

EDITORIAL COMMENT

Diagnosis of Hypertrophic Cardiomyopathy

Who Is in Charge Here—The Physician or the Computer?*

Toby R. Engel, MD



*“Once a new technology rolls over you,
if you’re not part of the steamroller,
you’re part of the road.”*

—Stewart Brand (1)

“**M**om. Dad. Good news. I’ve passed the tryouts and will play on my high school’s football team.” My thoughts immediately turned to the story I’d been told of my uncle who suddenly died as a very young man, playing basketball, I think. Images of articles I have seen concerning sudden death in youth from hypertrophic cardiomyopathy (HCM), from coronary anomalies, or other congenital and genetic disorders came to mind. Can one imagine telling your teenager, “No. First get yourself an echo . . . and more.” Thankfully, this is not a real anecdote. And, parenthetically, the incidence of sudden death events in competitive school sports is published dramatically, but is not so overwhelming—1 death per 220,000 athletes (2). However, it emphasizes the need for an easy, routine way to identify HCM.

SEE PAGE 722

In this issue of the *Journal*, Ko et al. (3) report that apparently all one needs is computer analysis of a routine digitized 12-lead electrocardiogram (ECG). That is awfully simple, but wait. When I first learned how the investigators put a simple ECG into a little black box and came out with the answer, I could not believe it. And reading the technology involved

seemed difficult for I and most physicians to critique. Just the title of this report by Ko et al. (3) was disarming: a convolutional neural network? Reading on, we learn that we need to use a machine learning platform called TensorFlow that enables using deep learning models based on tensors (multidimensional arrays of data). I offer this sample of the methodology to tease the reader of this editorial. Are we all expected to understand and critique this technology? But this unfamiliar manner of problem solving does work. Just for example, please examine the receiver-operating characteristic curves comparing sensitivity with 1 – specificity (Figure 2 in Ko et al. [3]). There is quite excellent diagnostic performance in a large series (3,060 patients with validated HCM after excluding left bundle branch block and paced patients vs. 63,941 control subjects matched for sex and age), from a reliable clinical source (Mayo Clinic). The neural learning was done in a manner tedious for humans, by repeated iterations until a combination of data resulted in the greatest area under the receiver-operating characteristic curve. For instance, so many trials that it could not be done by a horde of assistants and fellows. Thus, we ought to accept this computer technology because it works. Of particular interest, referring to the fictional clinical problem of my son the football player with which I introduced this piece, the results were particularly useful in younger patients (<40 years; patients <18 years old were excluded). A key limitation in a normal network of artificial intelligence (AI) is the lack of “explain-ability,” but this should not detract us from applying AI when useful.

Some points warrant emphasis. In the subgroup with ECG criteria for left ventricular hypertrophy, the AI performance was nearly identical to the population as a whole (the same area under the curve). Similar performance held for subjects with normal ECG by

*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of JACC or the American College of Cardiology.

From the Cooper University Hospital, Camden, New Jersey. Dr. Engel has reported that he has no relationships relevant to the content of this paper to disclose.

standard interpretation (about 10% of patients with HCM), suggesting that routine ECG screening is insufficient. Diagnostic performance was optimal in younger subjects, perhaps because older subjects have more comorbidities. Indeed, the AI approach used here may be more pertinent in younger patients. We must await a trial, presumably from a different data source, to confirm its success in a younger population, specifically one where the majority of subjects is <40 years old and where a substantial number are <18 years old. Finally, I have learned from trying to digest the methods used in this work that computer learning can be superior to algorithms for diagnosis that are based on striking features of the clinical data. And this can apply to therapeutic decisions. I congratulate Ko et al. (3) for their work, but really, we should admire the computer that did all the heavy lifting. It follows that we need not fear using AI, nor trying to understand how it works, when it helps us care for patients.

But what recommendations shall I make for my son? As to my speculations, I will ignore financial concerns and availability. There is no clinical experience with this test. How often will a positive test predict symptoms or events? Should we seek a diagnosis in the absence of symptoms? As I presented the case of “my son,” I raised the specter of a frightening

event as the very first symptom. But his story was special because of his family history. Lacking such a history, what to do if the AI answer is positive? Some further testing is easy on the patient, such as echocardiography. But positive test results lend to more testing, such as, for example, exercise testing, catheterization, electrophysiologic study. And how far need we go with positive results—restriction of activities and consideration of treatment in the absence of troublesome symptoms? This requires further prospective studies or advice that I feel not qualified to provide. On the other hand, if sensitive testing as provided by the sort of computer analysis suggested by the study of Ko et al. (3) is negative, further study and concern is not warranted. But what if there is no family history to suggest risk—is special ECG testing in that case warranted at all? Further confirmation of their data is in order, along with a prospective clinical study trial or at least some reported experience, but we should congratulate Ko et al. (3), who seem to have led the way to a solution of a most worrisome problem.

ADDRESS FOR CORRESPONDENCE: Dr. Toby R. Engel, 10564 Cox Lane, Dallas, Texas 75229. E-mail: tobyrengel@gmail.com. Twitter: [@CooperHospital](https://twitter.com/CooperHospital).

REFERENCES

1. Brand S. Brainy Quote website. Available at: https://www.brainyquote.com/quotes/stewart_brand_172275. Accessed January 2020.
2. Maron BJ, Gohman TE, Aeppli D. Prevalence of sudden cardiac death during competitive sports activities in Minnesota high school athletes. *J Am Coll Cardiol* 1998;32:1881-4.
3. Ko W-Y, Siontis KC, Attia ZI, et al. Detection of hypertrophic cardiomyopathy using a convolutional neural network-enabled electrocardiogram. *J Am Coll Cardiol* 2020;75:722-33.

KEY WORDS hypertrophic cardiomyopathy, neural machine learning