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Original Communication

Virtopsy – The concept of a centralized database in forensic medicine for analysis and comparison of radiological and autopsy data

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Abstract

Recent developments in clinical radiology have resulted in additional developments in the field of forensic radiology. After implementation of cross-sectional radiology and optical surface documentation in forensic medicine, difficulties in the validation and analysis of the acquired data was experienced. To address this problem and for the comparison of autopsy and radiological data a centralized database with internet technology for forensic cases was created.

The main goals of the database are (1) creation of a digital and standardized documentation tool for forensic-radiological and pathological findings; (2) establishing a basis for validation of forensic cross-sectional radiology as a non-invasive examination method in forensic medicine that means comparing and evaluating the radiological and autopsy data and analyzing the accuracy of such data; and (3) providing a conduit for continuing research and education in forensic medicine.

Considering the infrequent availability of CT or MRI for forensic institutions and the heterogeneous nature of case material in forensic medicine an evaluation of benefits and limitations of cross-sectional imaging concerning certain forensic features by a single institution may be of limited value. A centralized database permitting international forensic and cross disciplinary collaborations may provide important support for forensic-radiological casework and research.

Keywords: Virtopsy; Forensic medicine; Radiology; Database; Digital autopsy; Post-mortem

1. Introduction

In recent years, forensic radiology has experienced intensive and rapid progress that is supported by the development of clinical radiology.[1] Recently implemented cross-sectional radiological and optical surface documentation methods have gained recognition and applications in forensic medicine.[2–6]

Currently, we use multi-slice computed tomography (MSCT), magnetic resonance imaging (MRI) and a 3D surface scanning for objective and non-invasive documentation of internal and external body injuries of selected cases in addition to conventional autopsy.[3–6] Although these methods are not yet routine in forensic medicine the reported results are promising.[2]

After gaining experience in the growing domain of forensic cross-sectional radiology and optical surface

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documentation within the Virtopsy project at the Institute of Forensic Medicine in Bern (Switzerland), a problem in the validation and analysis of data acquired was established. Forensic-radiological examination data are once assessed regarding forensically relevant findings and then stored on CDs. Some data are lost and some remain unused. In the first three years after the implementation of cross-sectional imaging in forensic medicine within the Virtopsy project, about 13 cases (range 6–20) per half year were examined using MSCT and MRI. In the first six months, since our institute acquired its own computed tomography (CT) scanner (Emotion 6, Siemens, Germany), we have already examined around 50 cases with the CT scanner alone. This is approximately one sixth of the whole year's deceased cases at our institute. The expected number of deceased that undergo forensic-radiological or 3D optical surface documentation, and thus the number of datasets to archive, is rising with each year.

In collaboration with the Institute for Evaluative Research in Orthopaedic Surgery at the University of Bern (Switzerland), we attempted to address this problem by creating a database with internet technology for forensic cases. The following presents the goals and concept of the centralized virtopsy database for use in forensic medicine.

1.1. Goals of the Virtopsy database

With the implementation of new documentation tools in forensic medicine, such as cross-sectional and optical imaging, the need of a prospective and capacious database has emerged. It is anticipated this database will have potential in or serve as a:

1. digital and standardized documentation system for forensic radiological and forensic pathological findings in forensic medicine that is accessible 24 h a day and 7 days a week by all registered users via internet;
2. tool for comparison of the radiological and autopsy findings, i.e. evaluating the accuracy of the virtual autopsy approach (radiology) in comparison with the in the community currently accepted gold standard autopsy approach: validation of forensic cross-sectional imaging as a non-invasive examination method in forensic medicine;
3. forensic-radiological, pathological and epidemiological information source;
4. means for collection, archiving and distributing anonymous medical data both online and offline;
5. tool for the continuing research in forensic medicine;
6. tool for the continuing education of young specialists in forensic medicine and especially in forensic cross-sectional radiology;
7. tracking tool for quality control;
8. conduit for the cooperation and exchange of experience between forensic institutions at on national and international level (telemedicine);
9. instrument for standardization of the service, education and research in forensic medicine, hence being a step towards successful accreditation.

1.2. Background

On the basis of pioneering work in the field of orthopaedic and trauma documentation initiated by Professor M.E. Mueller in the 1960s, the Institute for Evaluative Research in Orthopaedic Surgery of the University of Bern has advanced the concept of centralized documentation to enable the establishment of international registries.[7–9] Over the past 5 years various additional clinical databases, primarily for surgical specialities, were created.[9]

In 2000, a new methodology in centralized data management was built and devised using the latest innovations in medical informatics by the Institute for Evaluative Research in Orthopaedic Surgery.[9] The outstanding advantage of this technology is that the end user is not required to purchase, install, or maintain any specialized software or hardware. All technical servicing is performed at the central server (Fig. 1). Accordingly, examination protocols can be easily and quickly distributed to a large user community, while data retrieval and analysis are conducted centrally. Such a system enables an easy setup of local, national or even international registries. For participation, end users only need a personal computer with access to the World Wide Web and a user account. The need to purchase hardware only arises when a participating hospital would like to keep full control and hence responsibility for all sensitive data sets (see below in Privacy Issues).

The workflow-based database validates the quality of the collected data. All validation checks are performed at the point of data entry so that the user cannot submit incomplete, invalid or inconsistent data sets. Error messages pointing out missing or contradictory answers are displayed and the data cannot be saved until all of the preprogrammed validation criteria are met. This setup guarantees an accurate, integrative, valid and competent data sampling and eliminates the need for retrospective data correction. The enormous human and financial resources needed to key in paper-based data and to correct and complete invalid datasheets is saved using modern internet and computer technologies.

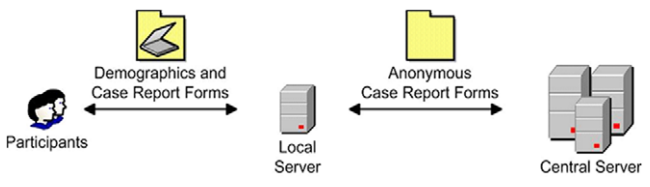

Fig. 1. The order of the data exchange within the Virtopsy database. Note the anonymous data exchange between the local server at our institute and the central server at the Institute for Evaluative Research in Orthopaedic Surgery (University of Bern).