Risk Analysis in Radiation Protection

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GBS 21/09/2019

Conclusions

- We need X-rays
- They're a risk among others
- We should use protective and monitoring devices
- We should spare patients skin and monitor their radiation doses

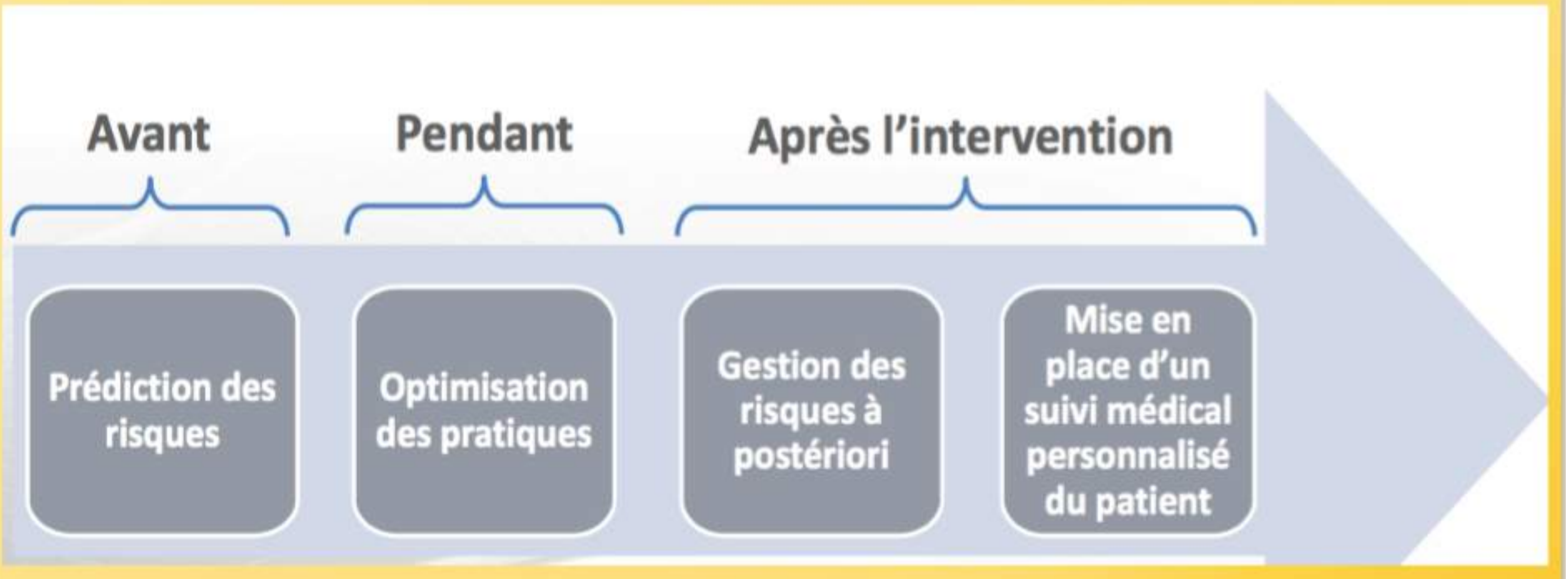
Risk analysis

- Which risks ?
- For whom ?

L'évaluation des risques a pour objet d'identifier les dangers ou les facteurs de risques puis d'analyser les conditions d'exposition des travailleurs à ces dangers ou facteurs de risques. Elle vise à connaître, de manière exhaustive et précise, les risques à traiter et à mettre en œuvre des mesures effectives, visant à l'élimination de ceux-ci, conformément aux principes généraux de prévention.

Risk analysis identifies dangers or risk factors, then analyses the exposure conditions (of workers or patients) to these dangers or risk factors.
It tries to be aware, as much and as precisely as possible, risks to be taken into account and to implement efficient mechanisms to eliminate the risks, as foreseen by the general precautionary principles

Gestion des risques



Risks in IR

- Contrast agents
- Infections
- Dissections
- Bleeding
- Cardiac arrest, stroke
- …
- **Ionising radiation**

Patient risks

Deterministic skin effects

AJR 2001; <u>173</u>: 3-20

Review

Skin Injuries from Fluoroscopically Guided Procedures: Part 1, Characteristics of Radiation Injury

Titus R. Koenig[1], Detlev Wolff[2], Fred A. Mettler[3], Louis K. Wagner[1]

Interventional procedures in radiology and cardiology often involve high radiation doses to patients' skin. The potential for skin injury was discussed in 1994 [1]. More than 70 injuries have been reported in the referenced literature during the last decade or are known through other tween reported skin damage and known patterns of progression to assist physicians in the recognition of these injuries. We also identify factors that can help improve patient care.

Fundamental Facts About Skin Injury

body's first response occurs as an internal biologic response in dysfunctional cells. This stimulated response goes unnoticed by the host when the biochemical changes are minor.

Deterministic Versus Stochastic Effects

Skin changes such as erythema, ulcers,

AJR 2001: 173:

Review

Skin Injuries from Fluoroscopically Guided Procedures: Part 2, Review of 73 Cases and Recommendations for Minimizing Dose Delivered to Patient

Titus R. Koenig[1], Fred A. Mettler[2], Louis K. Wagner[1]

The benefits of fluoroscopically guided interventional procedures are reflected in the increasing number of interventions that are performed each year. In 1996, more than 700,000 interventional procedures were performed in the

Case Reports

The site of the skin injury depends on the type of procedure and corresponds in all cases to the beam entrance site. The site of injury is on the back when the tube is in a posteroanterior projection (e.g., transjugular intrahepatic

that required 65 min of fluoroscopy. The machine failed in its pulsed mode, which resulted in a continuous output at a high tube current. The subsequent skin dose was estimated as between 15 and 26 Gy. At 3 weeks the patient developed pruritus and her skin

Types of procedures associated with severe injuries

Coronary Angioplasty

Courtesy F Mettler MD

Radiofrequency Ablation

Vañó, Br J Radiol
1998; 71, 510 - 516

TIPS placement

Nahass et al, Am J Gastroent
1998; 93: 1546-9

Uterine embolization

Courtesy: Shope, FDA

Renal angioplasty

Dandurand et al, Ann Derm
Vener 1999; 126: 413-417

Neuroembolization

Springer CARDIOVASCULAR AND INTERVENTIONAL RADIOLOGY
▸ springer.com

Cardiovasc Intervent Radiol. 2017; 40(8): 1131–1140.
Published online 2017 May 11. doi: 10.1007/s00270-017-1674-5

PMCID: PMC5489635
PMID: 28497187

Radiation-Induced Skin Injuries to Patients: What the Interventional Radiologist Needs to Know

Werner Jaschke,[✉1] Matthias Schmuth,[2] Annalisa Trianni,[3] and Gabriel Bartal[4]

▸ Author information ▸ Article notes ▸ Copyright and License information Disclaimer

Abstract

Go to:

For a long time, radiation-induced skin injuries were only encountered in patients undergoing radiation therapy. In diagnostic radiology, radiation exposures of patients causing skin injuries were extremely rare. The introduction of fast multislice CT scanners and fluoroscopically guided interventions (FGI) changed the situation. Both methods carry the risk of excessive high doses to the skin of patients resulting in skin injuries. In the early nineties, several reports of epilation and skin injuries following CT brain perfusion studies were published. During the same time, several papers reported skin injuries following FGI, especially after percutaneous coronary interventions and neuroembolisations. Thus, CT and FGI are of major concern regarding radiation safety since both methods can apply doses to patients exceeding 5 Gy (National Council on Radiation Protection and Measurements threshold for substantial radiation dose level). This paper reviews the problem of skin injuries observed after FGI. Also, some practical advices are given how to effectively avoid skin injuries. In addition, guidelines are discussed how to deal with patients who were exposed to a potentially dangerous radiation skin dose during medically justified interventional procedures.

Keywords: Interventional radiology, Radiation, Skin injuries

Journal of Radiological Protection

PRACTICAL MATTER ARTICLE

Lessons from two cases of radiation induced skin injuries in fluoroscopic procedures in Bulgaria

D Kostova-Lefterova[1,2], J Vassileva[3] and M M Rehani[4]

Published 15 November 2017 • © 2017 IOP Publishing Ltd

Journal of Radiological Protection, Volume 37, Number 4

Abstract

Background: Radiation-induced injuries to patient skin as a result of fluoroscopy guided interventional procedures are infrequently reported, often misdiagnosed and there is a need to learn lessons from every injury. *Methods:* This paper describes two cases of radiation induced skin injuries that are, to the best of our knowledge, the first ever reported cases from Bulgaria and possibly from Eastern Europe, and would thus have educational value. *Results:* The important messages from the skin injuries reported here are: lack of awareness among part of the interventional specialists about the potential for radiation induced skin injury, misdiagnosis after injury happened because of lack of awareness and knowledge among general physicians, dermatologists and surgeons who followed up cases of skin injuries; the lack of system to monitor patients with relatively high exposure; the important role played by the medical physicist in diagnosing the injury and overall in initiating actions; the role of training and informational material displayed in interventional facilities. *Conclusions:* For avoidance of skin injuries from interventional procedures it is of utmost importance to implement a system that includes (a) regular monitoring of radiation dose parameters of the procedure; (b) established trigger values for reporting; (c) procedure for patient follow-up if a trigger value is exceeded; (d) instructing the patient who has received exposure above the trigger value to self-examine the irradiated area of the skin for any itching/redness and report it back.

Stochastic effects

Gut. 2005 Jun; 54(6): 889–890.
doi: 10.1136/gut.2005.066605 PMCID: PMC1774558

Diagnostic radiation exposure and cancer risk

M B Frenz and A S Mee

Author information ► Article notes ► Copyright and License information ►

Diagnostic and therapeutic radiological investigations are an essential part of the workup of patients with a number of clinical problems across a variety of medical specialties. Although new non-*x* ray technologies have started to replace traditional investigations these have not lead to a reduction in radiation exposure. In contrast, based on global statistics and projections, radiation exposure of patients is increasing, in particular as a result of new indications and use in cross sectional imaging.[1] In addition, multiple investigations of patients with chronic disease can lead to substantial individual radiation exposure as surgical practice increasingly relies on the use of cross sectional imaging to aid diagnosis and treatment.[2] New imaging techniques, in particular computed tomography (CT) colonography, have become attractive alternatives to conventional colonoscopy.[3] However, the necessity for both prone and supine scanning means that radiation exposure is double that of a conventional abdominal scan which can lead to a theoretical increase in the risk of exposure related cancer and death.[4]

HOUNSFIELD REVIEW SERIES

Cancer risks from diagnostic radiology

E J HALL, DPhil, DSc, FACR, FRCR and D J BRENNER, PhD, DSc

Center for Radiological Research, Columbia University Medical Center, New York, NY 10032, USA

ABSTRACT. In recent years, there has been a rapid increase in the number of CT scans performed, both in the US and the UK, which has fuelled concern about the long-term consequences of these exposures, particularly in terms of cancer induction. Statistics from the US and the UK indicate a 20-fold and 12-fold increase, respectively, in CT usage over the past two decades, with *per caput* CT usage in the US being about five times that in the UK. In both countries, most of the collective dose from diagnostic radiology comes from high-dose (in the radiological context) procedures such as CT, interventional radiology and barium enemas; for these procedures, the relevant organ doses are in the range for which there is now direct credible epidemiological evidence of an excess risk of cancer, without the need to extrapolate risks from higher doses. Even for high-dose radiological procedures, the risk to the individual patient is small, so that the benefit/risk balance is generally in the patients' favour. Concerns arise when CT examinations are used without a proven clinical rationale, when alternative modalities could be used with equal efficacy, or when CT scans are repeated unnecessarily. It has been estimated, at least in the US, that these scenarios account for up to one-third of all CT scans. A further issue is the increasing use of CT scans as a screening procedure in asymptomatic patients; at this time, the benefit/risk balance for any of the commonly suggested CT screening techniques has yet to be established.

Received 15 November 2007
Revised 29 January 2008
Accepted 7 February 2008

DOI: 10.1259/bjr/01948454

© 2008 The British Institute of Radiology

Lancet. Aug 4, 2012; 380(9840): 499–505.
doi: 10.1016/S0140-6736(12)60815-0 PMCID: PMC3418594

Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study

Mark S Pearce,[a,*] Jane A Salotti,[a] Mark P Little,[c] Kieran McHugh,[d] Choonsik Lee,[c] Kwang Pyo Kim,[e] Nicola L Howe,[a] Cecile M Ronckers,[c,f] Preetha Rajaraman,[c] Alan W Craft,[b] Louise Parker,[g] and Amy Berrington de González[c]

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Summary

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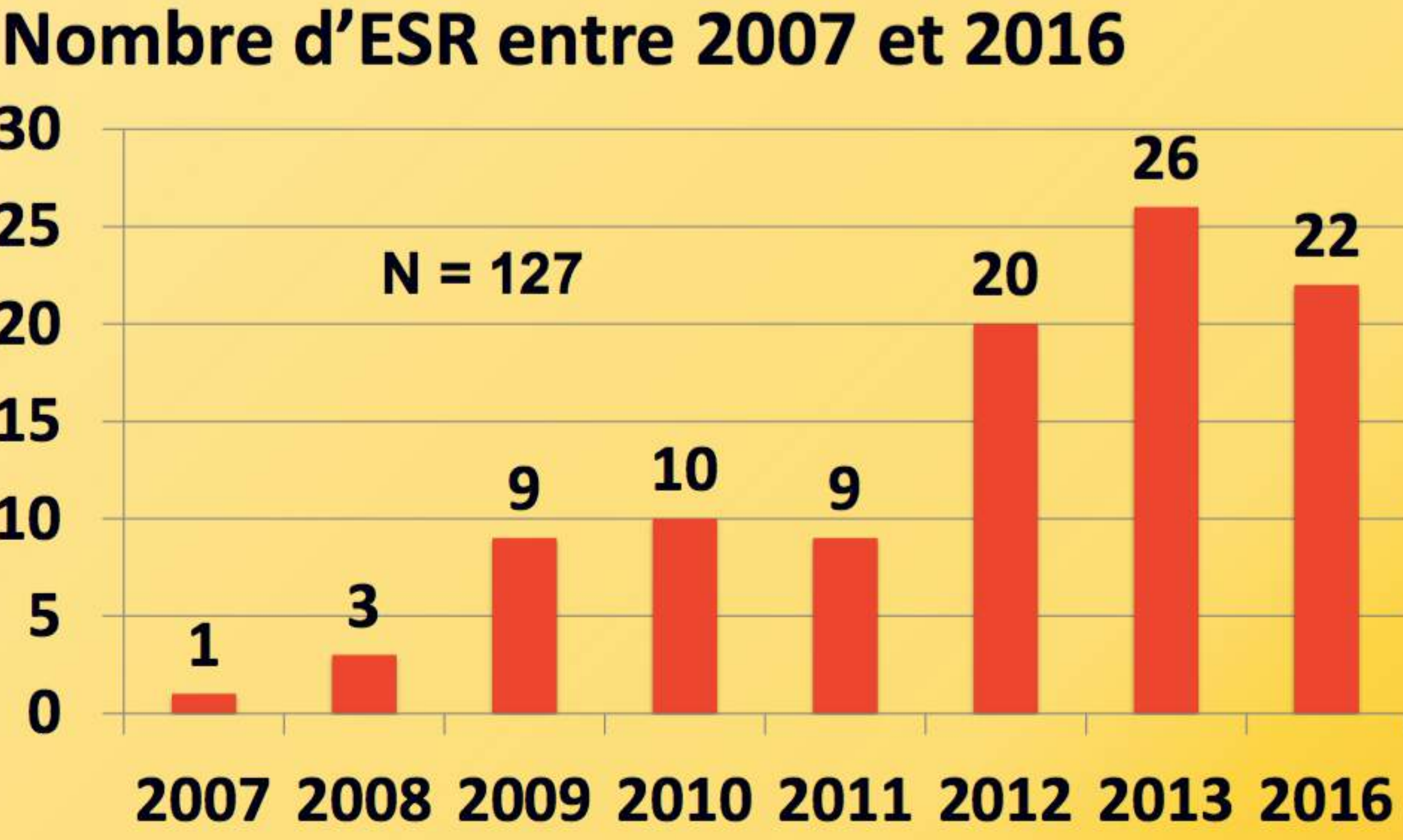
Background

Although CT scans are very useful clinically, potential cancer risks exist from associated ionising radiation, in particular for children who are more radiosensitive than adults. We aimed to assess the excess risk of leukaemia and brain tumours after CT scans in a cohort of children and young adults.

In France (IRSN)

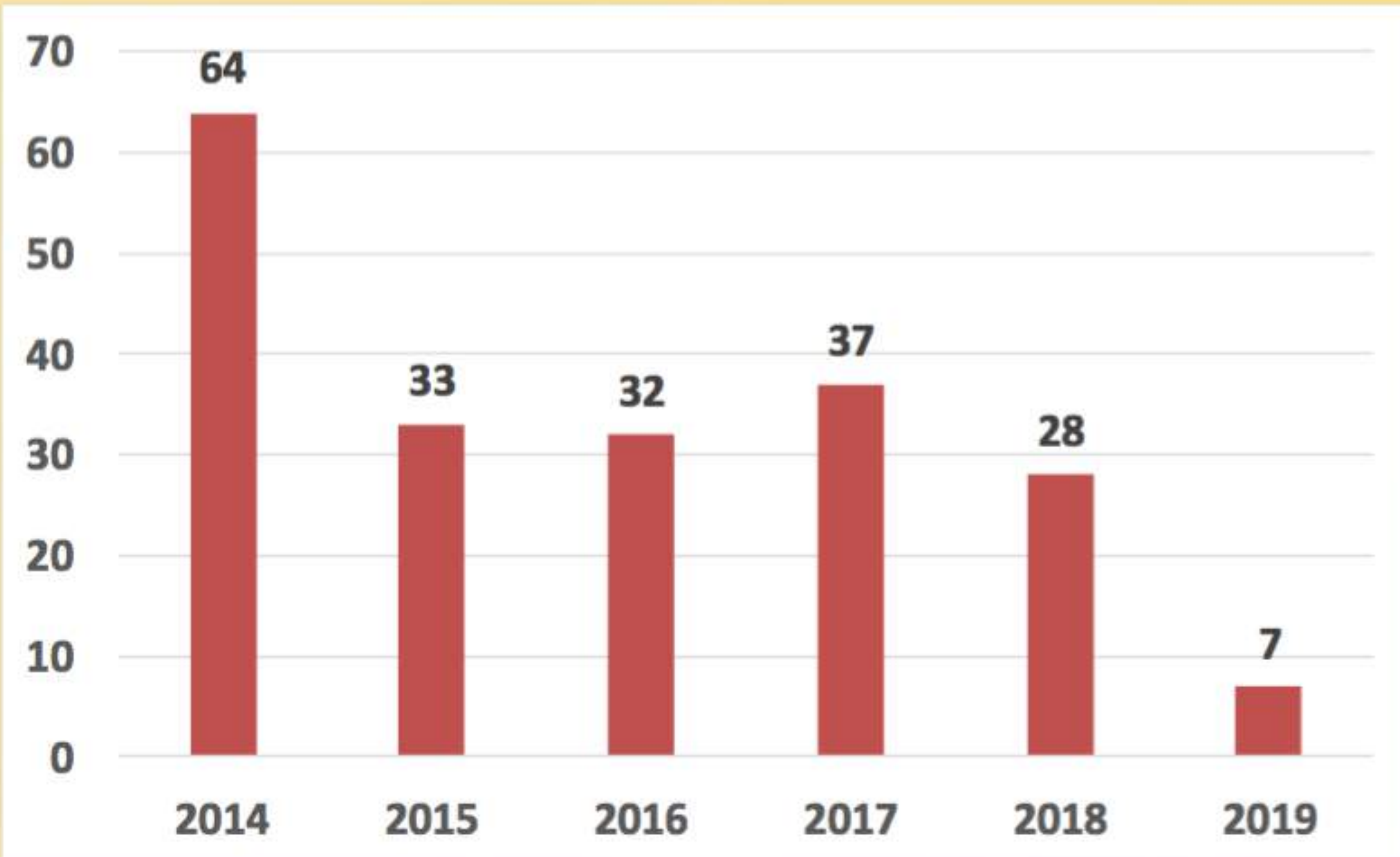


2 centers - Belgium
> 5000 mGy AK@IRP

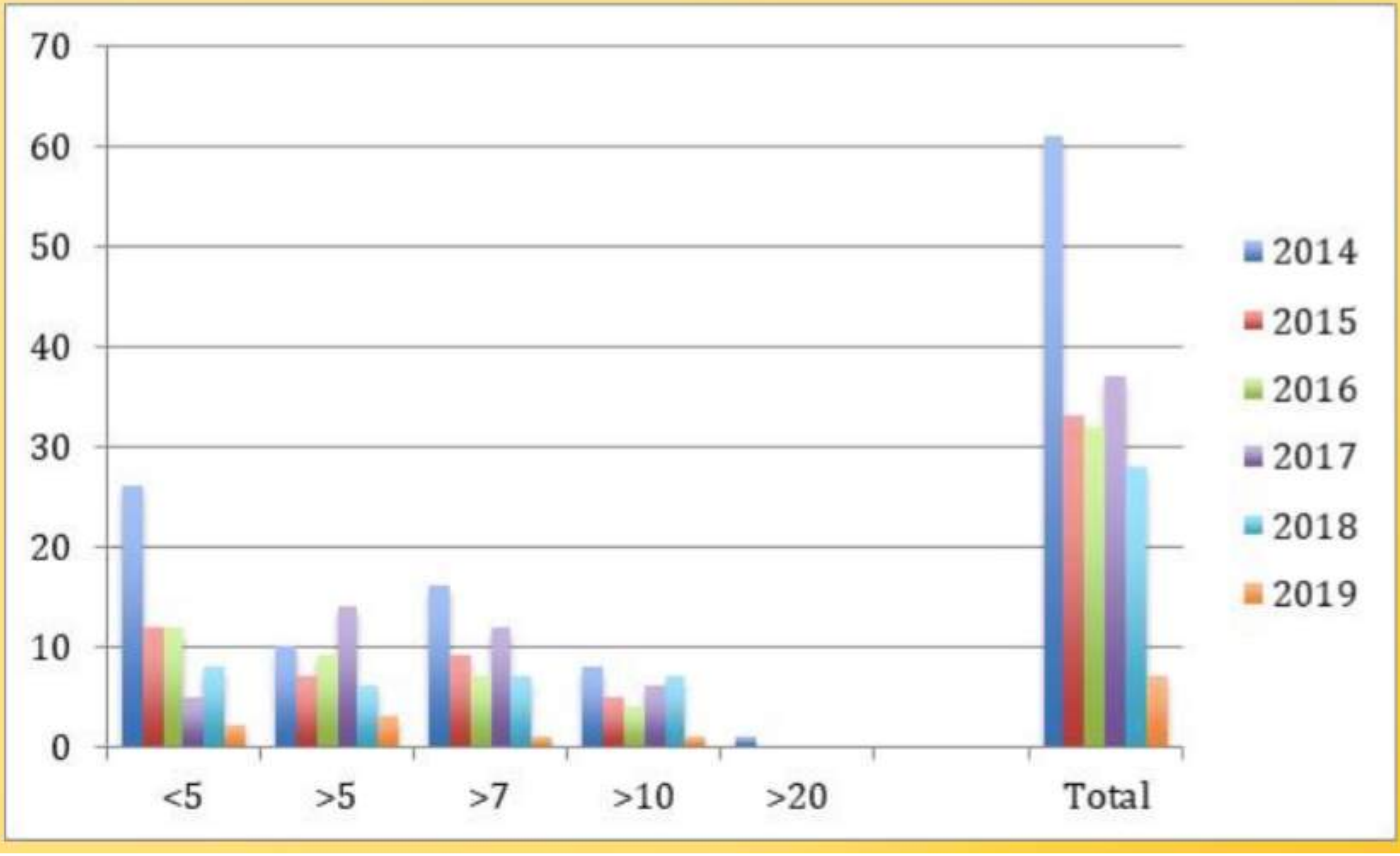
- 2018
  - 4 cases (IC)
- 2019
  - 9 cases (Neuro-IC-EVAR)
  - 7 cases (TIPS-IC)

Nombre de cas dépassant les alertes par année

(CAATS) - 9 centres



Nombre de cas dépassant les alertes, par année et par seuil d'AK (CAATS)



Staff risks

Staff risks?

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Occupational Radiation Exposure to the Surgeon

Gordon Singer, MD, MS

Author Affiliations

Reprint requests: Dr. Singer, Kaiser Permanente, 2045 Franklin Street, Denver, CO 80205.

Abstract

Increased use of intraoperative fluoroscopy exposes the surgeon to significant amounts of radiation. The average yearly exposure of the public to ionizing radiation is 360 millirems (mrem), of which 300 mrem is from background radiation and 60 mrem from diagnostic radiographs. A chest radiograph exposes the patient to approximately 25 mrem and a hip radiograph to 500 mrem. A regular C-arm exposes the patient to approximately 1,200 to 4,000 mrem/min. The surgeon may receive exposure to the hands from the primary beam and to the rest of the body from scatter. Recommended yearly limits of radiation are 5,000 mrem to the torso and 50,000 mrem to the hands. Exposure to the hands may be higher than previously estimated, even from the mini C-arm. Potential decreases in radiation exposure can be accomplished by reduced exposure time; increased distance from the beam; increased shielding with gown, thyroid gland cover, gloves, and glasses; beam collimation; using the low-dose option; inverting the C-arm; and surgeon control of the C-arm.

IAEA Cataract study

Lens opacities observed in

- 1/3rd to ½ main operators
- 1/4th to 1/3rd Nurses

- Lens of the eye, threshold in absorbed dose is now considered to be 0.5 Gy (against 0.5 to 2 for detectable opacities and 5 for visual impairment) .
- Occupational Exposure Lens of Eye Limit
  - **20 mSv in a y** (against 150), averaged over defined periods of 5 y, with no single y exceeding 50 mSv

J Urol. 2005 Sep;174(3):948-52; discussion 952.

Radiation exposure and the urologist: what are the risks?

Hellawell GO[1], Mutch SJ, Thevendran G, Wells E, Morgan RJ.

Author information

Abstract

PURPOSE: Endourology is established in urology practice with routine use of fluoroscopic guidance. Medical personnel are rarely exposed to direct radiation exposure but secondary exposure occurs via radiation scatter. There are few reports on scatter radiation exposure and the subsequent risk to medical personnel involved in urological fluoroscopic procedures. We review the risks of scatter radiation exposure to medical personnel with reference to the routine use of fluoroscopic imaging in urological practice.

MATERIALS AND METHODS: We measured staff radiation exposure during a series of ureteral endourological procedures using LiF:Mg,Ti thermoluminescent dosimeters placed at the extremities of the operating surgeon, the assistant and the scrub nurse. Doses for percutaneous nephrolithotomy (PCNL) procedures were calculated by extrapolating from the ureteral procedure thermoluminescent dosimeter data. Theoretical scattered radiation dose rates were also calculated.

RESULTS: The average ureteral procedure fluoroscopy time was 78 seconds with an exposure rate of 71 kV, 2.4 mA. The surgeon received the highest radiation exposure with the lower leg (11.6 +/- 2.7 microGy) and foot (6.4 +/- 1.8 microGy) receiving more radiation than the eyes (1.9 +/- 0.5 microGy) and hands (2.7 +/- 0.7 microGy). For a predicted annual caseload of 50 ureteral cases, the dose received does not exceed 0.12% of the Ionising Radiations Regulations 1999 annual dose limit for adult workers. Radiation exposure during PCNLs is higher but does not exceed 2% of the annual dose limits even if 50 PCNLs are performed annually.

CONCLUSIONS: Fluoroscopic screening results in radiation exposure of medical personnel. The estimate of maximum scatter radiation exposure to the surgeon for 50 PCNL procedures a year did not exceed 10 mGy. This amount is less than 2% of permissible annual limits of equivalent dose to the extremities. Medical personnel should be aware of scatter radiation risks and minimize radiation exposure when involved in fluoroscopic screening procedures.

Urologic Nursing

The Risk of Radiation Exposure To Assisting Staff in Urological Procedures

A Literature Review

Tarun Jindal, MS | Disclosures

Urol Nurs. 2013;33(3):136-139.

Print

Abstract and Introduction

Abstract

Fluoroscopy is an integral part of urology and is used for various procedures, such as extra-corporeal shock wave lithotripsy, percutaneous nephrolithotomy, uretero-renoscopy, and ureteral stenting. This technique exposes the urologist and assistants to radiation, which is known to have deleterious effects. Although there have been studies that determine the amount of exposure and the risks to the operating urologist, the risk to the assisting staff remains largely undetermined. A literature review was conducted to determine the risk of radiation exposure during urological procedures, with emphasis on data concerning assisting staff. Data from nine major studies is presented in this article.

Radiation Exposure to the Urologist Using an Overcouch Radiation Source Compared With an Undercouch Radiation Source in Contemporary Urology Practice

Andrew M. Harris

Department of Urology, University of Kentucky Medical Center, Lexington, KY

PlumX Metrics

DOI: https://doi.org/10.1016/j.urology.2017.12.011 | Check for updates

Article Info

Abstract Full Text Images References

Objective

To compare radiation dosage to the urologist using an overcouch system, x-ray tube over table, and an undercouch system, x-ray tube under table. Urologists continue to perform more endoscopic surgery requiring fluoroscopy. Fluoroscopy, or electromagnetic radiation, can cause cellular damage when passing through tissues. These systems are compared with respect to radiation dosage to the urologist.

Methods

A single urologic surgeon utilized a dosimeter badge while using an overcouch system. The dosimeter exposure was higher than expected and an undercouch system was then employed. Dosimeter exposure levels between the overcouch and the undercouch systems were examined and compared.

Results

Over the 4 months reviewed for the overcouch system, radiation doses to the body averaged 3.63mSv, those to the eye averaged 3.73mSv, and those to the extremities averaged 3.72mSv. The 3-month averages for the undercouch system exposure to the body, the eye, and the extremities were 0.31, 0.35, and 0.35mSv, respectively. The difference in radiation exposure between the 2 systems was significant ($P \leq .001$). The average number of radiation cases between the 2 systems was not significantly different ($P = .37$). The average fluoroscopy time for the procedures between the 2 systems was not significantly different ($P = .24$).

Conclusion

Overcouch fluoroscopy systems expose the urologist to significantly higher, potentially dangerous levels of radiation. Urologists using an overcouch system should strongly consider as low as reasonably achievable precautions and proper utilization of lead aprons, thyroid shields, and lead glasses. Radiation safety training should be considered.

Radiation protection in the endoscopy suite

Minimizing radiation exposure for patients and staff in endoscopy: a joint ASGE/IAEA/WGO guideline

Review team:
Lance Uradomo
Henry Cohen
Michael Fried
John Petrini
Madan Rehani

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Gastroenterology Research and Practice
Volume 2013 (2013), Article ID 587574, 7 pages
http://dx.doi.org/10.1155/2013/587574

Abstract
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Full-Text ePUB
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Clinical Study

Optimisation of Radiation Exposure to Gastroenterologists and Patients during Therapeutic ERCP

Khalid Alzimami,[1] Abdelmoneim Sulieman,[2] Georgios Paroutoglou,[3] Spiros Potamianos,[4] Marianna Vlychou,[5] and Kiki Theodorou[6]

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[2]Radiology and Medical Imaging Department, College of Applied Medical Sciences, Salman bin Abdulaziz University, P.O. Box 422, Al-kharj 11942, Saudi Arabia
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Received 12 November 2012; Revised 18 January 2013; Accepted 4 February 2013

Academic Editor: Stuart Sherman

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Abstract

This study intended to optimize the radiation doses for gastroenterologists and patients during therapeutic endoscopic retrograde cholangiopancreatography (ERCP) and to compare the doses based on available data obtained by other researchers. A total of 153 patients were studied in two Gastroenterology Departments, (group A, 111; group B, 42). Thermoluminescent dosimeters (TLD) were used to measure the staff and patients entrance surface air kerma (ESAK) at different body sites. The mean ESAK and effective doses per procedure were estimated to be 68.75 mGy and 2.74 mSv, respectively. Staff was exposed to a heterogonous doses. The third examiner (trainee) was exposed to a high dose compared with other examiners because no shield was located to protect him from stray radiation. Patients and examiners doses were lower compared to the lowest values found in previous studies taking into consideration the heterogeneity of patients and equipment. Staff doses during ERCP are within the safety limit in the light of the current practice.

Gastroenterol Res Pract — Gastroenterol

Gastroenterol Res Pract. 2013; 2013: 587574.
Published online 2013 Mar 26. doi: 10.1155/2013/587574

PMCID: PMC3622381
PMID: 23589714

Optimisation of Radiation Exposure to Gastroenterologists and Patients during Therapeutic ERCP

Khalid Alzimami,[1] Abdelmoneim Sulieman,[2,*] Georgios Paroutoglou,[3] Spiros Potamianos,[4] Marianna Vlychou,[5] and Kiki Theodorou[6]

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Abstract

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This study intended to optimize the radiation doses for gastroenterologists and patients during therapeutic endoscopic retrograde cholangiopancreatography (ERCP) and to compare the doses based on available data obtained by other researchers. A total of 153 patients were studied in two Gastroenterology Departments, (group A, 111; group B, 42). Thermoluminescent dosimeters (TLD) were used to measure the staff and patients entrance surface air kerma (ESAK) at different body sites. The mean ESAK and effective doses per procedure were estimated to be 68.75 mGy and 2.74 mSv, respectively. Staff was exposed to a heterogonous doses. The third examiner (trainee) was exposed to a high dose compared with other examiners because no shield was located to protect him from stray radiation. Patients and examiners doses were lower compared to the lowest values found in previous studies taking into consideration the heterogeneity of patients and equipment. Staff doses during ERCP are within the safety limit in the light of the current practice.

Curr Opin Anaesthesiol. 2011 Aug;24(4):445-50. doi: 10.1097/ACO.0b013e328347f984.

Radiation safety for anesthesiologists.

Dagal A[1].

Author information

Abstract

PURPOSE OF REVIEW: To review the recent literature on the implications of occupational radiation exposure in anesthesia practice.

RECENT FINDINGS: Wide variation and lack of reduction in operator doses of medical radiation strongly suggests that more attention must be paid to the factors influencing radiation dose
Radiation-related cataract formation might be a stocha
medical radiation ophthalmic dose limits are currently
significant risk to the fetus for pregnant women workin
safety measures are implemented.

SUMMARY: Radiation is increasingly utilized in medic
exposed to unsafe doses while providing high-quality
exposure, the potential risks, and safe practices helps
anesthesia team.

REVIEW ARTICLE

Year : 2012 | **Volume** : 6 | **Issue** : 1 | **Page** : 14-20

Risk and safety concerns in anesthesiology practice: The present perspective

Sukhminder Jit Singh Bajwa, Jasbir Kaur

Department of Anaesthesiology and Intensive Care, Gian Sagar Medical College and Hospital, Ram Nagar, Banur, Punjab, India

Date of Web Publication 14-Nov-2012

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crossref 3 Citations

DOI: 10.4103/0259-1162.103365

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Abstract

Newer developments and advancements in anesthesiology, surgical, and medical fields have widened the functional scope of anesthesiologist thus increasing his professional responsibilities and obligations. While at workplace, anesthesiologist is exposed to a wide array of potential hazards that can be detrimental to his overall health. Numerous risks and safety concerns have been mentioned in the literature, but the magnitude of challenges in anesthesiology practice are far greater than those cited and anticipated. Many times these challenging situations are unavoidable and the attending anesthesiologist has to deal with them on an individual basis. These hazards not only affect the general health but can be extremely threatening in various other ways that can increase the potential risks of morbidity and mortality. This article is an attempt to bring a general awareness among anesthesia fraternity about the various health hazards associated with anesthesia practice. Also, a genuine attempt has been made to enumerate the various preventive methods and precautions that should be adopted to make practice of anesthesiology safe and smooth.

Semin Cardiothorac Vasc Anesth. 2017 Jun;21(2):165-171. doi: 10.1177/1089253217692110. Epub 2017 Feb 12.

Occupational Radiation Exposure of Anesthesia Providers: A Summary of Key Learning Points and Resident-Led Radiation Safety Projects.

Wang RR[1], Kumar AH[2], Tanaka P[3], Macario A[3].

Author information

Abstract

Anesthesia providers are frequently exposed to radiation during routine patient care in the operating room and remote anesthetizing locations. Eighty-two percent of anesthesiology residents (n = 57 responders) at our institution had a "high" or "very high" concern about the level of ionizing radiation exposure, and 94% indicated interest in educational materials about radiation safety. This article highlights key learning points related to basic physical principles, effects of ionizing radiation, radiation exposure measurement, occupational dose limits, considerations during pregnancy, sources of exposure, factors affecting occupational exposure such as positioning and shielding, and monitoring. The principle source of exposure is through scattered radiation as opposed to direct exposure from the X-ray beam, with the patient serving as the primary source of scatter. As a result, maximizing the distance between the provider and the patient is of great importance to minimize occupational exposure. Our dosimeter monitoring project found that anesthesiology residents (n = 41) had low overall mean measured occupational radiation exposure. The highest deep dose equivalent value for a resident was 0.50 mSv over a 3-month period, less than 10% of the International Commission on Radiological Protection occupational limit, with the eye dose equivalent being 0.52 mSv, approximately 4% of the International Commission on Radiological Protection recommended limit. Continued education and awareness of the risks of ionizing radiation and protective strategies will reduce exposure and potential for associated sequelae.

KEYWORDS: cardiac anesthesia; monitoring; noncardiac surgery; research; risk management

World Neurosurg. 2016 Feb;86:220-5. doi: 10.1016/j.wneu.2015.09.059. Epub 2015 Sep 30.

A 5-Year Retrospective Analysis of Exposure to Ionizing Radiation by Neurosurgery Residents in the Modern Era.

Zaidi HA[1], Montoure A[1], Nakaji P[1], Bice A[2], Tumialán LM[3].

Author information

Abstract

BACKGROUND: The potential for radiation exposure during neurosurgical training has increased dramatically in the last decade. Incorporation of instrumented and minimally invasive spinal surgery and neuroendovascular procedures into the curriculum has led to increased potential for exposure to ionizing radiation. Contemporary neurosurgery residents' exposure to radiation has not been previously reported.

OBJECTIVE: To determine neurosurgery residents' exposure to radiation over the course of 7 years of training.

METHODS: Retrospective analysis of a prospectively maintained radiation database from July 2009 to July 2014 for all neurosurgery residents based on radiation dosimetry data. Standard radiation safety precautions were used (e.g., lead gowns or aprons), although compliance was not specifically monitored.

RESULTS: Thirty-eight neurosurgery residents were monitored from 2009 to 2014. Radiation exposure data were available for 34 residents for the final analysis. A total of 20,541 days of radiation monitoring data were available. The mean deep dose equivalent over this period was 0.67 ± 0.75 mrem per resident/day. The calculated maximum cumulative exposure during the course of residency training was 12.15 ± 13.50 mSv, approximately equivalent to 6 computed tomography head scans.

CONCLUSIONS: To our knowledge, this study is the first to quantify radiation exposure for neurosurgery residents in the current era of training. From this work, efforts may be initiated to increase awareness and safety with regard to radiation exposure. Although the total dose is not high, a better understanding of the impact of radiation exposure on practitioners may help to drive institutional policies to reduce occupational exposure.

WORLD NEUROSURGERY

< Previous Article August 2016 Volume 92, Pages 353–359 Next Article >

Hazards of Ionizing Radiation and its Impact on Spine Surgery

Uri P. Hadelsberg, Ran Harel

PlumX Metrics

DOI: https://doi.org/10.1016/j.wneu.2016.05.025 | Check for updates

Article Info

Abstract Full Text References

Background
Spine surgery relies heavily on imaging, with radiography-based devices being the major operating room imaging modality. Radiation exposure is an occupational risk historically recognized shortly after the discovery of radiation itself. Exposure of both patients and operating room staff is of increasing concern as the knowledge regarding the hazards of radiation is steadily accumulating.

Methods
We conducted a literature review of the history of radiation exposure limits and updates on current studies showing the risks of low-dose exposures.

Results
Multiple studies reporting on radiation exposure risk and methods to reduce exposure risks are discussed.

Conclusion
We discuss the methods to reduce operating room staff exposure to the minimal amount, thus reducing occupational risks. We recognize that increasing awareness to radiation exposure hazards and promoting the knowledge of methods to reduce exposure of surgeons, nurses, and technicians could result in a reduction of exposure to radiation.

Int Orthop. 2009 Dec; 33(6): 1747–1751.
Published online 2008 Oct 29. doi: 10.1007/s00264-008-0681-1

PMCID: PMC2899183

Language: English | French

Radiation exposure to the orthopaedic surgeon during periacetabular osteotomy

Inger Mechlenburg,[✉] Henrik Daugaard, and Kjeld Søballe

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This article has been cited by other articles in PMC.

Abstract

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The objective of this study was to directly measure the radiation exposure to the orthopaedic surgeon and to measure dose points to the surgeon's fingers, thyroid gland, and forehead during intraoperative fluoroscopy in periacetabular osteotomy (PAO). In a series of 23 consecutive periacetabular osteotomy procedures, exposure monitoring was carried out using thermo luminescent dosimeters. The effective dose received by the operating surgeon was 0.008 mSv per operation which adds up to a yearly dose of 0.64 mSv from PAO. The median point equivalent dose (mSv) exposure under PAO was 0.009 for the forehead and thyroid gland, 0.045 for the right index finger, and 0.039 for the left index finger. The effective estimated yearly dose received by the operating surgeon was very low. Wearing a lead collar reduces radiation exposure to the thyroid gland while the lead gloves did not protect the surgeon's fingers.

J Perioper Pract. 2018 Jan 1:1750458918785268. doi: 10.1177/1750458918785268. [Epub ahead of print]

Radiation risk amongst orthopaedic surgeons - Do we know the risk?

Gowda SR[1], Mitchell CJ[2], Abouel-Enin S[3], Lewis C[2].

Author information

Abstract

Radiation risk amongst orthopaedic surgeons and theatre personnel is increasing with increased use of fluoroscopy imaging. Increased radiation risk has been shown to be associated with an increased risk of malignancies, ocular and thyroid disorders. Very high exposures have been reported in spinal surgery and during intra-medullary nailing. With an increase in modern and percutaneous methods, the use of intra-operative fluoroscopy has increased as well. The aim of this article was to review the available evidence of radiation risk amongst healthcare personnel. A systematic search was carried out in PubMED, CINAHL and Cochrane on intra-operative radiation in trauma and orthopaedic operating room. Inclusion criteria were clinical studies and systematic reviews reporting on radiation exposure, fluoroscopy time and references to specific safety guidelines. This article highlights the safety aspects of radiation protection and harmful effects of radiation during orthopaedic procedures. The responsibility to minimise radiation exposure in operating theatre lies with the team within the operating room.

KEYWORDS: Radiation risk / Orthopaedic procedures / Radiation protection

J Am Acad Orthop Surg. 2018 Apr 15;26(8):268-277. doi: 10.5435/JAAOS-D-16-00342.

Radiation Exposure and Health Risks for Orthopaedic Surgeons.

Hayda RA[1], Hsu RY, DePasse JM, Gil JA.

Author information

Open/close author information list

Abstract

Orthopaedic surgeons are routinely exposed to intraoperative radiation and, therefore, follow the principle of "as low as reasonably achievable" with regard to occupational safety. However, standardized education on the long-term health effects of radiation and the basis for current radiation exposure limits is limited in the field of orthopaedics. Much of orthopaedic surgeons' understanding of radiation exposure limits is extrapolated from studies of survivors of the atomic bombings in Hiroshima and Nagasaki, Japan. Epidemiologic studies on cancer risk in surgeons and interventional proceduralists and dosimetry studies on true radiation exposure during trauma and spine surgery recently have been conducted. Orthopaedic surgeons should understand the basics and basis of radiation exposure limits, be familiar with the current literature on the incidence of solid tumors and cataracts in orthopaedic surgeons, and understand the evidence behind current intraoperative fluoroscopy safety recommendations.

ASTR
Annals of Surgical Treatment and Research
http://thesurgery.or.kr
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Ann Surg Treat Res. 2017 Mar; 92(3): 156–163.
Published online 2017 Feb 24. doi: 10.4174/astr.2017.92.3.156
PMCID: PMC5344806
PMID: 28289670

Radiation hazards to vascular surgeon and scrub nurse in mobile fluoroscopy equipped hybrid vascular room

Jong Bin Kim, Jaehoon Lee, and Kihyuk Park

Author information ► Article notes ► Copyright and License information ► Disclaimer

Abstract

Go to:

Purpose

Go to:

The aim of the present study was to identify the radiation hazards to vascular surgeons and scrub nurses working in mobile fluoroscopy equipped hybrid vascular operation rooms; additionally, to estimate cumulative cancer risk due to certain exposure dosages.

Methods

Go to:

The study was conducted prospectively in 71 patients (53 men and 18 women) who had undergone vascular intervention at our hybrid vascular theater for 6 months. OEC 9900 fluoroscopy was used as mobile C-arm. Exposure dose (ED) was measured by attaching optically stimulated luminescence at in and outside of the radiation protectors. To measure X-ray scatter with the anthropomorphic phantom model, the dose was measured at 3 distances (20, 50, 100 cm) and 3 angles (horizontal, upward 45°, downward 45°) using a personal gamma radiation dosimeter, Ecotest CARD DKG-21, for 1, 3, 5, 10 minutes.

Results

Go to:

Lifetime attributable risk of cancer was estimated using the approach of the Biological Effects of Ionizing Radiation report VII. The 6-month ED of vascular surgeons and scrub nurses were 3.85, 1.31 mSv, respectively. The attenuation rate of lead apron, neck protector and goggle were 74.6%, 60.6%, and 70.1%, respectively. All cancer incidences among surgeons and scrub nurses correspond to 2,355 and 795 per 100,000 persons. The 10-minute dose at 100-cm distance was 0.004 mSv at horizontal, 0.009 mSv at downward 45°, 0.003 mSv at upward 45°.

Conclusion

Go to:

Although yearly radiation hazards for vascular surgeons and scrub nurses are still within safety guidelines, protection principles can never be too stringent when aiming to minimize the cumulative harmful effects.

Occupational radiation exposure: How much should I worry?

9th August 2016 932

Christopher G Carsten III

Christopher G Carsten III, Greenville Health System, Greenville, SC, USA

Radiation safety practices have made tremendous advances since the discovery of Roentgen's X-rays over 120 years ago. The sacrifices of early practitioners have led to the knowledge that now allows us to perform truly amazing therapies to the benefit of our patients. This knowledge, however, can also be beguiling. While we now know how this energy behaves and what we need to do to minimise our risk, we may assume that we have tamed its danger. "Time, Distance and Shielding" are simple concepts, so surely we as skilled and knowledgeable practitioners can easily apply these basic principles on a daily basis and be safe in our occupational environments, correct?

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31st August 2018

Radiation-Induced DNA Damage in Operators Performing Endovascular Aortic Repair

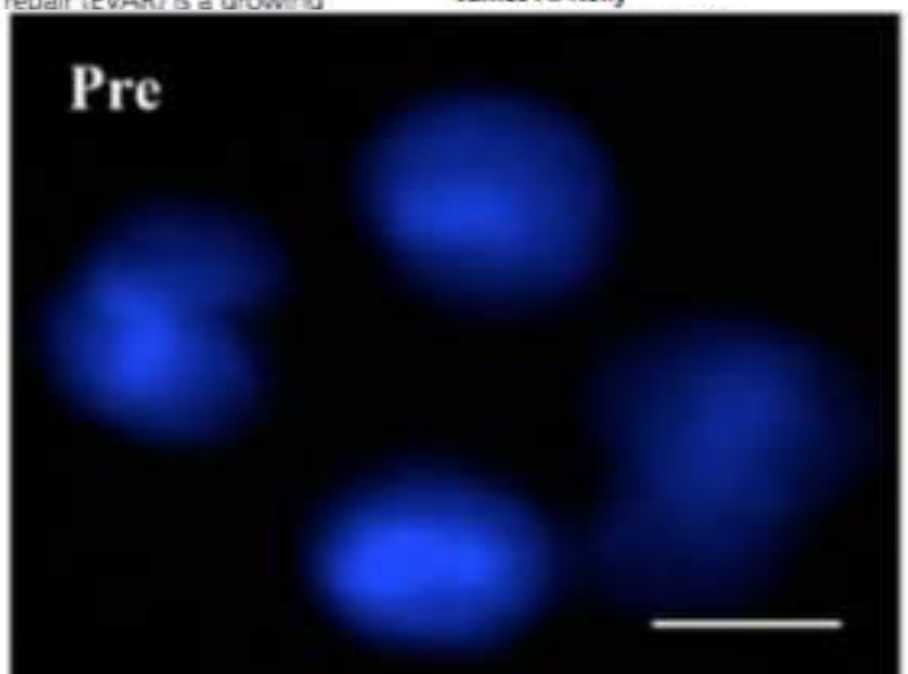
Editorial, see p 2417

Tamer El-Sayed*
Ashish S. Patel, PhD*
Jun S. Cho
James A. Kelly

BACKGROUND: Radiation exposure during fluoroscopically guided interventions such as endovascular aortic repair (EVAR) is a growing concern for operators. This study aimed
markers in operators perfoming EVAR.

METHODS: Expression of the DNA dam
DNA damage response marker, phosph
mutated (pATM), were quantified in cir
operators during the peri-operative peri
branched, and fenestrated) and open a
cytometry. These markers were separat
operators but this time wearing leg lea
body protection and compared with th
legs. Susceptibility to radiation damage
operators' blood in vitro.

RESULTS: γ-H2AX and pATM levels inc
immediately after branched endovascul
endovascular aortic repair (P<0.0003 fo
increased after infrarenal endovascular
Expression of both markers fell to basel
hours (P<0.003 for both). There was no



expression after open repair. Leg protection abrogated γ-H2AX and pATM response after branched endovascular aortic repair/fenestrated endovascular aortic repair. The expression of γ-H2AX varied significantly when operators' blood was exposed to the same radiation dose in vitro (P<0.0001).

CONCLUSIONS: This is the first study to detect an acute DNA damage response in operators performing fluoroscopically guided aortic procedures and highlights the protective effect of leg shielding. Defining the relationship between this response and cancer risk may better inform safe levels of chronic low-dose radiation exposure.

United Kingdom. E-mail bijan.modarai@kcl.ac.uk

Sources of Funding, see page 2415

Key Words: aortic aneurysm ■ DNA damage ■ endovascular ■ occupational exposure ■ radiation

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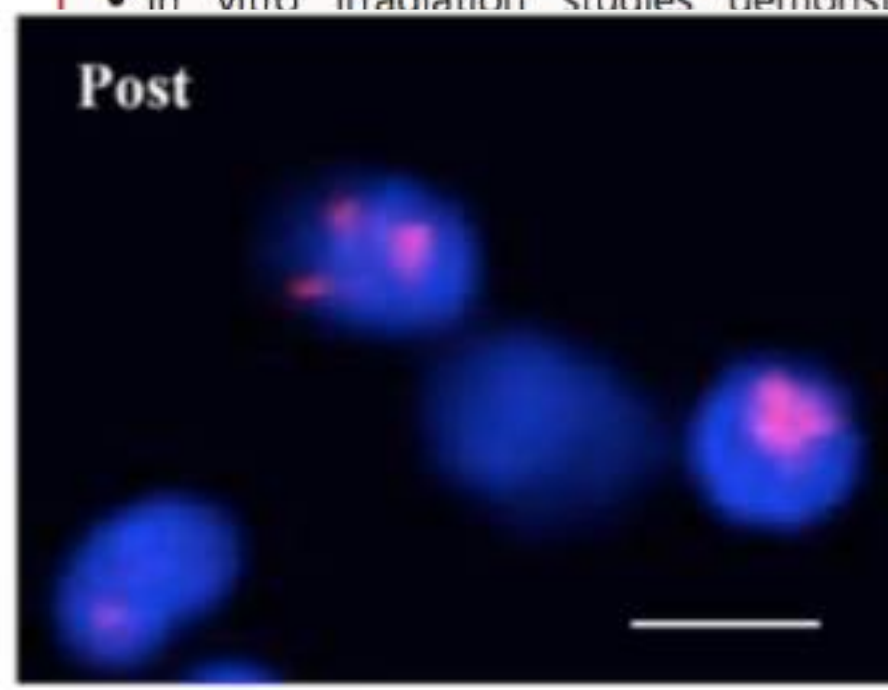
Clinical Perspective

What Is New?

- This is the first study to detect acute radiation-induced DNA damage in operators who carried out endovascular aortic repair by demonstrating an increase in the expression of DNA damage/repair markers, γ-H2AX, and phosphorylated ataxia telangiectasia mutated in their circulating lymphocytes immediately after procedures.
- In vitro irradiation studies demonstrated that
radiation-
the DNA



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- Wearing lower leg protective lead shielding is essential for reducing scatter radiation-induced DNA damage.
- The use of cellular markers, including γ-H2AX and phosphorylated ataxia telangiectasia mutated, which readily lend themselves to high-throughput sampling, may facilitate individual risk profiling, improve our understanding of the mechanisms involved in occupational radiation-induced mutagenesis, and define optimal protection strategies.

Circulation. 2017;136:2406–2416. DOI: 10.1161/CIRCULATIONAHA.117.029550

Clinical Review

AUGUST 6, 2018

Radiation Risk in Residency: Is It Worth the Worry?

What Should a Pregnant Resident Do?

Many surgical trainees are in their childbearing years, and few have the opportunity to formally educate themselves on occupational radiation exposure. We found that the under-lead radiation dose is minimal during a typical vascular rotation that might be experienced by a resident or student. It would be prudent for residency programs and medical schools to provide information regarding radiation exposure and risk stratification. Trainees also must take it upon themselves to be informed and prepared.

On the basis of previous reports and our observational data, the risk for harmful radiation exposure to a trainee or fetus during a vascular surgery rotation is minimal and should not deter female trainees in their childbearing years from participating in complex endovascular cases that could enhance their training.

Velazquez, MD

men, only 24%
trainees are
although they
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s.[2]

dose of 43 mrem, equivalent to a tissue depth of 1 cm applied to the whole body; an eye dose of 48 mrem, equivalent to a tissue depth of 0.3 cm to the eye lens; and a shallow dose of 49 mrem, equivalent to a tissue depth of 0.007 cm applied to the whole body, or skin dose. Dose under the lead garment was reported at levels below the limit of detection.

Objectives: To measure the radiation exposure of the operating team during endovascular aortic procedures, and to determine factors that predict high exposures.
Materials and methods: Electronic dosimeters placed over and under protective lead garments, were used to prospectively record radiation exposure during endovascular aortic repairs performed in a designated interventional radiology suite. Univariate and multivariate linear regression analyses of predictors of radiation exposure were performed.
Results: A total of 26 infra-renal and 10 thoracic endovascular cases were studied. Median (IQR) patient age and body mass index were 76.0 (70.0–81.8) years and 26.2 (23.9–28.9) kg/m^2 respectively. Over-lead exposure to the operator was higher for thoracic than for infra-renal procedures (421.0 [233.8–597.8] µSv vs. 52.5 [27.8–179.8] µSv, $p = .0003$), reflecting a significant exposure to unprotected parts of the body. Under-lead exposures for operator and assistant were 5.5 (2.0–14.2) µSv and 1.0 (0.0–2.3) µSv respectively, which for an average caseload would comply with total body effective dose limits. Type of case and percentage of digital subtraction angiography (DSA) time in left anterior oblique angulations predicted dose to the operator ($p < .0001$).
Conclusions: Thoracic procedures, DSA runs and obliquity of the C-arm are strong predictors of radiation exposure during endovascular aortic repairs. Understanding scatter radiation dynamics and instigating measures to minimise radiation exposure should be mandatory.
© 2013 European Society for Vascular Surgery. Published by Elsevier Ltd. All rights reserved.
Article history: Received 27 February 2013, Accepted 29 May 2013, Available online 19 July 2013
Keywords: Occupational radiation exposure, Dosimetry, Endovascular, Aortic repair

Special Review

Cancer Risks among Radiologists and Radiologic Technologists: Review of Epidemiologic Studies

Shinji Yoshinaga, PhD, , Kiyohiko Mabuchi, MD, DrPH, , Alice J. Sigurdson, PhD, , Michele Morin Doody, MS, and , Elaine Ron, PhD

[1]From the Radiation Epidemiology Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Bethesda, Md (S.Y., K.M., A.J.S., M.M.D., E.R.); and Research Center for Radiation Safety, National Institute of Radiological Sciences, 4-9-1 Anagawa, Inage-ku, Chiba 263-8555, Japan (S.Y.). Received July 17, 2003; revision requested September 29; revision received November 7; accepted January 29, 2004. **Address correspondence to** S.Y. (e-mail: *yosinaga@nirs.go.jp*).

DOI: http://dx.doi.org/10.1148/radiol.2332031119

Abstract | Full Text | Figures | References | Cited by | PDF

Radiologists and radiologic technologists were among the earliest occupational groups exposed to ionizing radiation and represent a large segment of the working population exposed to radiation from human-made sources. The authors reviewed epidemiologic data on cancer risks from eight cohorts of over 270 000 radiologists and technologists in various countries. The most consistent finding was increased mortality due to leukemia among early workers employed before 1950, when radiation exposures were high. This, together with an increasing risk of leukemia with increasing duration of work in the early years, provided evidence of an excess risk of leukemia associated with occupational radiation exposure in that period. While findings on several types of solid cancers were less consistent, several studies provided evidence of a radiation effect for breast cancer and skin cancer. To date, there is no clear evidence of an increased cancer risk in medical radiation workers exposed to current levels of radiation doses. However, given a relatively short period of time for which the most recent workers have been followed up and in view of the increasing uses of radiation in modern medical practices, it is important to continue to monitor the health status of medical radiation workers.

© RSNA, 2004

EuroIntervention. 2012 Jan;7(9):1081-6. doi: 10.4244/EIJV7I9A172.

Brain tumours among interventional cardiologists: a cause for alarm? Report of four new cases from two cities and a review of the literature.

Roguin A[1], Goldste

⊕ Author inforn

Abstract

AIMS: Interventio
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METHODS AND
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CONCLUSIONS:
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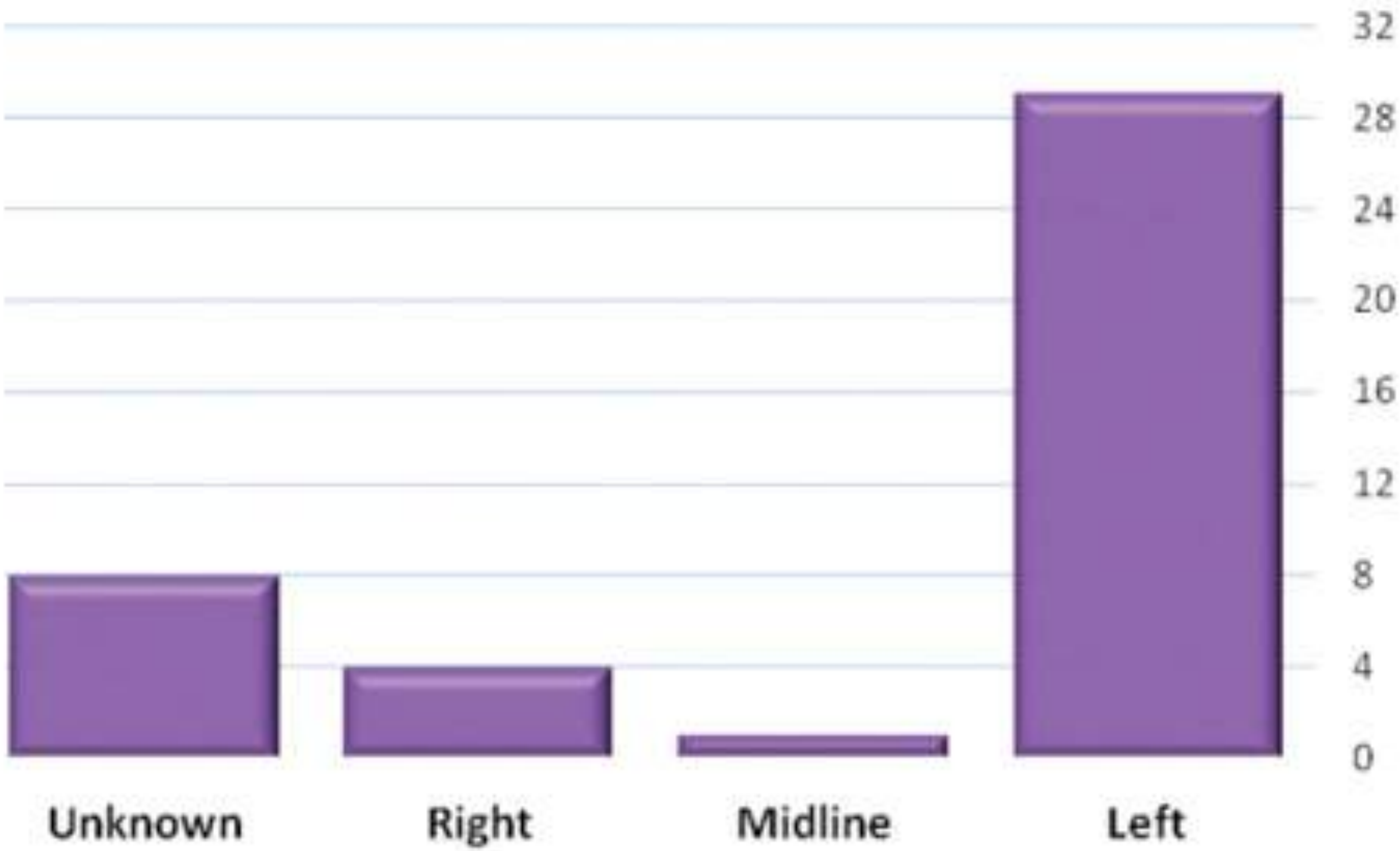

ose increased
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t few months. For all
volved, specialty

(cardiologist vs radiologist), and number of years in practice. These data were obtained from the medical records, interviews with patients, when possible, or with family members and/or colleagues. The present report documented brain and neck tumors occurring in 31 physicians: 23 interventional cardiologists, 2 electrophysiologists, and 6 interventional radiologists. All physicians had worked for prolonged periods (latency period 12 to 32 years, mean 23.5 ± 5.9) in active interventional practice with exposure to ionizing radiation in the catheterization laboratory. The tumors included 17 cases (55%) of glioblastoma multiforme (GBM), 2 astrocytomas (7%), and 5 meningiomas (16%). In 26 of 31 cases, data were available regarding the side of the brain involved. The malignancy was left sided in 22 (85%), midline in 1, and right sided in 3 operators. In conclusion, these results raise additional concerns regarding brain cancer developing in physicians performing interventional procedures. Given that the brain is relatively unprotected and the left side of the head is known to be more exposed to radiation than the right, these findings of disproportionate reports of left-sided tumors suggest the possibility of a causal relation to occupational radiation exposure.

JACC Cardiovasc Interv. 2015 Aug 17;8(9):1197-1206. doi: 10.1016/j.jcin.2015.03.027.

Invasive Cardiologists Are Exposed to Greater Left Sided Cranial Radiation: The BRAIN Study (Brain Radiation Exposure and Attenuation During Invasive Cardiology Procedures).

Reeves RR[1], Ang L[1], Bahadorani J[1], Naghi J[1], Dominguez A[1], Palakodeti V[1], Tsimikas S[1], Patel MP[1], Mahmud E[2].

⊕ Author information

Abstract

OBJECTIVES: This study sought to determine radiation exposure across the cranium of cardiologists and the protective ability of a nonlead, XPF (barium sulfate/bismuth oxide) layered cap (BLOXR, Salt Lake City, Utah) during fluoroscopically guided, invasive cardiovascular (CV) procedures.

BACKGROUND: Cranial radiation exposure and potential for protection during contemporary invasive CV procedures is unclear.

METHODS: Invasive cardiologists wore an XPF cap with radiation attenuation ability. Six dosimeters were fixed across the outside and inside of the cap (left, center, and right), and 3 dosimeters were placed outside the catheterization lab to measure ambient exposure.

RESULTS: Seven cardiology fellows and 4 attending physicians (38.4 ± 7.2 years of age; all male) performed diagnostic and interventional CV procedures ($n = 66.2 \pm 27$ cases/operator; fluoroscopy time: 14.9 ± 5.0 min). There was significantly greater total radiation exposure at the outside left and outside center (106.1 ± 33.6 mrad and 83.1 ± 18.9 mrad) versus outside right (50.2 ± 16.2 mrad; $p < 0.001$ for both) locations of the cranium. The XPF cap attenuated radiation exposure (42.3 ± 3.5 mrad, 42.0 ± 3.0 mrad, and 41.8 ± 2.9 mrad at the inside left, inside center, and inside right locations, respectively) to a level slightly higher than that of the ambient control (38.3 ± 1.2 mrad, $p = 0.046$). After subtracting ambient radiation, exposure at the outside left was 16 times higher than the inside left ($p < 0.001$) and 4.7 times higher than the outside right ($p < 0.001$). Exposure at the outside center location was 11 times higher than the inside center ($p < 0.001$), whereas no difference was observed on the right side.

CONCLUSIONS: Radiation exposure to invasive cardiologists is significantly higher on the left and center compared with the right side of the cranium. Exposure may be reduced similar to an ambient control level by wearing a nonlead XPF cap. (Brain Radiation Exposure and Attenuation During Invasive Cardiology Procedures [BRAIN]; NCT01910272).

Cardiovasc Revasc Med. 2017 Jul - Aug;18(5S1):S22-S26. doi: 10.1016/j.carrev.2017.04.009. Epub 2017 Apr 22.

Radiation safety in the cardiac catheterization lab: A time series quality improvement initiative.

Abuzeid W[1], Abunassar J[2], Leis JA[3], Tang V[4], Wong B[5], Ko DT[6], Wijeysundera HC[6].

Author information

Abstract

BACKGROUND: Interventional cardiologists have one of the highest annual radiation exposures yet systems of care that promote radiation safety in cardiac catheterization labs are lacking. This study sought to reduce the frequency of radiation exposure, for PCI procedures, above 1.5Gy in labs utilizing a Phillips system at our local institution by 40%, over a 12-month period.

METHODS: We performed a time series study to assess the impact of different interventions on the frequency of radiation exposure above 1.5Gy. Process measures were percent of procedures where collimation and magnification were used and percent of completion of online educational modules. Balancing measures were the mean number of cases performed and mean fluoroscopy time.

INTERVENTIONS: Information sessions, online modules, policies and posters were implemented followed by the introduction of a new lab with a novel software (AlluraClarity©) to reduce radiation dose.

RESULTS: There was a significant reduction (91%, $p<0.05$) in the frequency of radiation exposure above 1.5Gy after utilizing a novel software (AlluraClarity©) in a new Phillips lab. Process measures of use of collimation (95.0% to 98.0%), use of magnification (20.0% to 14.0%) and completion of online modules (62%) helped track implementation. The mean number of cases performed and mean fluoroscopy time did not change significantly.

CONCLUSION: While educational strategies had limited impact on reducing radiation exposure, implementing a novel software system provided the most effective means of reducing radiation exposure.

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KEYWORDS: Cardiac catheterization; Quality improvement; Radiation safety


GE-OEC Fluorostar CMCK
0073_inconnu, -
60 kV
1.64 mA
71/80
09.01.2014
12:42:39
Autowindow
36
34

- Growing use and increasing complexity
  higher exposure to both patients and medical staff

➔ Now mostly decreasing

through

- Education & Training

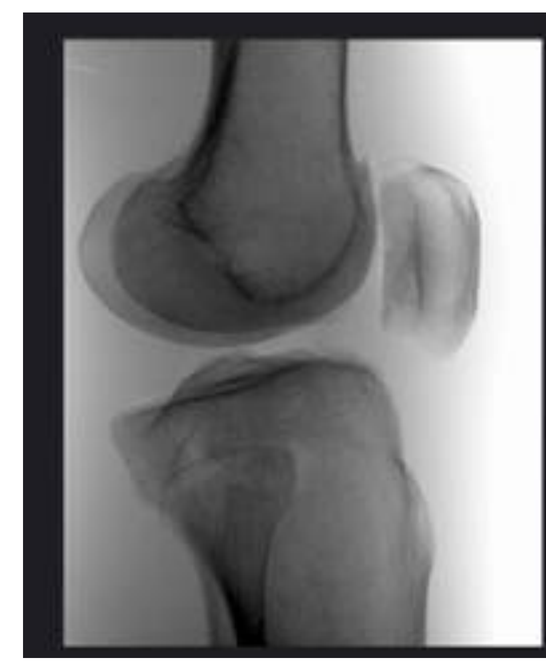
- Help from manufacturers


SIEMENS
SOMATOM
Sensation

Type of equipment

C arm

mini C arm



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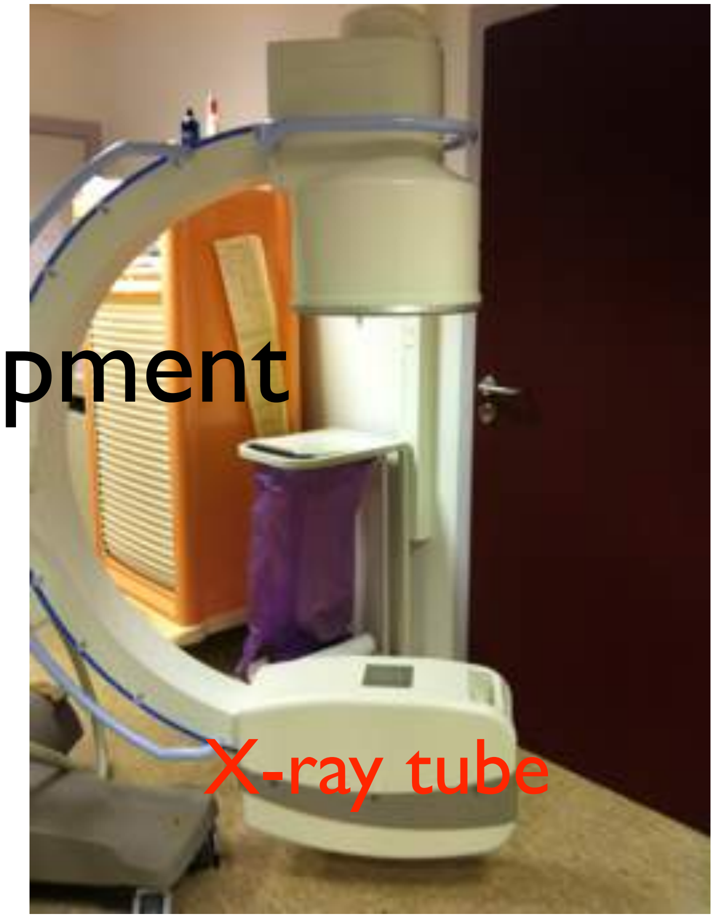
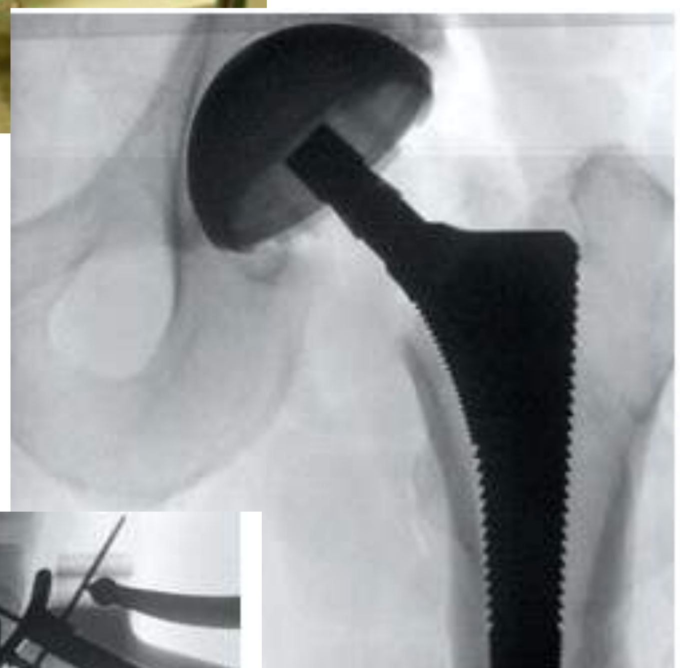
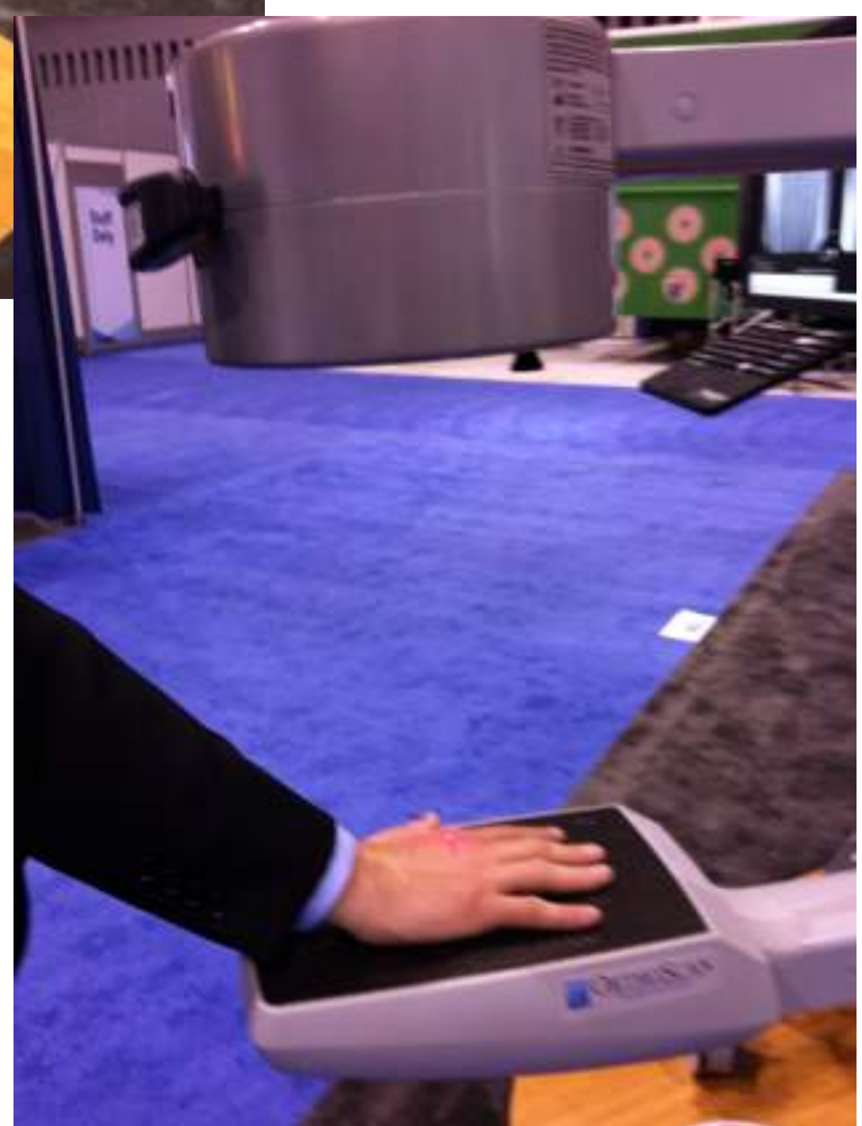
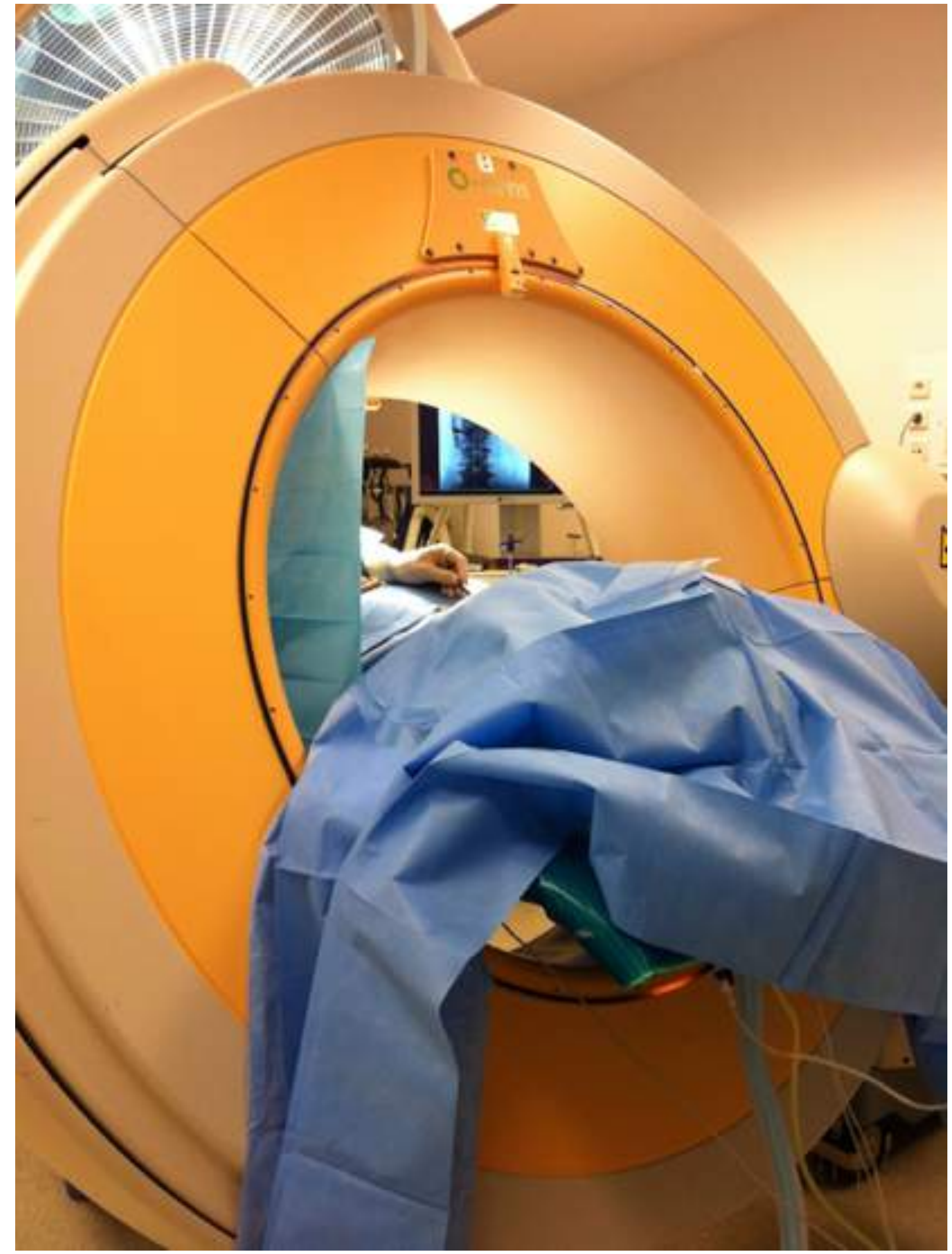
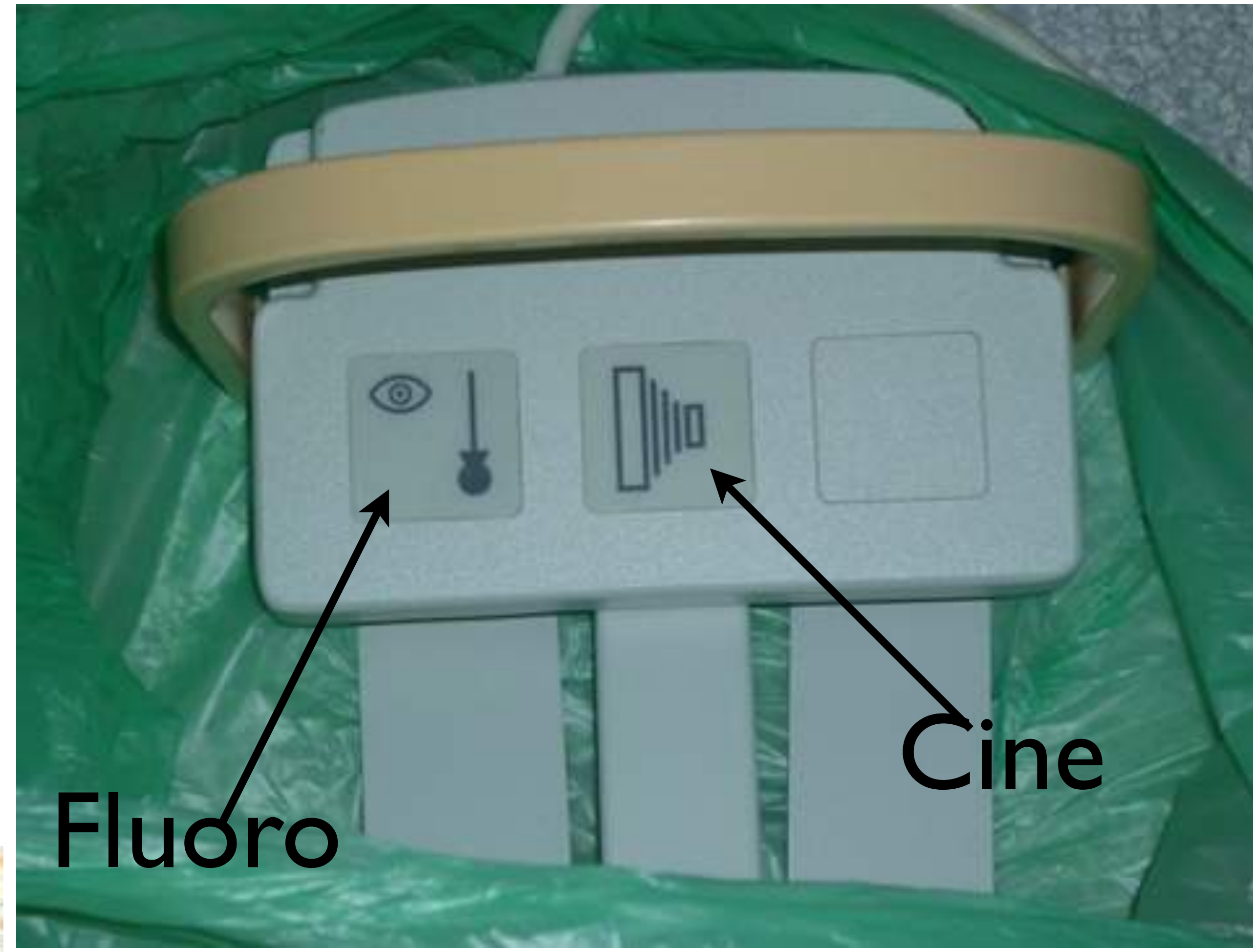
Know your equipment









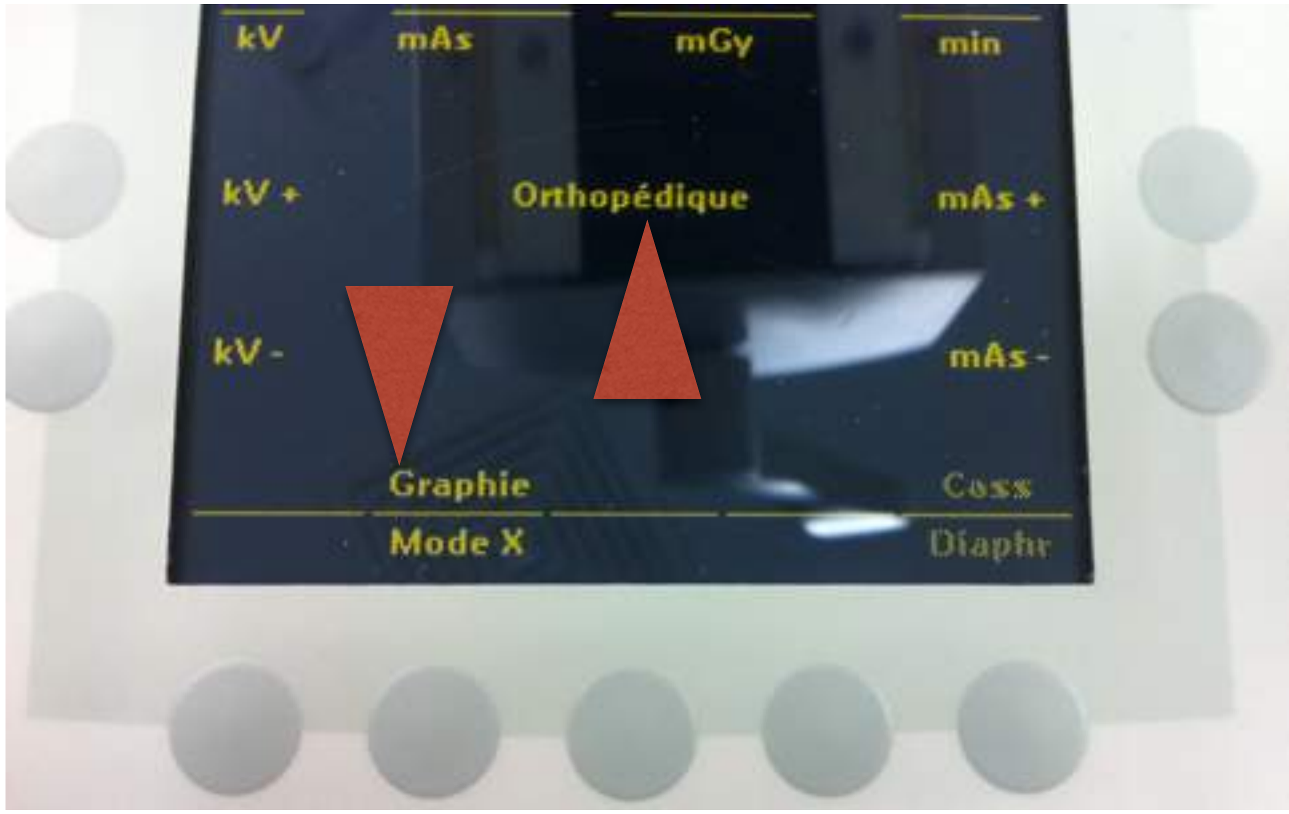


Know your equipment

Equipment : 2 types of detectors

Flat Panel detector

Image Intensifier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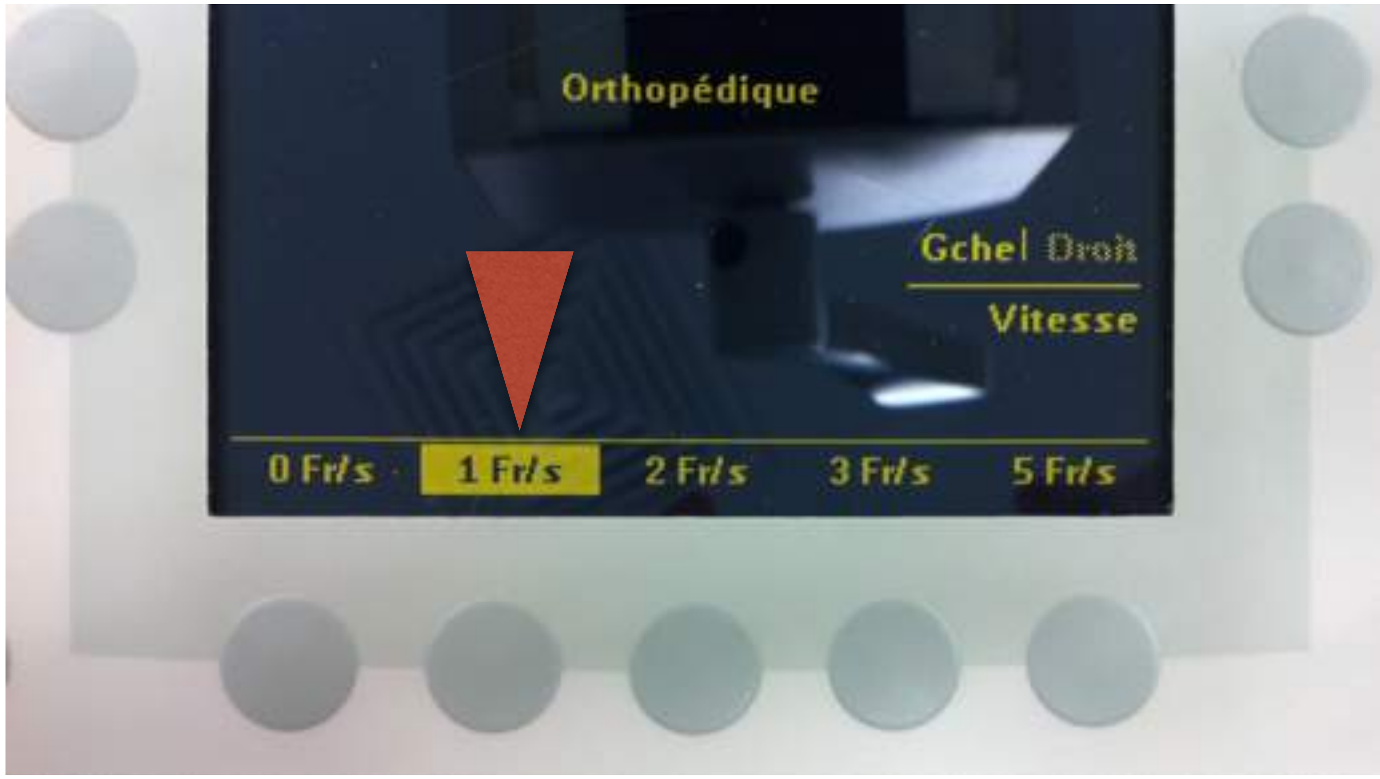
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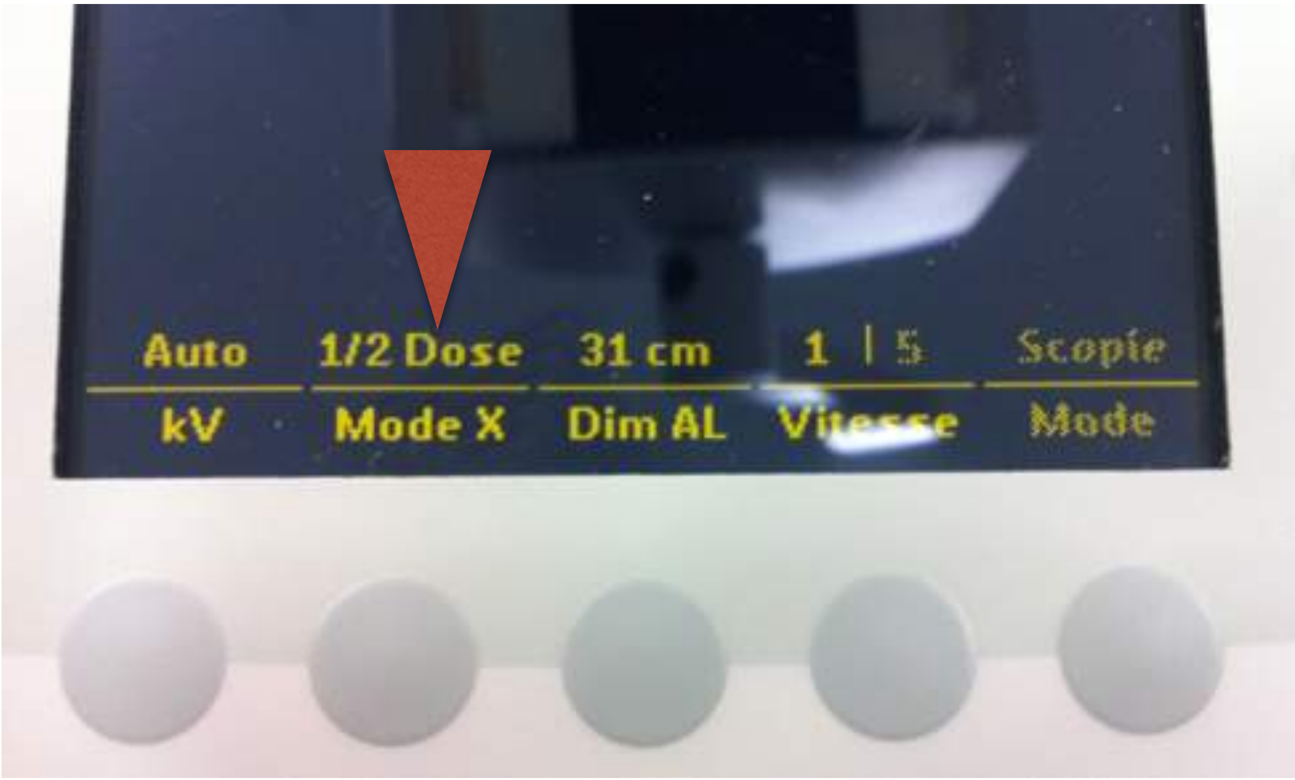
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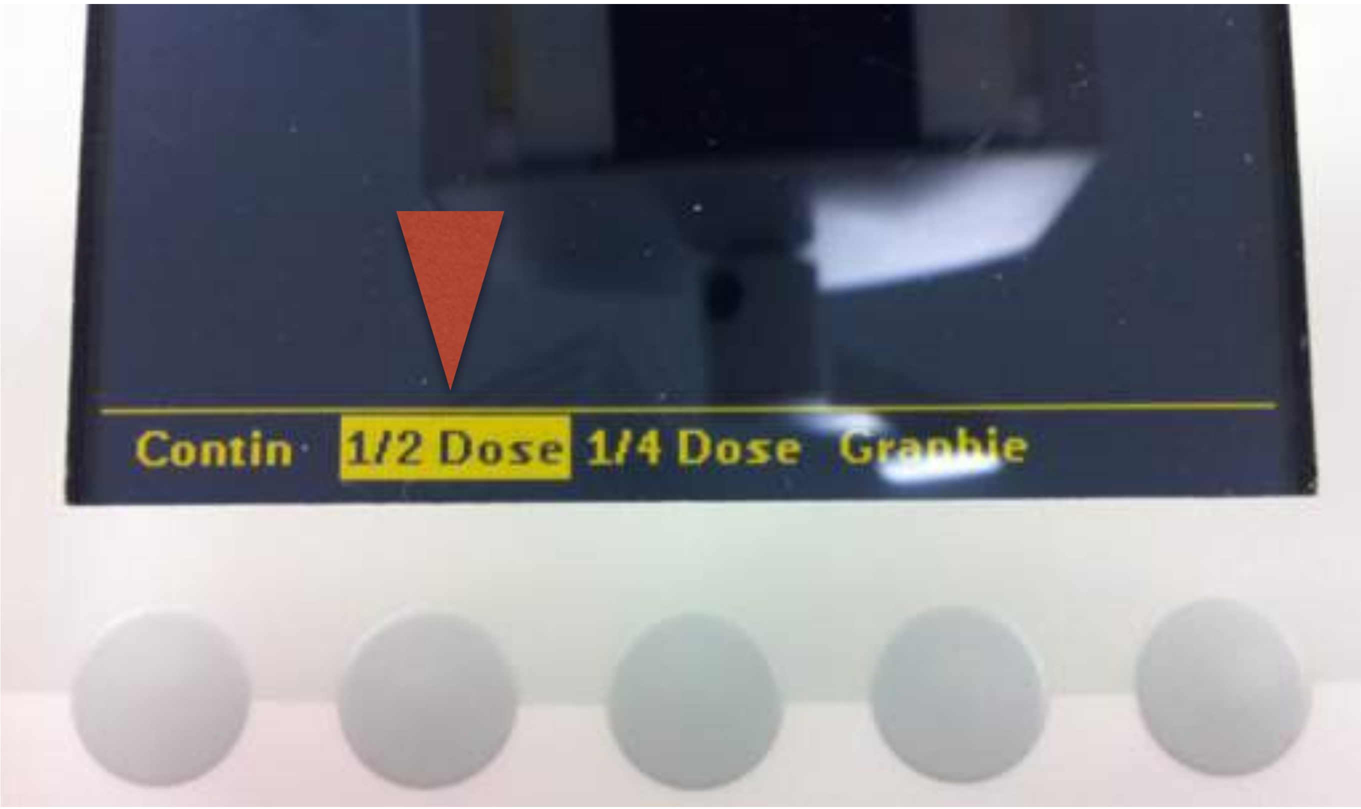
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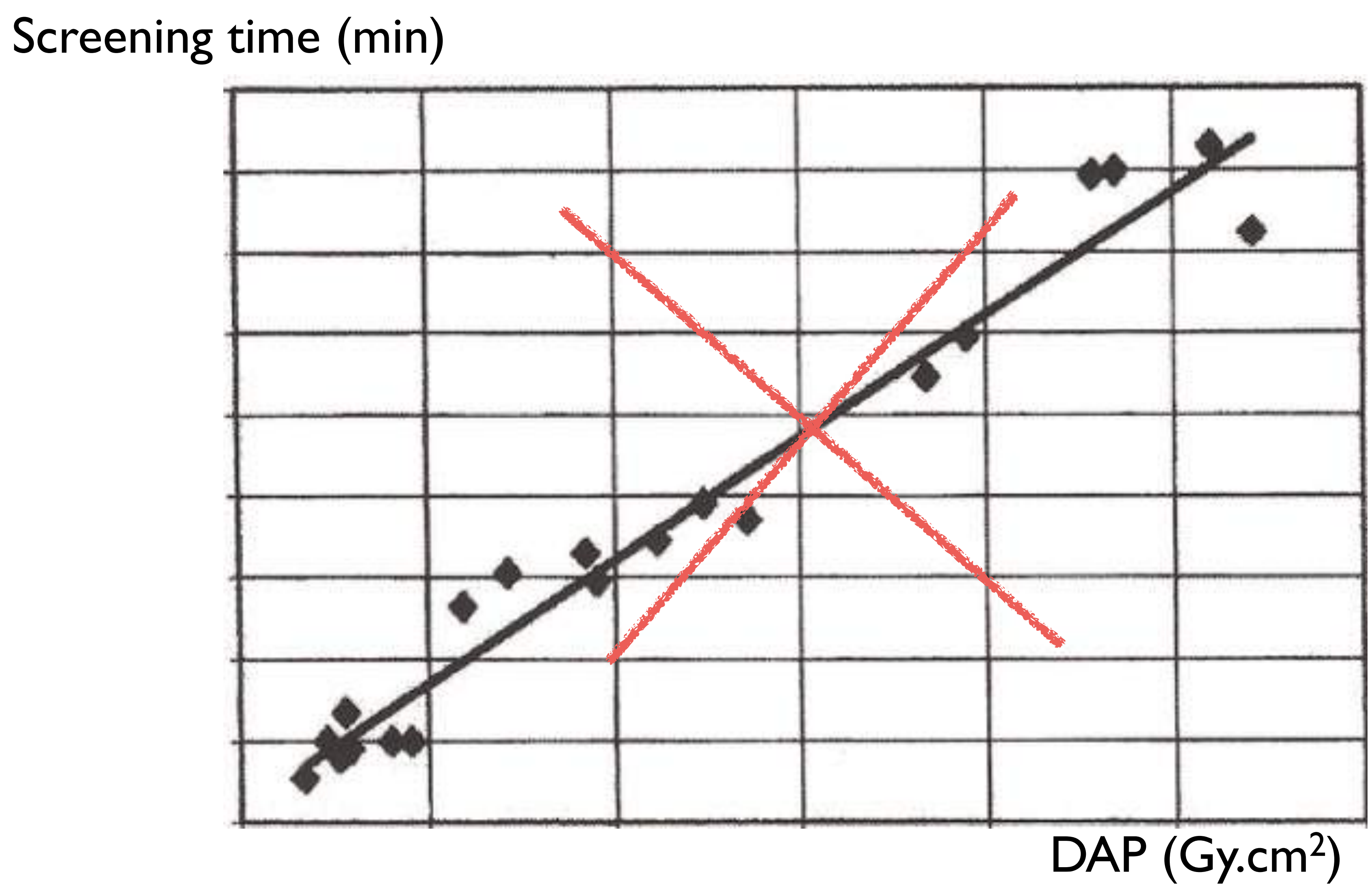
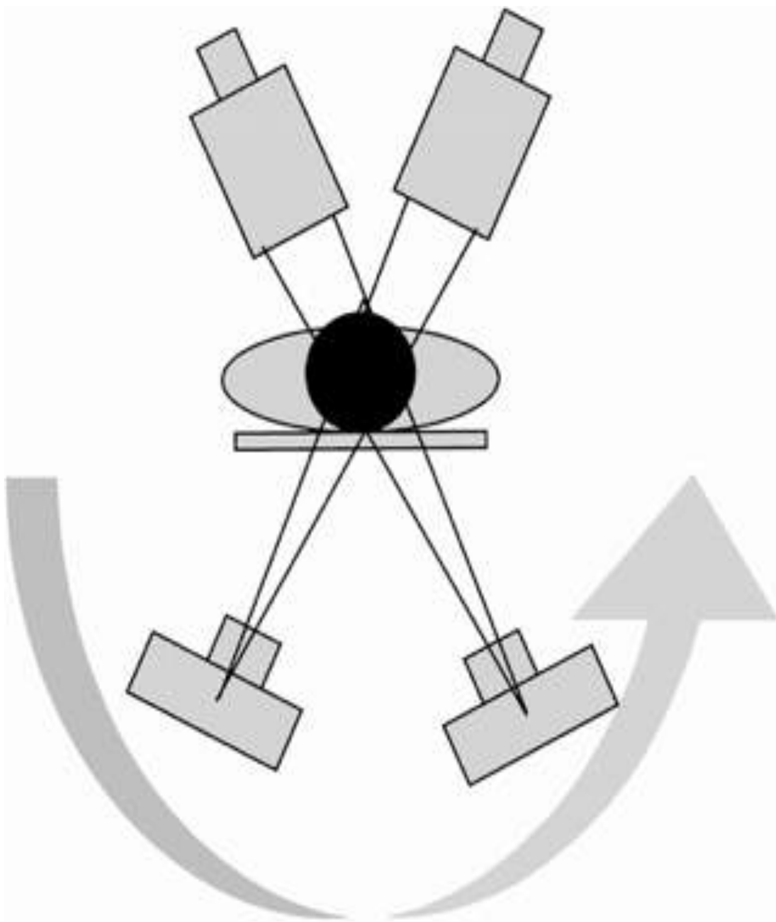
Fluoroscopy time



There is a strong positive correlation between fluoroscopy time and radiation exposure and dose

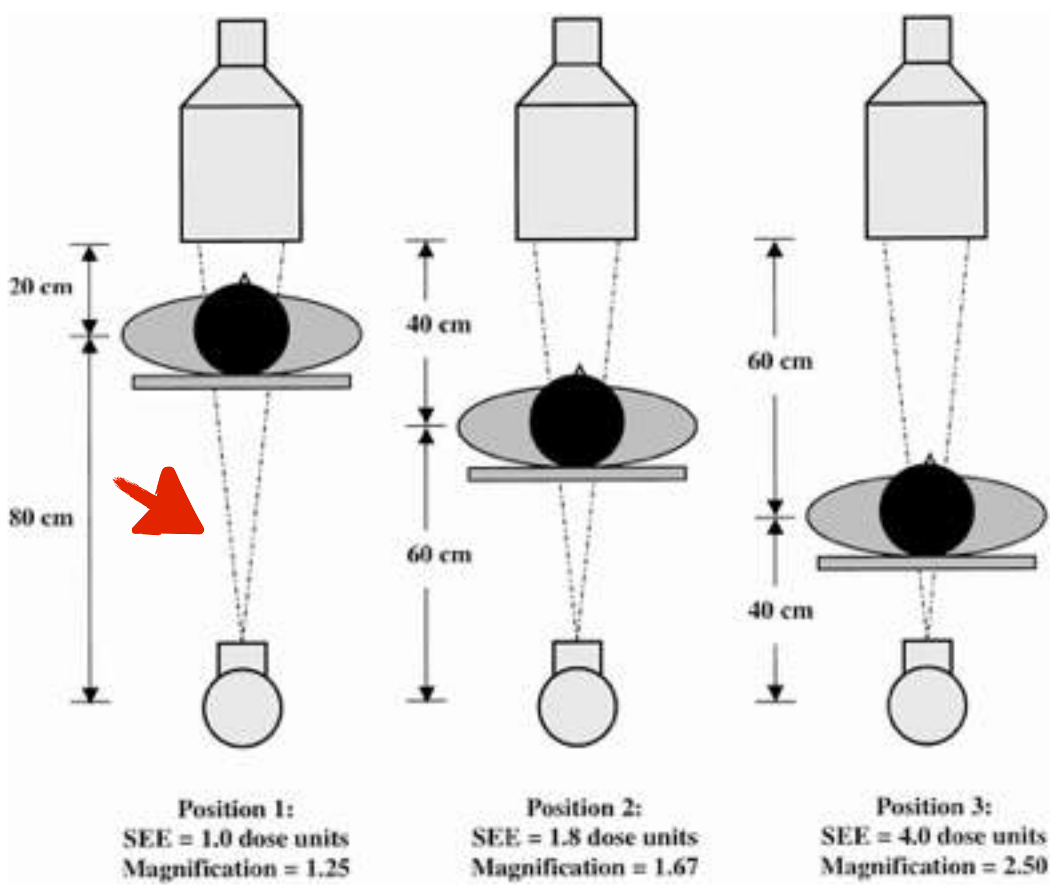
Larkin C, et al. Gastrointest Endosc 2001;53:161-164

Change beam projections



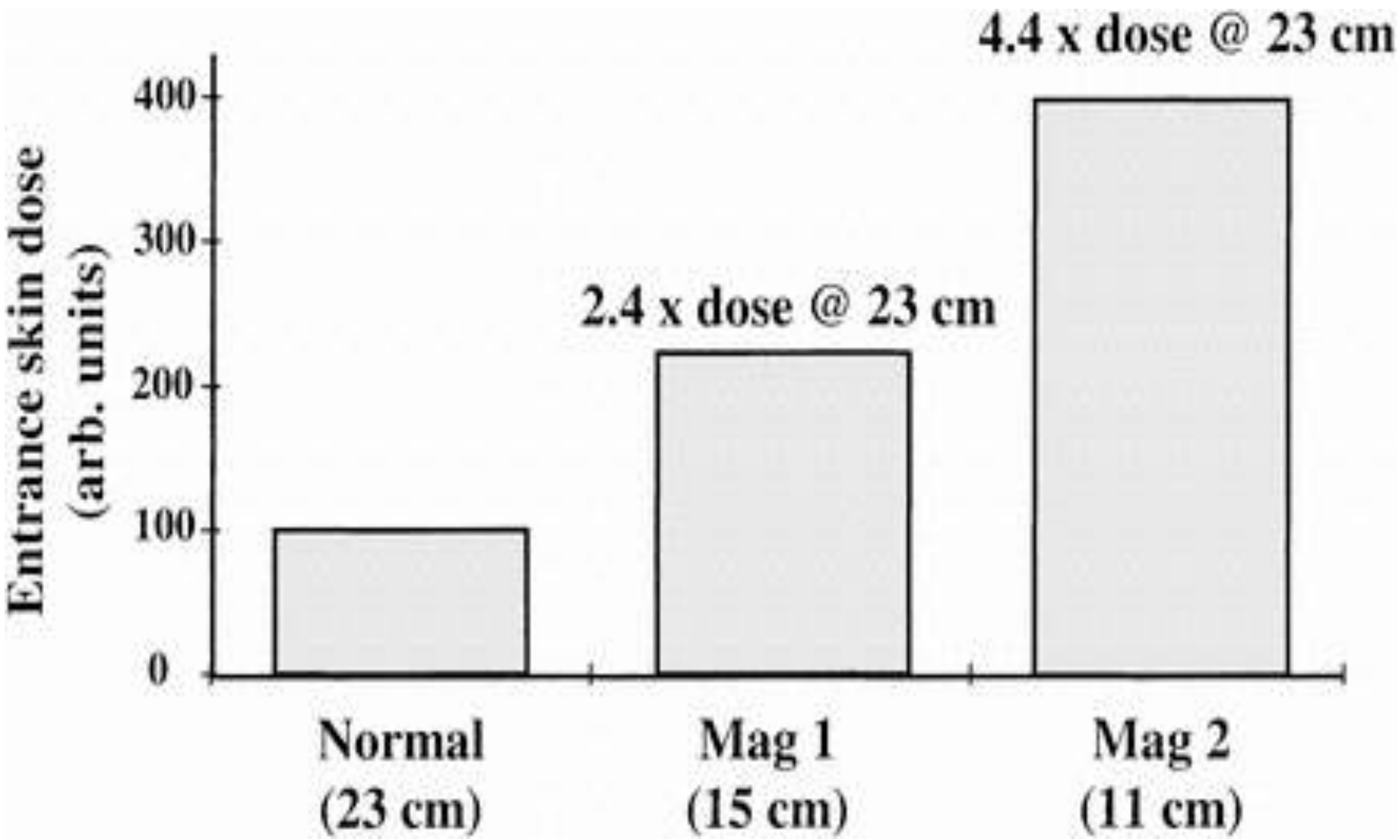
Patient skin dose sparing

Increase SPD, decrease PDD

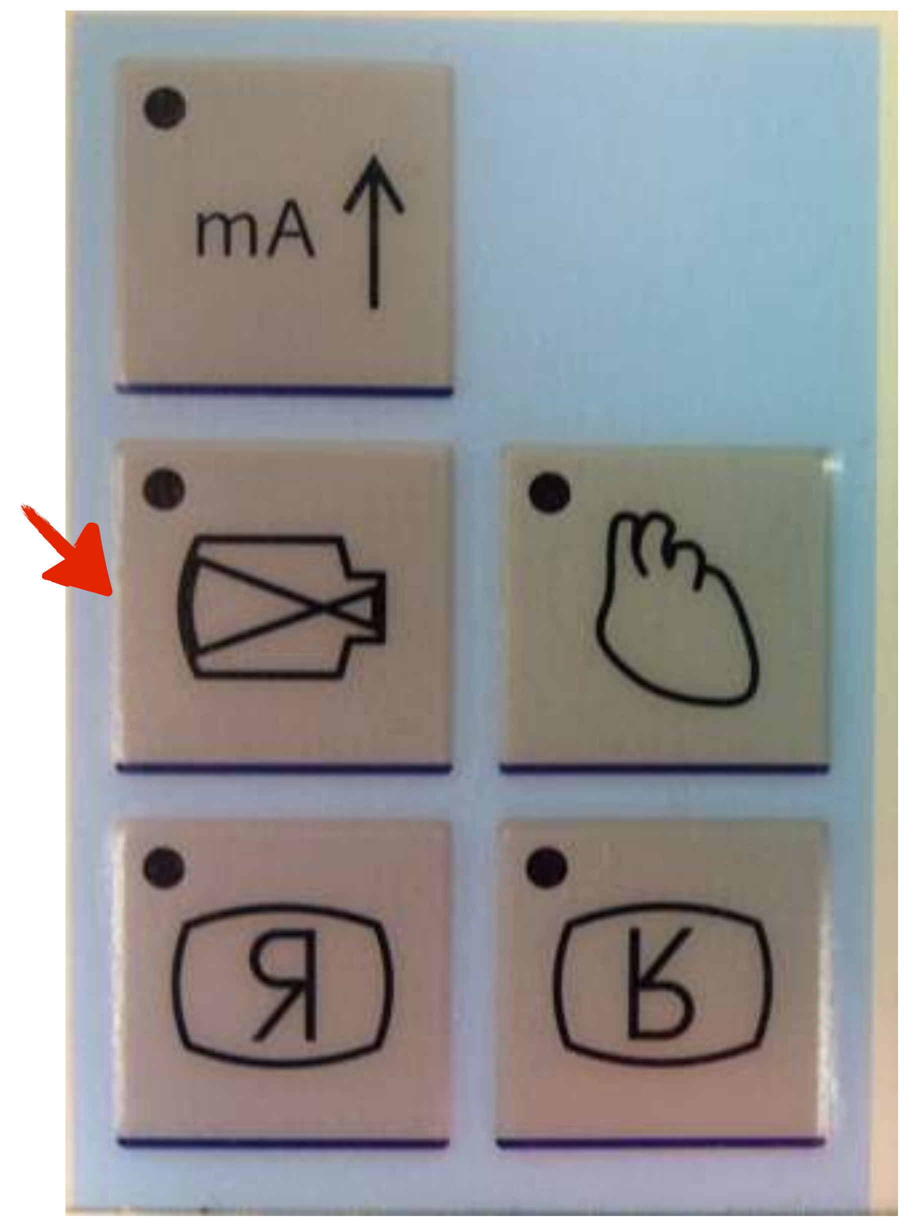


Patient skin dose sparing

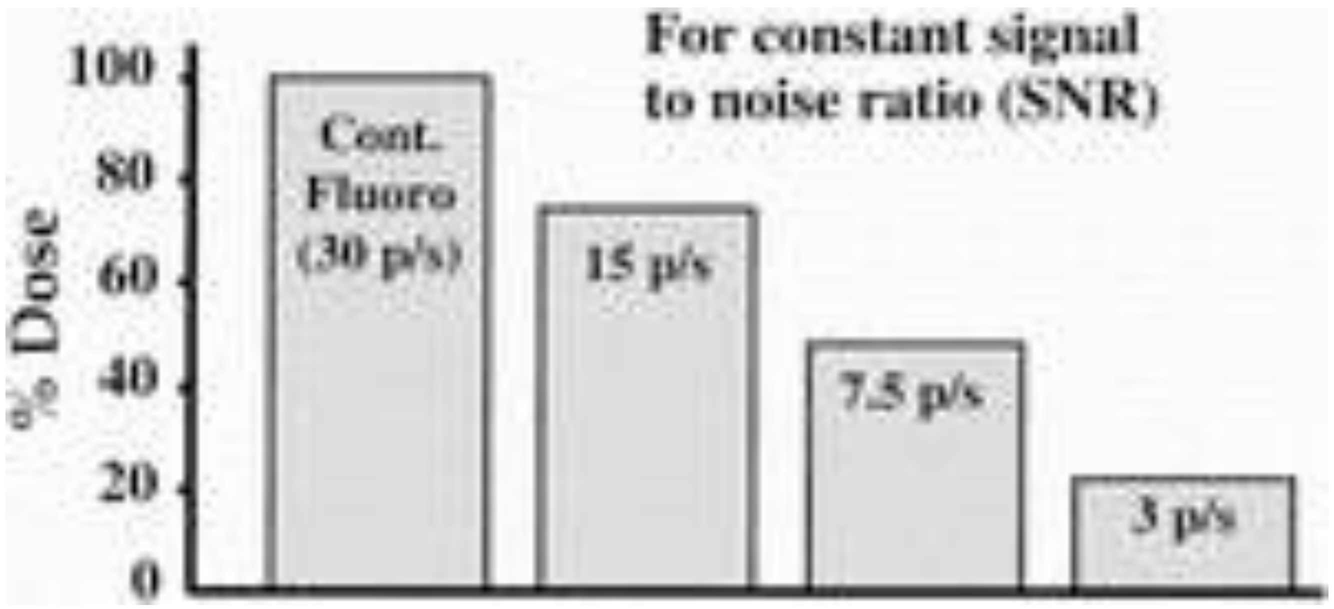
electronic magnification



Patient skin dose sparing



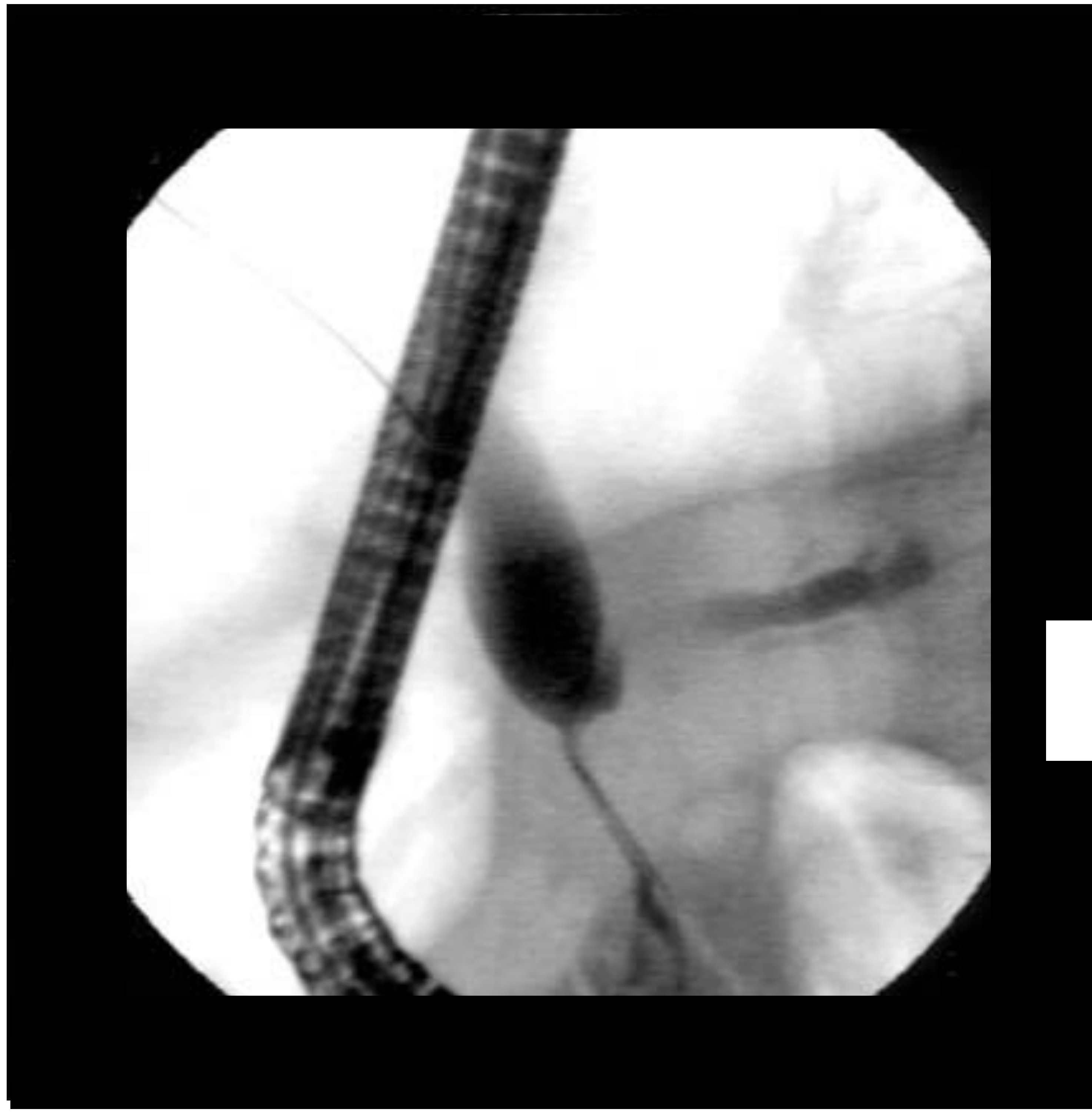
pulsed fluoroscopy



Patient & staff dose sparing

Collimation to reduce exposure

FOV 15



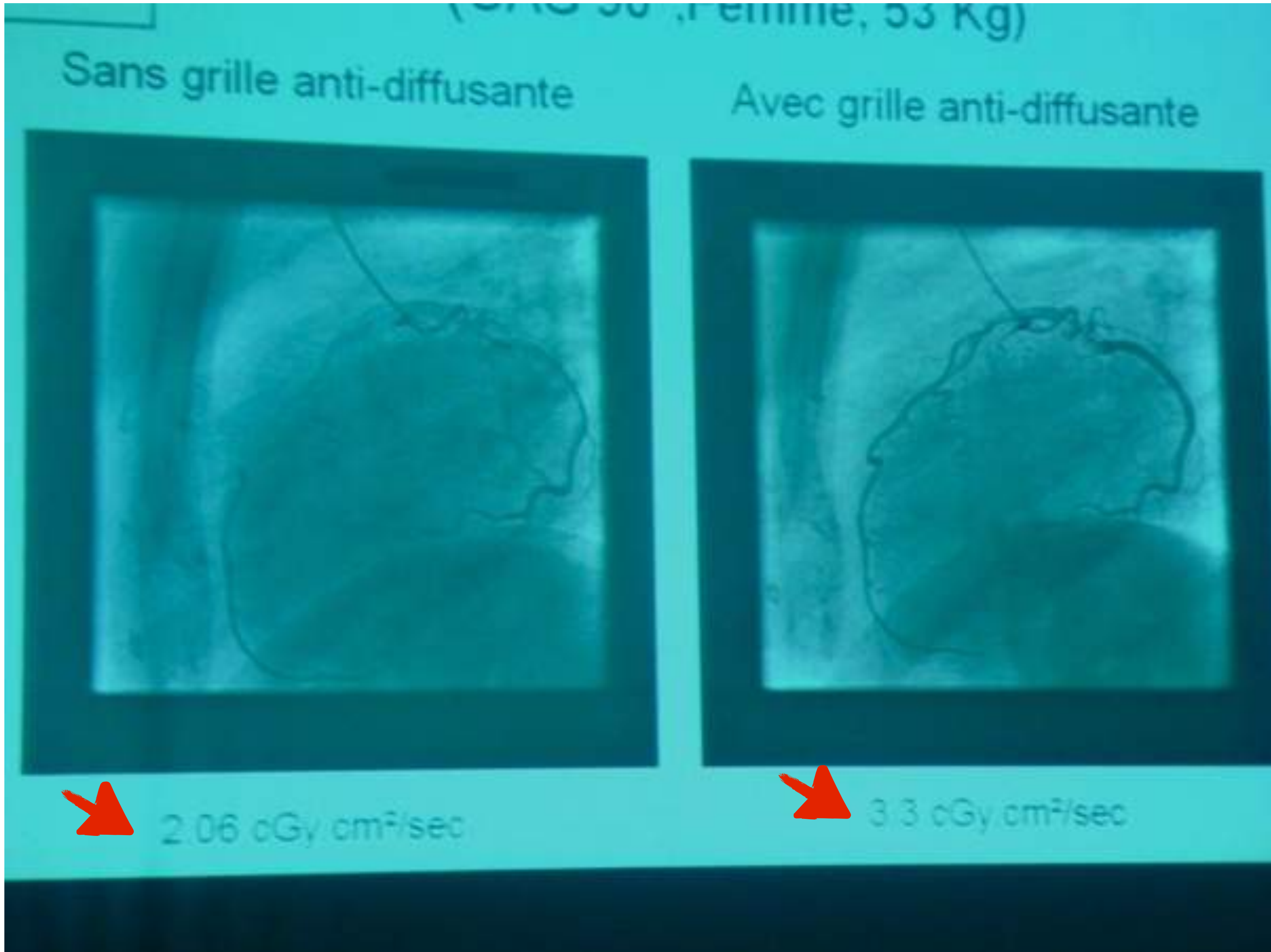
dose reduction 25%

Positionnement virtuel de la collimation et/ou des filtres

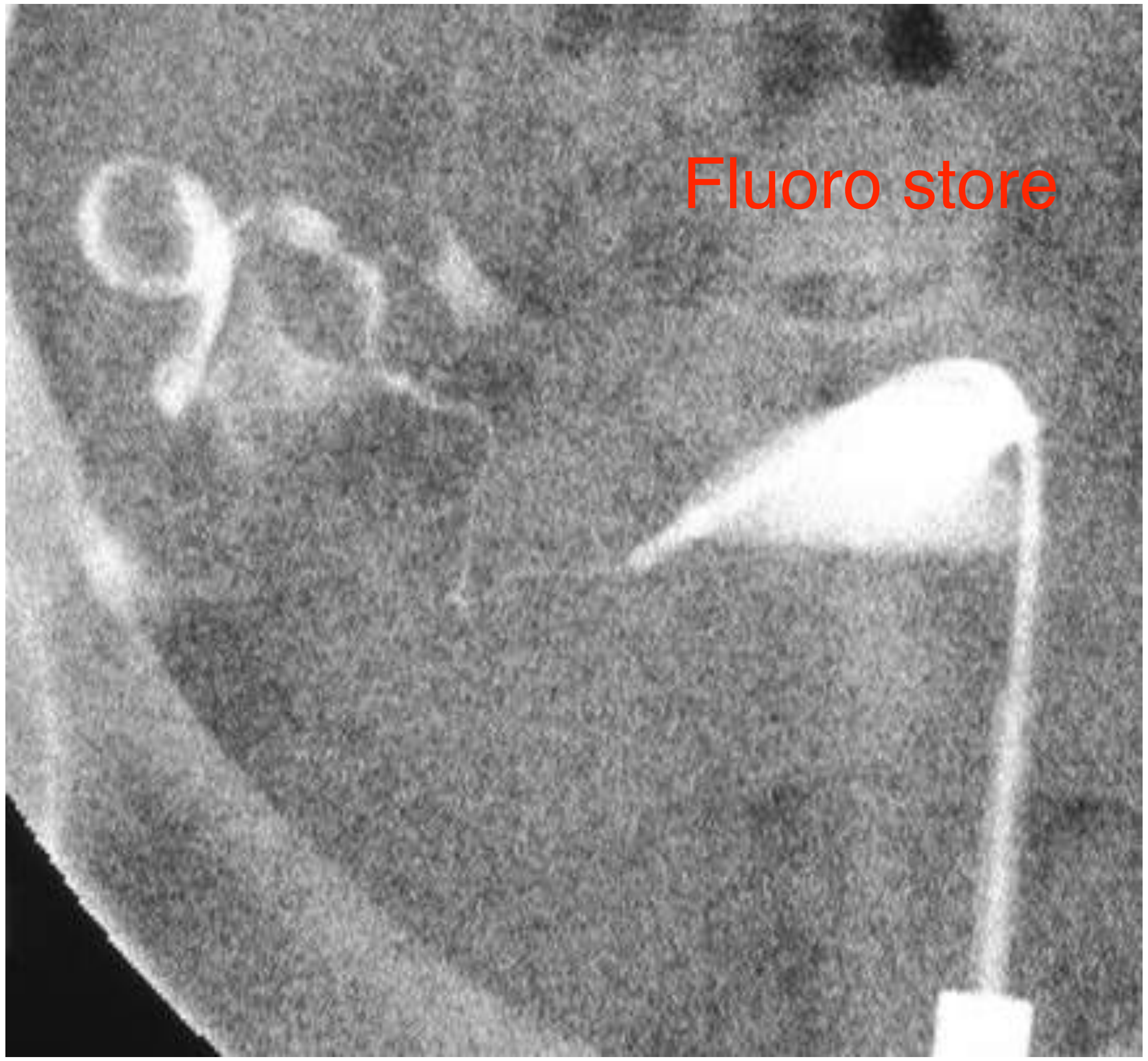
- Manipulation des diaphragmes et des filtres sur la dernière image de scopie disponible

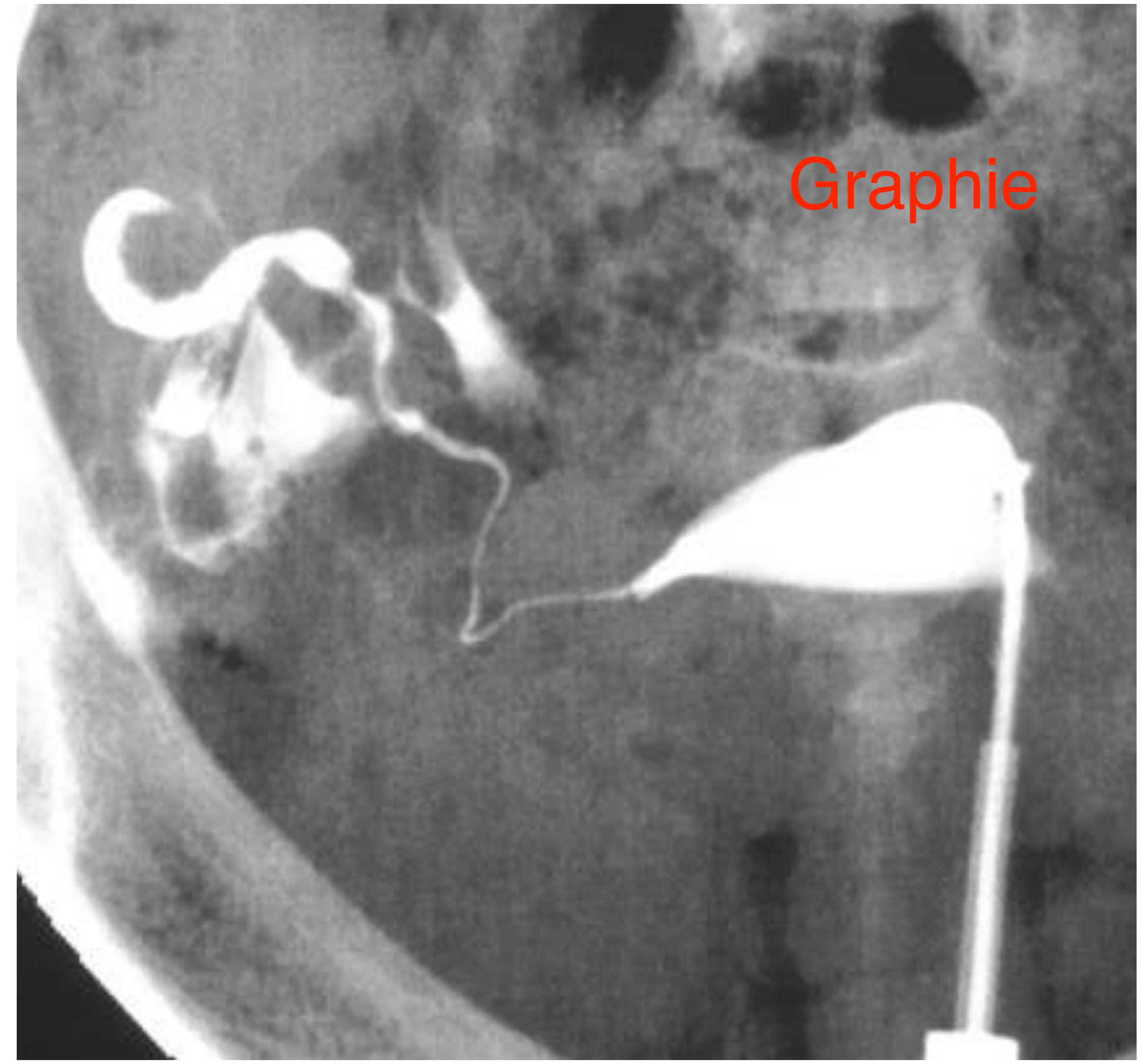
- Pas d'irradiation nécessaire

Antiscatter grid



Digital Fluorography vs. Radiography





Is lower-dose digital fluorography diagnostically adequate compared with higher-dose digital radiography for the diagnosis of fallopian tube stenosis?

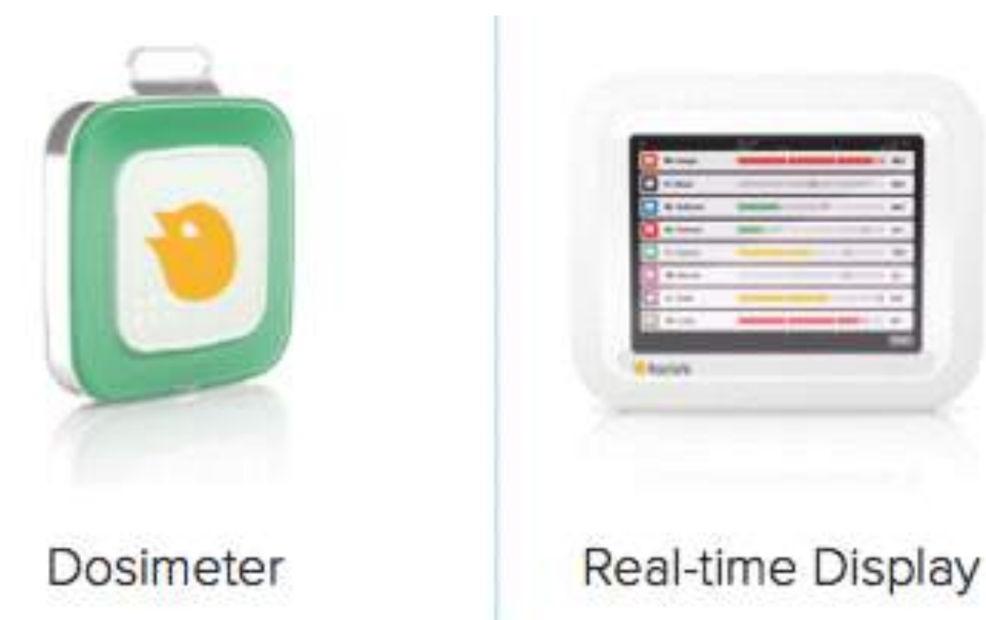
Cardiovasc Intervent Radiol 23(2): 126-130, 2000

Monitoring of Radiation Exposure : **staff**

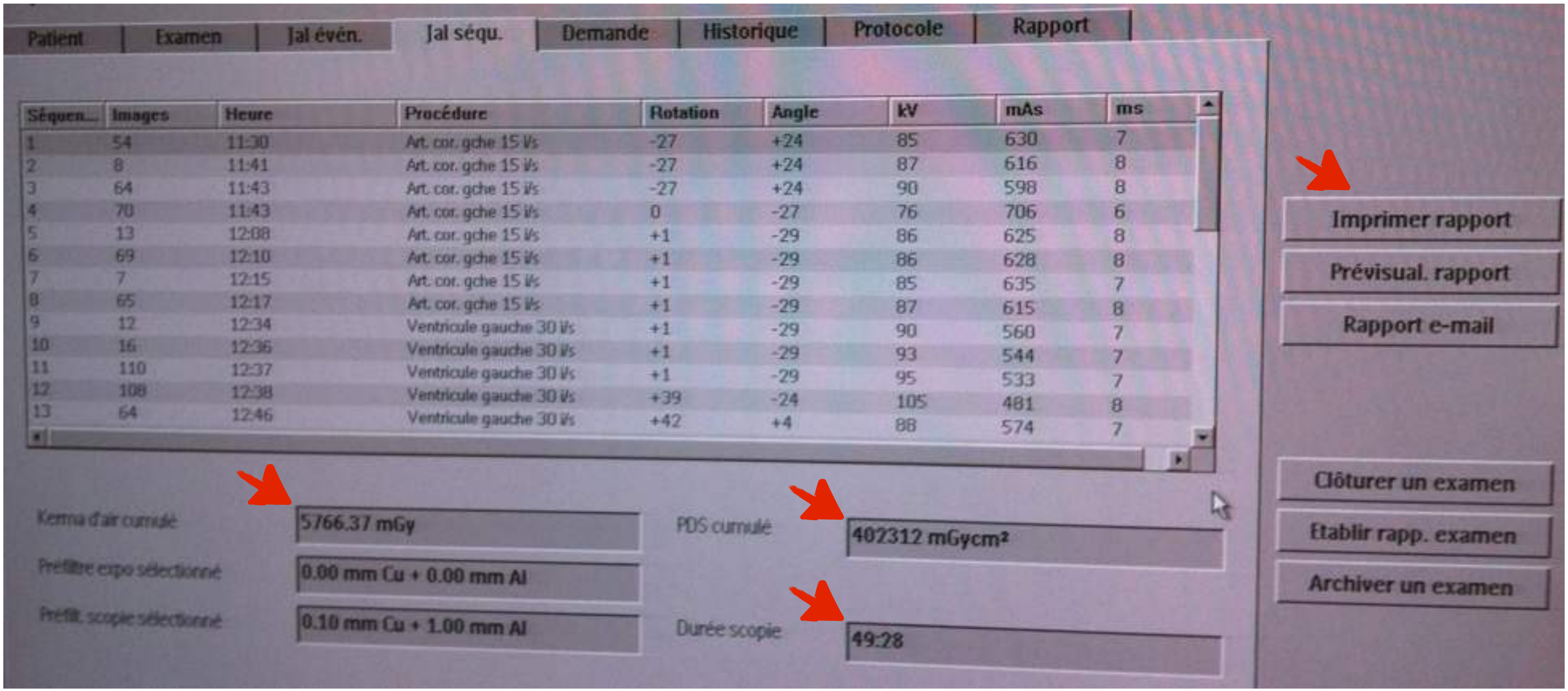
- **Main goals**
  - Compliance with dose limits (E, H_{skin}, H_{lens})
  - Detection of unexpected exposure
  - Optimisation (mainly for fluoroscopy)
- **Standard method**
  - 1 dosemeter, under the apron
  - But : parts of body are not protected

Monitoring of Radiation Exposure : **staff**

- **For dose-intensive fluoroscopy:**
  - 2 dosemeters, 1 under, 1 over the apron
  - Extremity ring dosemeters
  - Operational dosemeters



Monitoring of Radiation Exposure :
Patient dose indices



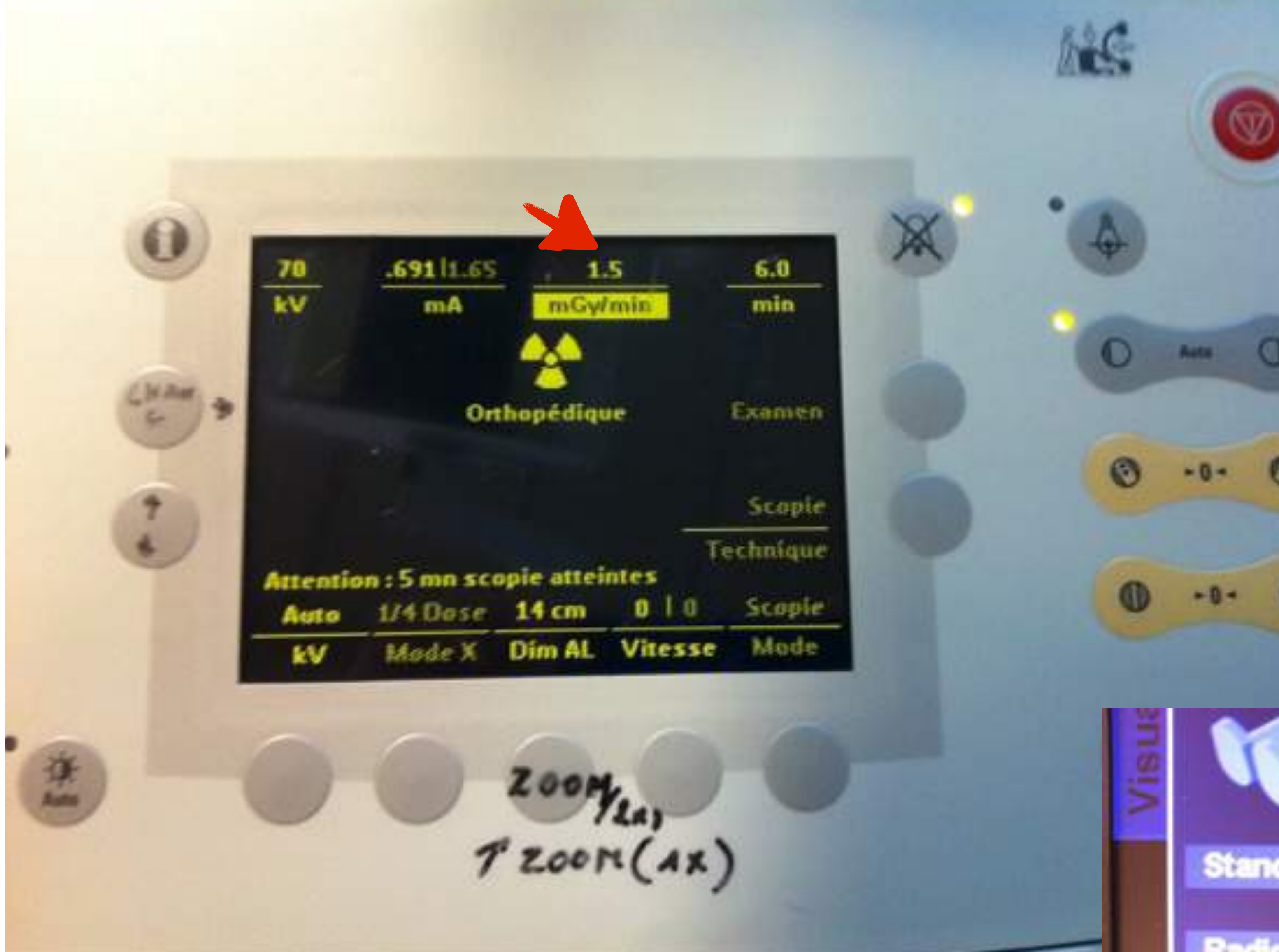
Patient First Name	Antoine
Patient Middle Name	
Patient ID	
Study Date	30/12/2011 11:16:46
Accession Number	
Study Description	kypho L1
Performing Physician	[redacted]

Fluoroscopy Dose

Mode Of Operation	Exposure Time (sec)	Exposure (mGy)	DAP (mGycm2)
Fluoro	76.49	78.94	10711.65
High Level Fluoro	0.00	0.00	0.00
Total	76.49	78.94	10711.65

3D Dose

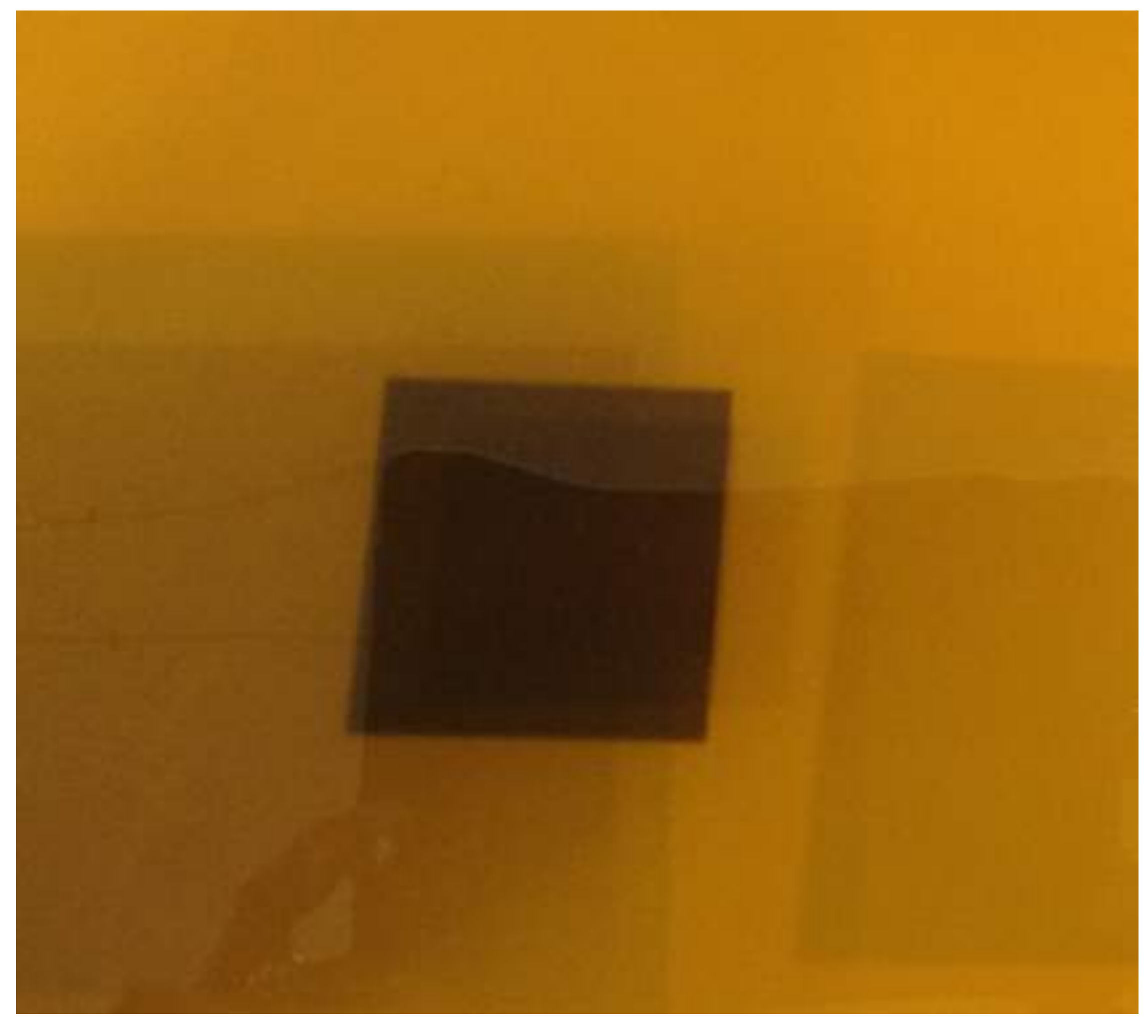
ID	kVp	mAs	CTDI (mGy)	DLP (mGycm)	Phantom (cm)
Total				0.00	



70
kV
.691 1.65
mA
1.5
mGy/min
6.0
min
Orthopédique
Examen
Scopie
Technique
Attention : 5 mn scopie atteintes
Auto
kV
1/4 Dose
Mode X
14 cm
Dim AL
0 | 0
Vitesse
Scopie
Mode
Auto

Standard
Radioscopie pulsée
8P/s
00:00:00
0.00 cGycm²

Direct measurements



Room lead protections

Same kind of effect with a moving door

Protection
Interventional
System
Against
X-rays

2 mm Pb : UNE PROTECTION QUASI-TOTALE

Réduisez votre irradiation, en bénéficiant d'un effet atténuateur supplémentaire de 2 mm Eq Pb

Protection	*80 kV*	*125 kV*
Sans	*1*	*1*
Tablier (T) 0.5 mm Pb	*17*	*8.1*
T + Ecran (E) 0.5 mm Pb	*53*	*29*
T+ E+ Porte 2 mm Pb	*2272*	*1378*

Individual lead protections

lead glasses

lead googles

Individual lead protections

Individual lead protections


COCOONS
Go Over


A
B
*


LEMER PAX

Keep detector close to patient.

Collimate.

Position shield in between patient and operator.

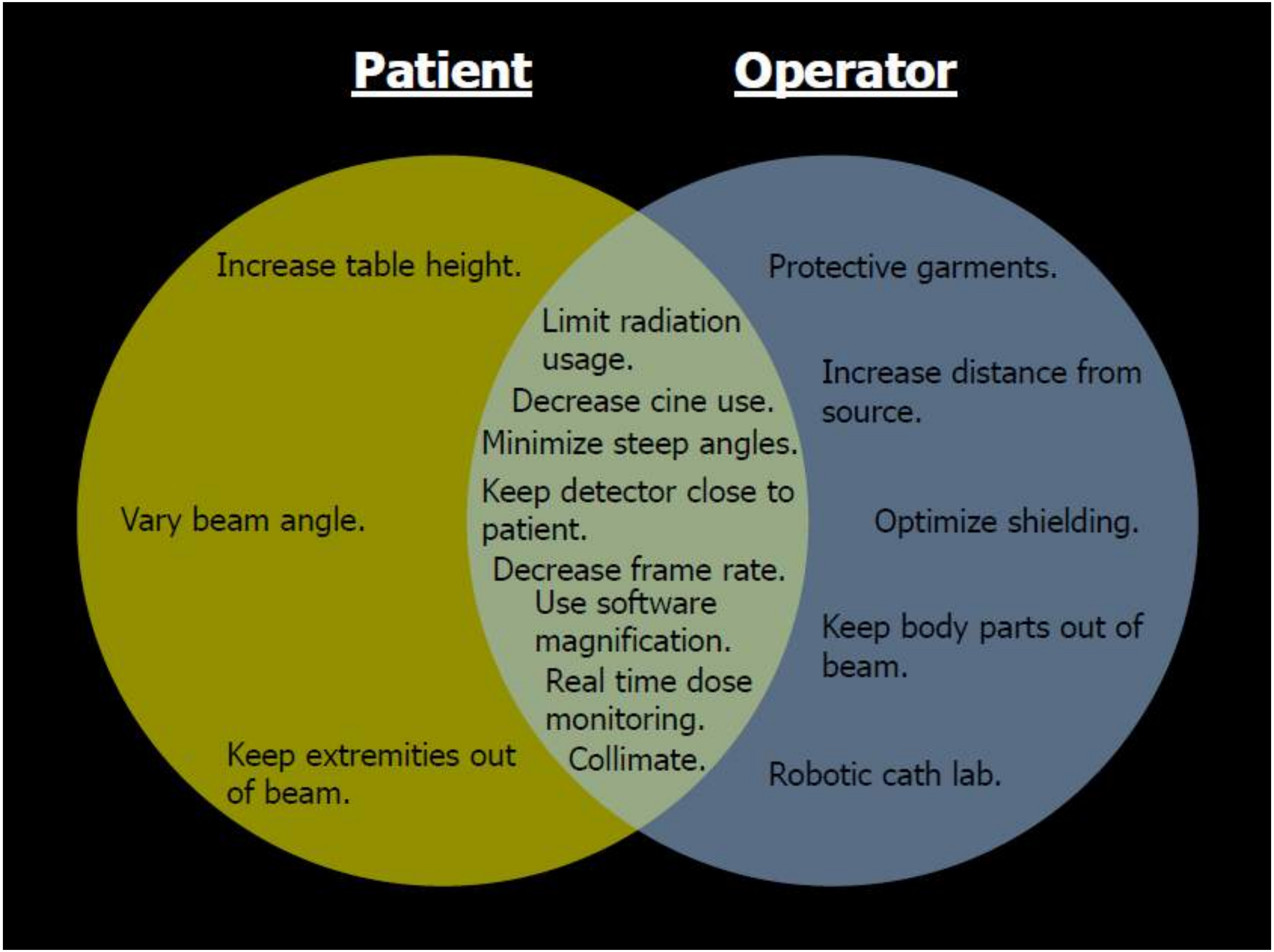
Radiation safety cap.

Radiation safety glasses (with side panels).

Lead skirt and vest with thyroid collar.

Movable lead skirt.

Disposable shielding.



Patient
Operator
Increase table height.
Vary beam angle.
Keep extremities out of beam.
Limit radiation usage.
Decrease cine use.
Minimize steep angles.
Keep detector close to patient.
Decrease frame rate.
Use software magnification.
Real time dose monitoring.
Collimate.
Protective garments.
Increase distance from source.
Optimize shielding.
Keep body parts out of beam.
Robotic cath lab.

NATIONAL CANCER INSTITUTE THE SOCIETY OF INTERVENTIONAL RADIOLOGY

INTERVENTIONAL FLUOROSCOPY

Reducing Radiation Risks for Patients and Staff

Strategies to Manage Radiation Dose to Patients and Operators

IMMEDIATE	LONG-TERM
OPTIMIZE DOSE TO PATIENT	
Use proper radiologic technique: • Maximize distance between x-ray tube and patient • Minimize distance between patient and image receptor • Limit use of electronic magnification **Control fluoroscopy time:** • Limit use to necessary evaluation of moving structures • Employ last-image-hold to review findings **Control images:** • Limit acquisition to essential diagnostic and documentation purposes **Reduce dose:** • Reduce field size (collimate) and minimize field overlap • Use pulsed fluoroscopy and low frame rate	**Include medical physicist in decisions** • Machine selection and maintenance **Incorporate dose-reduction technologies and dose-measurement devices in equipment** **Establish a facility quality improvement program that includes an appropriate x-ray equipment quality assurance program, overseen by a medical physicist, which includes equipment evaluation/inspection at appropriate intervals.**
MINIMIZE DOSE TO OPERATORS AND STAFF	
Keep hands out of the beam **Use movable shields** **Maintain awareness of body position relative to the x-ray beam:** • Horizontal x-ray beam – operator and staff should stand on the side of the image receptor. • Vertical x-ray beam – the image receptor should be above the table **Wear adequate protection** • Protective well-fitted lead apron • Leaded glasses	**Improve ergonomics of operators and staff:** • Train operators and staff in ergonomically good positioning when using fluoroscopy equipment; periodically assess their practice • Identify and provide the ergonomically best personal protective gear for operators and staff • Urge manufacturers to develop ergonomically improved personal protective gear • Recommend research to improve ergonomics for personal protective gear

Conclusions

- We need X-rays
- They're a risk among others
- We should use protective and monitoring devices
- We should spare patients skin and monitor their radiation doses