

Quality assurance for radiation dose reduction in thoracic CT

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Context

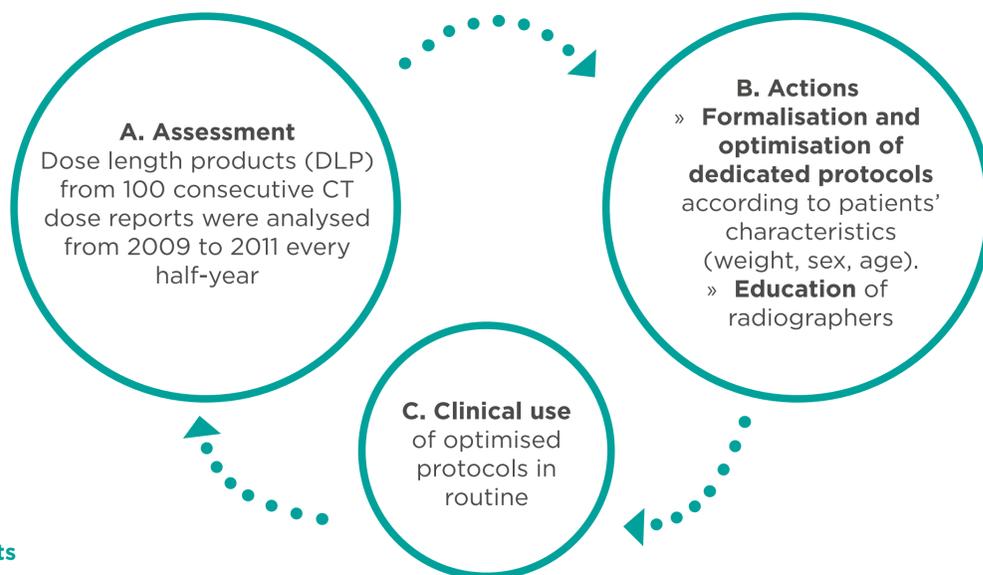
Radiation dose is a matter of concern in thoracic CT due to :

- » **Frequency** of this standard examination
- » **Repeated exams** for the follow-up of **chronic pathologies**.
- » Need to reduce radiation exposure of **radiosensitive organs** (thyroid, breast, lung)

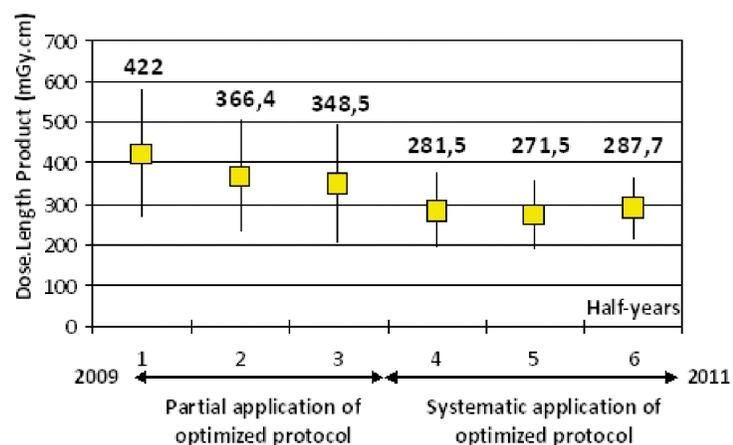
Materials & Methods

CT acquisitions were performed on a 64-detector row CT scanner (LightSpeed VCT, GE Medical Systems).

The Deming's wheel was applied to radiation doses reduction received from thoracic CT:



Results & Impacts



1. Decreasing doses

From the systematic use of the optimised protocol for thoracic CT:

- » **Significant decrease in radiation dose values** - about 33% over two years.
- » **DLP mean values close to 280 mGy.cm** associated to a reduction of radiation doses distributions.
- » **No DLP value superior or equal to 475 mGy.cm** - which is the **French CT diagnostic reference level** for thoracic CT.

2. Dedicated protocols for lung transplant patients

- » **Retrospective study including 66 lung transplant recipients after lung transplantation over 10 years.** Thoracic CT exams were performed systematically in daily routine to evaluate early and late graft complications. The median number of thoracic CT exams was 18 (min: 9-max: 43) per patient with a median effective dose equal to 144mSv (min: 72-max: 344). Cumulative organ doses for lung, breast and thyroid were estimated at 109mGy (min:38-max:204), 62mGy (min: 34 - max: 151) and 52mGy (min:27-max:125) respectively. **No breast, thyroid or lung cancer related to radiation doses was detected, but dose reduction needs to continue.**
- » Evaluation of **breast dose reduction** and image quality by using **bismuth shielding** for three breast thicknesses on an anthropomorphic phantom in thoracic CT. Implications for patient care: shielding should be used to optimise breast dose reduction for patients with breast thicknesses up to 2cm in the supine position.

3. Awareness among French pulmonary physicians

Publication of questions and answers in the Journal de la Société Pneumologue de Langue Française about radiation safety in thoracic CT.

References

Breast dose reduction during thoracic CT : comparison between shielding and low kilovoltage for various breast thicknesses' MP. Revel, I. Fitton, E. Audureau, ML. Chabi, P. Rousset- Conference paper: Radiological Society of North America 2013 Scientific Assembly and Annual Meeting
 'Post-transplantation radiation doses in lung transplant patients: towards the patient dosimetry individual card' I. Fitton, A. Hernigou, G. Chatellier, M.J. Guerrero, V. Boussaud, C. Amrein, G. Frija, MP. Revel- Conference paper: ECR 2013

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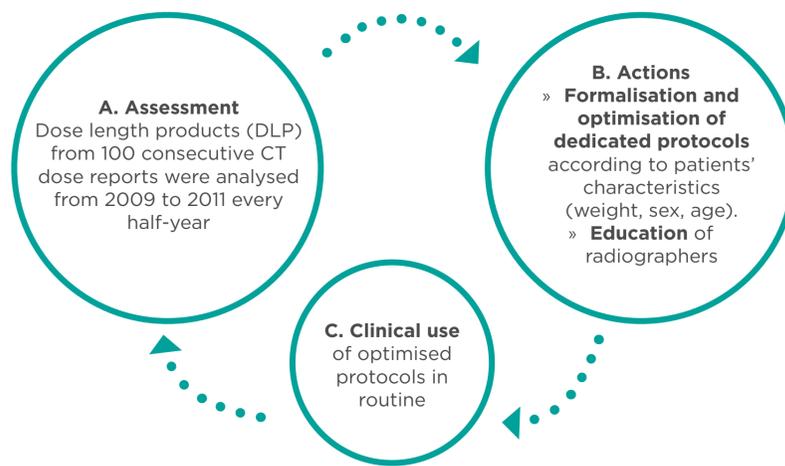
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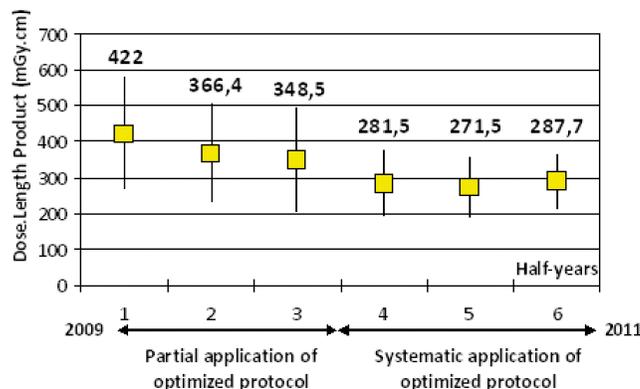
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2. Dedicated protocols for lung transplant patients

- » **Retrospective study over 10 years including 66 lung transplant recipients after lung transplantation (mean age @transplantation: 26±12 years) with survival superior to three years.** All morphological exams were recorded from the day of transplantation. Medical reports including dosimetry informations and acquisition parameters were collected, and data extracted for each imaging modality for all patients. 8067 imaging procedures were analysed: 95% were based on ionizing radiations. Median numbers of procedures (min-max) per patient were: 45 (15-312) for bedside chest radiography, 28 (6-74) for conventional chest radiography, 18 (9-43) for chest Computed Tomography (CT), 3 (0-8) for lung scintigraphy. Thoracic CT exams were performed systematically in clinical routine to evaluate the early and late graft complications. The high values of effective doses were mainly due to chest CT examinations. The median effective dose related to chest CT was 144mSv (min:72-max:344). Cumulative organ doses for lung, breast and thyroid were estimated to 109mGy (min:38-max:204), 62mGy (min:34-max:151) and 52mGy (min:27-max:125) respectively. **No breast, thyroid or lung cancer related to radiation doses was detected but it is necessary to follow this patient group to confirm these data. Indeed, cumulative organ doses reached of each patient are far from being negligible, especially for lung, breast and thyroid, more radiosensitive in young patients.**
- » Evaluation of **breast dose reduction** and image quality by using **bismuth shielding** for three breast thicknesses on an anthropomorphic phantom in thoracic CT. **Implications for patient care:** Shielding should be used to optimize breast dose reduction for patients with breast thicknesses up to 2 cm in the supine position.

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References

1. Breast dose reduction during thoracic CT : comparison between shielding and low kilovoltage for various breast thicknesses' MP. Revel, I. Fitton, E. Audureau, ML. Chabi, P. Rousset- Conference paper: Radiological Society of North America 2013 Scientific Assembly and Annual Meeting
2. 'Post-transplantation radiation doses in lung transplant patients: towards the patient dosimetry individual card' I. Fitton, A. Hernigou, G. Chatellier, MJ. Guerrero, V. Boussaud, C. Amrein, G. Fria, MP. Revel- Conference paper: ECR 2013