Radiology

Deep Learning for Cardiac MRI: The Time Has Come

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Conflicts of interest are listed at the end of this article.

See also the article by Tao et al in this issue.

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The impending impact of artificial intelligence, machine learning, and deep learning radiology applications on the practice of radiology has led to speculations ranging from benevolent partnership to career-limiting competition (1,2). Numerous manuscripts describing potential artificial intelligence applications are submitted to medical journals each day. Many of these address dubious conditions with limited clinical applicability. In this issue of *Radiology*, Tao and colleagues (3) address a well-defined clinical challenge—the automation of cardiac MRI left ventricular volume analysis. It is surprising to learn that while commercial programs are available for automated MRI volume analysis, human operator intervention has nearly always been required.

In the October 2010 issue of *Radiology,* my colleagues and I (4) reported on the use of volume analysis for systolic and diastolic function in 386 participants, which clarified the time-consuming task of manually defining and analyzing 20 cardiac phases of eight axial sections that resulted in 160 regions of interest per participant for a total of 61 760 measurements. This illustrates the tedious nature of such analysis. Indeed, for that study, medical student volunteers defined most of the regions of interest, which were then corrected by the principal investigator. Each participant analysis required 45 minutes or more of human intervention for the evaluation of all 20 cardiac phases.

In their well-performed multivendor, multicenter protocol consisting of 400 clinically diverse patients, Tao and colleagues (3) analyzed only two cardiac phases: diastole and systole. Hence, equivalent human-assisted analysis would be expected to require perhaps 10 minutes of interaction. The authors successfully automated cardiac MRI volume analysis so that a standard examination consisting of eight short-axis cine sections could be analyzed for myocardial mass, end-diastolic and end-systolic volumes, and ejection fraction in less than 1 second per patient. The described deep learning methodology for automatic cardiac MRI volume analysis would considerably improve the efficiency of cardiac MRI report generation.

The success of Tao et al should be applauded and then placed in perspective. It may require some time before this or similar applications become available as approved software applications. The automated execution of a well-defined task such as myocardial volume determination is a readily teachable machine task. How much farther will artificial intelligence need to advance to compete with an experienced radiologist performing more complex procedures? For example, the difficulties involved in analysis of cardiac MRI in congenital heart disease are much greater and much less well defined.

Futurists predicting the decline of radiology careers because of advancing data science should consider the number and costs of the computer program modules required to replace the varied work of a subspecialty radiologist. Tao and colleagues developed a cardiac MRI volume analysis program that would be only one such module. As professors and educators, we can tell our trainees that while data science is an important tool in the service of our radiology practice, we are a very long way from a comprehensive robotic radiologist. In the meantime, radiologists and data scientists will have a firm and growing partnership.

Disclosures of Conflicts of Interest: disclosed no relevant relationships.

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