RADIATION ALERT

EBT solves growing media and research concerns involving CT radiation dose

Continued national media coverage of radiation concerns is increasing consumer demands for answers and alternatives involving imaging procedures. Multi-detector CT (MDCT) scanner manufacturers and radiology premiums placed on achieving fast, high resolution images amenable to 3-D formats are adding fuel to the fire and increasing the liability associated with its unethical use.

ALARA ("As Low As Reasonably Achievable") is a principal recommended by the International Commission on Radiological Protection (ICRP) for limiting the doses received by persons.

There are three key features in the system of dose limitation recommended by ICRP:

1) **Justification** means that any proposed activity that may cause exposure to persons should yield a sufficient benefit to society to justify the risks incurred by the radiation exposure. This feature is based on the assumption that any radiation exposure, no matter how small, carries with it a certain level of risk that is proportional to the level of exposure.
2) **Optimization** is also known as the practice of ALARA. This means that the radiation exposures resulting from the practice must be reduced to the lowest level possible considering the cost of such a reduction in dose. Optimization, or ALARA, is required by nearly all licensing agencies, including the Nuclear Regulatory Commission.
3) **Dose Limitation** involves setting upper limits on the dose that may be received by any member of the public from all man-made exposures other than medical exposures.

For the past 20 years, Electron Beam Tomography (EBT) has played a significant role in facilitating compliance with ALARA. The fastest image acquisition speeds in the industry result in unparalleled temporal resolution and low dose exposure to patients. Compared to the effective radiation delivered by conventional CT and the aggressively marketed MDCT scanners, EBT is the sleeping giant of low dose diagnostic imaging alternatives.

MDCT Screening Exams Deliver Higher Radiation Dose to Breasts than Mammogram

4 slice MDCT (vs. 4 view Mammogram = 0.2)	Lung	Calcium Score	Virtual Colonsocopy	Full Body
Breast dose **(rad)**	0.41	3.7	0.94	1.8

University of Cincinnati and Duke University in Durham, NC - AuntMinnie.com, December 4, 2003

Effective Dose During Cardiac CT Significantly Lower for EBT

EBT vs. MDCT	Calcium Score	Coronary CT Angiography
EBT **(mSv)**	0.7	1.1
4 slice MDCT **(mSv)**	2.6-4.1	9.3-11.3

Circulation, February 18, 2003

Radiation Exposure During Cardiac CT (EBT and MDCT) vs. Coronary Catheterization

	Coronary Calcium Score		Coronary Angiogram		
Effective and organ specific dose	EBT	MDCT	EBT	Cath	MDCT
Effective dose **(mSv)***	1.1-1.3	1.5-6.2	1.5-2.0	2.1-2.5	6.7-13
Breast **(mSv)**	4.3	6.5-18	5.9	6.9	25.6-44
Lung **(mSv)**	2.6	4.9-16.6	3.9	8.1	22.7-37.6

Radiology, 2003

*Calculated by multiplying actual organ doses by "risk weighting factors" (which give each organ's relative radiosensitivity to developing cancer) and adding up the total of all the numbers—the sum of the products is the "effective dose".

Continued on the back.

Continued from the front.

The most profound examples involve radiation exposure to the breasts and the untold story behind radiation exposure during CT angiography (CTA) of the coronary arteries.

Breast - Research studies have demonstrated MDCT attempts to perform Coronary Calcium Scores exposed the breasts with radiation equivalent to 19 conventional mammograms (3.7 rads).[1] By design, the EBT scanner delivers 2-6 times less radiation, and since the beam is directed from underneath the patient, less than 20% of the radiation reaches the breasts.

Coronary CTA - The newly marketed 64-slice MDCT scanners expose patients to almost 10 times the radiation (11 mSv) received by EBT (1.3 mSv) with no statistically significant improvement in prognostic value. One recent 16-slice MDCT study utilizing 0.5 mm slice thickness reported doses as high as 24.2 mSv per patient (the equivalent of 100 chest x-rays or 10 conventional coronary angiograms.)[2]

During his talk at a "State-of-the-Art" imaging symposium at the 2005 European Congress of Radiology (ECR) in Vienna, Dr. Mathias Prokop, the noted CT expert and professor of radiology at the University Medical Center Utrecht in the Netherlands, talked about the possibilities and problems associated with the 16-, 32-, 40- and now 64-slice machines coming into widespread use. "Two problems which are quite substantial and quite important are the noise increase and the **trend toward dose increases in order to compensate,**" Prokop said. "I see these as **the most important limiting factors for (MDCT) using these new scanners.**" Nevertheless, reducing slice thickness for high-resolution imaging can increase the dose exponentially. "It's something that many people will do, **hopefully not in clinical routine practice,**" he said. "But if you reduce your slice thickness (from 5 mm to 1 mm), the noise goes up by the square root of five, or from 100% to 224%. The only way to compensate for that is to **give five times the dose**, which I think **in clinical practice is usually not acceptable.**"

In the most recent 2005 AHA Scientific Statement involving the role of noninvasive testing in the clinical evaluation of women with suspected coronary artery disease, the AHA advised that with respect to Coronary Artery Calcification scores, "…some limitations remain for MDCT including slower speed of the acquisition (EBT 50 to 100 ms, MDCT 200 to 330 ms), **higher radiation dose (EBT dose 0.7 mSv, MDCT dose 1.5 to 1.8 mSv)**, and possibly greater interscan variability of measurement (EBT 11% to 16%, MDCT 23% to 35%)."

Electron beam tomography is the only CT device specifically designed from inception for cardiac imaging. Not only is it the "gold standard" for Coronary Calcium assessment, it just so happens that it is the ideal modality to satisfy the lowest values of radiation exposure that are consistent with satisfactory cardiac image quality. The evolution of CT imaging has created opportunities for multi-detector spiral CT (MDCT) to participate in the non-invasive diagnosis of cardiac disease. However, the rapid technical advances have prevented the standardization of scanning protocols for MDCT, and controversies about optimal tube current and voltage are ongoing.

[1] Study performed by researchers from the University of Cincinnati and Duke University, presented at RSNA, December 2003.
[2] From the Department of Diagnostic and Interventional Radiology, University Hospital Essen, Germany, April 8, 2002.