DTS Imaging Improves Lung Nodule Detection With Minimal Dose Increase Compared With CXR

Written by Maria Vinall

Digital tomosynthesis (DTS) imaging is a relatively new technique that is increasingly being used for a variety of thoracic indications. It is important that clinicians understand both the diagnostic capability of this technique and the patient dose relative to conventional chest x-ray (CXR) and computed tomography (CT). John M. Sabol, PhD, General Electric Healthcare, Waukesha, Wisconsin, USA, presented the results of the GE Healthcare VolumeRAD Lung Nodule Detection Study [NCT00963651], an international, multicenter clinical trial showing that DTS has improved sensitivity for the detection of pulmonary nodules compared with conventional CXR with no loss of specificity and at a similar, minimal radiation level (< 0.1 mSv).

The study included 158 patients (with nodules, n = 115; without nodules, n = 43) referred for diagnostic CT as part of standard of care for suspicion of pulmonary nodules or other indications. All patients received a diagnostic chest CT scan, followed by conventional posterior-anterior (PA) and lateral (LAT) CXR and then DTS. The primary objective of the study was to determine whether adding DTS to CXR increases physician accuracy in the detection of lung nodules between 3 and 20 mm in diameter when compared to conventional PA/LAT CXR. A secondary analysis was conducted to determine the relative ability of DTS plus CXR to identify nodules 3 to 4 mm, > 4 to 6 mm, > 6 to 8 mm, and > 8 to 20 mm in diameter. Other outcomes included the degree of agreement with CT for case management as defined by the Fleischner Society guidelines [MacMahon H et al. *Radiology*. 2005].

DTS was associated with a 3.6-fold improvement in sensitivity for nodules of 3 to 20 mm diameter compared with CXR. For nodules of 4 to 6 mm diameter, for which x-ray is particularly challenged, DTS showed a 7.6-fold improved sensitivity. As measured by the area under the receiver operating characteristic (ROC) curve, there was a significant increase in case management utility with tomosynthesis (Figure 1). For all nodule sizes, increases in sensitivity and area under the ROC curve were achieved with no decrease in specificity.

For the effective dose calculations, digital imaging and communications in medical metadata were extracted for all image data. CT dose index and the dose-length product were calculated using the methods described in the appropriate technical reference manual. The effective dose was calculated using dose-length product conversion factors from the International Commission on Radiological Protection Publication 103 [ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4)]. The effective dose for CXR and DTS was calculated using the PCXMC 2.0 Monte Carlo tool [Sabol JM. *Med Phys*. 2009]. Calculation of absorbed dose was based on estimates of incident air kerma from exposure technique data and the assumption of average-habitus patients.

Data for dose estimation were available for all 158 patients in the study for some modalities and for 91 patients for all modalities. For the 91 cases with valid data for all modalities, the mean effective dose was 0.059, 0.088, and 4.86 mSv for CXR, DTS, and CT, respectively.

The effective dose of DTS was 1.5 times greater than that for 2-view CXR. The CXR and DTS effective doses were significantly less than that for CT ($P < .01$), and the same minimal relative radiation level (< 0.1 mSv) as that of 2-view CXR.

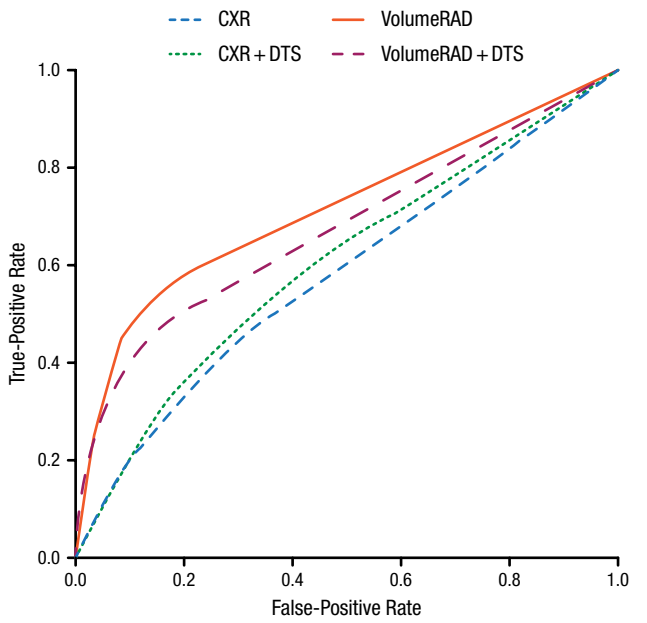
To conclude, DTS is a low-dose option for volumetric thoracic imaging and improves lung nodule detection.

Peer-Reviewed Highlights From the

Radiological Society of North America 100th Scientific Assembly and Annual Meeting

November 30–December 5, 2014
Chicago, IL, USA

Figure 1. Case Management (Further Imaging) ROC



Tomosynthesis requires ($P<.01$) a smaller dose than CT and the same[a] ($P<.01$) minimal relative radiation level (<0.1 mSv) as 2-view CXR.

ACR, American College of Radiology; CT, computed tomography; CXR, chest x-ray; DTS, digital tomosynthesis; ROC, receiver operating characteristic; VolumeRAD, GE VolumeRAD tomosynthesis.

[a]ACR Appropriateness Criteria® Radiation Dose Assessment Introduction, 2012.

Reproduced with permission from JM Sabol, PhD.

AUS Predicts Residual Nodal Disease After NAC

Written by Rita Buckley

Axillary ultrasound (AUS) after neoadjuvant chemotherapy (NAC) can help to restage axillary nodal basins for patients with clinical node-positive (cN1) breast cancer, sparing many from the morbidity associated with axillary lymph node dissection (ALND). H. Carisa Le-Petross, MD, University of Texas MD Anderson Cancer Center, Houston, Texas, USA, reported the results of a secondary end point of the American College of Surgeons Oncology Group (ACOSOG) Z1071 trial [Boughey JC et al. *JAMA*. 2013].

The prospective, multicenter ACOSOG Z1071 trial evaluated the false-negative rate (FNR) for nodal staging with sentinel lymph node (SLN) surgery performed after NAC in women initially presenting with biopsy-proven cN1 disease. The study evaluated the likelihood that the FNR in patients with ≥2 SLNs examined was <10%, the rate reported from many studies for women undergoing SLN surgery who present with clinically node-negative (cN0) disease.

ACOSOG Z1071 enrolled 756 women with breast cancer (clinical T0 to T4, N1 to N2, M0) who received NAC and then underwent SLN surgery with ALND. SLN surgery correctly identified the axillary nodal status in 91.2% of patients. The FNR was 12.6% (39 of 310) in patients with cN1 breast cancer with ≥2 SLNs resected (90% Bayesian credible interval, 9.85% to 16.05%).

The objective of the secondary end point was to evaluate the correlation between lymph node (LN) features on AUS after NAC with the final nodal pathology at surgery.

Study enrollment could occur prior to, during, or after chemotherapy. All patients were required to have a physical examination and AUS. AUS was performed after completion of NAC, within 4 weeks prior to surgery. This was followed by SLN surgery and ALND.

The study classified the LN morphology as normal or abnormal. AUS images were read locally and reviewed centrally to determine nodal cortical thickness (in millimeters), nodal size, and cortical morphologic features. Dr Le-Petross referenced a previous study in which the cortical morphologic features were used as predictors of metastasis in breast cancer [Bedi DG. *AJR Am J Roentgenol.* 2008].

Of the 756 women enrolled in ACOSOG Z1071, 611 had AUS images available for central review; 370 (60.6%) had residual nodal disease (N+) on final pathology, while 241 (39.4%) had no residual nodal disease (N0).

The analysis of the secondary end point found that of the AUS findings for LNs, the features that significantly predicted residual nodal disease were cortical thickness >3 mm for N+ ($P<.0001$) and lack of fatty hilum visibility (48 patients [81.4% N+] vs 11 patients [18.6% N0]). LN size was not significant (long axis to short axis ratio, $P=.28$).

To conclude, LN status is an important prognostic factor used to guide local, regional, and systemic treatment decisions. It is important to restage breast cancer and nodal status after NAC and prior to surgery. In N+ patients, AUS performed after NAC can provide information to help determine what type of axillary surgery is indicated after NAC. This could help ensure that only those individuals who may benefit from ALND would be exposed to the potential morbidity of the procedure. Nodal morphology, such as cortical thickness and presence or absence of fatty hilum, should be used to predict the presence of residual nodal disease.