AAOS Now

Radiation exposure in the OR: Is it safe?

By Annie Hayashi

Study examines fluoroscopy use in minimally invasive surgery

Minimally invasive surgical procedures have many benefits, but the use of fluoroscopy is problematic for operating room (OR) personnel concerned about radiation exposure. The patient's exposure is limited to one operation. But the surgeon and the OR staff are repeatedly exposed to radiation during multiple procedures.

To determine the safety of two different fluoroscopic methods, **Garrick W. Cason, MD,** and his colleagues, **David P. Rouben, MD,** and Todd C. Bonvallet, MD, conducted a prospective study examining the safety of fluoroscopy and comparing the radiation exposure of single C-arm versus a two C-arm simultaneous fluoroscopic technique during minimally invasive lumbar spinal surgery.

Dr. Cason presented the findings of his study, "Radiation exposure to operation room personnel during minimally invasive spine surgery: A comparison of single vs. simultaneous biplanar fluoroscopy," at the 2008 Annual Meeting of the North American Spine Society (NASS).

Putting fluoroscopy to the test

To compare the amount of radiation surgeons and their OR staff are exposed to during the minimally invasive single level spinal procedures, Dr. Cason and his associates established two surgical groups of 10 patients each.

Dr. Rouben used single rotating C-arm fluoroscopy during surgery, and Dr. Bonvallet used two C-arms for simultaneous biplanar fluoroscopy.

"Biplanar fluoroscopy, using two fixed positioned C-arms, is used to guide medial-lateral and cranial-caudal placement of pedicle screws," said Dr. Cason, "while a single C-arm rotates from the anterior/posterior (A/P) to lateral planes—often requiring multiple exposures to obtain a quality image."

Patients were placed in the prone position on the operating table. Surgeons and scrub

technicians in both groups maintained approximately the same distance from the patients and the radiation source.

All patients underwent minimally invasive pedicle screw instrumentation after either anterior lumbar interbody fusion or transforaminal lumbar interbody fusion.

Measuring radiation in the OR

Radiation exposure was measured using duplicate thermoluminescent dosimeter badges that were strategically positioned on the surgeons' and scrub technicians' eyewear; on top of and underneath their thyroid shields; and at the waist—on top of and underneath—the lead aprons. Anesthesia personnel and the circulating OR nurse wore one badge on top of the lead apron.

Each badge was worn in the same position for each operation and captured the cumulative radiation exposure dose during the ten procedures. Both surgical time and fluoroscopy time were also recorded.

Is fluoroscopy safe?

"For an experienced spine surgeon, the use of either single or simultaneous biplanar fluoroscopy for minimally invasive spine surgery for posterior spinal instrumentation is safe," stated Dr. Cason.

Wearing lead aprons and thyroid shields reduced radiation exposure for the surgical staff in both groups by up to 50 percent. Surgeons and scrub technicians could also reduce their exposure by staying as far away as possible from the radiation source. "The effect is equivalent to wearing lead," said Dr. Cason (Fig. 1).

Biplanar fluoroscopy not only significantly reduced radiation exposure to the surgeon, scrub technician, and OR staff (Fig. 2), it also reduced surgical time compared to single C-arm fluoroscopy.

"After accounting for any differences due to the surgeon performing the procedure," said Dr. Cason, "the surgical time dedicated to the minimally invasive spine surgery alone was 12.3 minutes less in the simultaneous biplanar fluoroscopy group."

Dr. Cason also recommended the following modifications that could lower radiation exposure and would add less than a minute to the overall procedure time:

- Increase filtration and use a higher tube voltage/lower tube current.
- Set the pulsed fluoroscopic operation at 4 pulses per second.
- Position the C-arm under the table.

How many surgeries can be performed?

According to Dr. Cason, to avoid exceeding safe exposure levels, an experienced spine surgeon wearing full lead protection could perform up to 320 single-level minimally invasive spine

procedures per year using single C-arm fluoroscopy or up to 640 procedures using simultaneous biplanar fluoroscopy.

Including a second contiguous level would add 50 percent more radiation. Based on his data, surgeons could perform up to 210 two-level procedures using single C-arm fluoroscopy and up to 420 operations using simultaneous biplanar fluoroscopy without exceeding safe exposure levels.

Take safety precautions

Minimally invasive surgery using fluoroscopy is safe for the surgeon and the OR staff but only if certain steps are followed, concluded the authors. For example, the surgeon and OR staff should always wear lead aprons, thyroid shields, and protective eyewear, and should maintain a safe distance from the radiation source.

Biplanar fluoroscopy was found to be safer and less time consuming than single C-arm fluoroscopy but both were still considered to be very safe for surgeons and their OR staff.

Additional authors for this study include Joseph Rudd, PhD, and Timothy Ervin, BSE.

The authors did not have any disclosures for this study.

Annie Hayashi is the senior science writer for AAOS Now*. She can be reached at hayashi@aaos.org*

AAOS *Now*
December 2008 Issue
http://www.aaos.org/news/aaosnow/dec08/clinical1.asp

6300 North River Road Rosemont, Illinois 60018-4262 Phone 847.823.7186 Fax 847.823.8125

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