1. **What was the fluoroscopic time and BMI of the patient?**

Medical radiation constitutes almost half of the US population average annual radiation exposure. The Joint Commission advises physicians to review their practices to reduce radiation exposure as low as reasonably achievable without compromising patient care. The ACR recommends documenting fluoroscopy times for all procedures [1, 2]. Because of the obesity epidemic, there has been an increased reliance by the clinicians on radiology to perform fluoroscopic guided lumbar punctures (FGLP). Benchmarks have been suggested for fluoroscopy times based on patient body habitus[3]. Every attempt should be made to achieve or beat these published fluoroscopy times.

![Table 1: Benchmark fluoroscopic time in minutes based on BMI categories](image)


2. **What did you use for radiation protection?**

The utilization of a protective lead apron and thyroid shield are “standard of practice” among radiologists, nursing staff and technologists during a fluoroscopic procedure.

The eyes are considered to be the most “at risk” organ when considering radiation exposure. The yearly lens radiation exposure without protective eyewear almost never reached the current threshold limits at 150mSv[4]. In April 2011, the International Commission on Radiological Protection (ICRP) recommended...
changing the annual radiation exposure limit for the eye from 150mSv to 20mSv because of evidence indicating underestimated radiosensitivity of the lens [4, 5]. Currently the US Nuclear Regulatory commission is debating implementation of the recommended changes [6].

A lead curtain has been proven to reduce radiation exposure to the lower extremities and gonads [4, 5, 7, 8]. Depending on the type of fluoroscopic machine a leaded curtain can be used to limit radiation exposure to the upper torso, thyroid and eyes.

The Society of Interventional Radiology (SIR) and Cardiovascular and Interventional Radiology Society of Europe (CIRSE) does not recommend the use of radiation attenuating sterile gloves [6]. SIR, CIRCE and ICRP also recommend regular usage of two dosimeters (one superficial to thyroid shield and one beneath the lead apron at the abdomen) in order to provide a more accurate estimate of radiation exposure.

3. **What fluoroscopic mode did you use during the procedure?**

   Intermittent and pulsed fluoroscopy offer significantly reduced radiation dose to the patient and healthcare professional as compared with continuous fluoroscopy [9]. Of note, the actual dose reduction in pulsed fluoroscopy is somewhat less than expected as manufacturers increase tube current to compensate for increased image noise.

4. **What techniques did you use to reduce radiation scatter and dose during the procedure?**

   Collimation significantly reduces patient dose and should be used liberally to expose only the area of interest in the lumbar spine as it reduces patient dose and improves image quality [10].

   Beam filtration removes low energy photons that only contribute to patient dose and radiation scatter and do not improve image resolution [11]. Filtration is an intrinsic quality of the fluoroscopy unit and should be considered when purchasing/upgrading fluoroscopy systems.

   Grids reduce scatter reaching the image receptor and improve image quality, but at the cost of increased radiation exposure. The grid can effectively be eliminated when imaging small children [11]. With larger patients, grids may be considered if image quality (ie subject contrast) is compromised.

   The intensity of the x-ray beam is inversely proportional the square of the source to skin distance. Also, decreasing the object to detector distance will decrease scatter and patient radiation.

5. **Did you use magnification mode?**
Electronic magnification significantly increases radiation dose to the patient and can be multiplicative if other dose reduction factors are not being utilized. In general, magnification should not be used unless absolutely necessary [12].

6. **How many images and with which technique did you document your needle position?**

   The American College of Radiology and Society of Interventional Radiology Practice Parameters for reporting and archiving states that “for needle placement under direct imaging guidance, at least 1 image should be saved with the needle in final position at each treatment site [13].” Since the purpose of imaging is only to document position, ‘last image hold’ should be used which obviates the need for further irradiation [12].

7. **How did you monitor the patient’s radiation exposure/dose?**

   The largest source of radiation exposure under our control is medical radiation [15]. Due to reports of severe skin injuries in patients, monitoring radiation dose has become a crucial part of routine quality measures [16]. In addition, the FDA revised manufacturing guidelines for equipment manufactured after 2006 to increase patient safety from excessive radiation exposure [17]. Multiple medical, national and international organizations have issued policies regarding radiation safety in adult fluoroscopy [18]. Although fluoroscopic time is the most commonly reported estimation of dose, it is actually the least useful measure; but no other estimation has been widely implemented in practice [19, 20]. There is no perfect system for monitoring patient dose; however each facility should use the best indicator available to them under the guidance of a qualified medical physicist [21, 22]. Additional guidelines exist for patient monitoring and follow-up for excessive patient radiation exposure and can be found in the referenced materials [13, 22, 23]. All radiation dose data that is recorded by the fluoroscopy unit should be archived with the procedure images if possible [13, 21, 24]. Any procedure involving more than 10 minutes of fluoroscopic exposure should be recorded in the patient's permanent record [24].
REFERENCES

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