

[2003 Fall A15] Patient entrance skin radiation dose during three most common fluoroscopy-guided pain procedures

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Introduction: Use of fluoroscopy by interventional pain physicians has increased dramatically in recent years. Recent reports of radiation skin injuries during prolonged fluoroscopy-guided endovascular cardiac procedures and continued growth in complexity of interventional procedures requiring X-ray guidance, brought new a wave of concerns regarding patients' radiation safety (1,2,3). Little has been quantified with regard to patient radiation exposure with repeated procedures in pain clinics.

Method: 115 patients received fluoroscopy-guided injections (OEC 9600 C-arm fluoroscope) in low back and pelvic area. Fluoroscopy time and measurements of each patient's antero-posterior (AP) and lateral pelvic patient dimensions were obtained during the three most common injections performed in the pain clinic, sacroiliac joint, caudal and transforaminal epidural steroid injections. Calculations were performed to determine the patient's entrance (skin) absorbed radiation dose, using each patient's measured thickness along the radiation beam axis, the actual recorded fluoroscopy time used for each procedure and additional radiation measurements made on the C-arm. The additional measurements were made using varying thicknesses of plexiglas, which simulate patient tissue to ascertain the fluoroscopic technique set by the automatic brightness control (ABC). It is the fluoroscopic technique, i.e. kVp and mA, which determines the radiation exposure rate emitted from the C-arm. ABC varies kVp and/or mA with varying tissue thicknesses along the x-ray beam to achieve a required level of radiation at the image intensifier. Technique data and radiation output for the full range of patient thicknesses were interpolated from the measurements. Because radiation output varies with distance from the x-ray tube, generally described by an inverse-square relationship, the measurements and calculations for patient doses used typical set-up distances from the x-ray tube to the patient's skin surface. In our facility, the C-arm is used with the x-ray tube on top for positioning needs. It is different from the conventional use of C-arms where the image intensifier is on top. The absorbed skin doses are therefore in the back, at the injection site, for PA procedures.

Results: The average entrance skin absorbed dose and ranges for each procedure is presented in Table 1. As simulated patient thickness increased, the rate of exposure increased (Figure 1).

Conclusion: The study shows, that during short repeated procedures such under fluoroscopy guidance, all patients received absorbed radiation doses below the threshold dose that can produce skin erythema (<200 rad).

One of the major risk factors includes patient's thickness; as patient thickness increases, the distance from the X-ray source decreases and the automatic brightness control in contemporary fluoroscopy machines increases the fluoroscopic technique. Significantly increased patient skin dose results from both of these factors.

References:

1. Berlin L. Radiation-induced skin injuries and fluoroscopy. AJR 2001;July,21-25.
2. Koenig TR, Wolff D, Mettler FA, Wagner LK. AJR 2001;July, 3-11.
3. Koenig TR, Mettler FA, Wagner LK. AJR 2001;July, 13-20.

PROCEDURE	N	Average SD per procedure (rad)	Range of SD per Procedure (rad)	Range of TSD per patient (rad)
Sacroiliac joint injection	50	10.8	1.8-31.2	2.5-67.7
Caudal epidural steroid injection	77	11.4	1.1-86.7	2.2-132.7
Transforaminal epidural steroid injection	153	17.1	1.9-102.4	1.9-166.0

Table 1. The average entrance skin absorbed dose and ranges for each procedure. N = number of procedures; SD = skin dose; TSD = total skin dose from all procedures.

View Image 1

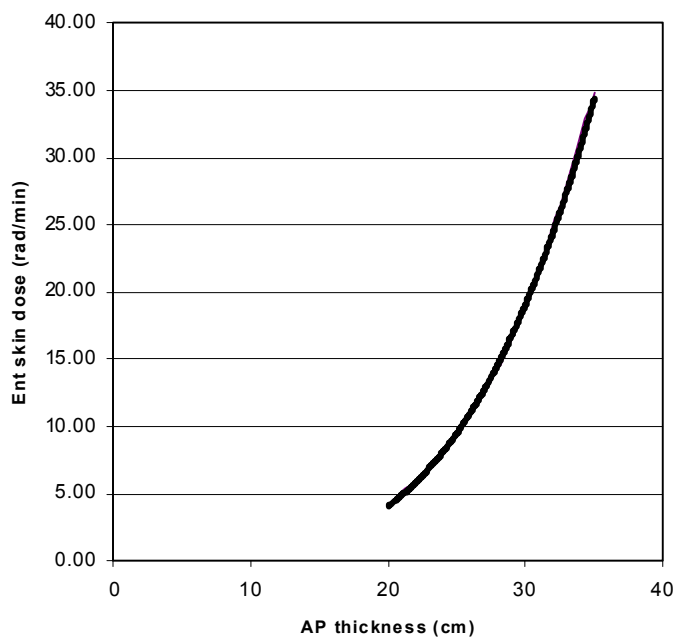


Figure 1. Entrance skin dose (rad/min) vs. AP thickness (cm).

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