Rechtsmedizin 2007 · 17:19–20
DOI 10.1007/s00194-006-0409-8
Online publiziert: 2. Februar 2007

H. Ezawa[1] · S. Shiotani[2] · S. Uchigasaki[3]
[1]Department of Pathology, the Research Center Hospital for Charged Particle Therapy, the National Institute of Radiological Sciences
[2] Department of Radiology, Tsukuba Medical Center
[3] Department of Legal Medicine, Nihon University School of Medicine

Autopsy imaging in Japan

The concept of Ai

In response to the worldwide decline in autopsy rates, postmortem imaging has been applied and reported as an alternative to autopsies [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]. In Japan, a new concept of autopsy imaging (abbreviated as Ai) has been proposed by the Research Center Hospital for Charged Particle Therapy at the National Institute of Radiological Sciences, since January 2000 [8].The reason for the abbreviation as Ai is to avoid confusion with AI, which is widely known as an abbreviation of artificial intelligence. Ai in Japan has both narrow and broad meanings as follows:

Ai without conventional autopsy (narrow meaning of Ai): when a conventional autopsy is refused by the deceased's next of kin, the role of Ai is merely a tool for postmortem imaging without confirmation by autopsy findings. In such cases, Ai may be a substitute for autopsy to some extent and is better than no autopsy.

Ai with conventional autopsy (broad meaning of Ai): when a deceased's next of kin gives consent to a conventional autopsy, Ai provides supplemental information to that of the conventional autopsy. In other words, Ai and autopsy are mutually complimentary, namely, the inside of the corpus is investigated twice.

The corpse is first scanned using X-ray, ultrasound, computed tomography and magnetic resonance imaging (MRI) and this scanning information (or imaging dissection) guides subsequent surgical dissection by the pathologists. The imaging diagnosis can be precisely confirmed because Ai corresponds point-for-point with the pathological findings.

Postmortem computed tomography as a prototype of Ai

The distribution of the medical examiner system (MES) in Japan has been limited to 5 major cities (Tokyo, Yokohama, Nagoya, Osaka and Kobe) due to a lack of funds and the limited number of specialists. In fact 85% of the Japanese population live in areas without an MES. In emergency rooms (ER) of areas without the MES, physicians have to write a certificate of death, as normally requested by the police, with an attestation as to the cause of death. Now, there are more than 10,000 CT units throughout Japan, constituting more than one-third of all CT units in the world. With this availability, postmortem computed tomography (PMCT) has been applied in many Japanese ERs and used by physicians as an alternative to the professional medical examiner.

From our experience of conducting over 800 PMCT examinations since 1985 at Tsukuba Medical Center in Japan, we are aware that PMCT fills three major roles [14]:

1. *Screening for causes of death:* PMCT can detect hemorrhagic lesions such as subarachnoid hemorrhage, cerebral hemorrhage, aortic dissection, and rupture of abdominal aneurysms. In acute heart failure, which is one of the most common causes of death, the indirect evidence of lung edema (pump failure) can be delineated with PMCT [9]. PMCT can also detect fatal injuries in cases of traumatic death.
2. *Screening candidates for autopsy:* PMCT findings can be used as a tool for advising the deceased's family of the necessity of an autopsy. If there is any discrepancy between the reported facts and PMCT findings, an autopsy is absolutely necessary in view of the possibility of a hidden crime.
3. *Provide guidance and/or supplemental information for the autopsy:* PMCT can be used as a guide map for a subsequent autopsy. Also, PMCT is better for the detection of air inside the body and of bone fractures. By combining PMCT findings and autopsy findings, the accuracy of diagnosis can be improved.

Rechtsmedizin 2007 · 17:19–20
DOI 10.1007/s00194-006-0409-8

Autopsy imaging in Japan

Zusammenfassung
„Autopsy imaging" (Ai), auch als postmortale Computertomographie (PMCT) bekannt, ist in Japan eine weit verbreitete Screening-Methode. Ai wird alternativ zur konventionellen Obduktion durchgeführt, wenn Letztere nicht angeordnet wurde. Aber Ai kann auch ergänzend zu einer Obduktion eingesetzt werden, um dem Obduzenten zusätzliche Informationen zu liefern. Es ist geplant, in Japan ein „postmortem image data accumulation center" zu etablieren und so eine Studie zur Durchführbarkeit computergestützter Diagnosen zu ermöglichen.

Schlüsselwörter
Postmortale Bildverarbeitung · Computertomographie · Computergestützte Diagnose

Autopsy imaging in Japan

Abstract
Autopsy imaging, also known as postmortem computed tomography (PMCT), is widely used in Japan as an alternative screening method when permission for a conventional autopsy has not been given. When permission has been granted it is also used to supply supplemental information to assist the medical examiner during the autopsy. Plans are in progress to establish a postmortem image data accumulation center in Japan and to carry out a feasibility study for a computer-aided diagnosis (CAD) system.

Keywords
Postmortem imaging · Computed tomography · Computer-aided diagnosis

Based on questionnaire sheet results we found that MRI is rarely used in ERs in Japan due to the much longer scanning time than for CT, although MRI is superior to CT in contrast resolution and postmortem MRI can delineate ischemic myocardium [5, 15, 16].

Future of Autopsy imaging

Committee members of Ai, consisting of specialized staff from the Tsukuba Medical Center and the National Institute of Radiological Science, reached an agreement regarding the concepts of Ai and PMCT being unified as Ai. Following this agreement, the Japan Society of Autopsy Imaging (JSAi) was established in July, 2003. By March 2005, the JSAi had over 240 members including medical doctors (doctors of pathology, forensic medicine, radiology, critical care and emergency medicine, internal medicine and surgery) as well as co-medical personnel (nurses, radiological technologists and clinical technicians).

We are hoping to establish a postmortem image data accumulation center in Japan in the near future. We are also interested in conducting a feasibility study for a computer-aided diagnosis (CAD) system for Ai, to enable comprehensive and automatic diagnosis of the entire corpus, thus screening cases that need further detailed investigation to determine the cause of death [17, 18]. When a CAD system for whole-body Ai is completed and in use, including mobile CT units in automobiles [13], it could play a role in medical audits for the deceased throughout the country.

Corresponding author

H. Ezawa
Section of Clinical Oncology, Research Center Hospital for Charged Particle Therapy,
National Institute of Radiological Sciences,
4-9-1 Anagawa, Inageku, Chiba 263-8555, Japan
e_hide@nirs.go.jp

Conflict of interest. No information supplied.

References

1. Ros PR, Li KC, Vo P et al. (1990) Preautopsy magnetic resonance imaging: initial experience. Magn Reson Imaging 8: 303–308
2. Brookes JAS, Hall-Craggs MA, Sams VR, Lees WR (1996) Non-invasive perinatal necropsy by magnetic resonance imaging. Lancet 348: 1139–1141
3. Woodward PJ, Sohaey R, Harris DP et al. (1996) Postmortem fetal MR imaging: comparison with findings at autopsy. AJR Am J Radiol 168: 41–46
4. Patriquin L, Kassarjian A, O'Brien M et al. (2001) Postmortem whole-body magnetic resonance imaging as an adjunct to autopsy: preliminary clinical experience. J Magn Reson Imaging 13: 277–287
5. Bisset RAL, Thomas NB, Turnbull IW, Lee S (2002) Postmortem examinations using magnetic resonance imaging: four year review of a working service. BMJ 324: 1423–1424
6. Thali MJ, Yen K, Schweitzer W et al. (2003) Virtopsy, a new imaging horizon in forensic pathology: virtual autopsy by postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI) – a feasibility study. J Forensic Sci 48: 386–403
7. Roberts ISD, Benbow EW, Bisset R et al. (2003) Accuracy of magnetic resonance imaging in determining cause of sudden death in adults: comparison with conventional autopsy. Histopathology 42: 424–430
8. Ezawa H, Yoneyama R, Kandatsu S et al. (2003) Introduction of autopsy imaging redefines the concept of autopsy: 37 cases of clinical experience. Pathol Int 53: 865–873
9. Shiotani S, Kohno M, Ohashi N et al. (2004) Non-traumatic postmortem computed tomographic (PMCT) findings of the lung. Forensic Sci Int 139: 39–48
10. Uchigasaki S, Oesterhelweg L, Gehl A et al. (2004) Application of compact ultrasound imaging device to postmortem diagnosis. Forensic Sci Int 140: 33–41
11. Rutty GN, Swift B (2004) Accuracy of magnetic resonance imaging in determining cause of sudden death in adults: comparison with conventional autopsy. Histopathology 44: 187–189
12. Griffiths PD, Paley MN, Whitby EH (2005) Post-mortem MRI as an adjunct to fetal or neonatal autopsy. Lancet 365: 1271–1273
13. Hayakawa M, Yamamoto S, Motani H et al. (2006) Does imaging technology overcome problems of conventional postmortem examination? A trial of computed tomography imaging for postmortem examination. Int J Legal Med 120: 24–26
14. Hamano J, Shiotani S, Yamazaki K et al. (2004) Postmortem computed tomographic (PMCT) demonstration of fatal hemoptysis by pulmonary tuberculosis – radiological–pathological correlation in a case of rupture of Rasmussen's aneurysm. Radiat Med 22: 120–122
15. Jackowski C, Schweitzer W, Thali MJ et al. (2005) Virtopsy: postmortem imaging of the human heart in situ using MSCT and MRI. Forensic Sci Int 149: 11–23
16. Shiotani S, Yamazaki K, Kikuchi K et al. (2005) Postmortem magnetic resonance imaging (PMMRI) demonstration of reversible injury phase myocardium in a case of sudden death from acute coronary plaque change. Radiat Med 23: 563–565
17. Hidefumi K (2001) CAD system as a second reader – Present and future. Proceedings of Korea-Japan Joint Conference on Bio-Medical Engineering, p 131
18. Nawano S, Murakami K, Moriyama N et al. (1999) Computer-aided diagnosis in full digital mammography. Invest Radiol 34: 310–316