Medical use of radiation in the endoscopy suite: a survey of the radiation protection practice during endoscopic retrograde cholangiopancreatography (ERCP) in Finland

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Authors: E. Saukko¹, A. Henner², S.-M. Ahonen²; ¹Turku/FI, ²Oulu/FI
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Aims and objectives

In its publication 117 released in 2010, the International Commission on Radiological Protection (ICRP) expressed concern about the fact that the use of fluoroscopy outside the imaging departments has increased significantly and expanded to the larger clinical areas. There has been general neglect and a lack of training, knowledge and awareness regarding radiation protection among of those working with fluoroscopy outside the imaging departments. [1]

Gastroenterology is one of the specialties which use fluoroscopy to aid endoscopic procedures, such as ERCP [1]. Endoscopic retrograde cholangiopancreatography (ERCP) is a highly technical and demanding invasive procedure used in the treatment of the hepatobiliary system [2-3]. ERCP may be performed outside the imaging department, e.g. in operating theatres or endoscopy unit [4]. During ERCP, both patients and healthcare staff are exposed to ionizing radiation and there is a potential risk of radiation-induced injury (Fig. 1). This makes the ERCP undoubtedly an interventional radiological procedure which requires the same level of radiation protection practice. However, ERCP is not generally performed by a radiologist, but by a gastroenterologist or even by a general surgeon. [3, 5-6]

Several previous studies have been performed in response to growing interest in radiation exposure during ERCP. Results about radiation exposure to patients [5-12] and endoscopy staff [5-6, 8-10, 13-14] in ERCP showed a significant variation in radiation doses. In the recent years occupational eye doses have been of special interest too, based on the ICRP new statement on tissue reactions and recommendation of a reduced dose limit for the lens of the eye from 150 to 20 mSv per year [16]. According to latest publications the occupational eye doses from ERCP may have the potential to exceed the new ICRP dose limit of 20 mSv [13-15, 17]. In addition, the published data concerning radiation protection practice in the context of endoscopy is limited and inadequate. The aim of this study was to investigate current clinical practice for radiation protection during ERCP.
Fig. 1: ERCP is performed under fluoroscopy guidance and associated with a radiation exposure for personnel and patient.

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Methods and materials

The study was conducted in Finland in the year of 2012. A sample of 10 Finnish hospitals, in which the ERCP procedures are performed, were purposively selected, and included five university hospitals and five central hospitals. A research permit was applied in accordance with guidelines set forth by the institutional board of each hospital.

The data (n=10) were collected by using a structured questionnaire developed for the study. The questionnaire was sent by mail to the hospitals. Questions (29 in total) were about respondent information, the ERCP volume of the hospital and ERCP circumstances, technical considerations of the fluoroscopic x-ray system used in ERCP, the current status and awareness of radiation protective equipment and as well as about maneuvers of using fluoroscopy during ERCP procedures. The survey was directed in each hospital to a person who participates in ERCP and controls fluoroscopy equipment.

Statistical analysis was performed using the IBM SPSS Statistics version 21 (2012) software. Frequencies and percentages were calculated for the data.
Results

A response rate of 100% was achieved in this study. Most of the respondents were female (90%, n=9) and 60% (n=6) of all persons were under 50-years. The respondent’s positions in hospital were radiographer (70%, n=7) or registered nurse (30%, n=3). Half of the respondents (n=5) had over 10 years of experience on ERCP.

The ERCP procedures were carried out in Finnish hospitals both in X-ray departments (n=6) and endoscopy units (n=4). An annual ERCP case volume varies according to the size of the each hospital, as follows: 100-199 (n=3), 200-299 (n=3), 300-399 (n=1), 400-499 (n=2) and 500 (n=1). The X-ray equipment used in ERCP consists of a stationary fluoroscopic X-ray system (n=2), multipurpose (c-arm) fluoroscopy system (n=6) or mobile c-arm unit (n=3), with X-ray tube located above (n=1) or under (n=10) the patient table. In one large hospital, two different fluoroscopic systems were used in performing ERCP. A radiographer was a part of ERCP team in seven out of ten hospitals and a radiologist was involved in ERCP in one hospital. Fluoroscopic equipment was operated by endoscopist (n=6) or by radiographer (n=5), but the endoscopist was a person who pressed the foot pedal to release an X-ray beam in each hospital. DAP-meter and LIH (last-image hold) function was found from all fluoroscopy systems used in ERCP. Patients were usually examined in the prone position during ERCP.

Radiation protection practice in ERCP was evaluated from the workers and patient perspective. Protective lead aprons (100%) with thyroid shield (100%) and leaded glasses (90%) were worn by staff during their work in controlled areas. Protection from scattered radiation was operated by the mobile shields (70%), lead curtains (90%) and ceiling-mounted protective shield (90%). Table 1 presents the diversity of radiation protective equipment used in ERCP in Finnish university and central hospitals. Protection of the patient during ERCP varied significantly between the hospitals. The use of a pelvic lead shield during ERCP was relatively low and a lead shield for protection of breast tissue in female patients was not used at all.

The use of the radiation dose reduction techniques during ERCP varied greatly among the hospitals, as well. Pulsed fluoroscopy was used in most of the hospitals (n=9), but the pulse rate varied greatly, from 1.5 fps to 15 fps. Fluoroscopy pulse rate was not modified at all during the ERCP in almost all of the hospitals. The results showed that a purpose of available fluoroscopy modes such as low, medium and high, was unclear for the respondents. There were many missing answers related to question about fluoroscopy modes. Collimation to the anatomic region of interest was done only in half of the hospitals (n=5) and additional radiographic images were taken during ERCP in seven hospitals (Fig. 2). Magnification mode seems to be quite common in the ERCP.
Table 1: The use of radiation protective equipment during ERCP in Finnish hospitals.

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Fig. 2: ERCP image obtained after injection of contrast media. Radiographic images requires higher dose rates compared with normal fluoroscopic images.

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Conclusion

The results of this survey demonstrate that the use of radiation in the context of endoscopy has its own specific maneuvers. In conclusion, a good radiation protection practice in ERCP requires optimization and recognition of a safety culture in the workplace. The essential principle for the use of fluoroscopy in endoscopy suite is concept of ALARA, which stands for "as low as reasonably achievable" [18].

There is a possibility to minimize the exposure to patients and staff during ERCP by using the dose reduction techniques and by appropriate shieldings. According to the results, the endoscopy staff was adequately protected by the use of lead aprons, thyroid collars and lead glasses, during their work in controlled areas. Other mobile or portable lead shields were used quite well, but protection of the patient during ERCP varied significantly between the hospitals. Modifying the beam by collimate the field size was not commonly in use during ERCP; even it is an easiest way to reduce the amount of radiation. In addition, radiographic images were taken during ERCP in most of the hospitals, but in some circumstances the fluoroscopic images may be sufficient for the documentation of findings. The use of magnification in ERCP is understandable in some cases, as the structure of pancreatic and bile ducts are small, but the images can be enlarged afterward in monitor without an irradiation. It is obvious that every action to reduce patient dose will have a corresponding impact on occupational doses [1]. Education programme in radiation safety and proper radiation hygiene for healthcare professionals working in ERCP environment will increase awareness of radiation risks and decrease an unnecessary exposure of staff and patients [19].

Some limitations of this study are acknowledged. A sample of hospitals in this study was relatively small, but as the hospitals were purposively selected, the whole country was regionally covered. A questionnaire was targeted at nurses and radiographers participating in ERCP procedures, but answers of the ERCP endoscopists would have been able to give a more complete picture of the radiation protection practice during ERCP, as well as a larger sample of hospitals. Furthermore, the observation method could provide an interesting and valuable information about the phenomenon under the investigation.
Personal information

Saukko Ekaterina, MSc;

Radiological Department of U-Hospital

The Medical Imaging Centre of Southwest Finland

Turku University Hospital

Kiinamyllynkatu 4-8

PO Box 52

20521 Turku, Finland

ekaterina.saukko@tyks.fi

Henner Anja, PhD;

Oulu University of Applied Sciences

School of Health and Social Care

Kiviharjuntie 8

90220 Oulu, Finland

anja.henner@oamk.fi

Ahonen Sanna-Mari, PhD;

University of Oulu

Institute of Health Sciences

PO Box 5000

90014 Oulu, Finland

sanna-mari.ahonen@oulu.fi
References


