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PART 1

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reduction in FD size helps reduce operator and patient doses as well as makes the procedure more convenient to perform.

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Dose mapping during an interventional cardiology procedure using a DACS

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Purpose: During an interventional radiology procedure, the patient's skin-dose can become strong enough. In order to avoid the skin deterministic effects to occur, an accurate estimation of the skin-dose mapping is highly needed. The aim was to develop a model to calculate and localize the radiation dose to integrate it into our Dose Archiving and Communication System (DACS) called DOSITRACE.
Material and methods: DOSITRACE uses a mathematical model to reconstruct a two-dimensional skin-dose mapping that reflects the magnitude, shape, and localization of irradiation fields. The reconstruction is based on geometrical and dosimetric information contained within the stored acquisition DICOM files.
The theoretical model was validated by comparison with clinical tests performed on phantoms. Gafchromic films were placed on the phantom's back and so were exposed identically to the skin. Four experimentations have been performed including 34 field projections simulating simple and very complex acquisition cases.
Results: Comparison between simulated and measured skin dose on phantoms showed a difference less than 15 %. Moreover, the simulation of DOSITRACE produces results with a very good level of geometrical accuracy: simulated and measured fields have the same shape, size, and localization. Very small field displacement were reported for very few ones and are due to machine's uncertainty on the tube angle (measured to be +/- 1 to 2°).
Conclusion: This study shows that our software is a reliable tool to warn physicians when a high radiation dose is reached and then deterministic effects can be avoided. Thirty chronic total occlusion procedures will be performed soon during real patient procedures.

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Validation of a bio-dosimeter in interventional radiology: preliminary study

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Purpose: In the case of external irradiation, knowledge of the exposition doses is essential to make a diagnosis and define the therapeutic strategy. We performed a preliminary validation study of a bio-dosimeter quantifying external irradiation.
Material and methods: 58 patients with intracranial aneurysms treated by embolization were included. Per procedural comparative measurements were performed: thermoluminescent dosimeter (to obtain the absorbed dose to the scalp), VS bio-dosimeter to obtain the level of DNA repair proteins (γH2AX) in hair bulbs after irradiation.
Results: There was a significant induction of γH2AX protein level after irradiation in 74% of patients who have received a > 200mGy dose, and a correlation trend between increase in γH2AX level and cutaneous doses > 500mGy.
Conclusion: These preliminary results suggest a validation of the bio-dosimeter, leading to carry on this study in order to include patients irradiated with larger doses, and precisely determine the threshold of sensitivity of the bio-dosimeter.

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Estimating radiation dose to the fetus during prophylactic internal iliac occlusion in patients with abnormal inherent or inserted placenta

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Purpose: The risk of fetal effects, including childhood cancer induction, are thought to be negligible at doses < 50 mGy. The aim of our study is to estimate fetal radiation dose associated with prophylactic internal iliac occlusion during section Caesarean in patients with abnormal placenta.
Material and methods: From November 2015 to December 2018 we performed a prophylactic occlusion of the internal iliac arteries in 33 pregnant patients, average age 35 years (23-48 years). The combined procedures were indicated in 17 patients with prenatally diagnosed placenta previa, in 1 patient with placenta praevia and adherens, in 11 patients with placenta praevia and placenta accreta, in 4 patients with placenta praevia and percreta. Fogarty embolectomy catheters were used for occlusion of internal iliac arteries inserted by cross-over technique. All procedures were performed in the hybrid operating room with X-ray system Philips Allura Xper FD 20.
Results: The insertion of Fogarty catheters was technically successful in all patients. We use low dose x-ray fluoroscopy (7.5 frames per second, more noise). Fluoroscopy times required for the insertion of Fogarty catheters were 1.1-4.2 minutes, average time was 2.2 minutes. The average estimated radiation dose to the fetus was 12.05 mGy, the median was 12.875 mGy (4.18-34.85 mGy). Complications related to the interventional radiology procedure were found in one patient (thrombosis of common femoral artery).
Conclusion: A prophylactic occlusion of internal iliac arteries is a simple and safe procedure with very low estimated radiation dose to the fetus.

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Prophylactic balloon occlusion of internal iliac arteries in women with placenta previa: analysis of the radiation dose to the foetus

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Purpose: To evaluate the foetal radiation exposure during the prophylactic balloon occlusion of the internal iliac arteries (PBOIIA) for the prevention of intrapartum hemorrhage. Moreover, we analyzed the safety and efficacy of this procedure.
Material and methods: We evaluated six consecutive pregnant women with placenta previa which underwent PBOIIA in conjunction with cesarean section. Three procedures were performed in the obstetric operating room fitted with a moveable angiographic C-arm system and three in the angiographic room with a fixed C-arm system. Fluoroscopic times, dose area products and foetal radiation doses were recorded. We also compared PBOIIA group with no endovascular intervention group (two cases) in terms of pre- and post-delivery hemoglobin, blood transfusion and the postoperative hospitalization time.
Results: The total mean dose area product (mGycm^2), mean foetal radiation dose (mGy) and mean fluoroscopic time (min) were 20978, 9.03 and 3.63, respectively. The mean foetal radiation dose and mean fluoroscopic time were 6.63 and 4.97 for the procedures performed in the obstetric operating room, but 11.43 and 2.29 when considering procedures in the angiographic room. Technical success was achieved in all six cases. One case needed blood transfusion (post-delivery hemoglobin from 8.5 to 7.4 g/dL). The mean postoperative hospitalization time was 3.33 days.

In the no endovascular intervention group all patients needed transfusion and one had hysterectomy. The length of hospital stay was 4 days.
Conclusion: PBOIIA was associated with an acceptable foetal radiation dose, which is below the specific threshold level for deterministic effect. It was safe and effective with the blood loss volume effectively controlled.

P-766

Effective dose management using digital subtraction fluoroscopy save (DSFS) technique for extremity angiography

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Purpose: Proper use of the "fluoroscopy save," option allows for the DSFS (digital subtraction fluoroscopy save) to be substituted for cases requiring hand injection DSA (digital subtraction angiography) images.
Material and methods: To best replicate a real clinical situation where a dye is injected into the patient, Phantom and vessel models were used. A polyvinyl chloride tube was curved to represent the vessel, which was placed inside an acryl box (3mm) with an entry and an exit site for the dye. The Phantom was placed above the box to commence the experiment. The device model used was 'Allular X-per FD-20,' with the table height set at 85cm, SID 100, and FD size 48. The glass dosimeter was attached at 2 points: surface of the phantom for surface dose and the location of the operator for neighboring dose, with the detector 1cm away. An auto-injector was used to administer 20mL of the dye at 1mL/sec, with the image acquired through both DSA and DSFS.
Results: On average, 79.19% of the surface dose was reduced from 4122.67μGy to 857μGy, the neighboring dose from 117μGy to 23.67μGy at 79.75%. Independent t-test was completed through SPSS (version 18; PASW statistics), with the analysis showing significant difference ($p<0.001$).
Conclusion: Compared to the DSA, DSFS allows image acquisition with 79% reduced radiation dose, and a higher frame rate useful for capturing branching of the vessels. Furthermore, DSA road map can be used in conjunction with DSFS, further reduction in radiation would be possible without compromise of patients' health.

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Percutaneous embolization of recurrent varicocele in pediatric population: patient dose exposure analysis

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Purpose: Spermatic vein embolization represent an effective and minimally invasive option for varicocele. In pediatric population it is currently reserved for surgical relapse. Aim of this work is to prove that the varicocele endovascular treatment in pediatric patients entails low rate of complications and recurrences with a low ionizing radiation exposure.
Material and methods: A consecutive retrospective series of 47 adolescent patients treated with endovascular retrograde embolization after post-surgical recurrence was collected. Images were acquired according to a strict protocol of low dose radioscopy. Dose area product (DAP) was recorded for each procedure. We estimated with Monte-Carlo Simulator by our Health Physics Unit the Effective dose (E) and malignancy risk.
Results: Results were as follows: therapeutic success in 46/47 patients (98%) with complete resolution in 41/46 (89%) and degree reduction in 5/46 (11%). No significant complications occurred. Average DAP was equal to 18881 mGyxcm2; average DAP was equal to 13208 mGyxcm2 after the introduction of flat panel (2013). Average E equal to 1,6 mSv and a risk of malignancy equal to 8,7 x 10^-5.
Conclusion: Percutaneous embolization of varicocele appears to be effective as surgical correction. Pediatric patients undergoing this treatment have very low values of ionizing radiation exposure with an equally low risk of malignancy. New technological devices combined with a greater experience of the operators can further reduce the dose administered to these young patient.

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Phantom study of real-time eye lens dose rate monitoring with a scintillator with optical fiber dosimeter

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Purpose: To evaluate real-time monitoring of the eye lens dose rate during fluoroscopy measured with a scintillator with optical fiber (SOF) dosimeter.
Material and methods: Posteroanterior (PA), right anterior oblique 30 (RAO30) and left anterior oblique 30 (LAO30) fluoroscopies (10 seconds exposure, 2.5 f/s) were performed at the phantom patient's chest and upper abdomen with a physician phantom positioned at the right thigh. Physician's left eye lens dose rate (μGy/s) was recorded with a SOF dosimeter (MIDSOF, Acrobio Co., Japan) with and without a suspended transparent leaded shield (2 mm lead equivalent) and leaded table skirt (0.5 mm lead equivalent). The median dose rate and interquartile range (IQR) of 10 times fluoroscopies in each condition were analyzed. Reduction factors of the dose rate were compared with the unshielded condition.
Results: The medians of eye lens dose rate without protection implements were 27.8 (IQR: 24.9-36.1), 32.4 (24.7-39.0) and 33.6 (29.8-43.6) μGy/s in PA, RAO30 and LAO30, respectively. The medians with a suspended shield were 19.6 (17.3-24.4), 23.5 (19.2-28.9) and 21.5 (19.1-27.7) μGy/s, respectively. The medians with a skirt were 17.6 (16.0-22.3), 19.8 (17.8-26.2) and 19.7 (13.0-27.3) μGy/s, respectively. The medians with both protection implements were 12.2 (10.7-15.7), 12.8 (10.6-15.9) and 12.0 (10.1-15.2) μGy/s, respectively. Use of a suspended shield or skirt alone significantly reduced the lens dose rate ($p < 0.001$). Use of both implements together was more protective than either used alone ($p < 0.001$).
Conclusion: Use of a suspended transparent leaded shield or/and leaded table skirt significantly decreases physician's eye lens dose rate.

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Radiation exposure in 250 patients in a single high-volume center for prostatic artery embolization (PAE)

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Purpose: In published studies, radiation exposure (RE) in PAE to the patient may reach critical levels as in the study of Andrade (JVIR 2017) with mean dose are products (DAP) of 45.070 cGycm² and a maximum exposure of 79.173 cGycm² in a single patient. The aim of this study was to assess the impact of experience on RE in this demanding procedure in a high-volume center (HVC).
Material and methods: Between January 2017 and September 2018, 250 consecutive patients with lower urinary tract symptoms (LUTS) secondary to benign prostate hyperplasia (BPH) were treated by intended bilateral PAE. For each patient, age, body mass index (BMI), Dose area product (DAP), fluoroscopy time (FT) were recorded. Examinations performed in 2017 (N = 121, Group A) were compared to the ones of 2018 (N = 129; Group B). A comparison to the literature was amended.
Results: All patients were male, mean age was 70.9 ± 8.6 years. Mean BMI measured 26.8 ± 3.6. Regarding patient related parameters, there were no differences between Groups A and B ($p>0.05$). Looking at procedure parameters, mean FT of all patients was 52.1 ± 23.8 mins. Mean DAP amounted for 10.515 ± 4.970 cGycm². There was no difference observed