

Episode 84. LVAD Emergencies

Jimmy: and I'm bringing you another episode of the Pharm So Hard podcast. Of course. I have another special episode for you guys today. We're gonna be talking about something that we've never done before. And if you're working at any place that deals with complex cardiology patients, this is where you're gonna want to tune in.

I'm gonna walk again again, you guys know me, but I'm gonna welcome my guest Raphaelle Lombardo. Again, she is a ED clinical pharmacy specialists, as she did her pharmacy school at UGA, then went on to complete a PGY one at Emory St. Joseph hospital. And she's been practicing ED since then. Her practice interest are gonna be neuro, shock, sepsis and antimicrobial stewardship.

But the big thing we're gonna talk about today is the thing that she basically got thrust into. She didn't have a choice when it came to this, when it came to complex cardiology patients and those that have end stage heart failure. So today we're gonna be talking about LVAD emergencies, and this was highly requested by a few people.

So I hope you guys really can enjoy this one. I'm gonna walk Raphaelle and just tell us a little bit more about yourself, where you're from and just welcome to the show.

Raphaelle: Hey, Jimmy, and Pharm so hard people. Uh, thanks so much for having me, um, on the podcast today. So a little bit about me. Um, I'm originally from the north, um, but I've moved around a kind of a transplant kid.

I moved around all over my whole life, ended up in Athens, Georgia, which is probably no surprises to how I ended up, uh, in pharmacy school, um, out there. But, um, for the last, since 2017, I've been the ER, uh, clinical specialist at Emory St. Joe's and, um, I think working there has truly been. Like you said I've had really no choice, um, in, uh, in learning about complex cardiology patients, but it's also been a true joy, um, just for a little background about where I work and what St Joe's is.

Um, St. Joe's is a hospital under the Emory healthcare system. Um, we are a 410 bed community tertiary care hospital. So it's a little bit different. We're a community hospital, um, in Atlanta, Georgia. Um, recently in the last few years, St. Joe's was designated as a level one emergency cardiac care center, uh, for the state of Georgia.

Um, so that gives you kind of an idea of the type of patient that we're, uh, serving there. Um, and on, um, as it relates to LVADs, we implant about 20 to 25 LVADs annually, um, and we're currently servicing and providing care for over a hundred of LVAD patients. So. Um, it's definitely something that we see all the time.

Jimmy: Yeah. That's something that's cool. Again, in my shop, we, we see them, but again, unless you just have, if you can thrust it into it by training, it's one of those things where if you're a busy ER, pharmacist, it's like, you can do your best, but podcast coming into play and having people who deal with that a lot more.

So thank you for, for sharing that with me. Uh, let's just go to the very basic, uh, the very basic thing. Uh, but again, right before we get to that, I'm gonna transition for a second.

All right. So you told us a little bit about your, your background and as far as the patients that you guys see at your hospital, let's just get very basic. What is an LVAD and why do patients need them?

Raphaelle: Yeah. Um, so an LVAD is a type of mechanical circulatory. Device that can be used as an advanced treatment, uh, for patients with end stage chronic heart failure.

Um, LVADs are very sophisticated, um, and they essentially augment the function of the failing native heart, um, and they, and they provide, um, and restore perfusion, um, by improving blood flow from the heart to the rest of the body. Um, so VADs are effective for both your short term management of like a, an acute decompensated heart failure, refractory to inotropic support.

And then you also have your long term therapy and that's gonna be a majority of, of where patients are actually getting LVADs place. Um, and your long term, um, management is for your heart failure patient. Um, for this indication specifically, the most common scenarios are gonna be two major indications.

You have a bridge to transplantation. Um, and what that means is, is that, uh, patients who are currently approved and listed for a heart transplant, um, but they're waiting, right. And they are, have limited time on their isotropic support and they need something in the, in between. And then you have your destination therapy or DT, um, BTT, and then DT destination therapy is for patients who aren't eligible, unfortunately for heart transplant.

Um, but they remain refractory to medical management. So these patients will live the remainder of their life on an L a, um, of course heart transplant is the gold standard, right? And optimal curative strategy for NCH, heart failure, but resources are limited. And so LVADs have really come into play and help bridge this gap.

Um, ultimately the goal of an LVAD um, much like, you know, standard pharmacologic, pharmacologic management for heart failure, um, you wanna improve their symptoms, reduce hospitalization, and of course, reduce mortality. Um, let's see, I think, um, if it's okay with you, Jimmy, um, I wanna, you know, to kind of truly understand what an LVAD is.

Um, not just about indication. I think it's really important to understand the anatomy, if you will, of the LVAD and it's basic component. Um, so I'm gonna try to describe this as best I can.

Jimmy: Sorry. If you had something you wanted to share, you could again, but let me know any pictures or anything like that.

We'll put those on the show

Raphaelle: notes. Oh, okay. Yeah. I'll just now would be probably a good photo. Um, do you want me to just, I have like, do you want me to just keep rambling on ? We're good. You have something you

Jimmy: can share it now.

Raphaelle: Oh, where I don't have it, actually. I don't have it pulled up. Let me see. That's fine.

Um, sorry for this delay. Oh, it's fine. Let me pull up. Now, how would I do this?

Jimmy: And you can share it. What we, you can do. You can just send me the picture and I'll just send it to you. Send it in two show. Yeah.

Raphaelle: Is that okay? Can I send it to you? All right. I'm not that technologically savvy. okay. Um, alright, I'm just gonna pick up, uh, so to truly understand, I think what an LVAD um, is it's really important that we touch on the anatomy of the LVAD and it's basic component.

So you have the pump itself, right? Which consists of an inflow cannula, which is surgically implanted or connected to the left ventricle. And then you have an outflow cannula that is connected to the ascending aorta mm-hmm . So therefore blood is directed from the left ventricle, um, through the pump and then exits at the ascending AOR.

The pump is powered, um, and controlled by an external controller. And then they also as an external power source and what's connecting the external source controller and power to the internal pump is a percutaneous weed. That's called the driveline. Um, the driveline typically exits the skin through the upper abdominal wall.

Um, so it's very like robot vibe. Um, the modern LVAD um, has significantly evolved over the years. Um, you have your older first generation models being what were called pulsatile pumps. Um, and these were originally designed to mimic normal physiology and Sile flow. Okay. So unfortunately, those, these were really heavy.

Um, they were, uh, they had multiple mechanical compartments. They were way less durable. Um, But the one cool thing about them is they actually had a, uh, ventilator system on the driveline and you can actually connect like a hand pull for tile pump. So if there's any device failure, patients could literally pump themselves.

Um, so, uh, now though we have our newer generation LVADs and, and these are different in that day, provide continuous flow versus pulsatile flow. Um, and your three major devices that we use these days is gonna be your hardware, or also known as an H HeartMate two and HeartMate three. Um, all of these VAs are your continuous flow bags, but the main difference between them is just how the blood is fun in the actual VA itself.

Um, so your HeartMate two is an axial flow and we're getting into the nitty grit and keep it short and sweet axial flow. So it flows like this. Centr flow is what your heart rare and your heart rate rehab. And it flows like this, or is fun like this. Um, and these were, you know, these are gonna be a majority.

The reason I bring any of this up is because when you have a L patient coming in, it is, it is in some ways important to know what type of bad they have while they all are continuous. Um, the Actel flow LVAD, the HeartMate too, has a propensity for higher, higher complications, um, specifically bleeding complications.

So that's just something to be aware of. It's nothing that really, you know, changes much about approaching the L ad patient. But I just think it's important to know. And also just because the, the

evolution of LVADS has really been a big deal and, and really important, um, and, and has helping patients, um, live longer.

Um, let's now. Okay. Hopefully that's not too boring now. Let's, uh, . Now that we've introduced like device components, let's talk about LVAD terminology. Um, there's three important L V ad parameters. Uh, I'll be using a lot through the conversation. So I think, um, there really important to know, um, and, and relate to alled function.

Um, and that's gonna be speed, power and flow. So, um, one reference that I read, um, in, in preparing for our conversation, I, I like the way that they described it as these three things, speed, power and flow are your vital signs of the LVAD. And I really like that. Um, it's a good way to think about it.

These three parameters are gonna be displayed on the LVAD controller and, and they'll be a part of all the assessments of an LVAD um, of any LVAD patient coming in now, as pharmacist. We're not gonna be assessing the LVAD at all, but I think it's important to be able, uh, to be able to understand the language behind what's going on the LVA cause that can help you have key, um, understanding and, and language to what's going on physiologically with the LVAD and then that your management.

Um, so without getting too technical and beyond like scope of conversation, understanding the relationship between those parameters or vital signs, um, is important. Um, so here we go flow through the LVAD is proportional to the speed that's set on the device. The, the speed is something is the only thing that is actually predetermined on the device.

Okay. So flow makes sense, right? Higher, the speed higher the flow, um, pressure differences at the inflow and outflow cannula also impact flow through the device. So L ad flow is dependent on pre-load and also very sensitive to after load much like your normal left ventricle, right. And then power. So power is the amount of power consumed to actually spin the pump and get it working.

So if your L a has, if you Jack up this weed on your LVAD right, you're using more power to pump and therefore, therefore your flow is increased. Does that make sense? Yeah. Cool. Um, so now we've gotten through all the fundamental, uh, discussion about LVADS. Um, and, and I think that's that, that as, you know, introductory of a, of a conversation that I can have about it, um, because knowing your LVAD anatomy really is gonna be, um, helpful and, and, and super important to understanding how to approach the LVAD uh, patient, when they arrive in the ER,

Jimmy: Perfect.

That's like a really break breakdown because I think you can look at this and we can kind of break this, just talk up into a little different sessions and, and having that background, that again, most of us, I don't know, flow and power and that stuff is, I just, Hey, have someone else. But again, what I've noticed through time, and you probably noticed the same thing, the more that you know about these things, the easier it is for you to help your team when drugs are involved.

So I think that's one of the things that we, we have to kind of go back and look at it all the times where I'm really, I'm a really big, like, um, intimidation guide. I, I love to know what blades are you

using or is it a mag? Is it a Miller? Why, you know, either a hyper emulated, what's your approach? What's your backup are using ability mm-hmm does it, does my drugs impact.

Slightly, but again, I, I just like to be involved in understanding the whole process and I go to the intubation trainings and stuff like that. So, this is something that, again, the more, you know, the easier it is, and it helps you build relationships with your team. So I think that's a really good, uh, point where we can kind of break this into different little parts and the MBA transition so that we have the background.

Now, let us move into the next session of this podcast.

All right. So now we have kind of background stuff. Let's go ahead and jump into the meat and potatoes. So today let's talk about the most common type of LVAD emergencies. Now I can sit here and, and tell you that I, I think I know some of these things, but realistically, I want to hear from you, what are the most common LVAD emergencies, and we'll get into what we can actually do.

Raphaelle: Awesome. Okay. So naturally, I mean, we just talked about how we have a patient who has a robot heart that is, you know, connected to an external device. So as you can imagine, there's a vast array of complications that can go wrong, um, or that can arise in the LVAD patient. So they can be really intimidating whenever they walk through the door.

Um, naturally newer developments and LVAD devices, you know, they've contributed to improved survival. So as a number of patients with LVADs rise, so does the frequency in which your LVAD patients gonna come to the ER? Um, so I think it's something that we just have to start getting comfortable with. I actually read on the 2017 intermax, uh, report, which it, for those who don't know what intermax is, it's a, it's a database for outcomes of patients that receive LVAD or mechanical circulatory systems, um, for treatment, heart failure.

So this report actually approximate half of patients with a newly placed LVAD presented the ER within the first month of implantation. And then patients present on average seven times to the ER, within the first year of implantation. So we gotta start learning and, and feeling a little more comfortable about this, especially as, uh, LVAD placements continued to rise and more, more technologies advancing.

Um, so I think this is becoming the normal, right. Um, so LVAD complications though, they can be broken down into two categories, or I like to break 'em down this way, um, and keep it simple. You have LVAD device complications. So like that would be something like a SU event, which we'll get into a pump thrombosis.

So something is actually wrong with the system. Um, I'm not gonna get too much into the, um, device failure type, uh, complications, cuz that has to do with the controller. Um, but I'm gonna be focusing on complications, um, that. You know where me, where like medicine would be involved from that perspective.

And then you have your other category, which is, um, like secondary or associated complications because of the LBA. So that's gonna be things like hypotension, um, or hemodynamic and stability, bleeding, stroke, infection, arrhythmia, um, and there's so many different, um, you know, categories or, or different complications.

And, and I think we could be here for hours talking about management strategies and what that means. And so, um, I think some of the things that I'm gonna focus on are your key complications that are one most common, right. and then once you're probably gonna see, and then ones where opportunity, um, like you said, for pharmacists that can, you know, for, um, involvement and having actual impact when intervening and seeing these patients.

Um, and so that's what we're gonna focus on. Um, today.

Jimmy: Perfect. Let's jump right into it. So let's just kind of transition so we know what they are again. How do we, the providers in general, we're speaking to an audience of physicians, nurses, pharmacists, so together, how do we manage these LVAD emergencies?

Because as soon as I hear a sick L a patient, I'm like I say a few choice words and so help help us walk, walk us through the management of these people.

Raphaëlle: All. So first things first, you're gonna call the heart failure team. You're gonna call the that's we've all you're board and you know, they're coming.

That's the they're always gonna that. I think let's, let's, let's start with hypotension, I think, because one of the first things that you're gonna realize, or, you know, one of the first things you're going to assess in the L V a patient. Vital. Right. Um, so I think we should just start there. So let's talk about some hypo and hypertension being one of your more concerning, um, you know, situations.

So I think the first thing that we need to acknowledge is how difficult it is to assess a blood pressure in the L V patient, um, with a, a continuous flow device specifically, remember, we're not talking about pal flow devices, old school devices, NOK phone of LVAD devices. These are. Um, your really sleek new, um, continuous flow devices.

So they have a much more narrow pulse pressure index. Um, so that might mean you don't feel a palpable pulse until, you know, unless okay. You might, if there's still some function from the native heart that is contributing to flow, you might. Um, but don't be surprised if that's not the case and you fill a radio pulse and one's not there, but they're up and talking to you, that's normal.

Um, which makes it crazy. Um, and obviously, it's crazy with, and obviously that makes measuring blood pressure with the manual or automatic, not reliable at all. Um, so you're gonna get blood pressures that are like 20, over 20. Like it's just gonna be stupid. It won't make sense. Um, your gold standard for obtaining, um, uh, any kind of measure of blood pressure or map is gonna be an art line.

Um, but that might not be something that's happening straight away in the ER, right. That might take a little bit of time, um, before we actually get to that place. Um, so without getting too much into the weights of it, you wanna use a Doppler to get pressure, and that's likely gonna give you the best estimate of a patient's map.

And that's really what we care the most about in L that patients to be completely honest, um, the international society of heart and lung transplant, which I will now, um, just, you know, I will call is H LT for the rest of this. So I don't have to spend five minutes saying that, um, it defines hypertension as a map of less than 60 and continuous flow LVADs.

Um, They actually also the is H L P has a, has a really nice systematic approach to hypotension, um, in the form of an algorithm and chart, which I know we all love. Um, so that's a really good reference to have in your back pocket. Um, when a hypotensive VAD comes through the door. So, um, this, this essentially to break it down, this algorithm break management into two categories, hypertension, the setting of low flow.

So remember we talked about flow, low blood flow, um, through the VA and then high, bad flow. So we're gonna start with high VAD flow. So if you're thinking about the VA and you have a hypertensive patient and they have high flow, we're thinking vasodilation, right? So this could be maybe vasodilating meds that's causing this.

Maybe the hydralazine that the patient's on is now too high of the dose. For the patient. Um, maybe they're on some other agents for, um, you know, pulmonary hypertension that's causing some of this vasodilation. And that could be maybe just acutely, that is now a dose that's too high for the patient or whatever that's going on.

Um, that could be contributing. Um, so we need to just remember, let's not forget about just the basics of, is it a med problem, right. Um, obviously we're gonna hold the med. We could assess fluid status of the patient and if necessary start vasopressors, um, where this is, you know, that could be, that is something to think about on the flip side, if you have a high, uh, hypotensive bad with high flow, In the setting of fever or lose cytosis we are now thinking sepsis distributive shock loss of vascular tone, right?

Less, less SBR, um, happening. So more vasodilation, therefore higher flow. So it's kind of counterintuitive. You think high flow means high blood flow, but really what's happening is there's less pressure going against that flow. So that's why it's high. Um, so you might actually see higher flows on the LVAD device in the setting of hypotension with distributive shock.

Um, now let's go to the flip side. We just went through high flow indications and what can happen. And now let's go to low flow. So low flow. We need to be thinking of factors impacting preload. Okay. So one quick way. And so let's keep preload on our mind. One quick way to assess radiology, um, of a low flow.

Um, hypotensive patient is actually the presence of jugular venous pressure J so if you have a hypotensive patient with low flow and they have low JV, we need to be thinking, okay, in the setting of pre low preload, that's probably an indication of low volume, right? So you've got low volume. For what reasons are they bleeding?

Are they hypovolemic because their diuretic is too high of a dose at this point. Um, Or is it something device related? Is it a section event, um, which we'll get into, um, is it a, an issue with the VA where it's kind of blocking flow, um, and so, or not, or, you know, impacting flow, um, to which the there's low LV filling pressure contributing to that.

Now let's get into high JVP. So remember we're talking about low flow, low preload, but high JVP, right? So that could actually, that's a little more complicated that actually might be an dication of right. Heart failure. Um, and in that situation, we would need an echo to actually confirm that, um, And that may warrant treatment with something completely different that may actually indicate that need for diuretics and possible isotropic therapy, definitely a call a, a CT.

So, that's what we're thinking on the flip side from the, from the device perspective, is there an obstruction, is there a pump thro? This that's impacting the LV from being tough from unloading and that's what's causing the backup of flow and the high JVP, um, and the low flow, right? You, you would still have a lower flow backup of, of, you know, your high JVP, but in the setting of an obstruction.

And so those, you know, different ways of thinking about hypotension can kind of lead you into how do we manage it. Um, and they're all very different. So hypotension can essentially be a manifestation, right. Of some LVAD specific complications, like suction events or obstructions, and then also some other, um, some other disease process or condition that's going on, like a sexist or an acute right.

Heart failure. Um, let's see. I think now, since I've mentioned these, um, device related complications enough, like suction and pump thrombosis, we can get into those because those are like the very LVAD specific things that are, are somewhat complicated, but I think it's really important. Scary it's

Jimmy: it's stuff that freaks us out.

That's

Raphaelle: what it's,

that's when you're really like you're, you're. Calling CTS and, you know, heart failure, like three times in a row, um, SU events. So yeah, it's not just scary. We're freaking out at this point. Um, a suction event is a, it's actually a common LVED complication. Um, and it occurs most often as a result of reduced preload.

Like I, like we said previously, so you have suboptimal left ventricular filling, which in turn can actually collapse. This sounds horrible. Gary collapse, the left ventricle wall. Okay. Um, and it causes the inflow cannula to kind of be covered in some capacity, um, or blocked. And so in this situation, you know, the pump is still pumping.

The pump is still spinning. It's going, let's go, you know, this is what I'm here to do. And so in the setting where you have, you know, an interface between the cannula and you actually, and the actual left ventricular wall, the pump's still spinning and the result is low flow. Um, it's kind of scary. So some signs and symptoms, right.

Hypotension, like we talked about. Okay. You also now have the interface of the left ventricle with a compartment. And what do you think that's gonna cause arrhythmias, primarily ventricular arrhythmias, a lot of irritation on the ventricle wall, um, makes sense. And also low flow alarm. The bad may actually be alarming the patient, like, Hey, I'm not getting flow through this thing.

Um, and so that might be, um, part of. Part of that presentation. Um, in this situation, you, you also like with hypertension, they're all kind of related, right? You have to identify and manage like the underlying etiology. Um, a lot of times it is hypovolemic states dehydration, he hemorrhage shock. Um, if you don't have enough flow or volume coming through the bed, the LV wall will then flat because that, that pump is still spinning.

Um, so although it seems we should, you know, fluid resuscitation and a heart failure patient that might be warranted, um, stopping diuretics and, and this is something pharmacy wouldn't do, but you actually can reduce the speed. Like I said, that's the one thing you can control on the bad device. You can reduce the speed, then that's not.

So you reduce and, and in reducing the speed, it actually just allows the ventricle to catch up a bit. Right. So it's not constantly trying to pump, pump up. You just reduce it a little bit. It gives it a little time to kind of, you know, um, we have more intravascular volume at that point and it kind of is allowed for us to catch up, um, without like speeding through and trying to con you know, keep the process going.

Um, again, you can also have an underfilled E uh, left ventricle because of if there's any evidence of right. Heart failure. We kind of talked about that, um, previously, so you may need isotropic support vasopressors, um, but this, but RB failures either seen most commonly right after surgery, which isn't the point of this conversation.

Um, or as, as a patient continues to have, um, an LVAD device and requires more chronic management later on in, in treat. And then lastly, not least straight up device failure. So if the device isn't working and there's no flow for whatever reason, then of course the inflow cannula is just gonna suck bell V wall in.

Um, so yeah, I feel as though it does sound extremely scary, but as long as you can correct that underlying ideology and identify it, um, then hopefully we can get them in top shape, um, and kind of hopefully tune 'em up from that perspective. Um, go ahead. Something

Jimmy: we're good. All these things you just have to kind of get to one point and we should panic to a degree to look.

But once we look, I think it appears to be longest. There is not like a significant. You know, failure of a few things happening at once, you should be able to fix one of those things where there's a suction for the device where there's some issues. And initially I was thinking, oh, sounds like AFib RVR, where you have to slow things down just to allow enough time for just refilling.

So it seems that can, all these things can technically be done if you just focus and have experts come in in the way in and just not panic all

Raphaelle: the way. Right, right, right. It's funny. How like, panicking, like not panicking is actually the first step. I think then the second step is calling the people in.

Um, but I think, you know, you're totally right. You're absolutely right. Um, now I will talk about the next device, um, related complication, which is, which is the most scary, um, is your pump thrombosis? Um, yeah, this one is, this one is definitely warrants the panic. Um, so this is a result of an obstructive thrombi lodged in the pump.

Um, and it is catastrophic, um, and it definitely warrants prompt, diagnosis and treatment. Um, pump related factors that contribute to a patient having, uh, thrombosis is basically due to the interaction at the interface between blood flowing through the device and the pump components itself. So what happens is, as blood is spinning through the, you know, a thousand rotations, uh, a

minute, this results in a hematologic effect, that's really unique, um, that happens to the LVE patient.

So, um, there is an underlying hemolysis that occurs, um, due to the increase, the me, this mechanical shear force that's exerted on the red blood cells as it goes through the pump. Um, and as it passes through the device, so you have a simultaneous release of intracellular clotting component. And that activates platelets in your coagulation system.

So you have both like hemolysis and clotting all happening within this process. And so you have the, it emphasizes, um, that there's a really delicate balance between providing optimal anticoagulation so that they don't have thrombosis, but then also potentially exacerbating bleed risk. Right. So to reduce pump thrombosis, LVED patients are managed on antiplatelets and anticoag.

Mainly gonna be Akron. And that could be anywhere from 81 to 3 25 and warfarin with an INR goal of two to three, they used to have device specific goals, but now we've realized that these, the, the goals of two to three is appropriate for all devices, which is really nice. Keep the consistent, um, so patient related factors, what are some, uh, patient related factors that can contribute to a patient having a thro, um, that could just be preexisting factors.

Did they have any factors before the L F AFib mechanical valves hypercoagulable stage any, uh, incidents of VCE for any reason? Um, are they non compliant? That's also possible, um, Which would be, it's truly unfortunate, but it's there. Um, and then, right, and then low flow states, like we talked about anything that would be contributing to low flow, um, maybe their blood pressure, for example, um, or if they have, you know, any kind of heart or right.

Heart failure, just, just anything that would contribute to a lower flow where you have more stasis, um, through the bed, um, management, um, or prevention is another thing. So in preventing other L a complications such as bleeding, right? Some patients may have lower INR goals because they have multiple bleeding events.

And if you have a patient with a low and I R goal that can unfortunately set them up for other pump problems, like a thrombus.

Jimmy: Perfect. So it seems like it just, you have, you have a host of different things where you, we can basically look at these thrombus and then the question comes okay. If they have that going on, If it's compromising things, do we pull the trigger on some of the bigger guns or what what's the, what's the next approach when it comes to thrombosis?

Raphaelle: Yeah. Okay. So here are some telltale signs, um, of, of a patient coming in with a pump thrombosis. So one they're gonna have power, the power elevations on their pump. So remember I talked about how the pump, we talked a lot about flow and speed so far, but there's also power. So if their power is up, that means that thing is using a lot of power to get some through something.

Does that make sense? So if you have power elevation, it's trying to overcome an obstruction. Um, in addition to having inadequate LV on unloading it, can't get through the device. Um, they also may have symptoms of acute heart failure. Because their LV is not being able to, to function properly. They may have a subtherapeutic INR, and most importantly, they may have evidence of hemolysis

and some, some key things that you wanna look for in some labs you wanna get, um, for these patients is gonna be, uh, lactate and LDH.

And what you'll find is that the LDH will be high. So when they say high, the guidelines say three times the upper limit of normal, um, at St. Joe's we, we say that, or an LDH is greater than equal to 500. Um, you're also gonna have hemoglobin, so T colored urine, um, because the renal system just can't absorb the way it needs to because it's being overloaded.

Um, you're gonna have a low Haptoglobin and you may have an elevated indirect, uh, Bilirubin as well. Um, so if you want, we can get into the nitty gritty of why those would be changed, um, or you know, why those labs specifically, um, but that may be for, um, another day or we can get into it. You tell me we can go, go right into it.

You wanna go into it? Okay, cool. So half the, that is primarily produced in the liver and, and, um, its function is to bind free hemoglobin, um, from life red cells. So prevent, and it prevents its toxic effects because hemoglobin levels become so depleted right in the presence of large free hemoglobin in hemolysis it's decreased.

Does that make sense? Goal indirect, Bilirubin that's elevated because the conversion of hemoglobin to Bilirubin essentially exceeds the liver's capacity to conjugate and excrete. It. Um, and then you have hemoglobin area, um, and that indicates a severe intravascular hemolysis because you are essentially, you've overwhelmed the absorptive capacity, um, in the renal tubular system.

Um, so all of these things kind of go into play, um, with these patients. However, those, you know, it's interesting because a patient may not have a full on thrombus yet, but what you will see is patients will start to kind of have little changes in their, um, lactate, dehydrogenase and, and slight increases over time.

So I say, if you're gonna see an LVAD patient in the ER, no matter what it is, check one, um, cuz it kind of will give a trend as to what's going on and if that's ever gonna be part of the issue. Um, so when it comes to throwing up the big gun, when do you actually know to pull the trigger on managing this?

Um, if the patient has new heart failure symptoms and any evidence of hemolysis. Then you pull the trigger. So, um, meaning like if there's any hemodynamic compromise to the patient, they're coming in, looking volume overloaded, like we talked about, um, their LDH is high, they have pre colored urine. Um, then that is definitely an indication, um, for pulling the trigger on pharmacologic management.

Um, and unfortunately that may even may need to consider, um, a surgical correction as well. So, um, for these patients, you intensify IV anticoagulation. Um, we typically go to high dose heparin first, um, being our major workhorse in this instance. Um, but direct inhibitors have some data as well by Val. I think there was a study recently that just showed that they had really good evidence.

Now, when I say studies, I mean, case reports, because that's kind of the limitation with LVADs, right. It's really small patient population. A lot of what we do is just based on. A case report did it

and they had good outcomes. So let's try, um, and we can also use, um, our GA band as there's also been some studies, um, with that as well.

Um, but I, I, we try to stick with heparin as much as we can just due to economic factors. And then also our GA band, the false elevation in the INR makes it just one extra, right. Run, more extra complicating factor in trying to manage this patient when they're already complicated. But it doesn't mean that you can't have an L a patient with real hit.

Um, considering these patients have been exposed to heparin so much. Um, you also then want to, along with that, you wanna manage their acute decompensated heart failure with diuretics and IHO. If you have to, they may have to be put back on Milone, um, if necessary during this time. Um, and then if all else fails, we go to the really big gun.

We go to all the place, which. I have mixed feelings about, but you gotta do what you gotta do. So, um, there's mixed results and case reports. Again, all of this that we do, which is also scary in and of itself is the fact that we are, we are using really big, really big guns to manage these patients with like five studies of, you know, two people.

So, um, it's not recommended first line, but if you gotta throw the kitchen sink, you gotta throw the kitchen sink and, um, big things there. You need to get a head CT. Um, you have to exclude any kind of subacute stroke that could have happened in the patient that maybe wasn't, you know, contributing to anything, but could potentially put the patient at risk for hemorrhagic conversion.

Um, or also if it is a, you know, it is possible that with a, with a, a pump thrombosis, little pieces break off and do cause strokes, but you know, are just little baby, you know, microvascular strokes and, and that could be, uh, obviously fatal for the patient if they converted. Um, you also have to, you know, when to, when would you consider all the place?

So you would, I know at St for St. Joe's, for example, um, we think about is the patient a surgical candidate. Like if we really had to take them back to the, or could we, and if we can't, for whatever reason, then we need to save this bed. Right. Um, also is the homolysis refractory, despite your high intensity, um, IV anticoagulation.

And does there continue to be hemodynamic compromise? Are they still hypotensive? Is the RV now failing? What else is going on? Um, in the setting of needing to switch from your IV anticoagulation to alts place, which I realized for the record in the ER, we may not be here, but I think it's important to know.

Um, let's say we're holding an LVAD pumps on both is that would be a real, real treat. Um, you would hold the heparin or the direct thrombin inhibitor of course. Um, and start the, um, Alta place. And actually there's some, there's some, and this sounds crazy counterintuitive. You may actually, if you know, and during all of this, you still continue to patient on warfarin, right?

Um, however, if you start AI plays, you may actually need to reverse. Which sounds wild, but you might in order to help prevent hemorrhagic conversion and major bleeding complications for this patient. So you may have to reverse the warfarin. Um, you try not to, but if that day that you start all placed and that INR is three, you gotta be really careful.

Um, and you may just use things like FFP. You might can use vitamin K, but ultimately we're gonna be blasting this, this, hopefully this th strongest out, and we don't want there to be any potential hemorrhaging events that could occur, um, in the patient with intracranial hemorrhages or severe GI bleeds being your major risk here.

Um, so it seems to completely counterintuitive, but it is something you may just have to, you know, consider and throw out there. Of course this would be primarily up to a cardiovascular, uh, or like a CTS surgeon. Who's managing the patient to decide. Um, what they feel comfortable with in that moment and what's going on, but these are just some of the complications that may arise and, and decisions that need to be made.

Um, when, when treating a pump on

Jimmy: that is wild to me because I, I sit back and I think about when someone told me, Hey, we may reverse for well, uh, going for a stroke. Hey, the patient's only something we may reverse. I'm not being part of that. I just say like this, I'm just not doing that. But when I think about these cases, when patients that are Oves, they're so delicate in the flow of their head.

And then I always tell my, my trainees when they ask what makes people high risk of, of bleeding. And I, I said, really weak tissue bleeds. So low flow to that tissue bleeds, um, extremely high flow and then low flow causing bleed and then old, old, old tissue bleeds. Mm-hmm so, and we thinking about these patients traditionally they're unless you have these non cardiomyopathies that are younger, for the most part, I would say your, your age is gonna be in the sixties and seventies.

So this old tissue they've had mild disruptive endothelium because for a chronic years are hypertension and then having heart failure and have low flow. And then you put a LVA D in with constant low potential flow that's prom time for bleeding and oh, prime. Sure. I don't a significant amount of studies to say that, but it just makes perfect sense for.

Raphaelle: Exactly. No, that's exactly it. And, and you know, now, especially LVADs are, like you said, with older patients. I mean, I think we have LVAD patients in their eighties, seventies. I mean, you name it. I mean, that's their lifelong, you know, treatment forever. They're never gonna get a heart. Um, and, and St. Joe's who do we see?

Uh, elderly heart failure patients. That's like a major part of our, uh, patient population. So that's definitely something that, you know, when I in, in residency and was learning all of this, I was like, I don't understand why are we reversing a patient with a pump ground? But like, it just goes against everything in your whole, everything that, you know.

Um, but like I said, these are not normal people. This is so different. Yeah. Um, but yeah, exactly what you said, the risk is.

Jimmy: So again for the, I feel like I have a good sense of what happens for these, these pumps, bro, missings, that nature, something that I feel a little bit more comfortable with that comes up sometimes is some of these driveline infections and that, that occur.

Can we touch on that? And cause again, these are the people who I, I see a decent amount of now and I feel a slightly comfortable, but again, this is something you probably it's bread and butter for you.

Raphaelle: Well, okay. So good news is that, you know, okay, we'll talk a little about why this happens. Okay. So while infection, um, you know, affect rates have actually decreased a lot with the new continuous flow and devices.

Um, but they remain like there it's a major, um, cause of high morbidity mortality in LVAD patient. Um, and if you think about it, it makes sense, right? You have LVAD require a connection between the pump, um, and the external controller by way of this driveline, right. Um, that interfaces with the skin. Um, and the driveline itself historically has been and continues to be the most common site for infection in an LVAD patient.

Um, the driveline exit site is basically a bacteria entry site. Um so you have infection, um, that can be, um, along this site and it could range from like superficial. So just involving the driveline site only, and then you have like deeper, uh, structure, uh, infections that can happen, like a pump pocket infection, which would be really difficult to eradicate or the pump itself.

Um, some risk factors may include trauma to the driveline. That's your biggest one. Um, you know, then not really paying attention and kind of. And washing it or cleaning it. Something happens with the trauma to the area, um, malnutrition duration of LVAD support. The longer you have the VA of course, the most like the more likely word of having an infection, obesity, poor hygiene, all of these things.

Um, luckily for us, a patient who comes into the emergency department, uh, presenting with infection, um, presents pretty, it's pretty straight. I mean, for LVADs, it's pretty straightforward. Um, you're gonna have normal, um, your normal. Local kinds of infection at the site, uh, pain, warmth, redness, drainage, uh, all the way to systemic symptoms, right?

So fever, Malays, those kinds of things. Um, evidence of shock, uh, sepsis, um, which again, may be indicated by a high flow. Um, that's how you really know it's, it's pretty bad. So basically you're more com most, you know, a common organisms for causing any of these types of infections are gonna be, um, your grand positive organisms that can claim to material and create biofilm.

So, um, your most common is gonna be like staph, RAs, and co negative staff, um, or strep. And then you also though, um, a lot of things actually show AOC and pseudomonas being high culprits as well, um, in LVAD. And so, um, that's something you have to consider whenever, um, treating the LVAD driveline infection, fungal infections are also possible, although less common.

And if you've got a fungal infection, Good luck. It's gonna take a lot to get rid of that thing. Um, and, and those are really what we hope doesn't happen. I mean, that is like so challenging to get rid of. Um, so your typical management, right, for all infections is source control. Unfortunately, that's not possible with an LVAD

So just one of those things to think about, um, whenever managing these patients. And I think as stewards in the emergency department, we do a. And trying to make sure that we're not

overtreating. We try to think, okay, where's this supposed to be the infection? Can we narrow in some way? Do we really need bank?

Do we really need pseudomonas coverage? Um, and this situation, yes, we do. So don't be afraid to use your big guns. I know, I know there is a reason to bank those, but you might actually need to use it. Um, you can also use like SEP, you know, use your antibiotic. What is the most common organism or actually look at the patient's history?

Do they have a history of, of driveline infections in the past? You may actually be able to get away, um, with using some, um, more narrow agents, depending on if the patient has a history of driveline infections. And especially if they have a history of driveline infections that are a little bit more that are deeper, um, and may actually involve more of the structure that's likely gonna be, what's still feeding and causing some of those problems.

Um, but don't be afraid to go broad. And in fact, that's what the guidelines do recommend. Um, I will say. The, um, is HLT guidelines has a specific section on managing infections related to LVAD, and it's really thorough and it's awesome. And it goes into like pre posts and during LVAD placement. And, um, but for, for after LVAD um, you know, complications, um, where they would come to us, that we would see, they said they go broad.

Um, and you may, you know, it's a good point just to bring up that we have to go broad because we can't do source control. And you may see patients who are actually on prolonged or lifelong, um, prophylaxis as well. So don't be surprised if you're all bad patients come in and they've like, I'm on doc for the rest of my life, or I'm on Keflex for the rest of my life.

Um, that's definitely a possibility.

Jimmy: So, again, those are the key ones. Again, they come in, I'm like, oh, this is gonna be easy. Cause again, I may just be lucky, but a lot of the ones that I got, usually they had recent cultures. Yep. You know, everyone's very comfortable. A patient knows what, where they're gonna grow.

I know. And you just like, you can go ahead and do bank for me. One thing that came up that probably has more data now in patient that had confirmed RSA is things like a read events and adult events. And, and those are that's when I get really, you know, happy. I, I know that the heart failure team is like, oh, you just do it downstairs.

That could save an admission. The patient really yep. Said some key situations where I think that, again, not necessarily a confirm indication, FDA indication, but now I feel like we have a decent amount of data out there that said that you could do, especially for confirm RSA. This can always say, uh, my phrase that I tell my team is like, I wanna take your patient from ICU to ICU later.

That's

Raphaelle: no, I love that. No, you're so right. And I'm so glad you brought that out. I mean, we have DBA, um, that's what we use at, um, at St. Joe's and Emory, and I mean, we have both of these options and there's such great options because, you know, I think, I think we have to, as VES are evolving, I think our first thing that we pulled the trigger on is like, oh my God, when VE they have to be admitted, they have to be, it doesn't matter.

I mean, they're completely fine. And they have just a little redness around the site, but they have to be admitted and. I mean, I think as we start to get more comfortable in managing these patients, we can kind of be advocates and go, okay, well, do they really, like, we can have conversations with the heart failure team and go, I know the ER is panicking and they're saying, you know, they need to be admitted for I antibiotics, but is this the first offense?

Do we know really what's going on? Are they having any issues with flow? Is there bad monitor freaking out and, and maybe there is something bigger going on or is it possible that we can give them something that would give them IV, you know, concentrated med for two weeks and they can just be at home freely and if something goes wrong, they can certainly come back.

So I think we have to remember that. There is evidence I don't know about have y'all given daba or, um, Rateim for these

Jimmy: patients. Yeah. When I, when I was in residency, when I was at avid health, Orlando, we had a huge population there and this was common. Like I was the unfortunate, the course, the, the site coordinator.

So every patient that got it, I had to, I I'm gonna go through my CT surgeon is like, we're using this. You can say what you want, we're using this it's OK. I started seeing it used a lot more for that. And I'm like, wait a second. Like, this is a pretty unique option downstairs. And I've seen it happen once or twice in the, in the ed, but we're usually if I can get my team to not freak out and, and we can say, okay, wait a second.

We give, give your, if you wanna give one dose an OBS them for a period time, right. Until we can finish the workup. And once the team comes down, write their note. Cuz again, if the patient's not sick, This is not gonna be a rapid thing. Like when they're sick heart, failure's gonna come down there. It's gonna be a whole gang.

If they're not, it's like, ah,

Raphaelle: Right. You'll know if you'll know if they need admitted or not. Because if heart failures, like, Hey, we'll come after round. You're like, DBO, let's go. Like, we're good. If there, if there's something really wrong though, you know, they'll be there and you need to admit there. Yeah.

Beat you

Jimmy: back to the room,

big ones. And I think the last thing that I, I want to hit on that, that scares people is the different arrhythmias that, that occur. Oh. And we manage them differently because again, like, I, I always think to myself, there's a chunk missing there. So what do I do now?

Raphaelle: Right. So, okay. Arrhythmias, they're gonna be really common in your all bad patients.

You know, you have that underlying cardiomyopathy, maybe they've had AIB before the implant. They've had probably some kind of right heart dysfunction at some point, then you have that

mechanical compression, like I said, as a ventricle from the inflow graft and sometimes just the interface of the flow, um, or of the, of the, uh, cannula with the actual wall of the LV just causes it to freak out.

Um, essentially. And so some patients may actually feel palpitation. But a lot of times it's really non specific. Um, they're just tired, nauseous, maybe a little lightheaded, maybe a little weak. Um, and I think the biggest indicator from most the patients is their ICD will shock them and they'll be like, whoa, what's going on.

um, so that's kind of your biggest indicator most and FY, you know, in case the listeners are aren't aware most LVE patients have an ICD because at that point, when you're so end stage heart failure, you are gonna have an ICD place. Um, so that is a good, you know, safety net there, um, that those patients will have.

Um, but they still can have atrial and ventricular arrhythmias, um, that can, that can be at play. Um, and, and truly medical management at least, um, is, is, is pretty similar. The only weird thing is, um, pharmacologically at least. Um, I guess the weird thing though, is especially, I wanna talk about ventricular arrhythmias because those are the most interesting, um, you'll find that your L V ad patient.

Can tolerate severe ventricular arrhythmias that would otherwise be considered life threatening. And they're there with minimal symptoms, if not up and talking to you. Um, and, and it's just wild when you go in and you're like, is that Vack? And he's just, Hey guys, um, it's completely bizarre. Um, but you have to remember the LVAD, right.

Is producing adequate cardiac output to meet and organ per, uh, perfusion. Right? So the brain's getting perfused. The patient is not attended. We are here with a VTAC that is of alive and well, for the most part, um, which goes against everything that you think of when you think of going into a ventricular tax or like a VFI patient room.

Um, so it is really impressive, um, actually to be a part of those discussions, that, that situation, um, but don't let their like surprisingly alive and well demeanor. Um, confuse you. It's still medical emergency. Um, even though they are responsive for the most part, uh, patients in sustain VT that have an LVAD even though the pump is supporting them that bright heart still can fail and be fatal.

Um, so of course, first things first IST an electrolyte problem. It very well could be, is it a section event problem? It very well could be. You can just potentially manage some of these things like we talked about previously. Um, I hyperemia and inadequate, like venous return for like a low flow state cause of the section, definitely a little soft fluid Bo that might actually fix the vent Durr.

Um, but then when it comes to actual managing them from like an anti rhythmic standpoint, um, you, you actually treat them the way that the guidelines for non LVAD patients are treated. Um, and actually I listened to a podcast, I think, um, about ventricular remand that was on. Yeah. So all of y'all go back to that and look at the data, but basically you have AMCA pro uh PIDE um, if, if, if it's a, the big thing here is if it's a ventricular arrhythmia due to actually an electrical problem, it may or may not work if it's due to the device, it's probably not gonna.

Yeah. Um, so it's just something to remember. Um, or just to kind of think about, if you try Amio it fails, you try lise, it, it still fails. Maybe there's something else that we're missing or we need to try, um, like maybe there, we need to get a point of care. Ultrasound is what's the left ventricle doing is there, if, if it's really small and things are fine are flowing and you have low flow, that's a suction event.

Let's give 'em a little fluid and see if they pop out of it. Um, but in the, in the instance where the patient isn't responding and they are more critical, um, and, and they start to have altered mental status. And even if they don't, you know, but we just can't get them out of this rhythm. Um, you still wanna cardio defibrillate them as you would with any other patient.

I know that we, we do this in patients who are, are, have evidence of being he dynamically unstable. Um, and, and some of these pieces, eventually, if you can't get a LVAD patient out of the vent, they will become unstable. Um, and so you do want to, um, shock them or as my provider say, good old Georgia power.

So so medicine, you have to get that involved in medicine. So you, uh, you definitely, uh, will probably still wanna employ that. However, the difference is sometimes when you, uh, shock a patient for a rhythm and a lot of the cases, your normal patient is. Extremely probably already, um, unresponsive and, and you may do some comfort measures, like maybe some pain meds though.

That patient is likely going to be far more responsive and awake than your normal patient. So you have to remember, you can't just shock them like anybody else. You have to actually have some appropriate sedation and pain management going on, um, for that patient. Perfect.

Jimmy: Perfect. So we're just gonna continue with our AML, same doses, everything like that.

And then that's, that's really the, the, the big gist of all, all of this. I think those are the things. Most of us can feel comfortable even attempting to step in a room with and it's just, it. It's great. I, I think you've mentioned it before, but I, I wanna make sure I highlight a point here, but the, the guidelines that help, uh, us manage these L a pain, can you just let people know again, that the society and they can, where can they find this, this, the

Raphaelle: particular guideline?

Oh yeah, absolutely. So is H L T international society apart lung, uh, transplant guidelines. They have, um, awesome guidelines. It's about managing patients with mechanical circulatory devices in general. Um, uh, their guideline is extremely inclusive and it has amazing references. And like I said, charts to, to, um, help guide, um, which we love a quick reference.

Right. Um, and then also within that specifically, I just wanna say in 2019, and, and this is a reference that I think every emergency, uh, provider pharmacist, anyone in the ER, should. Snow about and have is there's a, um, just two years ago, three years ago, they, they created a consensus statement for emergency management of LVAD uh, patients.

And it was developed with a collaborative effort from, is H L T, heart failure, heart failure, society of America and society for academic emergency medicine. So it is a comprehensive review of what

LVAD is, what management strategy should be employed. I used a lot of what they say to teach, uh, students and residents about these complications.

Um, and it's just like a really great reference. And so I think it's one of those that you wanna have. Um, also, you know, the American college cardiology, AJ they've supporters literature out there as well. Um, but it really is a, you know, really relying on the is H L P I think is really where you're gonna get most of your information here.

Jimmy: Perfect. I think that's the, the big thing. So again, thank you for coming any. Final things you wanna let the audience know. Again, we have a host of people listening here in around the world to be, to be honest. So any, any final thoughts that you have for L a about emergencies and just hope to ease some of our minds?

Raphaelle: Um, I think, I mean, I think these patients working with these patients don't let it intimidate you. I know it can be really intimidating and scary, but I, I will say working, you know, when an LVAD comes in, I think it's one of the best times for you to really have like that multi disciplinary care involved and to be a part of something really special.

Um, I know like at St Joe's, I, I mean, I'm sure about this is the way it is with all centers is I think when an L a patient comes in, you know, at that moment, you're gonna have heart failure on board. You're gonna have, ER, there, you're gonna have CPSs there. And depending on the situation you might have ID there.

You might also have GI there. If there's a bleed, you're gonna have all different disciplines taking care of this patient. And I, I. You know, that set you up for really good relationship that sets you up for being able to, um, put your recommendations out there and be involved in, in the care of a patient and, and that's continually evolving.

Um, so I just think it's a really good opportunity. So think of it from that perspective and maybe it'll be exciting and that scary

Jimmy: well, I guess definitely think you coming. Giving your expertise. Again, these are some very complex patients and it's something that the audience wanted. Again, I got at least 10 or 15 different reports and Hey, can we talk about LVADs?

Can we talk about some of these more assist devices? And we're probably gonna go and do, do more if, if possible, but again, thank you for coming on. And I think the audience, again, for listening to another episode, uh, just this know guys that we in the next few months, and by the time you guys hear this, there's gonna be some very exciting news for ER pharmacy.

Uh, I think I probably do the best I CanSurround myself with very, you know, impactful people and we have some special news coming next year, particularly about empower conference. If you enjoy that last year, trust me is gonna be phenom. We're gonna, we're gonna, we gonna really blow you away with the news.

We have releasing pretty soon. And then for some of the other things that we're gonna be doing, as far as our pharmacy pearls has definitely been something that we've been really getting back on

board, where our website has been revamped and ready to go. And, uh, PACU pharmacy, acute university is something that we, we actually make it a few changes to better you guys.

I think by the end of the year, we're gonna have something that's gonna really, really excite all people. Again, we're, we're focusing PACU on all acute care. So internal medicine, ID, oncology, all those things. And we really want to let you guys know that we have some pretty interesting things that we're gonna be partnering on is gonna be helpful for you guys.

So, uh, that's, that's all I have for today. Again, all this stuff's gonna be able to show notes, uh, check all that stuff out. Check all of our older sister sites again, packing for pharmacy pearls, and I'm gonna close out the same way I do every single time guys. You don't have to be a pharmacist. You gonna work in ED But everything you do. Make sure you Pharm so hard.