Do pulmonary function tests improve risk stratification before cardiothoracic surgery?

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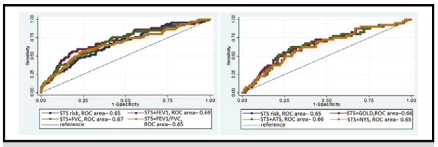
ABSTRACT

Objective: To assess the added value of pulmonary function tests (PFTs) and different classifications of chronic obstructive pulmonary disease (COPD) to the Society of Thoracic Surgeons (STS) risk model using a clinical definition of lung disease for predicting outcomes after cardiothoracic (CT) surgery.

Methods: We evaluated consecutive patients who underwent nonemergency cardiac surgery and underwent PFTs before CT surgery. We used the STS risk model 2.73 to estimate the postoperative risk for respiratory failure (RF; defined as the need for mechanical ventilation for ≥72 hours, or reintubation), prolonged postoperative stay (PPLS; defined as >14 days), and 30-day all-cause mortality. We plotted the receiver operating characteristics curve for STS score for each adverse event, and compared the resulting area under the curve (AUC) with the AUC after adding PFT parameters and COPD classifications.

Results: Of the 1412 patients with a calculated STS score, 751 underwent PFTs. The AUC of the STS score was 0.65 (95% confidence interval [CI], 0.55-0.74) for RF, 0.67 (95% CI, 0.6-0.74) for prolonged postoperative length of stay (PPLS), and 0.74 (95% CI, 0.6-0.87) for death. None of the PFT parameters or COPD classifications added to the predictive ability of STS for RF, PPLS, or 30-day mortality.

Conclusions: Adding individual PFT parameters or different COPD classifications to STS score calculated using clinically based classification of lung disease did not improve model discrimination. Thus, routine preoperative PFTS may have limited clinical utility in patients undergoing CT surgery when the STS score is readily available. (J Thorac Cardiovasc Surg 2016;151:1183-9)



Receiver operating characteristic analysis for respiratory failure in patients with PFTs.

Central Message

Routine preoperative pulmonary function tests may have limited utility in patients undergoing cardiothoracic surgery when the Society of Thoracic Surgeons score is available.

Perspective

In our practice, pulmonary function tests (PFTs) are usually performed in patients with a higher burden of comorbidity scheduled for more complex cardiothoracic surgery. The Society of Thoracic Surgeons (STS) score based on clinical definitions of lung disease afforded modest discriminatory ability for 3 studied outcomes. Adding individual PFT parameters or any of the chronic obstructive lung disease classifications did not improve the discriminatory ability of STS score alone.

See Editorial Commentary page 1189.

See Editorial page 918.

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Respiratory failure (RF) is a frequent complication after cardiothoracic (CT) surgery, ranging in frequency from 2% to 22%, depending on the population studied and the definitions used.[1-6] Numerous studies have identified RF as associated with increases in hospital length of stay, morbidity, and postoperative mortality, as well as greater resource utilization and costs.[2,7-11]

The most recent data from retrospective studies evaluating different predictors of RF after CT surgery have questioned the predictive value of chronic obstructive pulmonary disease (COPD) classification before surgery. However, individual pulmonary function test (PFT) parameters, such as forced expiratory volume in 1 second (FEV1), have been shown to be independent predictors of adverse outcomes, including postoperative mortality and RF.[9,10,12] In addition, forced vital capacity (FVC) has

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Abbreviations and Acronyms

ATS = American Thoracic Society
AUC = area under the curve
CABG = coronary artery bypass grafting
COPD = chronic obstructive pulmonary disease
CT = cardiothoracic
CVA = cerebrovascular accident
FEV1 = forced expiratory volume in 1 second
FVC = forced vital capacity
NYMH = New York Methodist Hospital
NYSDOH = New York State Department of Health
PFT = pulmonary function test
PPLS = prolonged postoperative length of stay
RF = respiratory failure
ROC = receiver operating characteristic
STS = Society of Thoracic Surgeons

been identified as a powerful independent predictor of mortality in the general population.[13]

The Society of Thoracic Surgeons (STS) risk model is a well-recognized and widely used tool for predicting adverse outcomes after CT surgery. It was developed and validated based on a national database comprising nearly 1 million patients. The data were used to create a statistical model predicting RF and 8 other postoperative outcomes.[14-17] Based on definitions used in the STS risk model, the presence and severity of chronic lung disease (CLD) may be defined by either clinical criteria or spirometry testing; however, a major underestimation of the prevalence and severity of CLD was reported when only the STS clinical criteria were used.[18] Moreover, the same study noted a significant underestimation of the incidence of adverse outcomes when only spirometry was included in the risk models.

The aim of the present study was to assess the added value of PFTs and classifications of COPD based on PFT results to the STS risk score derived from clinical data alone for predicting RF, prolonged postoperative length of stay (PPLS), and 30-day mortality in patients undergoing CT surgery.

METHODS

The study was approved by the Institutional Review Board of New York Methodist Hospital (NYMH), which waived the requirement for individual consent.

Patient Population

The study cohort comprised a total of 1685 patients who underwent index cardiac surgery at NYMH between April 2004 and January 2014. We excluded patients classified as unstable (ie, requiring pharmacologic and or mechanical support to maintain adequate blood pressure), patients who had undergone an emergency procedure (ie, earlier than planned surgery owing to ongoing, refractory, unrelenting cardiac compromise with or without hemodynamic instability) or a procedure not supported by the STS calculator, and patients who were lost to follow-up within 30 days after CT surgery (Figure 1).

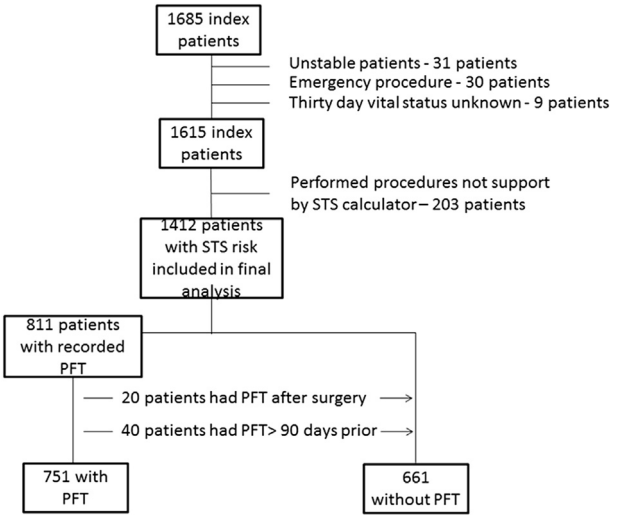

FIGURE 1. Patient flowchart. *STS*, Society of Thoracic Surgeons; *PFT*, pulmonary function test.

Data Acquisition

PFT reports were obtained from the NYMH Pulmonary Physiology Laboratory database. Demographic, clinical, procedural, and outcome data were obtained from patient charts. Data were originally entered prospectively and submitted quarterly to the NYSDOH Division of Quality and Patient Safety Cardiac Services program using NYSDOH Form 2254a, in accordance with state requirements.

STS Risk Calculation

STS risk was calculated retrospectively using the online STS calculator version 2.73 (http://riskcalc.sts.org), accessed between May 1 and August 1, 2014. Because of software limitations, STS risk was not calculated for patients undergoing double-valve interventions or 3 simultaneous surgical procedures. We calculated STS risk using data on the type of surgical procedure performed; patient age, sex, race, ethnicity, height, and weight; cardiac presentation; symptoms at the time of admission and time of surgery; left ventricular ejection fraction; history of recent heart failure, previous myocardial infarction, cardiac arrhythmias, CLD, cerebrovascular disease, peripheral artery disease, diabetes, hypertension, immunocompromised state, endocarditis, creatinine level, and renal dialysis; presence and severity of coronary artery disease, including involvement of the left main coronary artery; status of the procedure; and presence and extent of valvular disease. CLD was evaluated based solely on clinical parameters without PFT data (Table 1).

STS calculates the risk for 9 postoperative parameters, and here we report data for 3 of these: (1) operative mortality (death during the same hospitalization as surgery, regardless of timing, or within 30 days of surgery regardless of venue); (2) prolonged ventilation (>24 hours); and (3) prolonged postoperative hospital stay (>14 days after the date of surgery).

PFTs

The decision to perform PFTs was left to the discretion of the treating physician. Of the 751 patients who underwent PFTs, 652 had bedside spirometry testing and 99 had formal laboratory PFTs. PFTs were performed with the SpiroPro spirometer and Vmax Encore PFT System (CareFusion, San Diego, Calif). Outpatients were instructed to refrain from smoking and using bronchodilators for at least 4 hours before testing. The FEV1 and FVC values were determined by taking the best of 3 trials. The severity of airway obstruction was categorized according to the Global

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