OHTAC Recommendation

Based on the University Health Network Healthcare Human Factors Group Evaluation of Computed Tomography Radiation Safety Issues in Ontario

June 16, 2006

OHTAC Ontario Health Technology Advisory Committee

Issue Background

In April 2005, OHTAC reviewed and made recommendations for multi-detector CT angiography for coronary artery disease. The following was one of the recommendations made:

> "MOHLTC request the University Health Network's Usability Lab to test the use of 64-slice CT scanning under various circumstances and for various indications to determine how to best balance image quality for best patient management and radiation dose. The results of these testing parameters will form recommendations on the safe use of 64-slice CT for its various imaging uses, to be communicated to the Radiology community and hospital administrators in Ontario. A decision whether to inform patients of these risks will need to be made once the analysis is completed".

To implement this recommendation, OHTAC requested that the Healthcare Human Factors Group, based out of the University Health Network, undertake a study to investigate appropriate radiation dose issues associated with CT, including methods that can be used to reduce radiation dose, standards for testing and inspection of CT scanners, and radiation issues associated with coronary CT angiography and dental CT.

The study involved an appraisal of radiation dose issues found in a literature review, a CT survey of 20 Ontario healthcare institutions with 64-Slice CT scanners (18 respondents), and interviews with CT experts.

Findings

The appraisal revealed several important findings. In summary:

- CT radiation dose in patients is increasing (estimated to account for 10% of diagnostic exams but over 60% of total effective radiation dose).
- The effective radiation dose from a typical CT examination of the chest is approximately equivalent to three times the amount of natural background radiation that each Canadian receives per year. The effective dose from CT, however, can be orders of magnitude greater than a traditional plain film examination (e.g., 400 times more radiation dose from a typical CT chest examination compared to a plain film chest x-ray).
- The cancer risk from 100 millisieverts (mSv) (equivalent effective radiation dose of 10 typical abdominal CT examinations) was estimated by the National Research Council to be one out of 100 people, and six out of 1000 people by the International Commission on Radiological Protection.
- Studies have found a 10-35% higher effective dose from multi-detector CT than single-slice CT.
- Low-dose CT can reduce radiation dose without compromising image quality—30% of the healthcare institutions surveyed never used low-dose CT protocols.
- Diagnostic reference levels (DRL): the United Kingdom has had success with DRLs. DRLs can be used to identify institutions that consistently use higher radiation doses for the same clinical indications compared to other centres in the same region.

- Patient shielding: types and amount of shielding varied (Ontario survey).
- Lack of comprehensive Ontario CT regulations, guidelines, and standards have led to significant variability in the frequency and methods of CT scanner testing.
- Dental CT uses cone-beam technology. This technology can provide more clinically useful information than panoramic radiography, but radiation dose can be 4-15 times higher than radiography.

Recommendations Endorsed by OHTAC:

Below are the recommendations made by the UHN Healthcare Human Factors Group and endorsed by OHTAC:

General CT Radiation Dose Recommendations

- Recommend establishment of a CT Radiation Safety committee consisting of experts to advise, oversee, and implement methods to promote CT radiation safety. The CT experts should include but not be limited to radiologists, medical radiation technologists, physicists, dentists, Ministry of Health and Long-Term Care representation, and CT scanner manufacturer representation.
- Recommend amending the HARP Act and its regulations to include safety inspection of CT scanners.
- Recommend updating the HARP Act and its regulations to include the operation, use, testing, and inspection of CT scanners. The new federal safety code will be available in 2007/2008 (Safety Code: Recommended safety procedures for the installation, use and control of X-ray equipment in large radiological facilities), which will cover many aspects of CT, such as responsibilities and protection of owners, users, and operators of CT scanners, facility and equipment requirements, and quality assurance requirements. The new federal safety code may assist in setting the standards.

CT Scanner Testing and Inspection Recommendations

- Recommend establishment of guidelines for proper methods of CT scanner acceptance testing and periodic quality control testing, similar to the detailed guidelines currently available by the X-ray Inspection Services for other diagnostic x-ray equipment. The guidelines should be developed by the X-ray Inspection Services in collaboration with other physicists, engineers, and CT scanner manufacturer representatives. These guidelines should supplement the proposed 2007/2008 federal safety codes that will cover items such as frequency of testing. Information from the practical guide on CT scanner testing, Information Leaflet No.1: CT Scanner Acceptance Testing, developed by the ImPACT group could be incorporated.
- Recommend strengthening the existing resources for X-ray Inspection Services to provide field surveillance of CT scanners.

Radiation Dose Reduction Methods Recommendations

- Recommend development of methods (e.g. web-based repository) to help share best-practice CT protocols (and supporting data on adequacy of image quality) between healthcare institutions. Through protocol selection, radiation dose can be reduced in some cases by an order of magnitude without compromising image quality.
- Recommend collection and analysis of radiation dose information from institutions across Ontario on the various types of CT scans.
- Recommend development of diagnostic reference values. CT radiation dose data collected from institutions across Ontario can be used to set reference levels at say, 80th percentile of recorded radiation doses. Although existing reference values from countries such as the US and the UK could be adopted, it would be 51 more meaningful for Ontario institutions to compare their CT radiation dose output with Ontario (or Canadian) reference values.
- Recommend establishment of specific guidelines on patient shielding for various types of CT scans.

- Recommend development of a training program for interventional radiologists on CT fluoroscopy. No such training program exists in Ontario. The training program should be developed by interventional radiologists who are experts in CT fluoroscopy, in collaboration with CT scanner manufacturers.

Coronary CTA Recommendations

- Recommend establishment of guidelines on coronary CTA protocol parameters and techniques (e.g. prospective ECG gating) to minimize radiation exposure.

Dental CBCT Recommendations

- Recommend establishment of stipulations for the installation of new CBCT scanners in Ontario (e.g. monitoring of frequency, purpose, and dose from the examinations). The existing HARP dental CT advisory committee could be instrumental in developing the stipulations.
- Recommend development of training and continuing education requirements for operators of dental CBCT scanners (and dentists who interpret and order). The existing HARP dental CT advisory committee could be instrumental in developing the training and continuing education requirements. Training and continuing education programs could be developed in collaboration with educational institutions, such as the Michener Institute for Applied Health Sciences.

Additional OHTAC recommendations:

In addition to the recommendations made by the Healthcare Human Factors Group, OHTAC also recommends the following:

- Establishment of a process to examine the appropriateness of diagnostic modalities chosen for patients (e.g., accuracy versus risk) and explore the question of whether modalities should change to include safety issues.

- Define a process to allow the tracking and measuring of cumulative radiation exposure.

- The referral process for diagnostic imaging should be evaluated.

- Adherence to existing guidelines should be measured.