Radiation exposure in prostatic embolization

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Prostatic artery embolization (PAE) is a minimally invasive procedure that is being increasingly accepted as an alternative treatment of the lower urinary tract symptoms caused by benign prostatic hyperplasia (BPH). PAE is a time-consuming and technically challenging procedure due to the thinness of prostatic arteries and complex anatomic variations. The technique is characterized by long fluoroscopy times, the optional use of cone-beam computed tomography (CBCT) acquisitions, multiple oblique projections and magnification views, all of which can lead to high radiation doses to both patients and staff [1, 2, 3]. Very few studies have however actually quantitated radiation exposure in PAE. This article summarizes the results of our recent prospective single-operator study of radiation exposure in PAE.

STUDY DESIGN
We prospectively analyzed 25 PAE procedures carried out using a Artis Zee ceiling-mounted system (Siemens, Germany) from November 2015 through September 2016 in the largest public hospital of Recife-PE, Brazil. The mean age of the patients was 65.7 years (43-85y), mean weight 71.4 kg (54-88 kg), mean height 167.3 cm (155-180 cm) and mean prostate volume 79 cm³ (36-157 cm³). Fluoroscopy was performed at 15 images per second and digital subtraction angiographies (DSA) at 2 images per second, using a standard abdomen protocol (85 kV, 100 ms, 0.9-mm Cu -filter and a dose of 3,600 µGray per frame).

All procedures were performed under local anesthesia using a single common femoral artery approach with a 5F 11 cm sheath. Bilateral internal iliac artery catheterization was carried out using 5 F Mikaelson catheter; DSA was performed in ipsilateral oblique (40°) view using a power injector and 32cm field of view (FOV). After identification of the prostatic artery, a microcatheter and a 0.014” guidewire were introduced coaxially. Once the catheter entered into the prostatic artery the same ipsilateral oblique and frontal DSA were performed by hand injection in a 22-cm FOV. CBCT was performed only if the interventional radiologist (IR) judged it to be necessary.

PAE was performed using particles until the end-point of complete occlusion and reflux toward the origin of the artery was reached. Hand-injection DSA through the microcatheter was used to confirm complete occlusion. After bilateral embolization, the sheath was withdrawn and compression hemostasis performed for ten minutes. All patients were discharged in less than 24 hours. After each procedure several parameters were extracted from the DICOM headers, namely the fluoroscopy time, dose-area product (DAP; or kerma-area product), the number of images taken and irradiation parameters (voltage, current and pulse width) for DSA, fluoroscopy and CBCT techniques.

To evaluate the peak skin dose (PSD) to the patient, a Gaf-Chromic XR-RV3 film (Wayne, New Jersey) was placed under the patient. In all procedures, the radiologist wore a protective apron and thyroid collar; a ceiling-suspended
RESULTS
Bilateral PAE was successful in all patients and no skin lesions were seen. The average fluoroscopy time was 30.9 min (15.5-48.3 min). The mean total DAP per procedure was 450.7 Gy.cm² (248.3-791.73 Gy.cm²). DSA was found to be responsible for 71.5% of the total DAP, followed by fluoroscopy (19.9%) and CBCT (8.6%). The mean number of DSA series and images were 20.8 (9-36) and 463.5 (275-710), respectively. CBCT was performed in seven of 25 patients (28%), with the mean image acquisition number being 400 images (396-404). The mean patient PSD was 2,420.3 mGy (1,390 – 3,616) and the average effective dose for the IR was 17 µSv (4 – 47 µSv). The average equivalent dose in each location received by the IR during each PAE are shown in Table 1.

SIGNIFICANCE AND FUTURE DIRECTION
One case of radiation-induced dermatitis was reported after a PAE procedure, which had a fluoroscopy time of 72 minutes and a total DAP of 8 023.1 Gy.cm² [3]. Of other published reports were seen. The average fluoroscopy time was 30.9 min (15.5-48.3 min). The mean total DAP per procedure was 450.7 Gy.cm² (248.3-791.73 Gy.cm²). DSA was found to be responsible for 71.5% of the total DAP, followed by fluoroscopy (19.9%) and CBCT (8.6%). The mean number of DSA series and images were 20.8 (9-36) and 463.5 (275-710), respectively. CBCT was performed in seven of 25 patients (28%), with the mean image acquisition number being 400 images (396-404). The mean patient PSD was 2,420.3 mGy (1,390 – 3,616) and the average effective dose for the IR was 17 µSv (4 – 47 µSv). The average equivalent dose in each location received by the IR during each PAE are shown in Table 1.

CONCLUSIONS
PAE is a complex procedure and has now been shown to involve high radiation exposure for patient and staff. A change in the radiological protection culture among interventional radiologists should be encouraged, not to get the best image but to fully respect the ALARA principle.

REFERENCES