Checklists

Steven Y. Huang, MD; A. Kyle Jones, PhD *University of Texas, MD Anderson Cancer Center, Houston, TX*
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Introduction

The use of fluoroscopy has increased tremendously in the past few decades. Fluoroscopy is now routinely used in departments outside radiology, such as cardiology, endoscopy and surgery. While the corresponding improvement in patient care with fluoroscopy is undeniable, the use of this equipment, which can cause large amounts of radiation exposure to the patient and operator is concerning. In some states, personnel operating fluoroscopy require no specialized training. The combination of inadequate training and equipment capable of producing high radiation output can create serious consequences for the patient [1] and operator [2,3].

Minimizing radiation dose while maintaining adequate image quality is a complex problem. Dose reduction requires attention to several basic principles: (a) fluoroscopy time, (b) number of radiographic images obtained, and (c) control of technical factors that affect dose [4].

A checklist is a simple mechanism to effectively reduce radiation dose and improve patient and operator safety during fluoroscopy [5,6]. Physicians should already be familiar with the utility of checklists. During surgical or medical internship, physicians craft variably intricate checklists to help remember simple tasks, such as checking metoprolol dose or a CT scan result. These checklists work because they are readily adopted, simple and efficient.

For more complex problems, some may argue that the utility of checklists is limited. This may be true if the checklists are poorly constructed. Checklists can be good or bad. Bad checklists are vague, imprecise, long, hard to use and impractical. They treat the end users as ill-informed, spelling out every step. Good checklists, on the contrary, are precise, efficient and easy to use. They remind users of the most critical and important steps [7].

This section provides a list of tasks promoting radiation-safety items during fluoroscopy. The checklist is divided into pre-procedure, intra-procedure and post-procedure items. Of note, the pre- and post-procedure items are written in a READ-DO format (i.e., read each step, then do it). The pre-procedure portion of this checklist potentially can be integrated into most practice's Universal Protocol. Because the logistics of executing a READ-DO checklist during a procedure are impractical (similar to a pilot reading from a checklist while landing a plane), the intra-procedure items are intended to be presented as a DO-CONFIRM checklist (do the steps from memory, then pause and check).

Pre-Procedure (READ-DO)

1. Elicit prior radiation exposure (including radiation therapy) and time-course. Examine the area to be irradiated, specifically searching for injury from radiation, surgery and infection.
2. For cases in which high radiation exposure is expected, informed consent should include discussion of radiation risk.
3. Use ultrasound, if possible.
4. Operator(s) and staff wear appropriate radiation protection: lead aprons (0.5 mm Pb equivalent front and 0.25 mm on sides and back), thyroid collars and glasses
5. Room personnel wear radiation dosimeters on collar outside apron and front of torso underneath apron.
6. Patient and equipment positioned to maximize use of hanging lead shield and lead table skirt. A rolling shield should be used when the table skirt cannot be situated to protect the operator (e.g., head of the table).
7. Appropriate anatomical program set for the desired study. Many fluoroscopy units allow different imaging protocols, which vary factors such as pulse and frame rates, filtration, and set point for the automatic exposure control unit. Lowest feasible pulse rate set for proposed study.

8. If patient is pregnant, informed consent should include an in-depth discussion of the risks versus benefits of the procedure. A medical or health physicist may be necessary. Collimate the X-ray beam to avoid direct exposure to the fetus.

Intra-Procedure (DO-CONFIRM)

1. X-ray beam collimated to avoid unnecessary radiation exposure (especially radiosensitive organs, such as breast, thyroid, eyes and gonads)
2. Last Image Hold or Fluoroscopy Store functions are used whenever possible. If exposures are necessary, use lowest magnification, frame rate and collimate to the area of interest.
3. Source-to-object distance is as large as possible, while maintaining a comfortable table-working height for the operator. When tube is in lateral angulation, operator should place himself/herself next to the image receptor.
4. Image intensifier is as close as possible to the patient to reduce radiation scatter, except when deliberately using air gap technique for geometric magnification.
5. If X-ray beam angulations are necessary, minimize the path length through the patient. When using lateral projections, ensure patient's arms are out of the beam.
6. Overlap in field of view is minimized when performing exposures of large areas (e.g., lower extremity run-off arteriogram).
7. If hand injecting, extension tubing is available to move the operator away from the X-ray source. Use power injector whenever possible.
8. Communicate with the team about field of view, magnification, frame rate, contrast dose, length of run and suspension of respiration to avoid unnecessary/non-diagnostic imaging.
9. All unnecessary personnel should be behind protective screens or outside the room during image acquisition. Remind room personnel of the inverse square law (i.e., exposure at 6 feet is 2.8 percent of someone standing at 1 foot from the X-ray source).
10. If substantial radiation dose levels (SRDL) are exceeded, consider reducing radiation exposure or postponing completion of the procedure, as clinically appropriate.

Post-Procedure (READ-DO)

1. Review and record patient dose metrics (e.g., stored in PACS as an image or radiation dose structured report).

2. If dose metric exceeds thresholds, the patient should be advised of the radiation dose, possible effects and instructed on appropriate follow-up.

References

1. Shope TB. Radiation-induced skin injuries from fluoroscopy. Radiographics. 1996 Sep;16(5):1195-9. PubMed PMID: 8888398. Available at: http://pubs.rsna.org/doi/pdf/10.1148/radiographics.16.5.8888398. Accessed October 1, 2014.
2. DeAngelis LM. Brain tumors. N Engl J Med. 2001 Jan 11;344(2):114-23. Available at: http://www.nejm.org/doi/full/10.1056/NEJM200101113440207. Accessed October 1, 2014.
3. Roguin A, Goldstein J, Bar O, Goldstein JA. Brain and neck tumors among physicians performing interventional procedures. Am J Cardiol. 2013 May 1;111(9):1368-72. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23419190. Accessed October 1, 2014.
4. Miller DL, Balter S, Noonan PT, Georgia JD. Minimizing radiation-induced skin injury in interventional radiology procedures. Radiology. 2002 Nov;225(2):329-36. Available at: http://pubs.rsna.org/doi/full/10.1148/radiol.2252011414. Accessed October 1, 2014.
5. Image Gently Pause and Pulse Checklist. Available at: http://www.pedrad.org/Portals/6/Procedures/Pause%20and%20Pulse%20Checklist%20MDs.pdf. Accessed October 7, 2014.
6. Image Gently Technologist Check-Off List for Fluoro Examinations. Available at: http://www.pedrad.org/Portals/6/Procedures/TECH.CHECK.pdf. Accessed October 7, 2014.
7. Gawande A. The checklist manifesto: how to get things right. New York, NY, Metropolitan Books, Henry Holt and Co, LLC; 1st ed, 2010.

