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Commentary: Artificial intelligence for pulmonary nodules: Machines to diagnosis cancer

Sandra L. Starnes, MD

Ashraf and colleagues used 2 different machine learning algorithms, a traditional machine learning algorithm and a deep learning algorithm, to differentiate pulmonary nodules into benign, preinvasive, and invasive adenocarcinomas.¹ Computed tomography (CT) images from 2 author-affiliated centers in China and 1 author-affiliated center in the United States, and the publicly available dataset from the National Lung Screening Trial were reviewed and divided into training, validation, and testing sets. The models were best able to distinguish invasive adenocarcinoma from preinvasive subtypes (atypical adenomatous hyperplasia, adenocarcinoma in situ) and minimally invasive adenocarcinoma from invasive adenocarcinoma. They were less successful at differentiating preinvasive from minimally invasive adenocarcinoma.

Machine learning is a form of artificial intelligence in which computers can learn patterns from large datasets to make predictions. Traditional machine learning, such as the support vector machine used in the present study, requires manual input and can be labor-intensive. Deep learning algorithms, such as the convolutional neural network used in this study, does not require human input but requires larger datasets and can be subject to overfitting, performing worse in external databases, as noted by the authors. Machine learning has been studied in the detection of lung nodules, differentiation of benign and malignant nodules, and even prediction of outcomes in lung cancers.²

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CENTRAL MESSAGE

Machine learning in the management of pulmonary nodules could potentially transform the field. Thoracic surgeons should understand these technologies and be involved in current and future studies.

Strengths of this study include the large number of patients from multiple datasets and the use of 2 different machine learning technologies. Despite the large datasets, however, there were many patients who were classified simply as benign or malignant without any further specification, and there was a limited number of patients with the preinvasive subtypes.

Ashraf and colleagues should be congratulated for this particularly timely article, given that thoracic surgeons are seeing an increasing number of patients with indeterminate nodules, particularly small and part solid nodules, that are being detected with lung cancer screening. The majority of lung nodules detected on lung cancer screening are benign, and concerns regarding the false-positive rate and the use of invasive procedures for benign nodules may be partially responsible for the low utilization of lung cancer screening. Part solid nodules, in particular, are more likely to be malignant;³ however, they tend to represent more indolent cancers, and it is difficult to distinguish preinvasive from invasive cancers in these nodules. Sublobar resection results in excellent outcomes for preinvasive and minimally invasive adenocarcinoma, and thus it is important to distinguish these types preoperatively,⁴ which can be challenging. The use of machine learning technologies in the management of pulmonary nodules, while still in its infancy, will likely become increasingly important in the near future. Thoracic surgeons should

understand these technologies and be involved in current and future studies.

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Commentary: Rise of the machines

Brian Mitzman, MD

“Never place your trust in us. We’re only human. Inevitably, we’ll only disappoint you.”

—Robert Ford, PhD

The approval of low-dose computed tomography for lung cancer screening by the US Preventive Services Task Force¹ has led to the increased diagnosis of lung nodules with an unknown malignant potential. Nodules with minor concerning features are difficult to differentiate from benign processes without tissue confirmation.² Further, differentiating lower risk malignant lesions from their more invasive counterparts preoperatively would allow surgeons to choose a less-invasive surgical procedure, such as a wedge resection instead of a lobectomy. Ashraf and colleagues³ developed 2 novel machine learning algorithms to predict diagnosis of lung nodules on computed tomography scan. The first is a support vector machine model that uses image features for classification. The second model is a deep learning convolutional neural network. Although the vector machine model requires a smaller dataset, it is much more labor intensive because every nodule requires

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CENTRAL MESSAGE

Utilizing machine learning algorithms and neural networks as an adjunct to human judgment may increase our preoperative decision making as thoracic surgeons.

segmentation. The neural network has quite a bit of potential because it requires significantly less direct user interaction, but the required dataset to learn appropriate imaging features is much larger.

How did the 2 models perform? Looking at the results from the internal training dataset (see the authors' Table 3³), both models struggled with false positives differentiating hyperplasia from adenocarcinoma in situ. What does this mean in the real world? Not much because many still recommend resection for atypical adenomatous hyperplasia. When lumping all noninvasive nodules together against invasive adenocarcinoma, both models performed well with sensitivity and specificity more than 70%. This comparison is important because it helps surgeons determine who should be treated with a sublobar resection. Size is a confounding factor in the models' ability to recognize invasive nodules

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