

Introduction - Context



In October 2009, the Academic Hospital of Clermont-Ferrand (general hospital of about 2000 beds) declared to the French Authority the overexposure of a patient after a radiological procedure. This event concerned a 30 year-old patient, after two uterine artery embolizations justified by life-threatening recurring post-partum bleeding. The skin dose has been estimated between 12 and 16 Gy by the Institute for Radiation protection and Nuclear Safety (IRSN).

This unwanted event took place within the Department of Vascular Radiology, whose activity is both diagnostic and interventional. It has been the starting point of a global optimization process, initiated by the Department, with the technical support of IRSN. This poster presents the optimization actions successively undertaken in 2010 on one of their two radiological units dedicated to vascular and visceral interventional procedures (Allura®PHILIPS).

Skin lesion 14 months after embolizations.
Estimated dose: 12 to 16 Gy



Steps of the Optimization Process

1. Current situation in January 2010

For the most frequent procedures, analysis of the technical parameters and collection of DAP for about 20 patients.

2. Optimization of the technical parameters

Three steps of optimization have been successively proposed by IRSN, and implemented after medical validation based on image quality:

- Reduction of the "routine" frame frequency (6 f/s to 3 f/s in graphy mode),
- Manufacturer up-grade of the generator: higher kV and additional filtration,
- Implementation of a new "low-dose" fluoro mode in the routine practice, after evaluation of the quality image and of the associated dose saving.

3. Information of all the actors on patient radiological protection

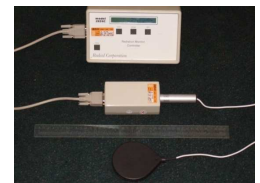
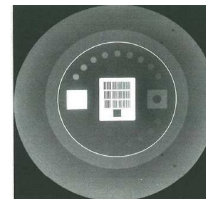
The involvement of all the actors (radiologists, radiographers, biomedical engineers, medical physicists, manufacturers...) is necessary.

4. Evaluation of the dose savings

For the most frequent procedures, collection of DAP after optimization actions for about 20 patients and comparison with step 1 data.

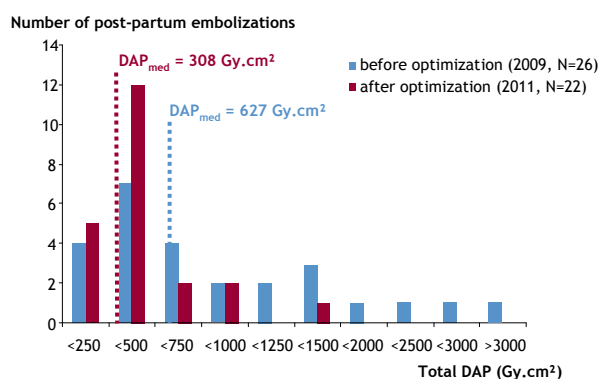


Interventional x-ray unit, equipped with one flat panel



Leeds TOR 18FG test object and Radcal 20x6-60 ion chamber used to assess image quality and entrance dose in radiology

Example of results



Distributions of total DAP* for post-partum embolizations performed in 2009 (before optimization actions) and in 2011 (after the 3 steps of optimization), on the Allura®PHILIPS unit. **Optimization actions have allowed a reduction of about 50% of the median value of the DAP for this procedure**, often performed on young women.

*Total DAP includes fluoro and graphy DAP.

Dose saving after each optimization action implemented

- Reduction of the "routine" frame frequency (6 f/s to 3f/s in graphy mode):
⇒ **Dose contribution of the "Graphy mode" divided by 2.**
- Manufacturer up-grade of the generator:
⇒ **Dose contribution of the "Graphy mode" reduced by about 45%,**
⇒ **Dose contribution of the "Fluoro mode" reduced by about 15%.**
- Implementation of a new "Low-dose fluoro mode" in the routine practice:
⇒ **Dose contribution of the "Fluoro mode" reduced by about 20%.**

Conclusion

Technical recommendations provided by IRSN allowed the department to optimize significantly their interventional equipments. However the key of the success of this initiative was the implication of all the actors: practitioners, medical staff, radiographers, biomedical engineers of the hospital and manufacturer. Care must now be taken to maintain, or even to improve, these results.

In France, image quality has been for years the first criteria in interventional radiology. Most of the procedures, even performed on recent equipments, are not optimized. These results show that optimization is possible, with the willingness and implication of all the actors.