Surgical Outcomes in a Large, Clinical, Low-Dose Computed Tomographic Lung Cancer Screening Program

Bryan L. Walker, BS, Christina Williamson, MD, Shawn M. Regis, PhD, Andrea B. McKee, MD, Richard S. D'Agostino, MD, Paul J. Hesketh, MD, Carla R. Lamb, MD, Sebastian Flacke, MD, PhD, Christoph Wald, MD, PhD, and Brady J. McKee, MD

Tufts University School of Medicine, Boston; and Departments of Cardiovascular and Thoracic Surgery, Radiation Oncology, Hematology and Oncology, Pulmonary and Critical Care Medicine, and Radiology, Lahey Hospital & Medical Center, Burlington, Massachusetts

Background. **Lung cancer screening with low-dose computed tomography is proven to reduce lung cancer mortality among high-risk patients. However, critics raise concern over the potential for unnecessary surgical procedures performed for benign disease as a result of screening. We reviewed our outcomes in a large clinical lung cancer screening program to assess the number of surgical procedures done for benign disease, as we believe this is an important quality metric.**

Methods. **We retrospectively reviewed our surgical outcomes of consecutive patients who underwent low-dose computed tomography lung cancer screening from January 2012 through June 2014 using a prospectively collected database. All patients met the National Comprehensive Cancer Network lung cancer screening guidelines high-risk criteria.**

Results. **There were 1,654 screened patients during the study interval with clinical follow-up at Lahey Hospital & Medical Center. Twenty-five of the 1,654 (1.5%) had surgery. Five of 25 had non-lung cancer diagnoses: 2 hamartomas, 2 necrotizing granulomas, and 1 breast cancer metastasis. The incidence of surgery for non-lung cancer diagnosis was 0.30% (5 of 1,654), and the incidence of surgery for benign disease was 0.24% (4 of 1,654). Twenty of 25 had lung cancer, 18 early stage and 2 late stage. There were no surgery-related deaths, and there was 1 major surgical complication (4%) at 30 days.**

Conclusions. **The incidence of surgical intervention for non-lung cancer diagnosis was low (0.30%) and is comparable to the rate reported in the National Lung Screening Trial (0.62%). Surgical intervention for benign disease was rare (0.24%) in our experience.**

(Ann Thorac Surg 2015;■:■–■)

The National Cancer Institute estimated that, in 2014, there would be nearly 160,000 deaths from lung cancer in the United States [1]. This annual mortality rate is greater than that of breast, colorectal, and prostate cancer combined. That nearly 80% of lung cancers have regional or distant site involvement by the time of diagnosis substantially contributes to the high mortality rate of this disease [2]. These data highlight the need for an effective method of early detection, such as screening with low-dose computed tomography (LDCT). In 2011, the National Lung Screening Trial (NLST) demonstrated a significant mortality benefit associated with LDCT lung screening of high-risk persons compared with chest radiography [3]. Within 6 months of publication, the National Comprehensive Cancer Network (NCCN) issued the first set of LDCT lung screening guidelines for clinical practice [4]. At the end of 2013, the US Preventive Services Task Force supported LDCT lung screening for high-risk persons, with a grade B recommendation [5]. In February 2015, the Centers for Medicare and Medicaid Services added LDCT lung screening as a covered benefit for high-risk beneficiaries [6].

Despite these recent advancements, many raise concerns about the potential for unnecessary surgery

Dr Wald discloses a financial relationship with Philips Radiology Medical Advice Network; and Drs AB McKee and BJ McKee with Covidien.

The Appendix can be viewed in the online version of this article [http://dx.doi.org/10.1016/j.athoracsur.2015.04.112] on http://www.annalsofthoracicsurgery.org

Accepted for publication April 20, 2015.

Address correspondence to Dr Williamson, Department of Cardiovascular and Thoracic Surgery, Lahey Hospital & Medical Center, 41 Mall Rd, Burlington, MA 01805; e-mail: christina.williamson@lahey.org.

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2015.04.112

Abbreviations and Acronyms

ACR	=	American College of Radiology
CT	=	computed tomography
EBUS	=	endobronchial ultrasonography
LDCT	=	low-dose computed tomography
LungRADS	=	Lung Imaging Reporting and Data System
NCCN	=	National Comprehensive Cancer Network
NLST	=	National Lung Screening Trial
PET	=	positron emission tomography
VATS	=	video-assisted thoracoscopic surgery

performed for benign disease as a result of false positive findings during screening [7–10]. Previous studies have shown substantial variability in the rates of surgery for benign disease. The NLST reported that 24.4% of patients who underwent surgical intervention were found to have non-lung cancer diagnoses [3]. Wilson and colleagues [11] report that 34.1% of patients who underwent thoracotomy or video-assisted thoracoscopic surgery (VATS) for suspected lung cancer were diagnosed with benign disease [11]. However, Crestanello and associates [12] from the Mayo Clinic and Flores and associates [13] from the International Early Lung Cancer Action Program (I-ELCAP) have reported considerably lower rates of 18.2% and 11.0%, respectively.

We reviewed the surgical outcomes in our lung cancer screening program at Lahey Hospital & Medical Center to evaluate our incidence of surgical intervention for benign disease. We believe that this is an important quality metric for clinical LDCT lung cancer screening programs.

Material and Methods

This is a retrospective review of a prospectively collected database from a single center with a large clinical computed tomography (CT) lung cancer screening program. The Lahey Hospital & Medical Center Institutional Review Board approved this study, with waiver of individual patient consent.

Eligibility

All screened patients met the NCCN lung cancer screening guidelines high-risk group 1 or group 2 criteria [4]. Group 1 patients were between 55 and 74 years old, had a 30 pack-year or more smoking history, and were current or former smokers who had quit within the past 15 years. Group 2 patients were between 50 and 74 years old, had a 20 pack-year or more smoking history, were current or former smokers who had quit for any length of time, and had one additional lung cancer risk factor excluding second-hand smoke exposure. These risk factors include personal history of smoking-related cancer, family history of lung cancer in a first-degree relative, chronic lung disease (ie, emphysema and pulmonary fibrosis), and known exposure to pulmonary carcinogens. Patients also had to be asymptomatic, have a physician order for CT lung screening, be free of lung cancer for at least 5 years, and have no known metastatic disease [14].

Imaging Acquisition

Image interpretation was performed by radiologists specifically trained and credentialed in CT lung screening using a structured reporting system and the NCCN lung screening guidelines version 1.2012 nodule follow-up algorithms (referred to hereafter as NCCN guidelines) [4, 14]. All CT lung screening examinations were performed on 64-row or more multidetector CT scanner at 100 kV and 30 to 100 mA, depending on the scanner and the availability of iterative reconstruction software. Axial images were obtained at 1.25 to 1.5 cm thickness with 50% overlap and reconstructed with both soft tissue and lung kernels. Axial maximum intensity projections (16 × 2.5 mm) and coronal and sagittal multiplanar reformatted images were reconstructed and used for interpretation. Estimated effective dose was, on average, 0.7 to 0.8 mSv for each low-dose CT scan.

Reporting System

We created a standardized CT screening reporting system, the Lung Imaging Reporting and Data System (LungRADS), which was modeled after the Breast Imaging Reporting and Data System (BI-RADS) used in breast cancer screening (see Appendix). This incorporates an NCCN guidelines–based nodule lexicon that reports mean nodule size in 1-mm ranges. Scans classified as LungRADS 4 were considered suspicious for malignancy and included growing solid or ground glass nodules, solid nodules greater than 8 mm, a change in a ground glass nodule that demonstrated a more solid component, and other findings suspicious for malignancy, such as enlarged mediastinal or hilar lymph nodes (more than 1 cm in short axis) or pleural effusion. All LungRADS 4 findings were referred for a pulmonary consultation and reviewed at our weekly multidisciplinary thoracic oncology conference, which then made recommendations regarding appropriate diagnostic interventions.

Data Abstraction

We reviewed results for consecutive patients undergoing clinical LDCT lung screening at our institution from January 2012 through June 2014 who had clinical follow-up at Lahey Hospital & Medical Center. The medical records of participants whose scans were suspicious for malignancy (LungRADS 4) were analyzed. Diagnostic interventions, surgical procedures, postoperative diagnoses, pathologic staging and histology, perioperative morbidity and mortality, and clinical follow-up were recorded. The complications and their severities were reported according to the NLST criteria, as listed in their supplementary appendix [3]. We also included prolonged air leak of 5 days or longer as an intermediate complication, as we considered this as a significant postoperative complication. Operative mortality included patients who died from any cause within the same hospitalization or within 30 days of surgery.