Cardiology & Cardiovascular Research

Research Article

Advancing Electrocardiogram Technology

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Abstract

An electrocardiogram (ECG) measures the electrical activity of the heart in order to diagnose cardiac conditions. These medical tests are non-invasive and cost-effective, simply requiring the clinician to place electrodes in various anatomical positions on the patient. The general ECG testing process has not changed over time; however, novel ECG technology is starting to see use in clinical practice. Therefore, the purpose of this literature review is to provide an overview of the effectiveness of advanced ECG technology and practical implications for clinicians.

Keywords

Electrocardiogram, Medical Devices, Technology.

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Received: February 20, 2024; **Accepted:** March 25, 2024; **Published:** April 03, 2024

Citation: Zachary Townsend. Advancing Electrocardiogram Technology. Cardiol Cardiovasc Res. 2024;2(1):1-2.

Introduction

An electrocardiogram (ECG) measures the electrical activity of the heart in order to diagnose cardiac conditions. These medical tests are non-invasive and cost-effective, simply requiring the clinician to place electrodes in various anatomical positions on the patient. The general ECG testing process has not changed over time; however, novel ECG technology is starting to see use in clinical practice. Therefore, the purpose of this literature review is to provide an overview of the effectiveness of advanced ECG technology, as well as practical implications for clinicians.

Discussion

The standard 12-lead ECG requires placement of ten individual electrodes- six chest electrodes and four limb electrodes. Glove-based ECG technology has attempted to simplify this process by incorporating all electrodes in one glove device. Because the electrodes are in a fixed position on the glove, this type of device may reduce one of the most common types of lead misplacement errors- limb lead reversal [1]. In order to test the effectiveness of the glove-ECG, researchers recruited a cohort of adult cardiology patients who underwent ECG testing using a standard 12-lead and glove-ECG. The glove-ECG was 93%-95.7% clinically equivalent to the standard 12-lead ECG throughout various phases of testing [1]. Reductions in electrode misplacement errors and prevention of lead wires becoming tangled are a few advantages of this type of ECG technology.

Similar to glove-based ECG devices, new patch-based ECG technology is beginning to see use in various settings. In a study among 100 participants undergoing ECG testing, the patch-based ECG was 96% clinically equivalent to a standard ECG in overall interpretation [2]. One major advantage of patch-based ECG devices is the combination of all chest electrodes in one large patch. These pre-connected and pre-positioned devices have

been shown to reduce ECG testing time and lead misplacement errors [2]. Many of these patch-based devices also have Bluetooth connectivity, which allows clinical-grade ECGs to be captured and sent to a secure cloud database for remote physician interpretation. This technology allows patients to record their own ECGs, with minimal to no training, in locations where access to care is a significant barrier. Finally, some of the latest advancements in ECG technology include smartphone-based devices, such as Kardia Mobile and Apple Watch. These devices are designed to capture medical-grade ECGs at the early onset of symptoms outside of clinical settings. Patients can then send the recorded ECGs to their physician for follow up. The devices are primarily advertised to detect atrial fibrillation, one of the most commonly treated cardiac arrhythmias. In a study involving 100 cardiac patients, the Kardia Mobile device provided comparable detection of atrial fibrillation and atrial flutter compared with standard ECG; however, there were significant difference in basic intervals measured by Kardia Mobile [3]. In another study involving 74 heart patients, the Apple Watch accurately detected atrial fibrillation, with a sensitivity of 93.5% and a specificity of 100% [4]. However, there was also a high percentage of unclassifiable recordings with the single-lead Apple Watch. Based on the results of these studies, smartphone-based ECGs may be useful for early detection and treatment of atrial fibrillation; however, future studies are warranted to investigate the clinical diagnostic value of such devices.

Conclusion

In conclusion, ECG technology is advancing, and these novel devices may provide several advantages over traditional ECG systems. Some advantages reported in the literature include greater efficiency and faster acquisition of ECGs, fewer lead-misplacement errors, greater ECG accessibility in remote/rural settings, and earlier detection of common cardiac arrythmias [1-4]. Additional research, most notably with larger sample sizes and more diverse samples in regards to cardiac diagnosis, are required in order to determine the clinical relevance of such technology. Nevertheless, these novel ECG devices show promise in the diagnosis, treatment, and management of cardiovascular disease.

References

1. Luc M, Fintel DJ, Klein HO, et al. Comparison of twelve-lead electrocardiogram using a glove-based recording system with standard methodology. Am J Cardiol. 2013; 112: 895-903.
2. Roy SK, Shah SU, Villa-Lopez E, et al. Comparison of electrocardiogram quality and clinical interpretations using prepositioned ECG electrodes and conventional individual electrodes. J Electrocardiol. 2020; 59: 126-133.
3. Lukasz K, Balsam P, Glowczynska R, et al. Kardia mobile applicability in clinical practice A comparison of kardia mobile and standard 12-lead electrocardiogram records in 100 consecutive patients of a tertiary cardiovascular care center. Cardiol J. 2021; 28: 543-548.
4. Pepplinkhuizen S, Hoeksema WF, Stuijt WVD, et al. Accuracy and clinical relevance of the single-lead apple watch electrocardiogram to identify atrial fibrillation. Cardiovasc Digit Health J. 2022; 3: S17-S22.