SSM24

Vascular/Interventional (IR: Radiation Safety)

Scientific Papers

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Wed, Dec 3 3:00 PM - 4:00 PM  Location: E352

Participants

Moderator
Sarah Beth White MD : Consultant, Guerbet SA Consultant, Vascular Solutions, Inc Research support, Seimens AG
Moderator
Robert G. Dixon MD : Nothing to Disclose

Sub-Events

SSM24-01

Should the Informed Consent Process for Interventional Radiology Procedures include the Risk of Radiation Exposure: The Interventional Radiology Patient Perspective

Rebecca Zener MD (Presenter): Nothing to Disclose, Daniele Patrice Wiseman MD, FRCPC : Nothing to Disclose, Amol Mujoomdar MD : Speaker, Cook Group Incorporated Speaker, Covidien AG

PURPOSE

Radiation exposure is inherent in interventional radiology procedures. A potential exposure of 1 mSv has been suggested as a cutoff for provision of risk information, as it corresponds to a 1 in 10000 cancer risk. Informed consent requires disclosure of rare yet potentially significant risks, yet patient knowledge of these risks is lacking. The purpose of this study is to explore patient perception of cancer-related risk exposure and whether inclusion of radiation risks in the informed consent is warranted.

METHOD AND MATERIALS

A multiple-choice survey was prospectively administered to 26 adult interventional radiology patients at a tertiary care centre (patient mean age = 61.4 years; 64% female; 36% male). 58% of patients had previously undergone an IR procedure. Statistical analysis with Fisher Exact test (p<0.05) was performed.

RESULTS

Most patients want to be informed if there is a radiation-related 3% increased cancer risk over 5 years (89%), or if the associated risk is 1 in 1000 (79%) or 1 in 10000 (63%). While half of the cohort considers 3% small, 35% want to further discuss the risks and alternate options, and 15% would only proceed if it were a life-saving procedure. Only 62% of patients were aware they were going to be exposed to radiation, irrespective of previous IR history. Most patients believe radiation consent should be routine for IR procedures (85%) and include radiation-related cancer risks (88%). A majority (62%) believes that the referring physician and the interventional radiologist are responsible for informing patients, and verbal radiation consent is sufficient. No significant difference was present between groups based on previous IR history (p>0.05).

CONCLUSION

Patient awareness of radiation exposure is suboptimal. Based on this survey, a majority of patients want to discuss cancer-related radiation risks in order to make informed decisions. Interventional radiologists should consider including radiation consent in the informed consent for procedures with anticipated doses above 1 mSv.

CLINICAL RELEVANCE/APPLICATION

Interventional radiology patients want to discuss cancer-related radiation risks in order to make informed decisions, and interventional radiologists should consider including radiation consent in the informed consent for procedures with anticipated doses above 1 mSv.

SSM24-02

Substantial X-ray Dose Reduction in Intra-arterial Therapy for Liver Cancer: A New Angiographic Imaging Technology

Ruediger Egbert Schernthaner MD (Presenter): Nothing to Disclose, MingDe Lin PhD : Employee, Koninklijke Philips NV, Julius Chapiro MD : Nothing to Disclose, Rafael Duran MD : Nothing to Disclose, Boris Gorode茨ki : Nothing to Disclose, Jean-Francois H. Geschwind MD : Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

PURPOSE

To investigate potential x-ray dose reduction, without compromising image quality, of fluoroscopy and digital angiography in the setting of liver cancer treatment.
To investigate potential x-ray dose reduction, without compromising image quality, of fluoroscopy and digital subtraction angiography (DSA) of a new angiographic imaging system in patients undergoing intra-arterial therapy (IAT) for liver cancer.

METHOD AND MATERIALS

In this ongoing prospective trial, 25 consecutive patients underwent hepatic IAT on a new imaging platform (AlluraClarity, Philips Healthcare, Best, The Netherlands). For detailed dose-logging, a radiation dose structured reporting (RDSR) system was setup that included air kerma (AK) and dose area product (DAP) for each run (fluoroscopy, digital subtraction angiography (DSA), single shot exposure and Cone Beam CT). The dose from this imaging platform was compared to 25 other consecutive patients who underwent similar procedures on the predecessor imaging platform (Allura, Philips Healthcare). DSA image quality for both imaging platforms was assessed on a five-rank-scale in a randomized and blinded fashion. Paired t-test was performed for BMI and fluoroscopy time, Mann-Whitney U test was used to compare image quality and dose of each type of run between the two imaging platforms.

RESULTS

Both patient cohorts showed no difference with regard to BMI (p=0.87) and fluoroscopy time (p=0.98). The new system resulted in a significant dose reduction in total AK and DAP of 58% and 60% compared to the old platform (median of 0.47 Gy and 143.41 Gy*cm2 vs. 1.12 Gy and 359.59 Gy*cm2, respectively (p<0.01)). Specifically, DAP for fluoroscopy and DSA decreased significantly by 60% and 77%, respectively (p<0.01). During the procedures, no relevant problems due to image quality were reported. Likewise, the blinded evaluation of image quality revealed no differences between the new and the old imaging platforms (mean score 1.16 vs 1.24; p=0.48).

CONCLUSION

The new imaging platform allowed for significant x-ray radiation dose reduction in patients undergoing IAT for liver cancer without compromising image quality.

CLINICAL RELEVANCE/APPLICATION

During the last decade, the use of hepatic IAT has steadily increased. Thus, the reduction of x-ray dose for both patients and clinicians is essential for radiation protection.

SSM24-03

Occupational Radiation Exposure during Endovascular Aortic Repair

Anna Margaretha Sailer MD, MBA (Presenter): Nothing to Disclose, Geert Willem H. Schurink MD, PhD: Nothing to Disclose, Martine Bol: Nothing to Disclose, Michiel W. De Haan MD, PhD: Nothing to Disclose, Wim Van Zwam MD: Nothing to Disclose, Joachim Ernst Wildberger MD, PhD: Nothing to Disclose, Cecile R. L. Jeukens PhD: Nothing to Disclose

PURPOSE

Aim of this study was to evaluate the radiation exposure to operating room personnel and its determinants during endovascular aortic repair procedures.

METHOD AND MATERIALS

Occupational radiation exposure was prospectively evaluated during forty-four endovascular aortic repair procedures. Procedures were performed between 07/2013 and 01/2014 on our hybrid operating room (Allura Xper with ClarityIQ, Philips Medical Systems, Best, The Netherlands). Twenty-two infrarenal aortic procedures (EVAR), eleven thoracic aortic procedures (TEVAR) and eleven fenestrated or branched aortic procedures (FEVAR) were included. Real-time over-lead dosimeters attached to the left breast pocket (DoseAware, Philips) were used to measure personal doses for operators (first (FS) and second (SS) surgeon), radiology technicians (RT), scrub nurses (SN), and anesthesiologists (AN). Besides protective apron and thyroid collar, no radiation shielding was used. Procedural dose area product (DAP), iodinated contrast volume, fluoroscopy time, patients’ weight and angulation of the C-arm were documented. Results were analyzed using regression coefficient and Kruskal-Wallis test.

RESULTS

Average procedural over-lead dose and standard deviation was 0.17 ±0.21 mSv for the FS, 0.042 ±0.045 mSv for the SS, 0.019 ±0.042 mSv for the RT, 0.017 ±0.031 mSv for the SN and 0.006 ±0.007 mSv for the AN. FS doses were significantly higher during FEVAR compared to EVAR and TEVAR (mean FS dose during FEVAR: 0.34 ±0.28 mSv, EVAR: 0.11 ±0.21 mSv, TEVAR: 0.06 ±0.05 mSv; p = 0.003). There was a significant correlation between the dose of the FS and procedural DAP (R = 0.686, p < 0.001) and iodinated contrast volume (R= 0.672, p < 0.001) and a weak correlation with fluoroscopy time (R= 0.396, p = 0.049). Usage of left anterior C-arm projections >60 degrees was associated with significantly higher FS doses (p = 0.02). For EVAR procedures, a significant correlation between FS dose and patient’s weight was found (R = 0.561, p = 0.024). SS dose and AN dose were significantly correlated with the FS dose (R= 0.668, p = 0.003 and R= 0.838, p < 0.001).

CONCLUSION

Strong predictors for high personal doses are procedural DAP, iodinated contrast volume, patient weight and left lateral C-arm angulation >60 degrees.

CLINICAL RELEVANCE/APPLICATION
SSM24-04

**Patient Radiation Dose Reduction during Transarterial Chemoembolization Using a Novel X-ray Fluoroscopy Imaging Acquisition and Processing Platform**

Ryan Michael Kohlbrenner MD (Presenter): Nothing to Disclose, Kanti Pallav Kolli MD: Research Grant, Koninklijke Philips NV, Andrew Grenville Taylor MD, PhD: Nothing to Disclose, Maureen Pearl Kohi MD: Nothing to Disclose, Nicholas Fidelman MD: Nothing to Disclose, Robert K. Kerlan MD: Nothing to Disclose, Robert G. Gould DSc: Research Grant, Koninklijke Philips NV

**PURPOSE**

To compare the patient radiation doses during transarterial chemoembolization (TACE) for hepatocellular carcinoma (HCC) performed with Philips Allura Xper versus Philips Allura Clarity imaging platforms.

**METHOD AND MATERIALS**

Total fluoroscopy time, cumulative air kerma, and cumulative dose area product data were retrospectively collected for 129 TACE procedures performed to treat HCC. The first 85 procedures were performed in an interventional radiology suite equipped with the Philips Allura Xper imaging platform. The subsequent 44 procedures were performed in the same suite following installation of the Philips Allura Clarity imaging platform. To confirm similarities in patient size, the anteroposterior diameter of the upper abdomen at the level of the portal vein bifurcation was assessed on CT or MRI for all patients in both groups. Mean values were compared using two-tailed t-tests.

**RESULTS**

Following installation of the Philips Allura Clarity platform, a 43.7% reduction in mean cumulative dose area product (3033.2 versus 1707.2 mGy-cm², p < 0.0001) and a 29.5% reduction in mean cumulative air kerma (1445.4 versus 1019.3 mGy, p < 0.001) were found in comparison to procedures performed with the Philips Allura Xper platform. Total fluoroscopy time was 20% greater (1679.3 versus 2015.7 seconds, p < .05) for procedures performed with Allura Clarity compared with Allura Xper. Patient size was similar between the two groups (Anteroposterior thickness of 268.4 versus 265.9 mm, p = .70).

**CONCLUSION**

The Philips Allura Clarity imaging acquisition and processing platform significantly reduces patient radiation dose when compared to Philips Allura Xper in patients of comparable size undergoing TACE for HCC treatment. Dose reduction was achieved despite an increase in average fluoroscopy time. Further studies are necessary to determine whether the increase in fluoroscopy time is related to image quality or bias in patient selection to treat more difficult cases in the new low-dose room.

**CLINICAL RELEVANCE/APPLICATION**

TACE procedures can be successfully performed at patient radiation doses significantly below current norms.

SSM24-05

**Radiation Dose Reduction in Two Common Interventional Procedures Following Allura ClarityIQ Upgrade**

Jaydev Kardam Dave PhD, MS (Presenter): Nothing to Disclose, David J. Eschelman MD: Consultant, Guerbet SA, Carin F. Gonsalves MD: Nothing to Disclose, Eric Laurence Gingold PhD: Nothing to Disclose

**PURPOSE**

To investigate radiation dose reduction post installation of an image processing upgrade for an interventional x-ray system.

**METHOD AND MATERIALS**

Philips Allura ClarityIQ upgrade provides automatic motion artifact reduction, temporal and spatial noise reduction, and contrast enhancement, allowing a reduction in radiation dose. Air kerma rate (AKR) measurements were made with acrylic simulating 9-27cm patient thickness for 19"-6" magnification modes and 2 dose modes, before and after ClarityIQ upgrade. Dose indicators (cumulative air kerma (CAK) and dose area product (DAP)) for two types of interventional procedures (chemo/immuno-embolization and routine catheter check/change) were analyzed for patients who were treated, before and after ClarityIQ upgrade, as part of their standard of care. Two experienced interventional radiologists (blinded to dose values) selected cases matching in complexity, number of digital acquisitions and fluoroscopy time, and provided a subjective evaluation of image quality.

**RESULTS**

For acrylic measurements, AKR was reduced by 25-77% after ClarityIQ upgrade. Thirteen chemo/immuno-embolization patients and 20 patients with routine catheter procedures were identified. There were no statistical differences in fluoroscopy time or digital acquisitions between the procedures for each patient (p>0.05). The mean reduction for the embolization procedures in CAK was 347 mGy (95% CI: 251-442 mGy; p<0.001) and in DAP was 159137 mGy.cm² (95% CI: 126282-191992 mGy.cm²; p<0.001) when ClarityIQ was used; resulting in a 37-79% reduction in CAK and 51-84% in DAP on a per patient basis. For
routine catheter procedures, the mean reduction in CAK was 33 mGy (95% CI: 17- 48 mGy; p<0.001) and in
DAP was 10795 mGy.cm² (95% CI: 6653-14937 mGy.cm²; p<0.001) when ClarityIQ was used, resulting in a
reduction of 27-81% in CAK and 14-89% in DAP on a per patient basis. Subjective evaluation of patient images
revealed no loss in image quality when ClarityIQ was used.

CONCLUSION

ClarityIQ upgrade resulted in a 14-84% reduction in radiation dose indicators to patients for the procedures
considered in this study, consistent with expectations based on phantom measurements, without loss in
perceived image quality.

CLINICAL RELEVANCE/APPLICATION

An image processing upgrade for an interventional radiology system allows reduced radiation dose in both
fluoroscopy and digital acquisition modes, reducing potential risks to both patients and staff.

SSM24-06 Significant Acquisition Dose Reduction Maintains Diagnostic Quality of Biplane Cerebral Digital
Subtraction Angiography

Amir Reza Honarmand MD (Presenter): Nothing to Disclose, Ali Shaibani MD: Nothing to Disclose, Michael Charles Hurley MBBCh: Nothing to Disclose, Christina Louise Sammet PhD: Nothing to Disclose, Sameer A. Ansari MD, PhD: Shareholder, RaPID Medical Technologies, LLC

PURPOSE

We aimed to investigate the feasibility of reducing the radiation exposure dose in diagnostic cerebral DSA
examinations while preserving the overall image quality for diagnostic purposes.

METHOD AND MATERIALS

Following IRB approval, a prospective study was performed on patients undergoing diagnostic cerebral DSA
using biplane flat detector angiography unit. DSA images were acquired using a predefined manufacturer
standard program by selecting detector dose of 3.6 μGy/frame (mean typical tube voltage (TTV): 80.6 kVP,
mean tube current (TC): 230.6 mA, using focal spot size (FS) of 0.6 and inherent filtration) and reduced
detector dose of 1.2 μGy/frame (mean TTV: 73.6 kVP, mean TC: 153.5 mA, using FS of 0.3 with additional
0.1/0.2 copper filter) dose protocols for each patient. Using identical contrast agent, contrast injection rate, and
fluoroscopy time, randomly selected internal carotid or vertebral arteries and their contralateral equivalent
arteries were injected to obtain standard radiation dose and low radiation dose AP and lateral DSA images,
respectively. Image quality assessment was performed independently by two neurointerventionalists. A 5 point
scale was used for qualitative evaluation of arterial, capillary, and venous phases of DSA images respectively.
The total score was defined as the overall diagnostic value. Paired sample t-test and Wilcoxon's signed rank test
compared the kerma-area product (KAP) and scores assigned to image quality parameters, respectively. P
value <0.05 was considered statistically significant.

RESULTS

Twenty-three DSA image series were obtained from nine patients (8M/1F, mean age: 65.9) undergoing
diagnostic DSA. Mean KAP was significantly reduced by 60% or 2.5 fold (1408.90 ± 419.18 μGy/m² versus
557.08 ± 214.56 μGy/m², P <0.0001). No significant difference was observed between image quality scores
assigned by the observers while assessing arterial (observer 1 (O1): P=1.0; observer 2 (O2): P=0.24), capillary
(O1: P=0.54; O2: P=0.3), venous (O1: P=0.14; O2: P=0.7) phases, and overall diagnostic value (O1: P=0.34;
O2: P=0.8).

CONCLUSION

Radiation exposure dose can be reduced significantly without compromising image quality for diagnostic
purposes in cerebral DSA studies.

CLINICAL RELEVANCE/APPLICATION

Significant reduction of radiation exposure dose is feasible while maintaining image quality for diagnostic and
therapeutic purposes in intracranial endovascular procedures.