

A Critical Review of
Ventricular arrhythmia is predicted by sum absolute QRST integral
but not by QRS width

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Introduction

Heart disease is the leading cause of death in the United States of America having contributed to more than 800,000 deaths in 2011.ⁱ Of these, it is estimated that over half were from sudden cardiac death (SCD).ⁱⁱ A common cause of SCD is a transient arrhythmia (usually ventricular tachycardia) that degenerates into ventricular fibrillation and subsequently leads to death in approximately 95% of patients.ⁱⁱⁱ Currently, one of the favored treatments for those at risk for SCD is the implantable cardioverter-defibrillator (ICD). Traditionally, candidates for ICD implantation were screened based on both ejection fraction and QRS width, however new research has shown that these markers may not be the most effective as previously thought.

Technical Summary

In research conducted at Johns Hopkins University in the last two years, results have shown that the sum absolute QRST integral (SAI QRST), which is the area between the absolute curve of an ECG signal and its baseline, may be a more accurate clinical marker of a patient's susceptibility to ventricular arrhythmias. The most important result in this paper is that patients with low and intermediate SAI QRST values (as defined by the researchers) were 300% more likely to have an episode of ventricular tachycardia or fibrillation. To calculate this figure, participants were placed into low, intermediate and high SAI QRST (<69,70-145,>145 mVms) categories, and "Kaplan-Meier survival curves were constructed."^{iv} In reality, these were not Kaplan-Meier survival curves but curves plotting a group's freedom from ICD shocking or antiarrhythmic pacing as function of time.

Additionally, it was shown that "QRS width is associated with ventricular tachyarrhythmia only if accompanied by a low SAI QRST."^v Based on the results of this study, it was decided that SAI QRST was a suitable predictor of tachyarrhythmias, especially because of its 95% negative predictive power. This strong negative predictive power allows a clinician to have a clear indication of whether ICD implantation is necessary for a patient. Ultimately, this should provide a higher standard of care for the patients, as they no longer have to undergo costly and potentially dangerous procedures.

Critique

In evaluating any journal article, one of the first things to look at is the methods section. If it is not completely clear how the experiment or study was

carried out, its results cannot be duplicated and used by other clinicians in the field. In this article, I believe that certain parts of the methods section could have been strengthened. One major example of this takes place when the author was describing how the SAI QRST integral was calculated. In it, they say, "all ECGS were analyzed by customized software in a robust automated fashion."^{vi} While I have some knowledge of how this process was completed, partly due to my experiences working with the primary author, the average person would not understand how this data was analyzed. To me, this is a glaring error and may have undermined the SAI QRST's usefulness, as other people seeking to use the marker may not have the ability to analyze their data in similar ways.

However, even with this shortcoming, I believe that the paper is very persuasive. Throughout the paper, the usefulness of the new marker is emphasized, and compared against the findings of past research. While the results may seem to be completely opposite of many previous studies, the results were backed up with a thorough statistical analysis from a large sample size ($n > 300$ people). This allows for an easy to read and informative paper that gives clinicians a useful tool for quantifying a patient's risk for ventricular arrhythmias and whether an ICD implantation will be useful or not. I have found that sometimes study papers such as these may represent excellent research but ultimately the paper is not very effective because it is not very clear what to do with the new findings. However, with this paper, this issue did not arise, since the marker's clinical usefulness is repeated throughout the results and discussion sections of the article.

Finally one aspect I found especially admirable was that the author was completely willing to admit something that was uncertain. While it would be nice to know exactly what SAI QRST is measuring, especially as it is the focal point of the paper, the author offers a suggestion of what is happening (action potential cancellation) but ultimately says that research needs to be conducted to further elucidate its meaning.

Conclusion

In summary, I believe that this paper did all that it set out to do. In less than five pages, the paper clearly explained the controversy surrounding the use of QRS width as a predictor of risk for ventricular arrhythmias. It also established a new marker (SAI QRST) and using statistical analysis of a prospective cohort study showed that this SAI QRST was a more effective predictor of arrhythmia and has a good deal of potential for helping make decisions as to whether a patient necessitates ICD implantation. To further strengthen the paper, I would recommend two improvements. With further explanation of how the data was collected and analyzed, other electrophysiologists would be able repeat the analysis and adopt the marker in their practice. Finally, a clear indication of what SAI QRST is actually measuring would be extremely helpful in validating the use of this marker in clinical medicine.

ⁱ Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Benjamin, E. J., Berry, J. D., Borden, W. B., Bravata, D. M., et al. (2012). Heart disease and stroke statistics--2012 update: a report from the American Heart Association. *Circulation*, 125(1), e2-e220. doi:10.1161/CIR.0b013e31823ac046

ⁱⁱ Lloyd-Jones D, Adams R, Carnethon M, et al. Heart disease and stroke statistics—2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation* 2009;119:480

ⁱⁱⁱ “Sudden Cardiac Death: Primary and Secondary Prevention.” – *Wake Forest Baptist Medical Center*. Web. 15.Mar.2012.<http://wakehealth.edu/Health-Central/Sudden-Cardiac-Death-Primary-and-Secondary-Prevention>.

^{iv} Tereshchenko, et al. (2010). Ventricular arrhythmia is predicted by sum absolute QRST integral but not by QRS width. *Journal of Electrocardiology*, 43(6), 548-552. Elsevier Inc. doi:10.1016/j.jelectrocard.2010.07.013

^v Tereshchenko, et al. (2010). Ventricular arrhythmia is predicted by sum absolute QRST integral but not by QRS width. *Journal of Electrocardiology*, 43(6), 548-552. Elsevier Inc. doi:10.1016/j.jelectrocard.2010.07.013

^{vi} Tereshchenko, et al. (2010). Ventricular arrhythmia is predicted by sum absolute QRST integral but not by QRS width. *Journal of Electrocardiology*, 43(6), 548-552. Elsevier Inc. doi:10.1016/j.jelectrocard.2010.07.013