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CT-Imaging Protocol for Heart Delineation in The Radiation Therapy Preparation Workflow

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Since CT-based 3D conformal radiation therapy has been in use in radiation therapy (RT), doses to the heart have been collected and attempts were made to correlate them to cardiac disease. Retrospective studies on large populations of patients treated either for breast cancer or for Hodgkin's lymphomas [1-4] showed a correlation between cardiac mortality and dose volume histogram (DVH) or normal tissue complication probability (NTCP) values of the heart. These studies maybe biased by the multiple cofactors of risk in cardiac diseases [2,5]. Moreover, RT-induced toxicities depend on the region of the heart that was irradiated and there is a need for improved imaging protocols to identify the heart substructures such as the coronary arteries. A recent dosimetric study [6] showed that evaluating the dose to the left anterior descending artery (LAD) may change the treatment strategy in breast irradiation. However, planning organ at risk volumes (PRV) must be defined with sufficient margins (ICRU 62) to include motions due to cardiac beating and breathing.

The magnitude of these movements can be evaluated by the use of breath hold (at inhale and at exhale breath times). Cardiac gated CT imaging may be useful to eliminate image blurring and identify the contours of small structures like the coronary arteries which diameter is in the order of the mm. Image resolution in-plane and in the cranio-caudal (CC) direction (slice thickness) is one important parameter, as well as collimation width and rotation time. Intra-venous contrast injection should be optimized to obtain a clear visualization of the heart substructures boundaries.

This preliminary study focuses on the establishment of an imaging protocol that could be used in routine for all thorax RT patients, using a large bore CT scanner (Toshiba Aquilion LB, Toshiba Medical, Puteaux, France) installed in the RT department (Table).

Conclusion

This protocol could be proposed to young patients with left side breast tumors, as well as mediastinal lymphomas. Future evaluation is needed to compare injected and non injected CT scan.

References

1. Giordano SH, Kuo YF, Freeman JL, Buchholz TA, Hortobagyi GN, et al. (2005) Risk of Cardiac Death After Adjuvant Radiotherapy for Breast Cancer. J Natl Cancer Inst 97: 419-424.

2. Chargari C, Kirov KM, Bollet MA, Magné N, Védrine L, et al. (2011) Cardiac toxicity in breast cancer patients: from a fractional point of view to a global assessment. Cancer Treat Rev 37: 321-330.

3. Kirova YM, de Almeida CE, Canary PC, Kuroki Y, Massabeau C, et al. (2011) Heart, coronaries and breast cancer radiotherapy. Breast 20: 196-197.

4. Kirova YM (2010) Recent advances in breast cancer radiotherapy: Evolution or revolution, or how to decrease cardiac toxicity? World J Radiol 2: 103-108.

5. Feng M, Moran JM, Koelling T, Chughtai A, Chan JL, et al. (2011) Development and Validation of a Heart Atlas To Study Cardiac Exposure to Radiation Following Treatment for Breast Cancer. Int J Radiat Oncol Biol Phys 79: 10-18.

6. de Almeida CE, Fournier-Bidoz N, Massabeau C, Mazal A, Canary PC, et al. (2012) Potential benefits of using cardiac gated images to reduce the dose to the left anterior descending coronary during radiotherapy of left breast and internal mammary nodes. Cancer Radiother 16: 44-51.

Toshiba 16 detector Aquilion LB (Toshiba Medical, Puteaux, France)	
Region	
Direction of acquisition	CR – CA (cranio-caudal direction)
Breathing status	Free breathing
Scout view	120 Kv / 10 mA
Patient position	Radiation Treatment position
Séries	**2 series**
- Without contrast	+ One without contrast
- With	+ One with
CT acquisition parameters	
Acquisition mode	Helical
Rotation time	1.5 sec
Rotation angle	360°
Collimator width	16 mm
Slice thickness (mm) / Interval	1 mm ou 2 mm
Pitch	0.937
Scan field-of-view (SFOV)	Second series (contrast enhanced) FOV 24 cm
kV / mA	120KV / 250mA ou 100 mA ?
CT reconstruction parameters	
Acquisition filter	Soft tissue standard
Reconstruction filter	FC 13
Reconstructed slice thickness and interval	3mmx3mm ou 1 mm * 1 mm
Contrast concentration	Ioméron 350
- Quantity (ml)	90-120cc
- Rate (ml/sec)	2.5-3 cc / sec.
- Start	< 15 - 20 sec

Table 1: Parameters used to image the patients' vessels.