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A four-year review of current local dose area product levels for paediatric fluoroscopy in an Italian referral centre compared with standard international guidelines

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Purpose-Objective

To our knowledge, very little published data exists on the current range of doses being delivered throughout Italian paediatric hospitals. A prospective single-centre study has been performed to assess dose area product (DAP) values in children having fluoroscopic examinations and to revise local diagnostic reference levels (DRLs).

Material and methods

From November 2010 to December 2012 and from January 2013 to November 2014 data from a total of 3,722 consecutive examinations performed in three dedicated fluoroscopy rooms were collected prospectively. For each examination performed the patients name, date, DAP (cGycm2), examination type, radiologist's name and machine were recorded.

All studies were performed using one of two different combined two-in-one radiography/fluoroscopy systems (AXIOM Luminos dRF and R200, Siemens) with digital flat panels. The DAP meter is calibrated by our radiation physicists on a yearly basis and a tolerance of 3% is considered acceptable. The exact technique was, at the discretion of the radiologist, tailored to the individual clinical question and included a mixture of grabbed images and spot exposures. Data (75th percentile, median) were collected on an individual basis from all examinations, grouped by age into five age groups (newborns, one-year-old, five-year-olds, ten-year-olds, and adults), stratified by specific examinations and compared with literature data derived from the National UK Radiological Protection Board (NRPB).

In two different consecutive two-year surveys, we analysed the exam quality and the average dose for each single operator (radiographer or radiologist) to correct the most frequent technical errors and refine the exam-protocol with the final goal of minimising the exam dose.

Results

The five most commonly performed examinations (3,673 cases from a total of 3,722 exams) were further analysed (Fig. 1).

DAPs (75th centile and median) for upper gastrointestinal studies (UGI) and micturating cystograms (VCUG/MUC) were substantially lower than the international literature reference doses reported as DRL in NRPB2000 just after the first survey in 2012 but improved after the second survey in 2014 (Fig. 2).

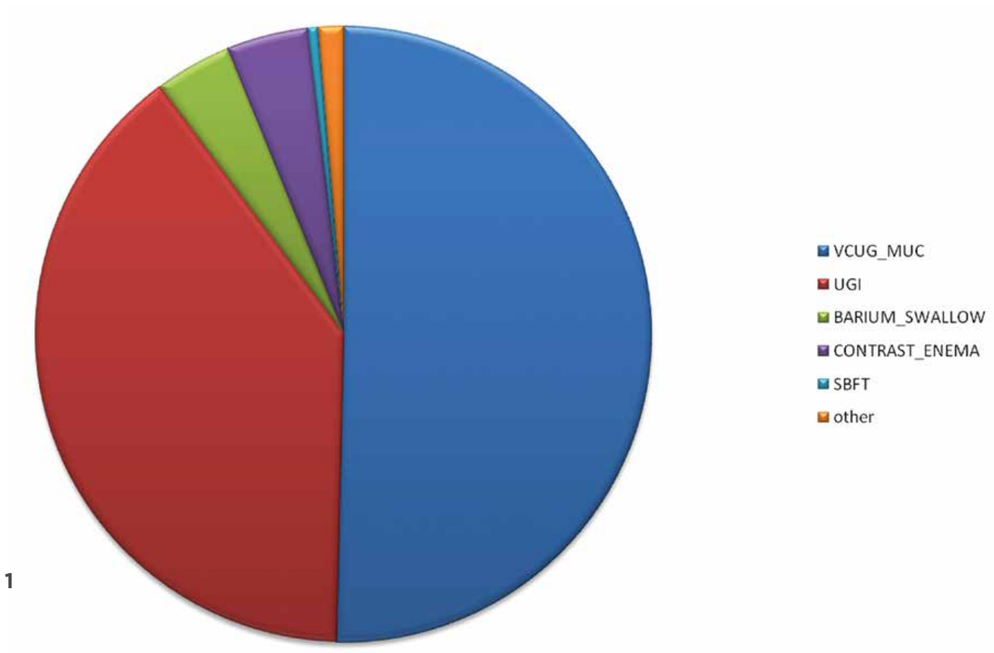

Fig. 1

OPBG DRL 2012

	Newborn	1	5	10	Adult
UGI	**22,9** *14,8*	**34,0** *28,7*	**67,5** *66,9*	**160,8** *127,3*	**323,7** *273,8*
Barium Swallow	**4,8** *5,4*	**25,4** *33,5*	**29,3** *25,0*	**71,6** *71,6*	**127,8** *78,4*
VCUG/MUC	**9,3** *7,2*	**21,2** *24,0*	**46,2** *44,7*	**99,5** *65,8*	**195,2** *131,2*

OPBG DRL 2014

	Newborn	1	5	10	Adult
UGI	**12,3** *7,8*	**16,2** *7,6*	**24** *21,5*	**85,3** *75,8*	**147,3** *127,3*
Barium Swallow	**5,7** *4,9*	**5,4** *5,5*	**17,1** *9,5*	**22,6** *18,9*	**38,2** *22*
VCUG/MUC	**4,1** *10,5*	**9** *9,2*	**18,4** *13,4*	**29** *34,5*	**81,3** *73,6*

Fig. 2

By reviewing our results once over a two-year period and optimising our technique in a step-by-step process, the DAPs followed a decreasing curve, improving from 2010-2012 to 2012-2014 in consecutive surveys up until the Hiorns scientific paper published in 2006 (Fig. 3-5).

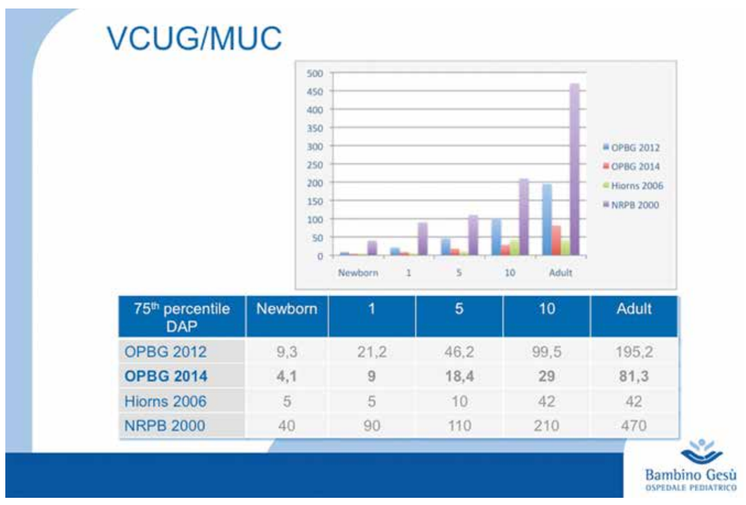

Fig. 3

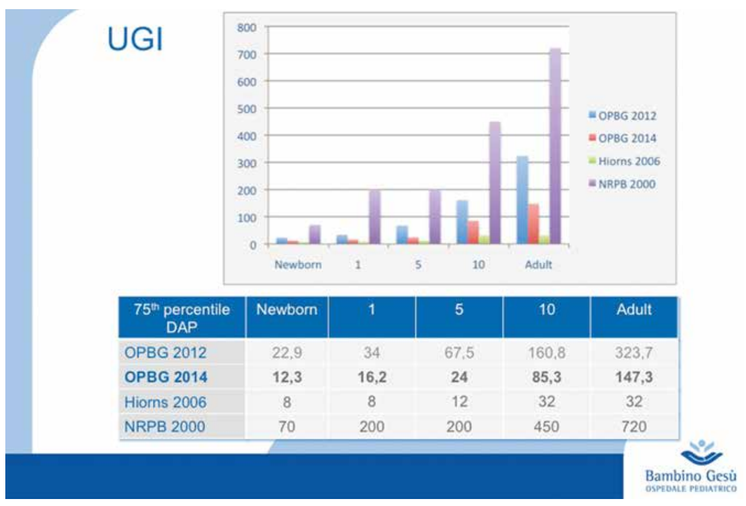

Fig. 4

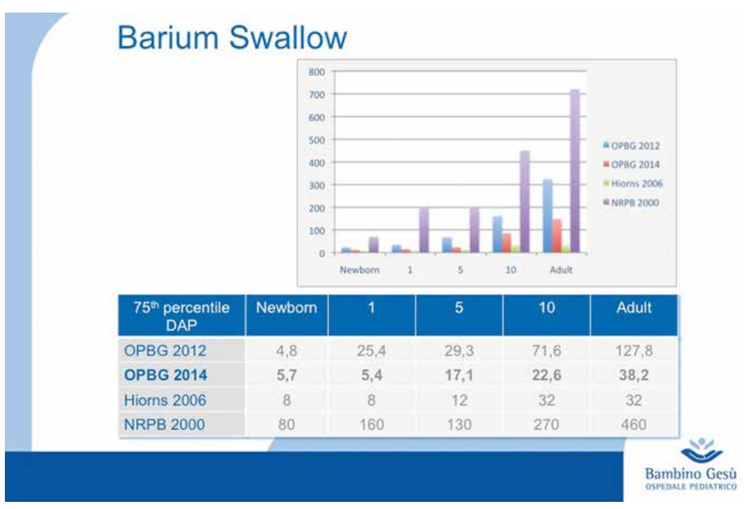

Fig. 5

DAPs for emergency exams were also lower than that reported in the literature even when higher compared to our diagnostic studies.

Discussion and conclusions

The risks of ionising radiation are higher in the paediatric population than in adults. It is therefore particularly important that the dose area product (DAP) used in imaging children should be as low as practicable whilst providing the clinician with diagnostic information. A wide range of radiation doses in paediatric diagnostic fluoroscopy are used depending on the age, sex, body mass, body thickness and cooperation of the child, and moreover on the type of equipment and its use by the operator. Standard diagnostic references are incomplete or absent in a lot of countries, in Italy they are based on the National UK Radiological Protection Board (NRPB).

The small DAP values in our examinations demonstrate the substantial reduction in dose and consequent risk that can be achieved when both equipment performance and operator technique are optimised. Different institutions can have several practices, but radiologists need to be aware of the range of DAPs achievable and that international literature does not necessarily represent best practice.

References

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