Reducing Radiation Dose in Pediatric Diagnostic Fluoroscopy

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PURPOSE

To assess radiation dose in common pediatric diagnostic fluoroscopy procedures and implement training on dose reduction methods in order to reduce radiation use.

METHODS

After obtaining consent from the involved Radiologists, fluoroscopy time and radiation dose area product (DAP) were recorded for three common fluoroscopy procedures including upper GI's (UGI), voiding cystourethrograms (VCUG) and barium enemas (BE) over a six month period. The results were presented to the radiologists followed by a single 1 hour training session on methods of reducing radiation dose including: reducing patient to image intensifier distance, collimation, use of pulsed fluoroscopy, and removal of the grid. Fluoroscopy times and radiation doses were then recorded for an additional six months. DAP was normalized to fluoroscopy time and non-parametric Wilcoxon testing was used to assess for differences between groups.

TABLES & FIGURES

Table 1. Patient age by study type.

		Age (months)		
		Pre-Training	Post-Training	
Study	Statistic	n = 945	n = 530	p-value
Overall	Median (LQ, UQ)	24 (3 - 84)	19 (3 - 72)	0.13
	Range	0.03 - 276	0.01 - 276	
BE	Median (LQ, UQ)	24 (3 - 84)	24 (3.5 - 96)	0.9
	Range	0.07 - 216	0.01 - 276	
UGI	Mean (SD)	24 (3 - 84)	22 (4 - 96)	0.9
	Range	0.03 - 276	0.03 - 228	
VCUG	Mean (SD)	24 (3.6 - 72)	14.5 (2 - 51)	0.005
	Range	0.03 - 228	0.10 - 228	

Table 2. Radiation dose (DAP) and fluoroscopy time pre-training by study type.

		Dose (μGy•m²)		Time (min)	
Study	N	Median (LQ, UQ)	[Min, Max]	Median (LQ, UQ)	[Min, Max]
BE	184	32.8 (8.6, 107.0)	[0.9, 1562.4]	1.1 (0.6, 1.8)	[0.1, 11]
UGI	456	16.9 (3.9, 66.4)	[0.01, 2077.1]	1.4 (0.5, 2.4)	[0.1, 9.8]
VCUG	305	12.8 (3.5, 43.2)	[0.3, 2251.8]	1.0 (0.5, 1.7)	[0.2, 7.3]

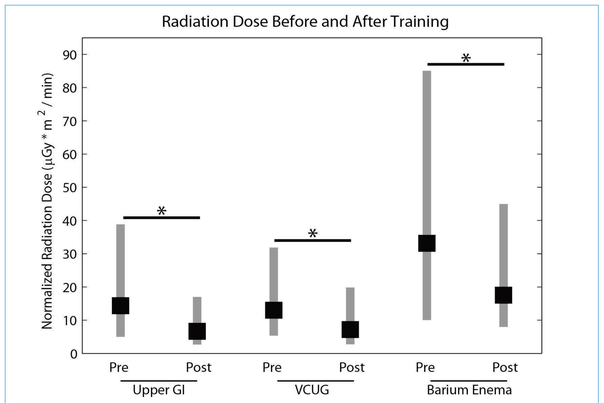

Figure 1. Median Radiation Dose Before and After Dose-Reduction Training.

For all study types, there was a statistically significant drop in normalized DAP ($p < 0.05$). Black squares represent median and gray bars represent lower and upper quartiles.

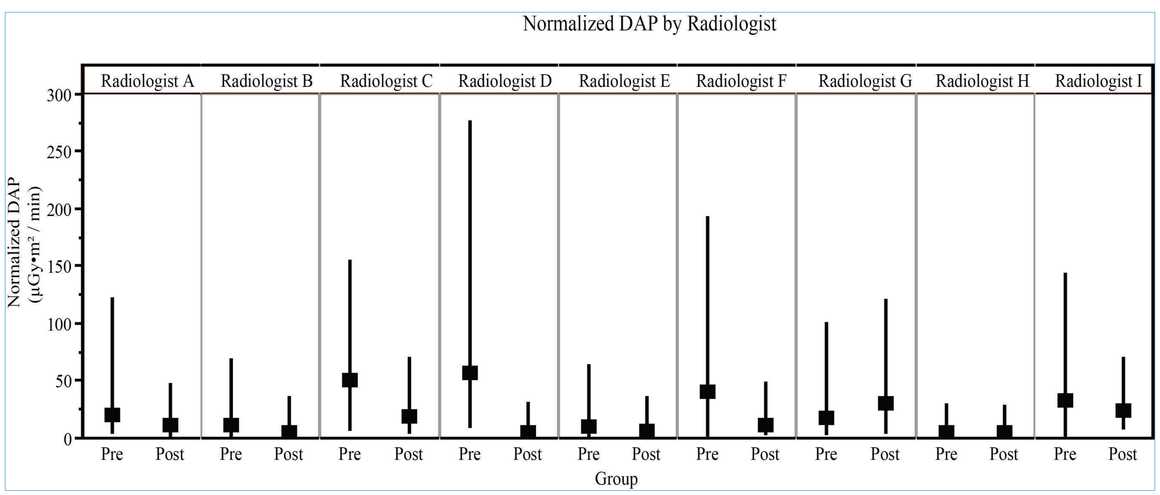

Figure 2. Median Radiation Dose Before and After Dose-Reduction Training by Physician. Nearly all physicians showed a reduction in normalized DAP after the single training session, with the exception of those with low doses initially. Many also showed reduced variability in normalized DAP (i.e. interquartile range) in the post-training period.

RESULTS

Data from a total of 1479 cases (945 pre-training & 534 post-training) from fifteen different radiologists were collected. There was no statistically significant difference in the age, proportion of exam types or fluoroscopy time between the pre- and post-training groups ($p > 0.1$) with the exception of a small decrease in median fluoroscopy time for VCUG's (1.0 vs. 0.9 minutes, $p = 0.04$). For all exam types, there was a statistically significant decrease in the median normalized DAP ($p < 0.05$) between pre- and post-training groups. The median and quartiles for pre-training and post-training normalized DAP's (μGy•m² / min) were 14.36 (5.00, 38.95) & 6.67 (2.67, 17.09) for UGI's, 13.00 (5.34, 32.71) & 7.16 (2.73, 19.85) for VCUG's and 33.14 (9.80, 85.26) & 17.55 (7.96, 46.31) for BE's (Figure 1).

CONCLUSION

With a single dose reduction training session, we were able to reduce radiation dose during common pediatric diagnostic fluoroscopic procedures by nearly 50%. Implementation of radiation dose tracking and use of short training sessions lead to clinically significant radiation dose reductions.

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