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Teaching crucial skills: An electrocardiogram teaching module for medical students

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Abstract

Background: Medical student performance in electrocardiogram (ECG) interpretation at our institution could be improved. Varied resources exist to teach students this essential skill.

Methods: We created an ECG teaching module (ECGTM) of 75 cases representing 15 diagnoses to improve medical students' performance and confidence in ECG interpretation. Students underwent pre- and post-clerkship testing to assess ECG interpretation skills and confidence and also end-of-clinical-year testing in ECG and laboratory interpretation. Performance was compared for the years before and during ECGTM availability.

Results: Eighty-four percent of students (total n = 101) reported using the ECGTM; 98% of those who used it reported it was useful. Students' performance and confidence were higher on the post-test. Students with access to the ECGTM (n = 101) performed significantly better than students from the previous year (n = 90) on the end-of-year ECG test.

Conclusions: The continuous availability of an ECGTM was associated with improved confidence and ability in ECG interpretation. The ECGTM may be another available tool to help students as they learn to read ECGs.

Keywords: Electrocardiogram; Assessment; Clinical skills; Self-directed learning

Introduction

An important skill for any physician is being able to interpret an electrocardiogram (ECG). Surveys of Internal Medicine clerkship directors indicate their belief that ECG interpretation is critically important for medical students [1,2]. Despite that fact, many clerkship directors who were surveyed report that the majority of their students have not come close to mastering this skill [2]. Several studies of ECG interpretation by first-year internal medicine [3], pediatrics [4], and family medicine [5] residents have confirmed these doubts, demonstrating that even many residents have poor ECG diagnostic accuracy.

Various methods have been implemented to optimize students' ECG interpretation skills. Studies generally report success with specific strategies ranging from one-hour lectures [6] to web-based programs [7,8] like those that can be found on YouTube [9]. Residency programs have applied self-study modules with success [10]. Other novel strategies such as puzzles [11] and interactive training systems [12] are designed to appeal to a wide variety of students' learning styles. Different students may benefit from varied training methods depending on their learning styles; therefore, offering a variety of options may help make it easier for students to learn to interpret ECGs. One theme that has emerged from a variety of strategies is that the repetition of material may be more important than its presentation [13]. One study found that assessing learners' knowledge (e.g., whether or not the test would count for anything) was significantly associated with improved performance [14]; others found that a summative examination drove learning motivations [15,16].

At our institution, the traditional medical school teaching mode is characterized by concentrated, yet integrated, basic science courses during the first year, followed by second year clinical clerkships with characteristically steep learning curves and intense self-study [17]. These clerkships are the core rotations completed by medical students during their clinical training and include Internal Medicine, Pediatrics, Surgery, Psychiatry, and others. During their eight-week

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Internal Medicine clerkship, medical students receive formal instruction in ECG analysis in two types of sessions that usually take place right before or during the first week of clerkship. One type of session is a workshop, in which students learn both to perform and interpret ECGs, by obtaining ECGs from classmates then learning to interpret those ECGs with a Cardiology faculty supervisor. The second type of session is a traditional lecture in which a cardiologist reviews and interprets ECGs in detail, using multiple ECGs and possible scenarios as examples. The workshops and traditional lectures are interactive, and students rate both highly.

Despite receiving formal ECG teaching, medical students at our institution were not confident in their ability to interpret ECGs at the conclusion of their Internal Medicine clerkships. In routine post-Internal Medicine clerkship evaluations, medical students provided feedback that supervisors were not necessarily reviewing ECGs with them. Furthermore, students reported discomfort with their ability to identify basic ECG abnormalities like ST-segment elevation or frank evidence of myocardial infarction. Test scores were also quite poor on the routine end-of-year ECG examination asking students questions about the rate, rhythm, axis, intervals, and diagnosis. In hopes of improving students' ability to interpret ECGs, we developed an ECG teaching module (ECGTM) and made it continuously available for repetitive use by medical students who were performing their Internal Medicine clerkship.

Material and methods

Module development

A working group comprising general internists, a cardiologist, several residents, and medical students was assembled. The overall structure of the ECGTM was intentional. Previous literature has shown that exposure to a clinical scenario positively contributes to a student's ability to interpret an ECG [18]. In creating the ECGTM, we considered the importance of contextualizing ECGs with patient cases. Members of the working group screened clinical scenarios and diagnoses representative of common conditions relevant to students on Internal Medicine. clerkship faculty then met to select 15 diagnoses that would be considered essential for all students to recognize. We also considered the importance of repetition [13], for which purpose nine physicians utilized ECGs from actual patients to create 75 unique cases. All slides were reviewed by at least two additional physicians for accuracy prior to implementation of the ECGTM. Table 1 depicts the repetition of diagnoses within the 75 cases.

Module structure

Each case presented via the ECGTM consists of two slides (Fig. 1). The first slide presents a one-line clinical scenario and a high-quality ECG reproduction electronically exported without patient identifiers from TraceMasterVue® (Phillips). Students are prompted to answer questions about rate, rhythm, axis, intervals, and overall interpretation before advancing to the second slide. The second slide contains answers to the questions and case-specific teaching points; this slide also has arrows or other visual aids that highlight relevant ECG findings.

Table 1
Diagnoses and number of cases in the ECGTM.

Diagnosis	Number of cases*
Normal sinus rhythm	8
Sinus bradycardia	6
Sinus tachycardia	10
Sinus arrhythmia	3
First degree atrioventricular block	9
Second degree atrioventricular block	3
Complete heart block	3
Myocardial ischemia	7
ST-elevation myocardial infarction	7
Hyperkalemia	4
Left bundle branch block	4
Right bundle branch block	4
Atrial fibrillation	8
Atrial flutter	3
Paroxysmal supraventricular tachycardia	2
Ventricular tachycardia	3

Repetition was used to emphasize teaching points for 15 diagnoses relevant to Internal Medicine and targeted at the level of medical students.

* Total number of diagnoses exceeds the total number of cases (75) due to the presence of ≥ 1 relevant diagnoses in some cases.

With a baseline assumption of self-directed learning, the ECGTM provides repetition not only of diagnoses but also teaching points and habitual practice. Students are prompted to use the same structure to interpret each ECG, answering questions about rate, rhythm, axis, etc. in a systematic manner. Once a student answers questions on a single ECG, then the next slide provides immediate feedback with the correct answers, allowing students to assess specific tasks was more challenging for them. For example, if a student misses several questions regarding how to calculate the axis, then this student may want to review how the axis calculation is done before proceeding further into the module; a student can also intensify learning by spending more time on slides related to a specific area of weakness.

Additionally, the organized index listing the 15 diagnoses and correlating ECG cases permits students to direct their own learning and proceed in a way that makes sense to them. For instance, students can decide whether to pursue ECG cases by diagnosis, complete the module in its entirety and return to review specific diagnoses, and/or use the ECGTM as a resource when caring for patients with specific differential diagnoses in order to refresh their knowledge about particular ECG findings. Though the design itself was not particularly novel, the ECGTM allowed for ease of access and repetition to aid students with their learning.

Module implementation

During the eight-week core Internal Medicine clerkship, the ECGTM was available to all students within the online course management program. The ECGTM was also available to students for the rest of the academic year, and could be downloaded to personal computers for use any time