

PATIENT SKIN DOSIMETRY IN INTERVENTIONAL CARDIOLOGY IN THE CZECH REPUBLIC

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Introduction

- More than 55 000 CA and more than 22 000 PTCA procedures (per 10,5 mil. inhabitants) performed every year in the Czech Republic in 22 interventional cardiology centres
- Diagnostic reference levels (DRL) for CA not established yet
- Skin dosimetry - not routinely performed
- Occurrence of maximum skin dose (MSD) higher than 2 Gy

- National Project „Radiation Exposures to Patients in Interventional Radiology“ (VaV SUJB 4/2008), duration 2008-2010
- Three cooperating hospitals performing more than 17 % (about 3 400) of all PTCA procedures in the Czech Republic every year



Purpose

- To establish a suitable method of MSD and skin dose distribution assessment for patients undergoing CA or PTCA
- To determine number of patients receiving MSD higher than 2 Gy
- To establish national diagnostic reference level for CA
- To suggest simple methods and procedural steps resulting in dose reduction and optimization of the procedures without loss of diagnostic information (use of collimation, frame rate, image acquisition projections...)



Materials and methods (1)

- 2 methods of skin dosimetry are used:
 - Gafchromic films (XR RV3, www.ispcorp.com)
 - Evaluating – use of a flat bed scanner, scan parameters 24-bit color, 72 dpi, without color correction, red channel used for dose assessment
 - Calibration – on PMMA phantom in clinically relevant beams
 - Reconstruction of skin dose distributions
 - Placement of X-ray field in entrance surface plane of patient according to exam protocol and summing of skin dose values for overlapping fields
 - P_{KA} of fluoroscopy is divided into image acquisition projections

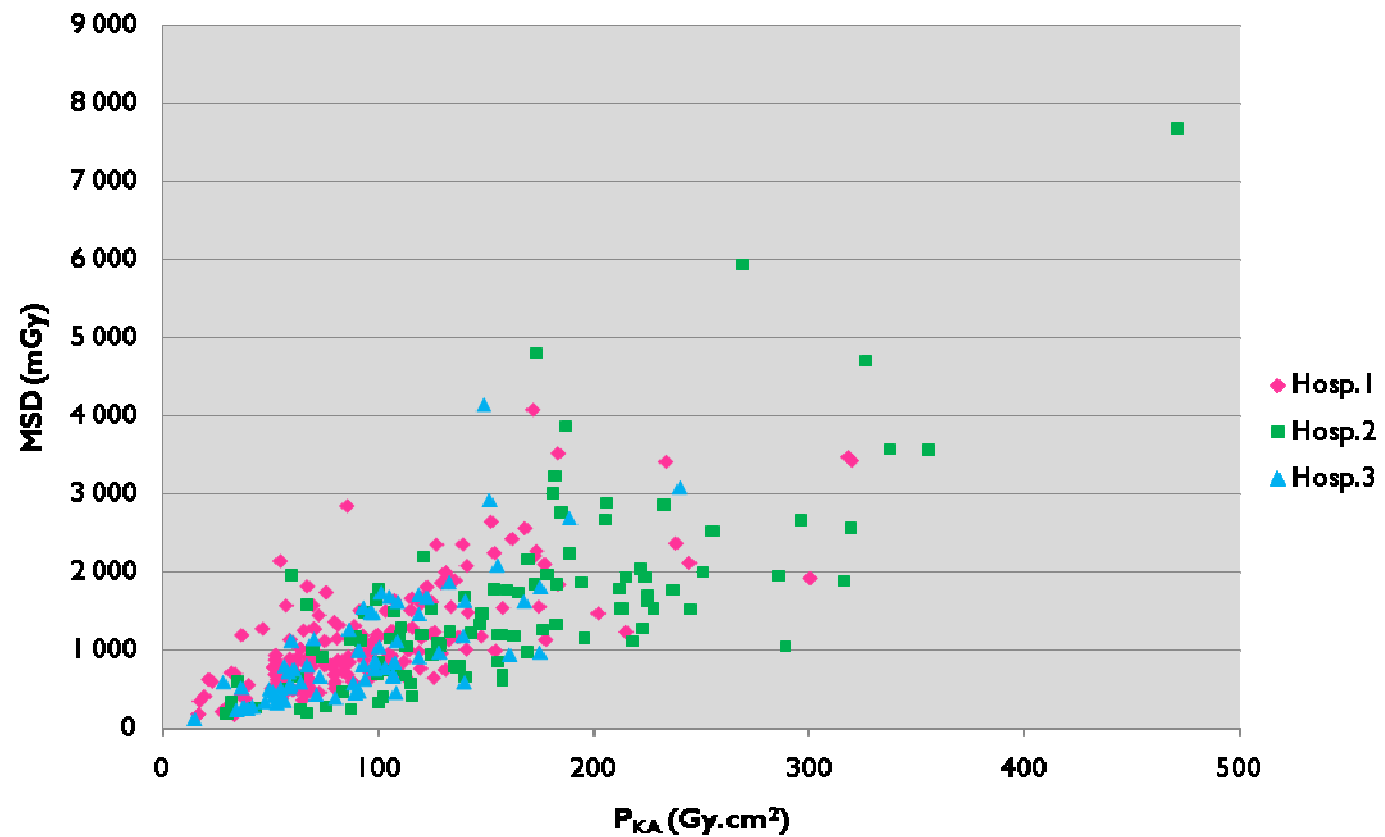


Materials and methods (2)

- Used angiographic systems: Siemens AXIOM Artis (two hospitals with an image intensifier, one hospital with flat panel detector)
- Data collection - exam protocols with dosimetric data (P_{KA} for fluoro and image acquisitions, cumulative dose, skin dose from image acquisition projections) and exposure parameters (fluoro time, number of frames, image acquisition projections)
- 270 patients were monitored by gafchromic film, more complicated procedures were requested
- Reconstruction of skin dose distribution was performed for 460 patients (118 for CA and 342 for PTCA)

Results (1)

- No CA with MSD higher than 2 Gy
- 44 PTCAs with MSD higher than 2 Gy (MSD 2-3 Gy: 28, MSD 3-4: 10, MSD 4-5 Gy: 4 and 2 MSDs higher than 5 Gy)

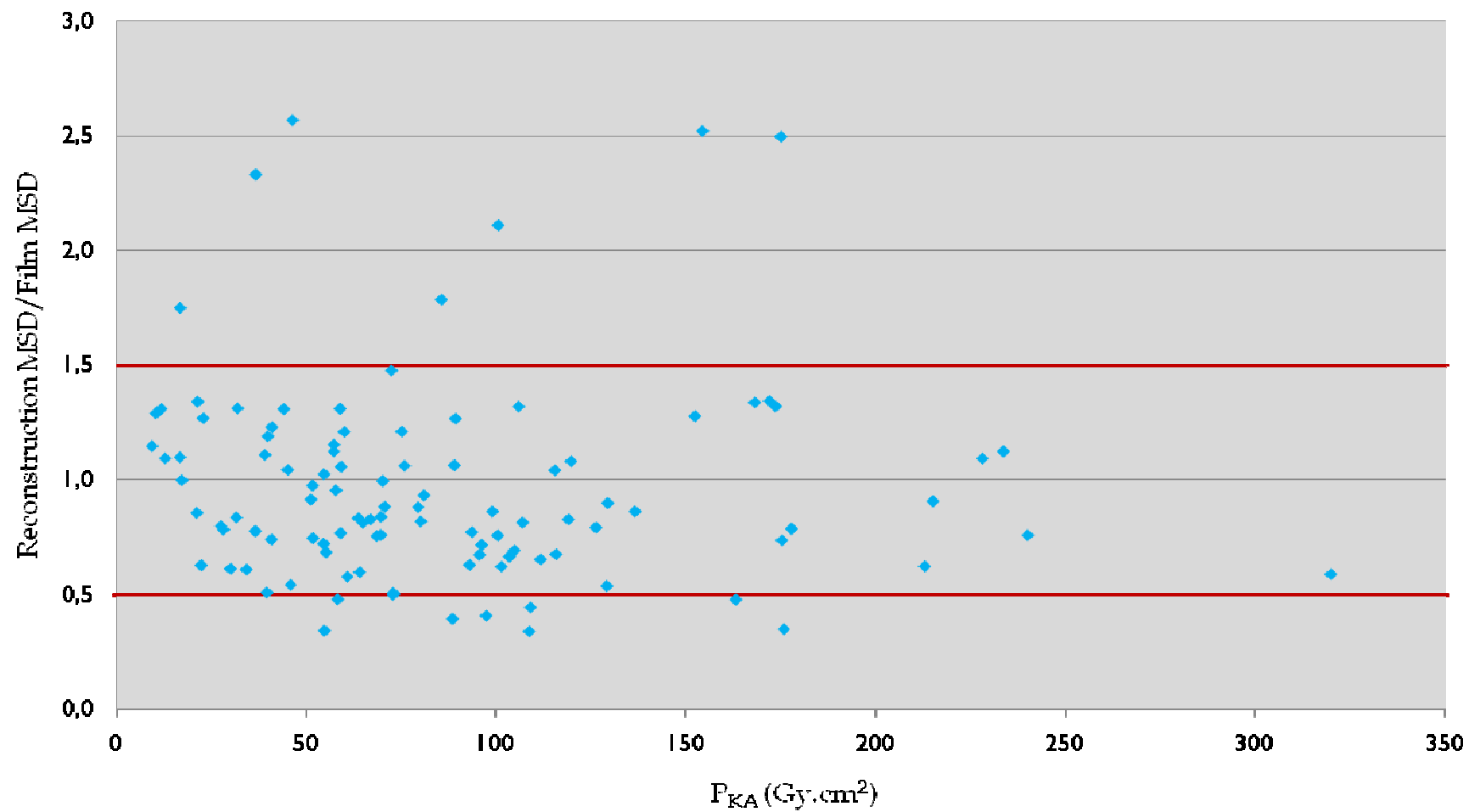




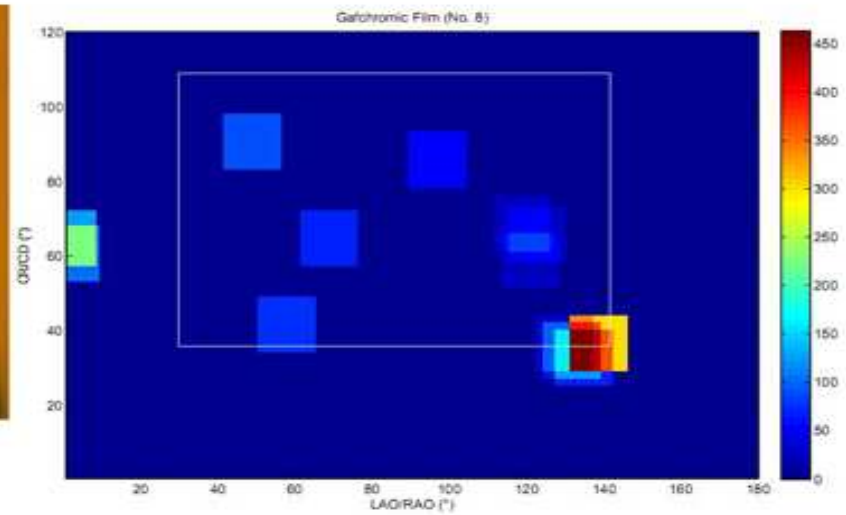
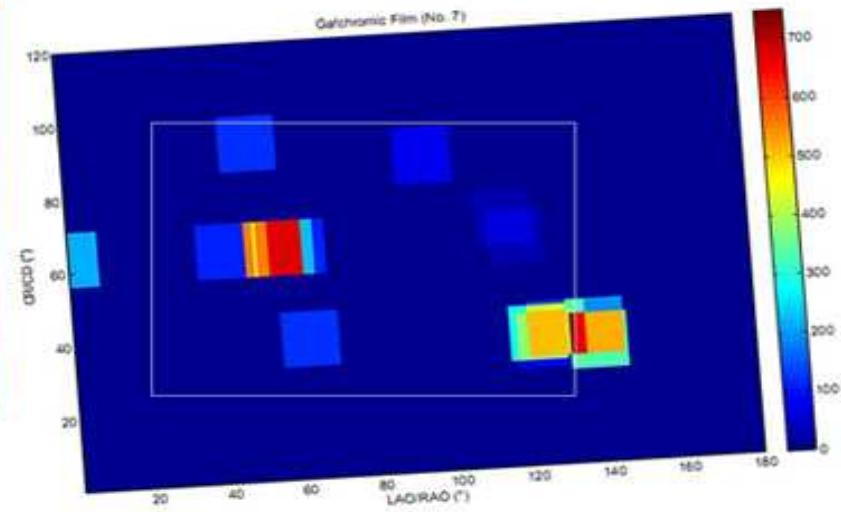
Results (2)

- It is difficult to determine trigger level of P_{KA} which indicates MSD higher than 2 Gy
- Ratio of MSD from reconstruction and MSD from film is in range 0,5 – 1,5 for 85 % patients – see next slide
- For all patients with ratio above 1,5 – about 70 % of P_{KA} was from fluoroscopy, therefore the accuracy of MSD from reconstruction is lower and MSD is overestimated
- Spatial distribution of radiation fields from reconstructions is in good agreement with spatial distributions of radiation fields on films

Results (3)



Results (4)



Examples of used gafchromic films and their reconstructions (dose in mGy)



Conclusion

- For CA procedures it is not expected MSD will be higher than 2 Gy
- For PTCA procedures MSD are higher than 2 Gy for approximately 10 % of patients
- The established method of reconstruction of skin dose distribution is useful tool for MSD estimation of heavily exposed patients who were not monitored by gafchromic film
- The method enables MSD estimation with accuracy ± 50 % for most of the patients
- P_{KA} value will not be used for MSD estimation due to poor correlation between P_{KA} and MSD