X線撮影、X線CT、MRIおよび頭部DSAを用いた死後画像撮像について

Introduction of endeavors for postmortem imaging using donated cadaver

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わが国では2010年頃より教育・研究のための死後画像の活用が始まり、複数の医学部で運用されている。杏林大学では2020年7月から死後画像の撮像を開始し、医学生は解剖実習時に献体の画像を参照できる。本学では、X線撮影、X線CT、MRIやDSAを行っており、特に造影に関する研究を行っているので一部を紹介する。

<Introduction> Over the past decade, postmortem imaging has been performed as an element of gross anatomy practice and cadaver surgical training in Japan. Since July 2020, faculty at Kyorin University have added postmortem imaging of donated cadavers to the curriculum for the medical and radiological science programs. Students are able to observe the cadaver's x-ray, CT, MR, and DSA images using the OsiriX application in their gross anatomy practical training. This cooperative research program has resulted in development of a contrast agent specific for cadavers, as well as the design of postmortem image protocols for CT, MRI and DSA.

<Imaging Protocols> Following transfer to Kyorin University, cadavers are set into a tray which can then be transferred between imaging modalities. Gross anatomy practice necessitates "full course" imaging involving (1) PM-XP (postmortem x-ray photography), (2) PM-MRI, (3) PM-CT, and (4) PM-DSA of cerebral vessels. Preparation for the "full course" requires establishment of two administration routes through both the femoral artery and common carotid artery (CCA) with a 14 Fr. indwelling needle.

"Full course" imaging begins with whole-body x-ray fluoroscopy to assess the condition of the cadaver, along with radiographs from head to femoral region and an elongated radiograph (PM-XP). Next, non-contrast and contrast-enhanced MRI is performed (PM-MRI) using a 3-tesla unit, quadrature detection (QD) coil, and 1.5 mmol/L gadolinium acetate tetrahydrate (original compound). 450 mL of the contrast agent is injected from the femoral artery, followed by MRA of abdomen, chest, and head, respectively. 50 mL is then added from CCA, followed by MRA of the cerebral vessels. The third stage of "full course" imaging involves non-contrast CT and CTA (PM-CT) using a 16-slice CT unit and 500 mL of 34-fold dilute solution of amidotrizoic acid (Gastrografin®). 500 mL is injected from the femoral artery, followed by CTA of head to femoral region. Following the CTA, 100 mL of saline is injected from the CCA to decrease the presence of residual contrast. The fourth and final step requires 2-directional (frontal and lateral projections) DSA of cerebral vessels, using 50 mL of 2-fold dilute solution of Gastrografin® with a manual injection rate of approximately 2 mL/sec. The frame rate for the DSA is set at 2 or 4 frames/sec for a total of approximately 20 seconds. After the first DSA, 100 mL of saline is injected from the CCA, followed by a second DSA acquisition using the same method.

<Imaging of extracted organs and 3D-image reconstruction> The brain of a donated cadaver is removed after postmortem imaging and fixed in formalin for neuroanatomy practice, and which is performed MR imaging and reconstructed 3D images again. Additional body organs may also be extracted for MRI or CT imaging as needed.

<Conclusion> Postmortem imaging is useful for medical students and radiological technology students alike. The cooperative research project at Kyorin University demonstrates the effectiveness of using donated cadavers to link the study of gross anatomy with that of imaging anatomy.

CLINICAL REPORT