Sudden Cardiac Death (Part 2)

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when you start taking a look at the kind of disturbances we can have as a result of this condition. Now, this is probably the first beat that you're looking at and going, that's not right. Something about that looks really bad.

So this is an EKG from a patient that does have prolonged QT syndrome, and what they're doing is, they keep on running their rate into the previous beat. Basically just running too fast, trying to get the heart to go before the heart is ready to go. And it's causing a rhythm that we called runs of ventricular tachycardia. So some of those beats that look pretty normal. Then all of a sudden, we get the peaks, peaks and valleys coming up nice and regular.

That's really what the patient's heart is doing. So we're running at a rate of roughly about 180. And it's all ventricular driven. It's not coming from the sinus node at all. It's actually over-driving that. Sinus node's trying to do its job, but it can't because ventricles decide they're going to go off and do their own thing.

What would happen if this rhythm was actually sustained? They keep on going in and out of it, but what would happen if they went into the ventricular tachycardia and stayed there?

I will say, based on the presentation, it is the obvious answer. That's a fatal rhythm. So you can tolerate ventricular tachycardia for a length of time. Basically, the better shape you're in, the longer you can tolerate being in it. But eventually it is going to kill you. It will put you in a full arrest, and you'll end up what you call flat liner, the most stable rhythm ever.

So-- I know. EMS sense of humor, takes a little while get used to it. So this is a patient here that's at a very high risk. Now, what's it going to look like when they're actually showing these runs? Well, think about this for a moment. Have you ever had too much caffeine? Because I'm standing in a college, I assume that's somebody's got to be saying, yeah, I've had too much caffeine before. You might be caffeinating right now. Absolutely. Once finals come around, you'll actually see. This we'll see an uptick in these types of calls. But once when you start feeling your heart's racing, just thump, thump, thump, thump, thump, thump, thump, thump, uncontrolled, fluttering sensation inside your chest.

Well, the heart is physically fluttering and bouncing around inside your chest. Sometimes you actually feel it hitting up against the inside of your chest wall. So they get that fluttering sensation. If it's something that's kind of like this, you're actually going to be going in and out of that fluttering sensation. And the skin, when that fluttering sensation is something that's really, really bad, the skin is what's going to tell the [INAUDIBLE]. Once when they start to real pale, really ashen gray, and the next one, probably in athletics are probably not the best measure of it, but they're getting really sweaty. I will say that they'd be getting sweaty for no reason

whatsoever, sitting on the sidelines on a 40-degree day, and haven't been in the game for the last 20 minutes. And now they're all of a sudden getting sweaty like they've just been running their butts off, being a real bad sign on that for them.

So if you start to see those things on somebody, get that fluttering sensation inside their chest, you might be dealing with this kind of situation. As I said, the skin is what's going to say, this is getting really, really bad. If you see somebody turn ashen gray for really no reason, that's a horrible sign, and we want to start taking a look at things right away.

So that's referred to as an R-on-T. So there's a few different ways that you can get there, and it's actually related to another condition I'm going to talk about here in a few different slides. We'll see if we can call it when it comes on up. But when they throw one heart beat as the heart's trying to re-polarize from a previous heartbeat, that's a pretty good way to mess up your electrical system and start causing malignant rhythms like this.

Just as in [INAUDIBLE], has anyone here ever heard of what's called a parasystolic rhythm? I will say, I've only encountered this once in my career, but this is what your heart actually runs two simultaneous rhythms. This particular patient was running ventricular tachycardia at the same time as she was running a sinus rhythm. And the EKG it really does look like you just took two rhythms and you smushed them together. Your heart can really do some fascinating things when it truly gets its mind set on that. But that was actually due to a [INAUDIBLE] polarization syndrome, very similar to this. There just wasn't activity to locate at on that one.

And continuing on down, making our EKGs look worse and worse. So the first one you kind of look at, and you go, that's not so bad. Now this one, you look at it, and you go, that looks like I gave a three-year-old a Crayon and told him to draw a straight line. So getting a little bit more obviously worse. Now this rhythm here, this is another one that oftentimes a lot of people misdiagnose. So this one goes under a French name. Most times in medicine, we have Latin names for everything, right? Sometimes a little bit Greek mixed in, this one actually goes with French.

So this is another one that can happen in response to an R-on-T or due to patients with electrolyte imbalances. Oftentimes potassium would be the biggest one on this. Which I'll throw out just a quick mention on potassium. When you start exercising, what happens in potassium levels? So kind of think about this for a moment. When you go out, you do activity, how much you damage your muscles? Say that you're going to go and run a marathon.

You don't want to damage your muscles. I mean, basically if-- once again, I'm sure somebody is going to get angry with me for generalizing something like this much. But when you go out and you do some weightlifting exercise, basically you're going to build up your muscles by beating on them and damaging them a bit. When they rebuild themselves back up from that damage, they come back a little bit stronger. Fair enough generalization? Nobody's going to be too angry at me for that?

Well, when you damage muscles, you damage cellular tissue, it's going to release some potassium out into the bloodstream. Now at the same time, the good news is that every time that you take sugar into your cells, insulin and sugar, that also carries potassium from the bloodstream back into the cells. So when you're exercising, when you're actually burning out sugar and you have that insulin-sugar transfer going, you actually end up decreasing potassium levels for a little bit as you're exercising. And then once you come to rest, you spike them up nice and high, and eventually they even themselves back out.

So if you're prone towards having issues due to low potassium or high potassium, exercises is a nice way of kind of exacerbating that and getting those problems to show. And this is one of the conditions you can end up in as a result of that, usually during the active exercise days when your potassium drops down a little bit. If it gets below about 3.5 milliequivalents, then you'll start showing this if you're prone towards it. And this is called torsade de pointes. Like I said, you got to go the French pronunciation, otherwise you end up saying "tor-sades de pointy." That doesn't quite sound as good.

So the other name for this, this is a specific type of what we call a polymorphic ventricular tachycardia. Once again, most of the time that we see a ventricular tachycardia, it's going to have a single site that got really, really ticked off about something, and starts speaking very loud and very fast. That's usually where most VTACs come from. However, with polymorphic ventricular tachycardia, we have a bunch of very angry sites inside the ventricles that are all going to start trying to speak at once. And in the torsade de pointes presentation, that's usually due to a potassium imbalance, and it follows a circular pattern throughout the ventricles. And kind of trade off exactly where the really pissed off site is going to be.

Now the other complication with this one, ventricular tachycardia, will be-- by the way, you look at the treatment of this stuff in a minute. I promise we will get there. But when we start talking about the ease of treating most cases of ventricular tachycardia compared to torsade de pointes, guess which one is really difficult to treat? This one up here.

So this one usually ends up requiring some added electrolytes. Usually, you got to give a gram or two of mag-sulfate to get this rhythm to go away. It's very malignant. It doesn't like to go away. Most cases of ventricular tachycardia, if you get an AED on them and shock them, that will make most cases go away. But the failure rate on defibrillating this particular rhythm is very high. So that's why I wanted to bring this one up. Oftentimes, these things can be treated a little bit more easy, but this one's a little bit more difficult. And when you take a look at the rhythm, what really sets this one apart is the fact that not every one of these piece looks the same. In fact, what torsade de pointes-- does anyone speak French?

You do? Do you know what it means in French?

Pretty sure torsade is like a compartment or like a lot or multitude kind of thing, and then pointes is just peaks.

Yeah. It literally means points. In fact, that's where that word in English comes from, is the French word, [INAUDIBLE]. So this comes down to literally mean twisting of the points is the translation on that. So you have one sharp point and one dull point on each one of the peaks and valleys. And this one, you see it flipping, talked about and that's where that name comes from, is twisting of the points. And that's what tells you that there is a whole bunch of different places that's getting involved in and generating this rhythm. It's not just one place of the ventricles. It's going to be a much more global issue, more like an electrolyte issue.

And then we have this one. I figured that we'd kind of come to one that maybe is just a little bit more comfortable for everyone, whereas the EKG strips here. Who wants to name this rhythm?

What's that?

AFIB.

Not AFIB. You're close, though. VFIB. Ventricular fibrillation. So this just basically means chaotic energy in the heart. So has anyone ever seen a flatline on TV? TV show comes on, and you just get the [BEEPING NOISE]. And then, of course, they take out the paddles with the goo on them, which we haven't used in over 15 years, in fact. I've been in the field for 16 years, and I have never even defibrillated somebody with paddles because we use stickers. They're much safer and much more effective.

But, of course, they got a flatline, and they put the paddles on them and shout, clear! Once again, not exactly the way we do things, but-- and then shock them. And they're shocked by it. What are they trying to do?

Start the heart.

Yeah. They're trying to start the heart. The secret of DFIB, it doesn't start the heart. It stops the heart. So what you're doing is, you're taking a fatal dose of electricity, and you're going to run it right across the heart to make sure the heart stops doing everything it's been doing. So kind of imagine this. You have a room full of people. Say if everyone were to get up right now and just start talking randomly. All that you hear is just you know white noise all the way on through. You can't make out a single thing. What happens when somebody gets up on top of the microphone and goes, quiet down?

Hopefully now everything just suddenly stops. That's what a DFIB does. Just simply says, shut up. Stop doing what you're doing, and then hopefully you have a chance to speak then. And that's what a DFIB does.

So this is a rhythm we've kind of mentioned a couple of times now. Let's say R-on-Ts. Some patients with that [INAUDIBLE] polarization can drop down into this rhythm, and they'll be instantly dead right now, no warning whatsoever. This is what you see on an EKG if you hooked

it up in time, is you would see this chaotic energy. If you were to actually open up their chest, the heart would not be staying still. It would be vibrating, sitting inside their chest twitching and shaking around, just vibrating around. It's kind of like what you see inside the rhythm. That's what it looks like the heart is doing. How do you make that stop?

Reset it.

Mm-hmm. Yeah. You shock it. You give a fatal dose of electricity to make the heart stop doing everything it's doing. And then we cross our fingers and hope that the sinus node takes over again. That's what you end up doing. So that's what ventricular fibrillation actually looks like, and that's something that's very treatable.

Now another way that we can get down to that-- so I said that this isn't going to be a very big trauma focus, but sometimes trauma can cause your electrical rhythm to get really far off, and this is actually going to be one of the more frequent ways that could happen, it's is a condition called commotio cordis. But we're going to take a little look at what happens when you do actually have commotio cordis and what this looks like.

So what we have here is a martial arts tournament, and we'll see this happen with just about any kind of contact sport. Usually, if it's a contact sport that has a little bit more focal trauma applied to you, it tends to be a little bit more common. So martial arts is good for it, hockey. Hockey pucks to the chest will do it. But we'll take a look at what commotio cordis is, and we'll kind of explain how this actually happens.

[VIDEO PLAYBACK]

What'd you see?

Punched in the chest.

Yeah, hit to the chest. So anyone been hit in the chest before and not dropped down? Probably. So this is one of those things. Like I said, a lot of these conditions, you really just have to line things up right. So in this particular case, when he was punched in the chest, he was punched right at the top of the sternum, right up here.

[END PLAYBACK]

That's the key location. It has to hit the top of the sternum right down the mid-line. You can't be off to the side, can't be to the ribs. You got to hit the sternum, and remember how we talked about that T wave, the heart re-polarization phase. When your heart is trying to get itself ready to beat again, that's an extremely vulnerable phase for it. That's what we call the relative refractory

zone. So if you were to hit the heart at that particular phase, one of three things is going to happen.

The best one is nothing. If the hit wasn't hard, not enough electricity to get it to actually respond, the heart was just simply too early in the re-polarization phase to be able to do much of anything for any reason. So that's the best outcome is when nothing happens. The second best outcome is, you force the heart to beat again. You can actually do that where you hit the heart in the relative refractory node. It'll actually depolarize and get itself another big beat. So not the best thing to do, but also once when that's done, it's just going to go through its reset phase and just keep on going like nothing ever happened.

Or, of course there's option number three, which is you drop to VFIB. So ventricular tachycardia is an option. Ventricular fibrillation is a very common option, and that's what happened in this particular case. The patient instantly went down into VFIB because every time that you hit the peak of the sternum, the extra weight, depending on the strength of the hit, about eight to 12 joules through the heart, every time you get hit to the sternum. In fact, we use that as a medical procedure.

So if we watch somebody go into VFIB, say that I have somebody in the back of the truck. They're sick, and I've been worried about them, and I got everything hooked up to them to monitor their cardiac rhythm, and I'm seeing the rhythm come across, and all of a sudden, I see VFIB come across the monitor. Guess what I'm going to do?

Yeah. I'm going reach on over and hit them on the peak of the sternum as hard as I can. It's called the precardial thump. I heard somebody back here say that. You'll also see this sometimes in the cardiac study labs. So if somebody is getting an echo-cardiogram, they got them up on the treadmill, going along, and all of a sudden the cardiologist sees this really ugly rhythm show up on there. And they come tearing into that room, throw them down onto the ground and start beating on their chest.

Of course, from the patient's perspective, this is really weird. It's like, what I did I do to get this? But you'll actually see that particular procedure used. So sometimes it can be used to the patient's advantage, but sometimes it really comes out to their disadvantage. And honestly, it doesn't take a whole lot. It doesn't have to be anything that's really spectacular. If we kind of back up and watch that hit again, it doesn't look like much. And there it was.

Now, I will say, when it comes down to martial arts, it doesn't look like much, but, boy, it's terrible any time that you actually feel it. So it was actually a pretty good hit, and one of the things you've notice, did he just suddenly drop down with the hit? Usually when you go into a ventricular fibrillation, you have about 10 seconds of lucidity. at that point, once he got hit, that's when he dropped into VFIB, but he still stayed lucid long enough to wander back to his line. that's when he started feeling really woozy up top, lost his balance, blurry vision, down onto the ground and out. At that point, he no longer would have had any recollection of what's going on. He is now in full cardiac arrest and is medically dead.

So that's commotio cordis. So while I said, we're not going to really focus too much on trauma, but when trauma actually causes electrical disturbances in the heart, we'll take a look at that. So that's that particular condition.