection of the aorta in three (13%). These findings were similar to those in the literature mentioned above. Roberts IS et al. [2], in 2012, assessed 182 unselected cases and found a major discrepancy rate between cause of death identified by radiology and autopsy of 32% for CT. The radiologists indicated in the CT reports that autopsy was not needed in 62 (34%) of 182 cases. In these cases, the major discrepancy rate compared with autopsy was 16%, which was significantly lower (p<0.0001) than for cases with no definite cause of death.

Our study had four cases in which a pathological postmortem examination was performed. Two cases which initially had only a suspected diagnosis were later given a definitive diagnosis [Fig. 1a,b, Fig. 2a,b], and no definitive diagnosis was made in the other two cases. Except responsible focus findings, many signs of changes due to a resuscitation procedure or post-death changes were recognized. Metter RB et al. [3], in 2011, analyzed 240 CT scans by obtaining a gray matter attenuation to white matter attenuation ratio (GWR) and associating it with an initial Glasgow Coma Scale motor score. Subjects with severe cerebral edema, defined by GWR <1.20, have very low survival rates with conventional care, including hypothermia. In our study, hypoxiac encephalopathy occurred in 17 (68%) of 25 cases of post-death changes and changes due to cardiorespiratory resuscitation. The total number of cases in group C was 39 cases (41.4 %); however, the resuscitation success rate was only 2.6%. Yanagawa et al. [4] reported a case in which, although changes in brain swelling and subarachnoid bleeding were shown on unenhanced head CT, the subarachnoid bleeding was negated by the postmortem examination. With regard to the blood retention attending brain death, blood vessels in the tentorium cerebelli, falx cerebri, and subarachnoid cavity showed high sorption and were considered to have contributed to the subarachnoid bleeding. In the present study we observed similar CT findings . Although a diffuse grand-glass lung shadow shows pulmonary edema due to cardiac insufficiency in many cases, the hypostasis due to a postmortem changes may be intermingled in such results [5,6]. Hepatic portal venous gas is also one of clinical findings suggestive of intra-abdominal pathologies, including bowel distention, intraabdominal sepsis, and pneumatosis [9,10]. Lai CF et al. [7], in 2004, reported two cases in which pneumatosis intestinalis and
hepatic portal venous gas developed after prolonged cardiopulmonary resuscitation (CPR). The pathogenic mechanism was most probably bowel infarction caused by poor mesenteric perfusion during and after CPR. In our study, portal venous gas was present in three cases (12%), and these cases had possibly the same likely mechanism. Kudo et al. [8], in 2003, examined the presence of intravascular heterotopic gas in 65 CT scans and suggested that it may have resulted from excessive positive pressure ventilation during airway management using an esophageal-atresia type tube or a laryngeal mask. In the present study, there were also two cases (8%) of subcutaneous/mediastinal emphysema. In these cases, the reason for the above findings may be related. The cases in which, even though CT had been performed, little information was acquired (Group D), mostly showed physiological changes, such as an arrhythmia or an electrolyte abnormality, and the resuscitation coefficient was as high as 34.6%.

While CT may be useful for non-traumatic patients presenting with cardiopulmonary arrest on arrival, CT images must be interpreted carefully because changes caused by resuscitation or caused postmortem, rather than by the culprit lesion, are often visualized. In order to ensure the accuracy of CT diagnosis, confirmation of comparison with pathology is considered to still be necessary. However, in our country, consent for pathological autopsy is not obtained in many cases. Therefore, when a likely cause of death determined by CT, the CT diagnosis is often considered the final diagnosis.
References


4. Yanagawa Y, Toshihisa S, Toshitaka I et al. False-positive CT sign of subarachnoid hemorrhage due to severe brain swelling. JJAAM(1999); 10: 469-72


10. Wiesner W, Mortele KJ, Glickman JN et al. Pneumatosis intestinalis and portomesenteric venous gas in intestinal ischemia: Correlation of CT finding with severity of ischemia and clinical outcome. AJR (2001); 177: 1319-1323
Personal Information

Correspondence to: Miho Ochi, Department of Radiology, Iizuka Hospital, 3-83 Yoshiomachi, Iizuka City, Fukuoka 820-8505, Japan

Tel: +81-948-22-3800, FAX: +81-948-22-3877

E-mail: mochih1@aih-net.com