

Background

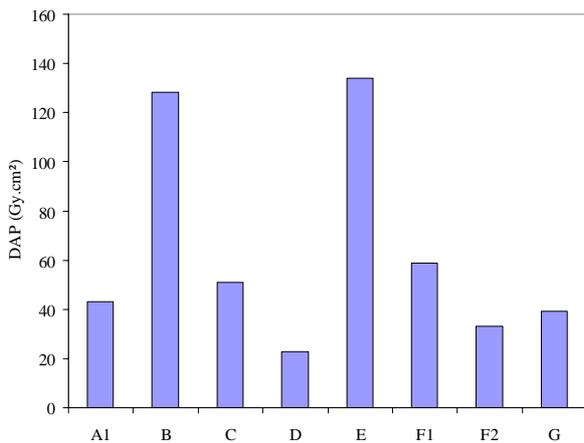
In vascular radiology, the radiologists use the radiological image to diagnose or treat a specific vascular structure. From literature, we know that related doses are high and that large dose variability exists between different hospitals. The application of the optimization principle is therefore necessary and is obliged by the new legislation. So far, very little fieldwork has been performed and no practical instructions are available to do the necessary work. It's indisputable that obtaining quantitative data is of great interest for optimization purposes. In order to gain insight into these doses and the possible measures for dose reduction, we performed a comparative study in 7 hospitals.

Objectives

Patient doses will be measured and calculated for specific procedures in vascular radiology and evaluated against their most influencing parameters. In view of optimization purposes, a protocol for dose audit will be set-up. From the results and conclusions in this study, experimentally based guidelines will be proposed, in order to improve clinical practice in vascular radiology.

Principal results

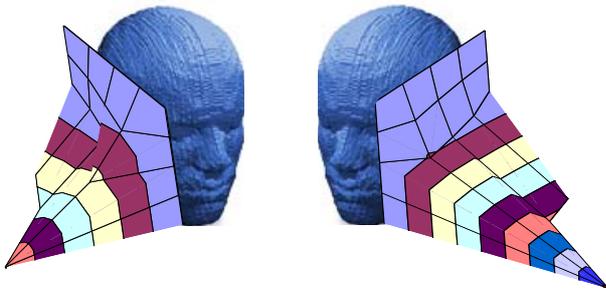
The dose measurements confirmed that doses are high indeed and that per procedure a large variability exists between different hospitals. The skin dose measurements showed that for the interventional procedure involved, reaching the dose threshold of 2 Gy - at which skin damage occurs as a consequence of ionizing radiation - seemed very realistic. Calculated effective doses for the diagnostic procedures could also be relatively high, in the order of 10 mSv, for angiography of the lower limbs.



Dose-area-product (DAP) Distribution for angiography of the lower limbs in the 7 contributing hospitals in the dose study

The quantification and analysis of patient doses in vascular radiology in 7 hospitals was very laborious, as these procedures are complex and not very frequent. The study taught us that E (effective dose) might be a useful tool for optimization purposes. In this point of view, new and appropriate conversion coefficients were determined for calculation of E in vascular radiology, with the use of the Monte Carlo computer code. If every projection in the examination is considered separately, E-calculations become complex and time consuming and therefore they are only recommended for studies with a small number of patients involved.

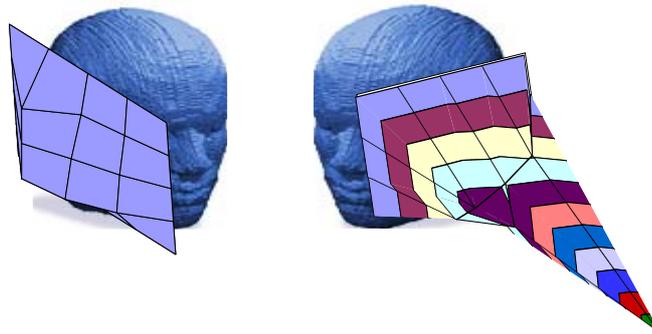
Angiography of the carotid arteries



| | | | | | |
|---------|---------|---------|---------|---------|---------|
| 0 - 5 | 5 - 10 | 10 - 15 | 15 - 20 | 20 - 25 | 25 - 30 |
| 30 - 35 | 35 - 40 | 40 - 45 | | | mGy |

Skin dose distributions around the patient's head for angiography of the carotid arteries

Cerebral embolisation



| | | | | | |
|---------|---------|---------|---------|---------|-----------|
| 0 - 0,5 | 0,5 - 1 | 1 - 1,5 | 1,5 - 2 | 2 - 2,5 | 2,5 - 3 |
| 3 - 3,5 | 3,5 - 4 | 4 - 4,5 | 4,5 - 5 | 5 - 5,5 | Gy |

Skin dose distributions around the patient's head for a cerebral embolisation

However, we also established a practical calculation, where only one single conversion coefficient is used in combination with the total DAP-value (Dose-Area-Product) of the procedure.

In view of optimization purposes, dose audits have already proven their value in the past and they could also be very useful in vascular radiology, although they are not straightforward due to the complex nature of the procedures. Thorough analysis of patient doses against all procedural and technical parameters made it possible to propose a dose audit protocol and to register, next to total DAP-values, also the number of frames, the average tube voltage and possible additional copper filtration. These data can be used to determine or to compare with DRLs (Diagnostic Reference Levels) and to estimate the effective doses by means of appropriate conversion coefficients. Finally, the dose analysis also made it possible to setup some specific, experimentally based guidelines for practical dose optimization.

Future developments

The research is in its final phase. A final version of the PhD will be delivered in January 2005. In collaboration with several university hospitals, we participate in a multi-centre project in Belgium that aims to optimize patient doses in vascular radiology and to evaluate their contribution to the collective dose.

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Main reference

L. Struelens et al., "Effective doses in angiography and interventional radiology: calculation of conversion factors for angiography of the lower limbs", *British Journal of Radiology*, 78 (2005)