ultimately diagnosed at final pathology. Conversely, some patients may be saved from overtreatment with lobectomy when sublobar resection or nonoperative therapy such as radiation would be adequate.

Computers generate computed tomography images from acquired data; perhaps we should use computers to convert that data into meaningful information. The process can be automated and is fast, with a mean time of 30 seconds in the present study.³ The optimal algorithms and proper variables remain to be determined in larger prospective trials. Radiomics is also evolving into radiogenomics, where radiomic data can be used to predict mutations in lung cancers and the response to chemotherapy.⁴ Many clinicians use widely available algorithms, such as the Mayo Clinic model, which incorporate clinical and basic radiographic data to predict the likelihood of malignancy.⁵ Ultimately, clinical information could be merged with radiomics to

help clarify or make the diagnosis, potentially sparing the patient additional diagnostic procedures and over- or under-treatment. Thus the patient and the surgeon would be allowed to focus on decision making, and potentially pull the doctor away from the machine and toward the patient.

References

1. Gawande A. Why doctors hate their computers. *New Yorker*. November 12, 2018.
2. Nagendran M, Chen Y, Lovejoy CA, Gordon AC, Komorowski M, Harvey H, et al. Artificial intelligence versus clinicians: systematic review of design, reporting standards, and claims of deep learning studies. *BMJ*. 2020;368:m689.
3. Yoshiyasu N, Kojima F, Hayashi K, Bando T. Radiomics technology for identifying early-stage lung adenocarcinomas suitable for sublobar resection. *J Thorac Cardiovasc Surg*. 2021;162:477-85.e1.
4. Thawani R, McLane M, Beig N, Ghose S, Prasanna P, Velcheti V, et al. Radiomics and radiogenomics in lung cancer: a review for the clinician. *Lung Cancer*. 2018;115:34-41.
5. Al-Ameri A, Malhotra P, Thygesen H, Plant PK, Vaidyanathan S, Karthik S, et al. Risk of malignancy in pulmonary nodules: a validation study of four prediction models. *Lung Cancer*. 2015;89:27-30.

See Article page 477.

Commentary: More science, less fortunetelling: Using radiomics to predict the invasiveness of lung cancer

Joanna Sesti, MD, and Subroto Paul, MD, MPH

Predicting the future is an age-old phenomenon. French astrologer Nostradamus is known for several accurate predictions, such as the development of the atomic bomb and the rise of Hitler.¹ Even Homer Simpson got it right in a 1993 episode named “Marge in Chains,” where events similar to our current coronavirus 2019 (COVID-19) pandemic and the notorious murder hornets were portrayed.² Despite these and many other predictions that have seemingly come true, the art of predicting the future

Joanna Sesti, MD, and Subroto Paul, MD, MPH

CENTRAL MESSAGE

Radiomics can be used to predict the invasiveness of ground-glass opacifications and sub-solid nodules.

is usually met with a large degree of skepticism. Fortunately, in the current era of increased computing power leading to a potential revolution in artificial intelligence and machine learning, fortunetelling may become more of a science and less of an art.

In this issue of the *Journal*, Yoshiyasu and colleagues³ present an analysis of radiomics to identify suitable

From Thoracic Surgical Services, RWJBarnabas Health, West Orange, NJ.

Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication May 17, 2020; revisions received May 17, 2020; accepted for publication May 18, 2020; available ahead of print May 25, 2020.

Address for reprints: Subroto Paul, MD, MPH, RWJBarnabas Health, 101 Old Short Hills Rd, Ste 302, West Orange, NJ 07052 (E-mail: Subroto.Paul@rwjbh.org).

J Thorac Cardiovasc Surg 2021;162:488-9

0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2020.05.045>

candidates for sublobar resections. Ground-glass and partially solid masses are increasingly being identified by chest computed tomography screening programs. Determining their appropriate treatment can be difficult. Sublobar resection is considered adequate for adenocarcinoma in situ or minimally invasive adenocarcinomas. However, preoperatively determining whether these lesions are truly not invasive tumors (pTIS, pT1mi) using current radiologic techniques is challenging.

Radiomics is the burgeoning field in which data hidden within radiologic images that are not perceptible to the naked eye are abstracted to unlock new information. In this manuscript, tumor volume, solid volume percentage, skewness, and entropy-level data abstracted from computed tomography images of the chest are used to create an algorithm to predict the invasiveness of ground-glass and sub-solid lesions. The authors create a model with a sensitivity of 85% and a specificity of 79% for distinguishing between the less-invasive (pTIS, pT1mi) and invasive lung cancers. The study is limited

by its sample size, and the model needs to be validated in larger studies.

With those caveats in mind, this study and others in development are the future. The ability to abstract new information from existing data may allow us to predict tumor histology, invasiveness, gene expression, treatment response, pathologic outcomes, etc. Imaging analysis may be combined with biomarkers (blood-based or otherwise) to strengthen predictive models. As the art of medicine and the science of technology continue to merge, we hope to move past the crystal ball and gain the ability to truly see the future.

References

1. History.com Editors (2020). HISTORY, A&E Television Networks. Nov 2009. Available at: <https://www.history.com/topics/paranormal/nostradamus>. Accessed May, 2020.
2. Oakley B. DVD Commentary for "Marge in Chains." In: *The Simpsons: The Complete Fourth Season* [DVD]. Los Angeles: 20th Century Fox; 2004.
3. Yoshiyasu N, Kojima F, Hayashi K, Bando T. Radiomics technology for identifying early-stage lung adenocarcinoma suitable for sublobar resection. *J Thorac Cardiovasc Surg*. 2021;162:477-85.e1.