

Manual Methods to Differentiate Wide Complex Tachycardias

Announcer: Welcome to Mayo Clinic's ECG Segment: Making Waves, Continuing Medical Education podcast. Join us every other week for a lively discussion on the latest and greatest in the field of electrocardiography. We'll discuss some of the exciting and innovative work happening at Mayo Clinic and beyond with the most brilliant minds in the space and provide valuable insights that can be directly applied to your practice.

Dr. Kashou: Welcome to Mayo Clinic's "ECG Segment: Making Waves." We're so glad you could join us. Today, we have a great episode planned for you as we discuss wide complex tachycardia differentiation, specifically focusing on the manual methods available to do so. We have an expert discussant joining us today who will help us better understand these approaches. So let's get started. Now, decades of clinical research have led to a variety of thoughtfully designed manual methods to differentiate wide complex tachycardias into ventricular tachycardia, VT, and supraventricular wide complex tachycardia. Apart from choosing the ideal electrophysiological determinants to secure accurate wide complex tachycardia differentiation, algorithms creators devise organizational structure and operative mechanics to enable their generalized use. In this episode, we're gonna discuss these various types of manual wide complex tachycardia differentiation methods available to clinicians today. And we're fortunate to have an expert in the field, Dr. Adam May, to join us to discuss this topic. Dr. May is a cardiac intensivist and assistant professor of medicine at Washington University School of Medicine in St. Louis. Dr. May's research interests are related to the discovery, development, and refinement of innovative processes to enhance the diagnostic capabilities of automated ECG interpretation. More specifically, his work has led to the development of automated methods designed to accurately differentiate wide complex tachycardias. His forthcoming research seeks to leverage the diagnostic capabilities of artificial intelligence techniques to better facilitate accurate rhythm analysis. Dr. May, thank you for joining us today.

Dr. May: Thank you, Anthony. It's my pleasure.

Dr. Kashou: Now, you know, we have you back again, but we can't think of anyone better to talk about this problem with. And so let's, you know, in the past, we've talked about some of the clinical implication, some determinants, some of those features to differentiate wide complex tachycardia as the hallmark features of VT. Now let's look at and dive into some of these conventional, the traditional manual methods that we have. Can you give and start with maybe a broad overview of the different types of manual methods that clinicians have at their disposal today to differentiate these wide complex tachycardias?

Dr. May: Yeah, absolutely. A great question. And thank you for having me, Anthony. So yes, there's a large number of different manual methods that are at our disposal and that we can use today. There's a large number of what I would categorize as strategic blueprints to help clinicians decipher what is the underlying rhythm, with that being SVT or ventricular tachycardia? Now, there's multiple types of designs, and I would broadly categorize them as being multi-step as being the first group where the users actually negotiate several prompted steps where they're asked to determine the presence or absence of a specific criteria. If a specific criteria that is specific for VT is present, then VT is your diagnosis. And only in the occasion where after

negotiating the entire multi-step algorithm with no responses to everything you would have supraventricular wide complex tachycardia, or SVT, as your diagnosis. Another of algorithm does include a VT as a default diagnosis. This was introduced by Griffith in the early 1990s where VT would be the default diagnosis unless highly specific criteria for SVT is present. There's also a unique criterion known as the Bayesian algorithm where different criteria are sort of collected together and put into a mathematical model to help determine the presence or absence of ventricular tachycardia. There's more simple criteria where it's just a single criteria, that being the R-wave to peak time in lead II, introduced by Pava and colleagues. And then there's the more recent variety of criteria, that being point scoring methods, the most prominent example of which would be the VT score where the more points that you accrue with that scoring method, the more likely VT is present. So those would be the broad categories for different manual methods to differentiate wide complex tachycardia into VT and SVT, all of which I use and I actually think fondly of. And again, these are all at our disposal and it could be very helpful to a clinician's clinical practice.

Dr. Kashou: Well, this is great. And you mentioned a lot right there. And me being more of a simple guy, let's kind of step back and maybe look at some of those that you mentioned in a little more detail. Maybe we could start with these multi-step algorithms which we tend to think are more of the commonly recognized, utilized approaches in clinical practice. What do you think are the common ones that are used? And maybe can you add a little bit of rationale of like why they were developed and where their formulation came about from?

Dr. May: Yeah, absolutely a fantastic question. So well with multi-step algorithms, these essentially have been present or at our disposal since the late 1980s and early 1990s. And they were essentially brought forth by both Marriott, and also Brugada separately. The most prominent algorithms that we have out there that are multi-step would be the Brugada algorithm. The Vereckei aVR algorithm, that happened a little bit later. And then also most recently in the past few years would be the limb lead algorithm, one that I've become quite fond of. Now, the purpose of these algorithm is essentially to provide a clear diagnosis in a very straightforward manner and to really remove the ambiguity in what is essentially a very complex task. And what these algorithms do is that they organize highly specific criteria in series and they prompt the user to address every one of these criteria separately to arrive at the diagnosis. As I mentioned, if a user is prompted with a question evaluating a very specific criteria for ventricular tachycardia, and if that criteria is present and you have an affirmative response, then VT is diagnosed, and end of story. You're done with the algorithm. And it is only after completing every single step within that series that you arrive at the diagnosis of supraventricular wide complex tachycardia. Now, every one of these algorithms that I mentioned really achieved great performance within research settings. And I find them to be a valuable tool in clinical practice. And for me, anecdotally, in a practical sense, I find that they work pretty darn well.

Dr. Kashou: Hmm. Yeah, it's interesting. And it's really nice when you're faced with already this difficult decision, but important clinical decision of figuring out what type of rhythm you're dealing with. Because, oftentimes, as we're taught early on and when we're learning ECGs, you know, VT until proven otherwise. But we know there's consequences of inappropriate management and treating something as VT if it's really not. And so having these steps, as someone that's more logical, it really makes sense. You're kind of using these features to narrow

down, what is it? You mentioned also this VT as a default diagnosis. What do you mean by this and what's its rationale?

Dr. May: Yeah, so this is a great method to help distinguish VT and SVT. Essentially, I find it to be one of the more creative ones that we have available. And, really, the underlying principle is that all wide complex tachycardias are VT until proven otherwise and only in the occasion where you have specific, specific criteria. For a right bundle branch block or a left bundle branch block being present, only in that circumstance can you diagnose supraventricular wide complex tachycardia. Now, this criterion is essentially the opposite of all other criteria where a specific criteria for VT must be present to achieve a VT diagnosis. This is different. VT is actually the diagnosis until it can be proven otherwise. So that essentially, it is a criteria that is very sensitive, with high sensitivity for a ventricular tachycardia. And it really decreases the likelihood that you're gonna miss VT. However, with this, there's a trade off. There's a trade off where you actually have decreased specificity. And, oftentimes, you can overcall VT by using this criteria in isolation.

Dr. Kashou: Hmm, yeah, it's interesting. And it's a nice starting point to, you know, as I was mentioning, starting with VT until proven otherwise. And it's good, but you do mention some of the potential implications in downstream effects of relying solely on this approach. The other one that I find interesting is that simple, that one-step method, the R-wave to peak time in particular. Can you define this one, the R-wave to peak time, and share a little bit about this method and how you use it clinically?

Dr. May: Yeah, so this criteria was more recently introduced. And it is as you said, it's a single, standalone criteria where you only have to apply one different criteria to determine whether a wide complex tachycardia is VT or SVT. Now to apply this criteria, you need to look at lead II and you need to evaluate the onset of the QRS complex to the peak of the first deflection, be it upright or downward. And if that duration from the onset to the peak is greater than 50 milliseconds, then you have VT. If it's actually less than 50, then you have SVT. Now, this is a highly specific criteria for VT. This comes at the detriment of having a lower sensitivity. Now, how I apply this criteria is, is I sort of add it to the mix of all of the other criteria. So I could still use the advantages of this criteria without being punished by the fact that it is not as sensitive as we would like.

Dr. Kashou: It's interesting, 'cause you mentioned the VT as the default diagnosing being sensitive. Well, you also have these counter ones to gauge you and lead you in the right direction. I mean, it's great to have one step and it gets you there. But as you know, there's always the counter balance of all these things. And the one I want to get to, because of all these approaches we've talked about and because it can't always clearly be defined which you're dealing with, a VT or not, we have these point-based algorithms that you've mentioned before where they use those scoring systems. Can you go over the rationale behind these methods and maybe describe some of the options that might be helpful to use in clinical practice?

Dr. May: Yeah, a great question, Anthony. I think point-based scoring methods are great, the most prominent, which would be Jasper Zebsky, I hope I'm pronouncing his name properly, VT score. And sort of the rationale for creating these type of methods really boils down to the fact

that a single criterion is generally not good enough to complete this complex task. And, really, despite all the criteria that are out there, oftentimes, you cannot confirm with certainty every ECG in terms of it being VT or SVT. But you can essentially use point-based scoring methods as an alternative to help you confirm the more, or at least a large swath of VT and SVT. So for instance, with the VT score, it's point based. And this score has a highly specific criteria, a number of highly specific criteria to which the user actually evaluates on the ECG. You accrue points for every one of those criteria being present on the ECG. And the more points you accrue, the more likely the diagnosis of VT is actually present. And then you can actually, if you accrue enough points, really with a high degree of certainty be able to diagnose whether VT is present. So it's sort of like building a case for the diagnosis. And that's a practice I do in general because I do use all of these algorithms in combination together to essentially build a case for a particular diagnosis being present or absent. And this type of scoring method by Jasper Zebsky, and more recently by Pachon and colleagues, they really use this type of rationale to help arrive at the correct diagnosis. And I find them to be incredibly valuable tools.

Dr. Kashou: And I think you said it right there, these are all tools and it's using all the tools in your toolbox. And the more you know about the multi-step ones, the hallmark features, the single, you know, the R-wave to peak time that you mentioned in lead II, the VT as a default, as you build up this in your toolbox, the better suited you are to approach these difficult rhythms. And I think that's been clear altogether. Now, why complex tachycardia differentiation is not easy. And we keep seeing this episode after episode when we have Dr. May with us. Now, familiarity with the available manual discrimination methods and the rationale helps provide a deeper understanding of why they were initially developed. And, hopefully, you found today's episode informative and learned something, because I sure did, every time I speak to him. Now, Dr. May thank you for sharing your expertise in helping us better understand this important topic. On behalf of our team, thank you for taking the time out and joining us. And we hope to have you back. As always, it's been a true pleasure.

Dr. May: Indeed it has. Thank you very much, Anthony.

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