Routine Dual-Energy Computed Tomography Scanning of the Neck in Clinical Practice: A Single-Institution Experience

Almudena Pérez-Lara, MD, PhD[a], Mark Levental, MD[a], Lorne Rosenbloom, MD[a], Gary Wing, RT[a], Reza Forghani, MD, PhD[a,b,*]

KEYWORDS

• Dual-energy CT • Spectral CT • Head and neck • Workflow • Radiology department productivity • Optimized DECT protocols • Virtual monochromatic images • Material decomposition maps

KEY POINTS

- Implementation of routine dual-energy computed tomography (DECT) scanning in a radiology department poses unique challenges for the technologists (production) and radiologists (interpretation).
- A properly trained and engaged team of technologists having access to clear preset protocols is helpful for maintaining a smooth and efficient operation.
- Predetermined DECT protocols resulting in automatic reconstruction of image sets at the computed tomography scanner console that are sent to the picture archiving and communication system can reduce or eliminate the need for additional manipulations, promoting routine use and enhancing the efficiency of radiologist workflow.
- Ultimately, vendor solutions for integrated and seamless workflow will likely be key for widespread use and to take advantage of the full range of DECT diagnostic capabilities.

INTRODUCTION

There are multiple emerging clinical applications for dual-energy computed tomography (DECT), including many applications in neuroimaging and head and neck imaging, which are discussed in detail in many of the accompanying articles in this issue. The various clinical applications and the potential added value of DECT for diagnostic evaluation of our patients will ultimately be the main drivers for routine and widespread use of this technology in the clinical setting. However, implementation of DECT in routine clinical practice has specific requirements and poses certain challenges that

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[a] Department of Radiology, Jewish General Hospital, McGill University, 3755 Cote Sainte-Catherine Road, Montreal, Quebec H3T 1E2, Canada; [b] Department of Radiology, Segal Cancer Centre and Lady Davis Institute for Medical Research, Jewish General Hospital, McGill University, Room C-212.1, 3755 Cote Sainte-Catherine Road, Montreal, Quebec H3T 1E2, Canada
* Corresponding author.
E-mail address: rforghani@jgh.mcgill.ca

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should not be ignored.[1] This is especially true in the current health care environment, with progressively increasing volumes in diagnostic radiology departments resulting in demands for increased productivity, from both the technologists and the radiologists interpreting these examinations. Widespread adoption of DECT in routine clinical practice will likely at least in part depend on seamless, workflow-friendly integration.

Routine use of DECT scanning can be challenging because it can affect the normal departmental workflow at multiple levels, both on the production (technologist) and interpretation (radiologist) side. Consequently, successful implementation in the clinical setting requires the development of algorithms for patient selection, optimization of scanning protocols, and establishment of an integrated working team composed of highly trained technologists and radiologists working closely together to ensure smooth workflow and optimal results.[1,2] The purpose of this article is to review the practical workflow implications of routine DECT scanning based on the experience at a single institution where a large percentage of elective neck computed tomography scans (CTs) are acquired in DECT mode using a fast kVp switching scanner (GE Healthcare, Waukesha, WI). This article provides an overview of the challenges encountered based on this experience and discusses strategies for addressing these challenges and enabling seamless workflow integration.

PROSPECTIVE SCAN ACQUISITION IN DUAL-ENERGY COMPUTED TOMOGRAPHY MODE

The various commercially available DECT scanning systems are discussed in detail in the first 2 articles in this issue and are not reviewed here (See Reza Forghani and colleagues' article, "Dual Energy CT: Physical Principles, Approaches to Scanning, Usage, and Implementation - Part 1," and Reza Forghani and colleagues' article, "Dual Energy CT: Physical Principles, Approaches to Scanning, Usage, and Implementation - Part 2," in this issue). However, the topic of acquisition modes is central to DECT workflow and is briefly discussed. As discussed in other articles in this series, most of the current clinical DECT systems enable scan acquisition in either DECT or single-energy computed tomography (SECT) mode. This means that the decision to acquire scans in DECT mode must be made prospectively. For these systems, a preset algorithm or protocol can simplify the process of determining which cases will be scanned in DECT mode. Scanners with a layered or "sandwich" detector (Philips Healthcare, Andover, MA) are the exception to this rule. Because spectral separation for these scanners is achieved at the level of the detector arrays, these scanners practically always acquire in "DECT mode."

DUAL-ENERGY COMPUTED TOMOGRAPHY SCAN SELECTION ALGORITHMS

Because most clinical DECT systems, including fast kVp switching scanners, enable acquisition in DECT or SECT modes, it is not unusual to have a subset of studies performed in SECT mode on these scanners. However, using a DECT scanner *exclusively* in SECT mode defeats the purpose of having such a scanner, and does not take advantage of its full potential. The only possible exception would be the use of a *dual-source* type of DECT scanner primarily devoted to cardiac imaging with the 2 sources being used simultaneously to improve temporal resolution.

The decision on whether or not to perform scans in DECT mode can be based on several factors, as with any other protocoling algorithm (**Box 1**). This could be based on specific referral patterns (eg, all brain oncology or head and neck oncology studies) or based on highly selective clinical indications (eg, all brain CT scans after intra-arterial interventions for ischemic stroke to distinguish hemorrhage from iodinated contrast). Alternatively, it may be done more broadly, based on the body area and/or certain general indications (eg, all adult neck studies, all brain CTs, all oncology studies). For scan protocols consisting of multiple acquisitions, a decision also has to be made regarding which phases should be acquired in DECT mode.

The indications for clinical use of DECT are currently based on studies demonstrating the

Box 1
Decision making for scan acquisition in dual-energy computed tomography (DECT) mode

- Most DECT scanners provide the option for scanning in DECT or single-energy computed tomography (SECT) mode and therefore the decision to acquire DECT images must be made prospectively (the exception being the layered or sandwich detector systems that essentially always acquire in DECT mode)
- Therefore, algorithms need to be in place for protocoling studies as DECT acquisitions prospectively
- Selection could be based on specific referral patterns, selective clinical indications, or more broadly based on the body area and/or certain general indications