**LUIS DIEGO PACHECO:** This talk, what we're going to talk about is sepsis. And I have no interest in talking to you about what you hear all the time, which is seven slides on chorionitis and the bugs that cause chorionitis and the antibiotics for chorionitis or for pyelonephritis or for endometritis, because you all know that better than I do and better than anyone else.

The main issue here is, most of the people that deal with obstetrics know what to do with the infection, know what needs to be drained, which antibiotics you need to give and so on. But when the patient actually starts being a little bit different than the rest and you start having some hypotension. And you start having some leaky lung, and the patient develops pulmonary edema. And the kidney stops working, and you become oliguric. Then people start feeling a little bit uncomfortable, like about fluid therapy, about vasosuppressors, and so on.

And what we're going to talk about. And what we're going to talk about here actually reflects the latest guidelines on how you treat sepsis. If anyone has any questions as we go, just feel free to raise your hand and ask it. And then, we'll try to clarify it, if I can, as we go.

So these are actually the main objectives. It's going to be, first of all, understand how do you define currently sepsis and what is the pathophysiology of sepsis and then know what to do about it and then acknowledge how do you apply this into pregnancy.

I think we need to stop-- and this is something that is going on nationwide now. We need to stop this thing about, well, there's no evidence that works in pregnancy. Or there's never going to be evidence that any of these critical care interventions actually work or don't work in pregnancy, because all the trials exclude patients.

There is no reason whatsoever to think that the use of vasopressors is going to be different in a pregnant patient than a non-pregnant patient. There's no reason to believe that one fluid, which is harmful for a non-pregnant is going to be non-harmful for the pregnant and so on. We just need to start learning about these things. People that take care of high risk pregnancy need to start, because there is a huge lack of intensivists in this country. And it's just going to get worse and worse and worse and worse. You're going to see a lot of hospitals that are going to have the surgeon and OB person taking care of the sick patients, because there's not enough intensivists for all the hospitals.

So if you go into an intensive care unit in this country, if you're going to die of something, it's going to be sepsis. The mortality of sepsis actually is extremely high. A couple of things have dropped the mortality, but not enough. And still, if you get severe sepsis, you have like a 20% to 30% chance of dying. And if you have septic shock, you have probably around a 40% chance of dying. So it's still pretty high.

And the important thing here is, early diagnosis and early intervention. And when I talk about early intervention, it's as simple as giving an antibiotic fast and giving two or three liters of fluid fast. In most cases, that actually makes a huge difference, as opposed to just waiting and not giving the fluid for one or two hours. That's going to actually worsen the outcomes.

So in the past, this used to be the definition of sepsis. It used to be the Systemic Inflammatory Response Syndrome. So it was actually proposed that you had Systemic Inflammatory Response Syndrome, if you had two of these four things. So if you have tachypnea or you have tachycardia, or you have a change in your white blood cell count. Or if you actually had a change in your temperature, then you would have two of these. We'll say, you have Systemic Inflammatory Response Syndrome.

This is extremely sensitive, but it is extremely nonspecific. If you look at any patient-- I'll bet you-- that you just did surgery on yesterday, you go on round on them, they're going to have SIRS. Because if you have a heart rate of 92 and you have a white blood cell counted of 12,100, then you have two criteria. And you have Systemic Inflammatory Response Syndrome.

So if you actually have two of these, you're said to have an Inflammatory Response Syndrome, correct. Now, if this Systemic Inflammatory Response Syndrome happens in the setting of an infection or you suspect that this patient has an infection. For example, you go in there, and you see someone with pyelonephritis. Clinically, you think that they have pyelonephritis. And they are tachycardic in the 110s. And they have a temple 38.2. Then, that is sepsis, because it is Systemic Inflammatory Response Syndrome, secondary to an infection.

Now, this actually changed. Part of this still, that's sepsis, what we talk about. And still, many people use it. If that's sepsis, then what's the difference between sepsis and severe sepsis? Severe sepsis is when you have sepsis with an organ dysfunction, like one organ failing.

So which organs can fail? Well, there's some obvious ones. For example, if you have sepsis and you start having trouble breathing, you have pulmonary edema, right. That's usually called noncardiogenic pulmonary edema, because it's not necessarily a problem of the heart.

It's not that you have an ejection fraction of 5%. It's because you have an infection. You have pyelonephritis.

The inflammation is not localized to the kidney. You have a massive inflammatory response. And these neutrophils. All these inflammatory cells, they injure your epithelium, same thing that happens in preeclampsia.

You have diffuse endothelial injury. That's why you third space. That's why you become edematous.

Well, you third space everywhere in the body. And you third space in the lung. And you start having some pulmonary edema. So that will be your lung failing.

But then also, there's a lot of other things. For example, obviously, if you become oliguric, then your kidney is failing already, because it's been hypoprofused.

Remember, in sepsis, what happens here is this massive inflammation produces a lot of substances, like nitric oxide and so on, that are going to vasodilate you. So you're going to be hypotensive, because you are profoundly vasodilated. But on top of it, your endothelium is injured. So your third spacing your albumin, and that's pulling water out and plasma out, fluid out.

So you're hypovolemic. And that's where you hypoprofuse all the organs. So you hypoprofuse the kidneys, and you become oliguric. So that'll be your kidney failing.

If you hypoprofuse your gut, how does that manifest? Ileus-- so if you have someone with an unexplained ileus, it can be a marker of sepsis.

If you hypoprofuse your liver, what are you going to have? You're going to have elevation in the LFTs. You're going to have elevation in bilirubin. So that's going to be your liver failure.

If you hypoprofuse your brain, what do you get? Confusion-- that's why when you get called to the ward and someone is confused, the first thing that's got to come to your head is going to be hypoxia, hypercarbia, and sepsis, because you hypoprofuse that and so on.

So if you have any organ failing, then that will already be severe sepsis. If you have thrombocytopenia or you have a prolonged in your INR or your APTT. That's your hematologic system failing.

Why does it fail? Remember that, if you have diffuse endothelial injury, when you injured the endothelium, you exposed the subendothelial collagen. Correct?

And if you expose the subendothelial collagen, then what are the platelets going to do? They're going to start adhering to it, try to create a clot. And then that's going to activate your clotting cascade. You're going to start developing all these little clots all run your body. How do you call that? DIC.

So that will be your DIC and your hematologic system failure. So as you see, any organ pretty much can fail. So that will be severe sepsis. You need one of those.

Septic shock is going to be that same patient, that you go in there. You give them fluid, and you cannot bring their blood pressure up.

So then, what do you need to do? Give them vasopressors, something to squeeze the vessels, because the main problem here is the vessels are dilated. So this concept, still, most people use them.

What people don't use is the serious thing that I told you before. So nowadays, the definition of sepsis is-- [PHONE] I like that. That's Evanescence, right?

The thing here is, nowadays, what they tell you is-- the important thing here is not to sit there and say, let me just sit here with this checklist, to see if you have sepsis. And then, when you go to 20 boxes, then you have sepsis. Then now, the patient is very sick.

The idea here is to think it early, treat it early, just like preeclampsia. I don't know if you guys know that you don't need proteinuria anymore to diagnose preeclampsia. That's coming in The *Green Journal* next month. The five gram thing for severe preeclampsia is gone.

It's not a criteria for its severity. You can diagnose preeclampsia in the absence of proteinuria.

That's the same principle. There's a lot of people that sit there and say, well, you have this headache. And you're hypertensive. And you have epigastric pain and nausea and vomiting. But you don't have protein.

So go home. And then, when you have the proteinuria, then you have preeclampsia. That happens. That happens a lot. So proteinuria is out of the picture. And you're going to see it in *The Green Journal* next month.

So same here, the idea is, if you suspect that someone has an infection-- someone comes in postpartum. And they just had a c-section a week ago. And you think they might have an abscess. And they look bad.

The definition of sepsis is going to be, you suspect an infection, and you have some of these. And that's how it says-- some of this. It doesn't say, you need to have two, three, four, five, six, or seven.

You don't need to learn this by heart. Everything actually makes sense. Obviously, I mean the systemic findings, like fever or hypothermia, tachycardia, tachypnea. So it's kind of the same thing, Inflammatory Response Syndrome.

Positive fluid balance, so if this is someone that came in and you already gave them two liters, and they're still not improving their blood pressure. Then, what we just talked about is happening. You're just third spacing the fluid. And the fact that you're requiring more and more fluids should alert you to say, this is not simply dehydration. This is probably you have a leaky vasculature.

Abnormal white blood cell count-- these things are just markers of inflammation. You can get them if you want to. Hypotension, vascular resistence, decreased urine output, so you have your kidney failure. Or you have someone that actually has elevated liver enzymes, like we talked, or thrombocytopenia or abnormal clotting times or hypoxemia. Or they are confused. Or they have an ileus. Any organ that you think, what will happen if this organ gets hypoprofused, starts failing. Then you say, this patient has some of this. That will go with infection.

Now, in terms of just feel them, if you just look at their extremities and their extremities are actually cold and mottled. They they're being hypoprofused. Or if they have a capillary fill of less than three seconds, they're being hypoprofused. And the physical exam is the most important thing.

And then, if you get a lactate level. You can. You don't have to, to make the diagnosis. Once you have sepsis, you're going to have to get it, because it's going to guide your therapy.

But the bottom line is, just look at the patient. And if you see that some organs are failing-- the GI tract, the liver, the lungs, the kidneys, et cetera-- if you see that something is actually wrong and the set in of infection, then just go ahead and make the diagnosis of sepsis. You probably will not kill anyone by giving, broad-spectrum antibiotics and a couple of liters of fluid really fast. But if you don't, and it was sepsis, then you will regret it. Because once this gets ugly, it's very hard to improve it.

So once you actually have the patient-- and let's say, this is a patient that came post c-section day seven. And you think they have an abscess. Their blood pressure is 80 over 30. So you say, well, this is likely an infection.

So how do you start treating them? So this is going to be pretty much the same for every patient. And everything I'm going to tell you here comes from critical care literature. It doesn't really come from of obstetrical literature. But there's no difference. There's pretty much difference.

Remember, most of these patients are going to present postpartum, as you know, the vast majority of them. But even if they're pregnant, if you don't treat the patient, you're going to end up with both mom and baby dead. You cannot just hang out with a mean arterial blood pressure of 30 and expect the baby to survive and say, I'm not going to give you a vasopressor, because it might hurt the baby. I mean, you need to improve the hemodynamics of the mother, to improve the profusion to the baby.

So the things you're going to do are get as many cultures as you can before you start the antibiotics. Now, don't delay the antibiotics. If someone comes in, let's say, from the EMS, with a peripheral line already working and no one can get blood cultures after 20 minutes of poking. Go ahead and start the antibiotics, and then get the cultures.

But ideally, get all the cultures before you start the antibiotics. You're going to start with broad-spectrum antibiotics. And remember, there's more than amp, gent, and clinda. I mean, obstetricians and gynecologists tend to use these antibiotics.

Everything is amp, gent, and clinda. Those are not even good antibiotics. Gentamycin hurts your kidneys. And then, clendomycin, for example, it doesn't even give you very good coverage for anaerobes. Metronidazole gives you better coverage, compared to clendomycin, according to the Infectious Disease Society of America.

So there are other antibiotics. So we're not going to talk about antibodies. But just know that there's a lot of other options. So start broad-spectrum antibiotics. And then source control. If this patient comes and has an abscess, then drain it.

Drain everything that needs to be a drained. Always choose the least invasive ways of draining. So a CT guided or ultrasound guided drain is way superior than opening the patient and draining the abscess.

So now, here comes the problem, not necessarily the problem. And this is actually easy. OK. You gave the antibiotics. You got your cultures. You gave your antibiotics. And you already drained the abscess, let's say.

But then the patient doesn't really look good. So the name of the gaming in sepsis is, you need to resuscitate early. And the first line of resuscitation is going to be fluids.

Now, the main problem here is going to be-- there's three components in the resuscitation-- fluids; vasopressors, which are going to be the medicines that will work mainly by squeezing your blood vessels and increasing your systemic vascular resistance; and then inotropes, which are going to be the medicines that will increase the cardiac output. So we'll talk about them, like all of them together. But if anyone has a question just let me know, because I'll see if we can go back and answer it.

This paper here is a paper that was published probably like 13 or 14 years ago, which is "The Early Goal Directive Therapy." And this is actually in the emergency room. And what they did was, they got these patients that came in with suspected sepsis. And they randomized them into this protocol or standard of care. So the patients that got the standard of care, that was kind of unfair.

Because if you go to an emergency room, you do know how it works. You go there you sit there for a while. And then you get seen by the intern. And then the intern actually comes to the resident, because the intern doesn't know what to do, talks to the resident. The resident doesn't know what to do, calls the fellow. The fellow doesn't know what to do. And then the fellow-- when someone knows what to do, it's been already three hours.

So there's a lot of delaying care, versus the people that actually came here. They had like an ICU doctor come and see them right away. So maybe just that accounted for the difference. But this actually was accepted, and pretty much everyone does this.

So this applies for the first six hours of sepsis. You come to the hospital. If you're within the first six hours, you probably should be doing this.

We're going to talk about this, because this is useless. The central venous pressure is useless to predict fluid responsiveness. It's completely useless. You might as well get an aluminium level, to see if someone needs fluid or not. It's as useless as that.

Having said that, the guidelines still say, you should use a CVP, just to make things simple. But hopefully, by the end of the talk, you'll know that this is not that good.

Patient comes in, and they're hypotensive. You're going to give fluid. Which fluid are you going to give them, crystalloids or colloids. Remember that, the crystalloids, we all have the same ones, either normal saline or lactated ringers or plasmalyte. You can use either.

And that is the first-line recommendation for fluid resuscitation in sepsis. That's what the Sepsis Surviving Campaign, in the guidelines of 2012, tells you to use, crystalloids.

Now, if you say, I want to use colloid, no problem. There's no difference in outcomes. You're not going to save anyone's life by giving a crystalloid or a colloid. And whoever tells you that albumin is better than normal saline is lying to you. The literature does not show that.

Now, out of the colloids, if you say, no, I don't want to use crytalloid. I want to use albumin. You can use albumin. There's no problem with that.

Do you guys use Hespan, hydroxyethyl starch? Don't use it anymore. Hespan, we use it a lot. But in sepsis, it's been associated to increased mortality, mortality and kidney injury. So it should not be used in sepsis.

And somewhere around there, you're going to see the reference there. There's actually two papers in*The New England Journal of Medicine* in the last year, addressing Hespan. So don't use Hespan.

So you're going to give them fluid. Don't make your life complicated, either crystalloid or albumin. Now, the problem here is going to be, when do you stop giving fluid. Because you start giving fluid, fluid, fluid, fluid, fluid, fluid, and these patients might need a lot of fluid. But if you give them more than what you need, you're going to hurt them.

If you give them less than what they need and you start of vasopressor, you're going to hurt them as well. So what they did here was, they giving fluid. And they used the central venous pressure. It is easy to use a central venous pressure, because it's an absolute. It's a number.

That's why the guidelines still use it, because it's very easy just to write it there. This is the number. So they will say, give fluid until you get a CVP of 8 to 12.

And the idea here is going to have to be to maintain a mean arterial blood pressure of more than 65. So your first goal initially is going to be, give fluid to achieve a mean arterial blood pressure of 65 a urine output of more than half a CC per kilo per hour. And that's pretty much it. That will be your immediate goal, to give fluid.

And still, the current Surviving Sepsis Guidelines tell you to use the CVP of 8 to 12. They do make an acknowledgement afterwards, and we'll talk about it later. But anyway, you're going to give fluid until you get this. Let's say, you give fluid. You get a CVP of 12. And you're MAP is actually more than 65. And your urine output is more than 0.5 CCs per kilo per hour. So then you're happy there with fluids.

Now, if you give the fluids and you reach this arbitrary point of 12. And you have not achieved a mean arterial blood pressure of 65. And we'll talk about 65. That's an arbitrary cut off.

All the literature in sepsis tells you to maintain a mean arterial blood pressure of 65. That's just as arbitrary as it gets, because it's the same for an 80-year-old, who has artherosclerotic disease, or a 19-year-old, who is otherwise healthy. The guidelines that you use say, and MAP of 65.

You and I know that, probably, the person who is 80 will need a higher MAP to maintain profusion to his organs, because he has all these vessels with artherosclerosis, versus the young person that probably needs a lower MAP. But it just makes things too complicated. So 65 is pretty much what's accepted. And that should be your end goal.

Now, if you give the fluids and you cannot achieve that, then what do you do? You're going to give them vasopressors, like levophed, norepinephrine, to squeeze the vessels. Does that make sense so far?

Now, regardless of if you were able to maintain an MAP only with fluids, or if you reached 12. This was below 65, and you gave the pressor. Then they did this measure, which is called the ScvO2.

And the SvcO2, what it is-- it's simply how saturated is the hemoglobin, after it oxygenates all your body, that comes back here into your neck. Obviously, you need a central line for that, which you have already placed, because you need a central line for the central venous pressure. Correct? Does that make sense so far?

So the principle of this ScvO2, this is easy to understand. All these things, if you just don't see them often, it sounds like, oh, my God, it's so complicated. It's easier than all the trisomy 21 thing there, the quad screen and the fifth screen and all those. This is way easier.

So imagine that blood comes from an artery, pumped by your heart. And then the hemoglobin comes here. And then all these little lines are like oxygen. So this hemoglobin here normally leave your lungs saturated like 100%. And then it goes to your left atrium, left ventricle. And then you pump it to the tissue.

This is the red cell coming here. As it goes through the tissue, the tissue is going to strike oxygen, right. Now, normally, you only use like 25% of the oxygen that goes to your tissues. The body is too smart.

So you have 75% of the oxygen that you deliver. You don't need it. You're just going to use it if you run into trouble, if you actually get hypoxic or whatever. So when this red cell goes here and the tissues extract the oxygen. And the red cell comes back all the way into your neck here, the superior vena cava, going into your atrium, before you go into the lung. The saturation of this hemoglobin should be more than 70%. Does that make sense?

So it was saturated like 97%. It delivered the oxygen that you needed. And then, when it comes back, still you have 70% saturation. Does that make sense? Now, the idea of measuring this is that, if this is lower than 70%, what it tells you is that there is ischemia going on in the tissues.

This is like, if you're poor and they let you go into a grocery store. And you have your little cart there, and you're hungry. You're going to get a lot of food in there. You're just going to get as much as you can.

They give you one minute to get food. You're going to get everything you can. But if you actually happened to just have a huge meal, and you're not hungry. And you go to the grocery store. You might get two things.

It's the same thing with the tissues. If the tissues are hypoxic, or hypoprofused, when that red cell comes through here, it's just going to get as much oxygen and pull as much oxygen as it can. And then, when the hemoglobin comes go back here, it's going to be 54% saturated. And what that tells you is, you need to increase oxygen delivery to the tissues. Even if your MAP is 65, still, you're not profusing the organs. Does that make sense?

Now, if you happen to have a ScvO2 that is less than 70%-- everything is easy so far, right. You gave the fluid. And then, let's say, you reach a CVP of 12. We'll talk about a that in a little bit.

And let's say, the MAP is not good, but you start the levophed. Now you're MAP is 65. Everything is good. Then I would say, hey, let's send an ScvO2. Send the ScvO2, comes back at 60%. You know it's got to be more than 70%.

So now it's, how do I improve oxygen delivery to the tissue. There's only two ways-- either increase the cardiac output or increase the hemoglobin. So in terms of transfusion, this protocol here, within the first six hours of sepsis-- only within the first six hours-- tells you that you can transfuse to a hemoglobin of 10.

So if they have a hemoglobin of eight, you can give them two units of blood. This only applies for the first six hours. Once you hit the ICU or your OB, antinatal, special-care unit, whatever that is, once you're there and it's been more than six hours, you will not transfuse, unless you drop below seven.

That's what all the guidelines say. Do not transfuse, because blood is bad for you. We think we're increasing oxygen consumption with blood. That's not true.

The blood in the blood bank that you have right now is not the same blood that your bone marrow produces. And it doesn't deliver oxygen. But that's a whole different topic.

Anyway, you can give blood. Or let's say, you're still within the first six hours. Hemoglobin was 8. You give two units.

Or you are past the first six hours, and the hemoglobin is six. So you say, OK, it's less than seven. I can give one unit of blood. Now you're hemoglobin is 7.3, past the first six hours for 10.1 in the first six hours.

And then you send another ScvO2. And let's say, it is 63%. So you increase it a little, but, still, you want it to be 70. So now you cannot give any more blood. What do you do now?

Give a medicine to increase the cardiac output. It's called dobutamine. So you just start them on a little dobutamine, low dose, like 2.5 to 5 max per kilo per meter of dobutamine.

That's going to make your heart increase the contractivity. And it's going to increase the heart rate. And it will increase cardiac output and subsequently oxygen delivery. Does that make sense?

So that's pretty much how you actually treat according to this. Yes, sir?

**SPEAKER 2:** So that one patient needs dopamine and arbutamine, versus the nore or epi?

**LUIS DIEGO PACHECO:** All right. So the norepi is mainly a vasopressor. So that one, you're going to use here. If you remain hypotensive, despite the fluid, then here you will do norepi. And that is actually-- the current guidelines say, norepi, first-line pressor; second line, epi. Dopamine, don't use it in sepsis, should not be used in sepsis anymore.

So here, you would use the vasoconstrictor, the levophen. Here, remember, that what you're trying to achieve is-- you already have an MAP, an acceptable MAP. What you're trying to do here is increase oxygen delivery.

And to increase the oxygen delivery, you don't need the medicine that squeezes. You need a medicine that helps contractivity. And the best one, the inotropes, pure inotropes are arbutamine and milrinone. That's it. And arbutamine is the one that has more evidence for sepsis. Does that make sense?

**SPEAKER 3:** Why would you not use vasopressors?

**LUIS DIEGO PACHECO:** Come again, ma'am.

**SPEAKER 3:** Why would you not use vasopressors?

**LUIS DIEGO PACHECO:** We're going to talk about vasopressors in a little bit. First line is levophed, and we'll talk about vasopressors, in a little bit. It's a good question.

All right. The question was, why would you not use vasopressors. I was told, I have to repeat that. OK.

So this is pretty much what we talked about. This is what we talked about it. And these are the references on how.

This is the paper here, the 2004 paper. That's the safe trial. That's the paper that shows the there's no difference between albumin and crystalloids.

There's a subgroup analysis of that trial saying, that if you use albumin, it might be better for sepsis. That's a subgroup analysis. The trial is negative, and then people just sit there to see what actually will be positive. So you can publish it, again. You cannot make decisions based on subgroup analysis, right.

OK. That's what I told you about the hespan. Don't use hespan, because it kills your kidney in sepsis. And you should have all those.

So we're going to talk a little bit more about fluids. The thing here is-- let's say, you gave the patient three liters of fluid or four liters. And still, your blood pressure is less than 65. And then you start to levophed, right, norepinephrine. That's pretty much what we've been talking about.

Now, people might stand there and say-- and this happens every day. You stand there. And you say, well, should I give more fluid or not?

So if the patient needs fluid, will certainly benefit from it. When you give fluid, what's the one thing you're looking for? There was a curve in physiology. Remember, the starting curve? That says, if I give you preload, you will increase your cardiac output.

And remember, the curve is like this, something like this, goes up like that? And this is preload, and this is cardiac output. So what I want to be is that the heart is on the steep portion of that curve. So that if I give you preload, you will increase your cardiac output. And that will increase your blood pressure. That's the only thing you're looking for when you give fluid.

Now, if the heart is on the flat curve, in the flat part of that curve, you will not respond to fluid. Doesn't matter if I give you fluid, I will not increase your cardiac output. Does that make sense? Yeah?

So this is the problem if you give fluid to people that don't need it. That fluid will only third space. Remember, in the setting of sepsis, you have diffuse endothelial injury, your third-spacing everywhere, right.

So all this fluid is going to go to the third space. And if I'm not going to increase the cardiac output, then all I'm doing is just sending it to the third space. So you can get worsened cerebral edema, pulmonary edema, heart edema.

There's something we're going to talk about, when we talk about hypertensive emergencies. There's something called diastolic dysfunction. You can have a heart that squeezes perfectly, 65% ejection fraction.

But let's say, someone with chronic hypertension, the muscle is so hypertrophied, that it has concentric hypertrophy. And it's not compliant. When you give fluid, a normal ventricle will expand like this and then squeeze, expand then squeeze. Well, if you have a thick muscle there, then during diastole, you cannot expand. And then, the fluid will accumulate and push backwards. And you develop pulmonary edema.

That's called diastolic dysfunction. You cannot expand the ventricles during diastole. So it doesn't matter if you squeeze well, you cannot relax. Same thing happens here. If you give people tons of fluid and they don't need it. And they start third-spacing. Just like you become puffy in your face and in your hands and in your feet.

The left ventricle becomes edematous. And when it's edematous, it's going to be non-compliant. So it cannot relax during diastole. And when you give them fluid, they develop pulomary edema.

You've got edema. When you give tons of fluid that you don't really need, you start third-spacing everywhere. The gut is not the exception.

You're going third-space to all the splanchnic circulation. You start developing ascites there. And then when you have an edematous bowel, the profusion pressure decreases. You develop an ileus. And what can you develop if all that happens together? Abdominal compartment syndrome-- and you can die from it, right here.

And then, if you I have a wound, you don't want the wound to be edematous, because of excessive fluid, or a graft, or if someone transplanted an organ in you or a vascular anastomosis. So fluid that you don't need is very bad for you.

So if you use the central venous pressure, that we were talking about, which is still in the guidelines, as your end point of given fluid, the problem is that, both the central venous pressure or the pulmonary arterial occlusion pressure, like putting a Swan, a PA catheter, in someone, they are useless to predict fluid responsiveness.

All these things are doing is just telling you what is the pressure in a certain part of the vascular tree. Central venous pressure, you have a line that gets right there into the superior vena cave, where it drains into the right atrium. All that's telling you is, what's the pressure there.

So let me just give you an example. And there are actually trials. I think it's this one here, that actually shows that the positive predictive value of a low CVP or low wedge, low pulmonary arterial occlusion pressure, for predicting fluid responsiveness is 50%. So out of the patients that you have there-- and they have a low CVP. Let's say, the central venous pressure normally is zero to eight. Most people, we'll say, like less than five or whatever. In these recommendations, less than 12, you give fluid.

But let's say, someone has a CVP off four, and they're hypotensive. Everyone would say, you need fluid. All that is telling you is that the pressure right there in the right side of the heart is four mercury millimeters, right.

So yeah, the patient it might be dry. I agree with you on that. But let's just take the example of someone that has what we just talked about the heart-- diastolic dysfunction. So imagine someone that has had three MIs, and they have a very fibrosed left ventricle.

And that ventricle, when it's not muscle and it's just scarred, it cannot do this-- fill and then expel, fill and expel. It cannot expand that much, because it is all fibrotic. That's diastolic dysfunction, what we're talking about.

So you can have a CVP of three, which will urge you to be fluid. And you will give the fluid. Well, you're not able to recruit cardiac output, because you cannot put that fluid inside the ventricle. So the ventricles will expand and squeeze harder. Does that make sense?

So even if you have a low CVP or low wedge, same thing, how do you know that this is going to increase your cardiac output? That's the question. You need to know, before you give the fluid, if you will be able to increase the cardiac output. And these measurements do not tell you that.

So what people do right now, to see if you need fluid or not, are one of two things-- something called passive leg raising or pulse pressure variation. We're going to talk a little bit about pulse pressure variation. And we're going to talk a little bit about passive leg raising. And this is the key here, passive leg raising, especially you guys that have a hospital.

You make a lot of money, with how many deliveries we're making. You should buy these little devices to measure cardiac output, noninvasively. And we'll talk about that in a little bit. And then you can now if you need fluid or not.

So let's say, you have your patient that came with the abscess. There's going to be mainly two groups of patients. One is going to be the group of patients that are going to be intubated.

Most patients that are going to be intubated, they're going to be in sinus rhythm. This is not a cardiac ICU. They can have A-fib occasionally or something. But most patients are going to have sinus rhythm. And they're going to be intubated. And they're going to have an a-line. Putting in an a-line is very, very easy. It's just like putting in a periperal IV.

Well, those patients that are intubated and you are debating if you need fluid or not. Those are very easy to know if they need fluid or not. And what you're going to do is, you're going to do something called pulse pressure variation.

So this patient is going to be on the ventilator. It's going to be in sinus rhythm. Because if they're not intubated and they are not in sinus rhythm, these thing that we're going to talk about doesn't work. You need to be on the ventilator and in sinus rhythm.

They need to be not triggering the ventilator. Triggering the ventilator means, let's say, you're on the vent. I put the rate at 10. But the patient is breathing 20. So on top of the 10, the patient is doing this, [GASPING], where the patient takes in inspectorate air. The ventilator senses and delivers a tidal volume.

So that will be triggering. How do you keep her from triggering? You just go to the bedside, increase the rate, like to 20. Increase the tidal volume, like to eight to 10 ml per kilo. So if you was 400, increase it to 600. And then you take over the breathing. Does that make sense? So the ventilator will give more than what the patient wants.

And then you just sit there. And in a matter of a minute, the patient is going to stop breathing, because the vent is doing more than what she needs. She is going to lose the desire to breathe, because the vent is doing it for her.

That's a requirement. Because if the patient triggers the vent and generates a little negative pressure, it's going affect what we're going to talk about. So that makes sense so far?

And you need to have an arterial line. And if you meet these criteria, what you're going to do is, you're going to look at the a-line tracing-- see, the red one on the monitor, when you have an a-line. And then, this is what you're going to do. You're going to look.

You know, the pulse pressure is systole minus diastole, right. So everyone is 120 over 80. So your pulse pressure would be 40. So in an a-line, the pulse pressure is going to be systole-- that's the systolic pressure-- minus diastole there.

So what you're going to do is, when the patient is on the vent, and they're on the a-line. You're just going to look at the tracing. And if you look at this, look at he difference between this one here. Systole is really high, compared to diastole.

And this one, the pulse pressure here is higher than the pulse pressure here, right. Does that make sense? The spike here is way higher than this spike. That means that, during the respiratory cycle.

There's variation of the pulse pressure. And that tells you, with a positive predictive value of 80% to 90%, that you need fluid. If the variation between on and the other is more than 13%, then you need fluid. And if it is less than 13%, you don't give them fluid.

Two minutes just to talk about this-- why is it that this happens? If you're on the ventilator, when the ventilator fires, and it actually gives you a tidal volume. That increases your pressure in the chest. When it increases the pressure on the chest, the lungs are like sponges. And they're full of blood.

When you increase the tidal volume and increase the pressure inside the chest, you squeeze those lungs. And when you squeeze that, it's like getting a sponge when you're taking a shower. And then you see all the water come out.

Same thing happens with the lung. You squeeze it. Where is that blood going to go? To the left side of the heart, because that's drained by the pulmonary veins. Go to the left atrium and left ventricle. So the left ventricle gets more preload. And if it gets more preload, it will squeeze more. And you will have an increase in your stroke volume.

Here, you see the increase in the stroke volume, versus during expiration. When the tidal volume comes out, you're not squeezing the lungs anymore. The left ventricle lets less preload. And then, you will have a smaller stroke volume. Does that make sense? So just by looking at this, you know that you can recruit cardiac output.

And then, the other way is-- the other group of patients are going to build the patients that don't meet that criteria. And this is actually most of the patients you're going to have. These are patients that are in the post-partum unit. They have an infection. They're not that terribly sick.

They are slightly hypotensive. You already gave them three liters of fluid. Since they're not on the ventilator, you cannot use what we just talked about. So then you say, well, how do I give you a fluid. How do I know if you need fluid?

So the classic teaching is, put a central and get a CVP. Don't do that. We already talked about it. That doesn't work.

So that's what I'm telling you. Since you have the money-- and otherwise, talk to [INAUDIBLE], if you don't get it. There are a lot of machines right now that are non-invasive cardiac output machines. The one we have is called a Cheetah. And what it is, it works by a thing called bioreactants.

And what it is, you just get these electrodes. They are like EKG pads. And you just pulled them here in the neck and in the chest. Put three electrodes there and hook it to the machine. And it gives you the cardiac output, beat by beat. That's it.

Now, a lot of people criticize these machines, because they say, well, it doesn't correlate with the PA catheter. Well, the PA catheter is no gold standard. The PA catheter has a lot of problems.

Plus, you're not really interested in what is the cardiac output. I don't care if the cardiac output is five, and it's measuring seven. I don't care about that. What I want to know is-- with that measurement that I have, I want to know if I can increase that some way, before I give you the fluid, meaning I can recruit cardiac output. Does that make sense?

How can you do it? Lay the patient in bed, 30 degrees, like all patients are in the hospital. And then, you just hook the machine. And you get their legs, and you raise them, like 30, 45 degrees, for one minute.

Normally, you have up to 300 CCs of blood in your legs. And when you raise them, now you're injecting 300 CCs-- it's like a unit of blood-- back into the central circulation. And look at the machine. And if you increase the cardiac output by more than 15%-- 1, 5, 15%-- then you need fluid.

Then that patient, you just put the legs down and give them a liter of fluid or 500 of arbutamine or whatever you want to do. And then, repeat the maneuver, until you don't increase cardiac output. That will be the point when you say, you don't need any more fluid.

So those are the ways you should look if patients need fluid or not. So let's say, you did both of those things. You gave the fluid, and you reach the point where you cannot recruit anymore cardiac output, based on what we talked.

So if your MAP is less than 65, then you need to start a medicine to constrict the vessels a vasopressor-- first-line, norepinephrine. So you will start levophed. It's the first one. Levophed is not contraindicated in pregnancy. And if you need it, you need it, because there's no other option. That is the first-line pressor.

Remember that, all pressors need to go through a central line. Because if you're giving one of those medicines through like a 22-gauge there in the wrist and that vein blows-- one thing is, when it actually blows. And you have some saline, and the patient has a little pain. And you just rub it and kiss it. And that's fine.

Here, it's different. This thing is going to cause diffuse constriction. You can lose be the hand, right. So it needs to go through a big line.

So in terms of what he was asking about dopamine. If you look at the guidelines from 2008 in sepsis, they said, you could use either/or-- dopamine or levophed or norepinephrine. Having said that, the problem with dopamine is that, it is very arrythmogenic. It causes a lot of tachycardia, way more than levophed.

There's a recent med analysis that shows a higher risk of dying if you get dopamine. So the current guidelines are, use norepi. So you would start levophed, once you have resuscitated with fluid. You never start a pressor, if you have not given enough fluid.

Because if you're volume depleted and you start a pressor, and you squeeze the vessels. You're going to end up killing the kidney, the gut, the heart. Every organ is going to be hypoprofused, so levophed.

One little thing about levophed. Levophed is mainly a vasoconstrictor. So it will squeeze your vessels. If you open any textbook and read about sepsis, it will tell you that-- it always says this, sepsis is a hyperdynamic state, with a high cardiac output and low resistances.

Remember-- we'll talk about this in the next talk-- blood pressure is cardiac output times resistances. So if you're hypotensive, it's one or the other. If you have a huge MI and your hypotensive, it's because your cardiac output went down.

Here, it's mainly because your SVR went down. Your vascular resistances went down, because you're vasodilated. So if you put a Swan on someone that has sepsis. Though, no one does it anymore, because it doesn't improve outcomes. If you were to put it, or you do an echo on someone that has sepsis. You're going to see that the cardiac output is 10 liters per minute.

So everyone is like, wow, the patient is dying. But I mean, she has a 15-year-old heart. It's so healthy, 10 liters per minute.

That is not true. The heart in sepsis is sick, because all these cytokines, like Interleukin 1, TNF alpha, and others, they inhibit contractivity. So if you can see there, more than half of patients with sepsis have an ejection fraction of less than 45%. The thing is that, you're so vasodilated. And you're so high hypotensive that-- remember, the blood pressure, that's the resistance that the heart has to empty.

So even if you have a heart that is barely doing this, since you're so hypotensive, there's no resistance to empty. So it is very easy for the heart just to empty. And that gives you the high cardiac output. That make sense?

But if you know from the get-go the heart is sick. So when you start the levophed, you already gave the fluid and now you start the levophed. Sometimes, the nurse might come an telly you, listen, I've been having to go up on that levophed to maintain an MAP of 65, which is the end goal. But I've tripled the dosage already, and the patient goes up and then falls, up and falls, up and falls.

What do you think is happening? Well, when you give the vasopressor, when you give the levophed and you squeeze those vessels, that sick heart now sees a lot of resistances. And now you're unmasking the heart dysfunction. And even though you're going up on your systemic vascular resistances, your cardiac output is going down. Does that make sense?

So when that happens, you should know that, the likely thing is that you're hurting the heart. How can you know if you're hurting the heart? Well, you can put a PA. You can get an echo et cetera. Or you can just-- what we talked about, remember the ScvO2 we talked about? Just get an ScvO2.

Because if you have a low cardiac output, which is what you're suspecting you're doing with the levophed-- if you have a low cardiac output, the time that it takes a red cell to go from here to here, through the tissue, is going to be a lot, because the cardiac output is low. You're barely pumping that red cell. Does that make sense?

If it takes a long time for this cell to go through here, that tissue is going to have more time to strike oxygen. So your ScvO2 is going to come back low.

Then, if that's low and it's 50%, give them an inotrope. Give them dobutamine on top of the levophed. Now you're going to give them the medicine to increase contraction of the heart. So give them dobutamine.

And when you give them dobutamine, you increase the cardiac output. When you increase the cardiac output, this cell is going to go faster through here. So you're going to decrease the time that it will strike more oxygen. And then you'll come back above 70%.

So titration of the ScvO2 to more than 70% is a way of-- real fast, there at the bedside-- that you might consider giving an inotrope. Alternatively, a lot of people, what they do is, they will start both together, the levophed with the dobutamine, knowing that can happen.

All right. So we're almost done.

Now, the question that I was asked earlier about vasopressing, why not start vasopressin? You know, vasopressin is actually-- first of all, the only trial available which is this one here, on vasopressin in sepsis, showed no benefit.

Vasopressin is a, quote unquote "new medicine," that-- everyone likes new things, right. Like, the new iPod comes out, and everyone's wants to get it the new iPhone and the new everything. And you're in line for three days. You don't even know what you're going to get, but you want it.

So vasopressin came out. And then it was like, oh, my God. Let's use it in heart arrest, in ACLS. It doesn't improve anything, compared to just epinephrine.

So it was all this thing that, use it here in asystole and PA. It doesn't improve anything and same thing here in sepsis. The thing about vasopressin is that, normally, you have-- you know vasopressin is right there next to oxytocin.

They're both in the posterior hypophysis. And you have a finite amount of vasopressin in your hypophysis. When you have a stress response, like, for example, sepsis, you secrete this vasopressing. And vasopressin is a pressor. It squeezes your blood vessels, in a different mechanism than katecholamine. So it goes to a V1 receptor and squeezes the vessels.

But the thing is that, you only have a certain amount of vasopressin. And then you're going to lack vasopressin. You need to synthesize more. And if the stress keeps going, you're going to have a relative deficiency of vasopressin. So that's where this comes from.

So this trial showed that it doesn't improve outcomes. But this trial didn't look at something. There's a very small subset of patients with severe sepsis. Let's say, the patient we've been talking about.

Same thing, you gave the fluids. You gave the levophed. Then you gave dobutamine. But then, things don't look good.

And then the MAP is still like barely 60, 55. And the heart rate is in the 170s. Because you're giving levophed, which-- like it or not-- it also stimulates the heart. It's a katecholamine. And dobutamine, that's giving a lot of tachycardia.

But you cannot stop the levophed. Because if you stop the levophed, the blood pressure drops even further. So that is called katecholamine-resistant septic shock. Despite the katecholamines, you cannot achieve what you want. And obviously, you've given fluid already, right.

So vasopressin, since it acts differently than practical the katecholamine, it will squeeze the vessels through a different mechanism. Then it makes sense there to say, you know what, let's add another pressor, that works differently.

So if you at the vasopressin and you squeeze the vessels, and your blood pressure improves. Then, that will give you room to come down on the levophed. And the tachycardia will improve. Does that make sense?

So that is an accepted indication for vasopressin. If you opt to use vasopressin, the dose is this one here-- 0.03 to 0.04 units per minute. And you will not titrate it. The katecholamines, like levophed, for example, you usually tell the nurse, titrate to an MAP of 65. So the nurse is going to be able to go up on the medicine, to maintain an MAP of 65.

This is just physiologic replenishment. You cannot titrate it , because doses higher than this are going to cause heart ischemia and renal ischemia. So you just leave it like that. If it works, perfect. If it doesn't work, you can leave it running if you wan to, but at this dose. So that's the thing about vasopressin.

All right. Just because of time, we're going to talk about each thing. But we're just going to go straight to the point.

Then, let's say, you have this same patient. You did, actually, the fluids. MAP was below 65. You started the levophed.

The cardiac output dropped. You add the dobutamine. The blood pressure is kind of so-so. You add the vasopressin. And still, the blood pressure is low.

So the use of steroids said sepsis is still controversial. But as of now, low doses of steroids could improve outcomes. These doses are not doses that will immunosuppress you. These doses are not going to increase your chances of infection.

These doses, all they're doing is actually just decreasing the excessive inflammatory response that is hurting you. That is causing all these cytokines that are vasodilating you. So when you have septic shock that does not respond to katecholamine-- despite the katecholamines, you're still hypotensive. Then you just go ahead and start the steroids.

You do not need to do an a ACTH test. You do not need to do anything. You just start them.

And the one that you're going to start hydrocortisone. Hydrocortisone is very similar to cortisol. So you're not asking the liver to do 1,000 enzymatic changes, in order to convert the prednisone you gave all the way to cortisol.

The way you're going to give is, you're going to it 200 milligrams on a continuous infusion per day. Why give the steroids? Why is it that they might work? Well, in the blood vessels-- this patient has been seeing a lot of katecholamines, both endogenous and exogenous.

This is like when you give oxytocin for three days, trying to induce someone. And then they bleed postpartum, because you have internalization of the receptors. Same thing happens here. If you've seen katecholamines for such a long time, you internalize the receptors.

And it doesn't matter how much katecholamines you give. Actually, you will not respond because the receptors are internalized. Cortisol helps move those receptors out. So that they will be exposed to the katecholamines you are giving. So that's why you would make an argument to give steroids. Does that make sense?

All right. Last thing, glucose control-- this thing has changed back and forth in the last 15 years. I'm going to skip everything there, until the current recommendation.

15 years ago in Belgium, there was this study that showed that, when you were septic, because of all these katecholamines, what's going to happen with your blood sugar. It's going to go up. So patients are going to be very high hyperglycemic.

If you're really hyperglycemic, it affects your neutrophils. And you don't fight infection well. And you die more.

So many years ago, it was actually proposed that, and there was a randomized trial showing that, if you gave them-- all these patients are going to need insulin. They're going to need an insulin drip, because they're going to be very hyperglycemic. And hyperglycemia is going to kill you.

But it was proposed that you needed strict glucose control. You needed to have the sugar between 80 to 110. That's too low.

And I remember. I was actually doing my fellowship when that happened in the ICU. And when we started doing that, you just saw the nurses running back and forth all day long with the amps of D50, because everyone was just actually developing hypoglycemia.

Apparently, it is recommended that, when you're critically ill, in sepsis and pretty much any critical illness-- and this applies in pregnancy. Same thing for pregnancy. There's no trials of pregnancy.

But why is it going to be different? Why is the pregnant patient going to die from hyperglycemia, if everyone else dies too, when you have sepsis, with hyperglycemia? So now they say, just be kind of a relaxed there. Keep it between 140 and 180. And this is pretty much what you should hit for, in sepsis and critical illness in general.

And obviously, nutrition is really important when you're sick. Remember that nutrition is seen as like a miscellaneous intervention. That's not true.

Remember how, at the very beginning, we talked about ileus? And we said that, ileus could be a marker of sepsis, because you're hypoprofusing the gut. And the gut is not going to move. And you get the ileus.

When you're not hypoprofusing that gut and you have that ileus, what do you think happens to the mucosa? If you don't feed someone for six days and they have ileus. They increased the pressure. What do you think is going to happen to the mucosa?

**SPEAKER 4:** [INAUDIBLE].

**LUIS DIEGO PACHECO:** Yeah, it's going to become atrophic. And if that's atrophic-- do you have bacteria in your gut? Lots of bacteria, and that's called bacterial translocation.

All that bacteria is going to go into your circulation. And that is why patients, suddenly, you're like, well, everything was getting so good. And now they're sick again.

Well, they can translocate psuedomonas. And they can translocate cytokines and a bunch of things, E coli, klebsiella, and then develop more infection. You need to feed patients, to maintain the integrity of the mucosa. And you just put a Dobhoff or an NG tube and feed them through there.

And that's what I had about sepsis. I don't know if you guys have any questions.

**SPEAKER 5:** One question-- I know you said that you see most of the sepsis postpartum. But actually, I've encountered that were septic were still pregnant. And they ended up being transported on ventilators. And we actually delivered them really quickly, after an hour or so, once they were put on dopamine. The norepinephrine wasn't used [INAUDIBLE].

But it just shunted blood away from the placenta, from the baby. I mean, you could just see the decels almost instantly, once they were on the dopamine. Is the norepinephrine pretty much going to do the same thing? I know [INAUDIBLE] pretty much after that with the uterus. And if I step in pretty much after that, with getting the baby delivered. Is that shown to be a good thing. Or is the uterus shunting the blood with the norepinephrine, like you do with dopamine?

**LUIS DIEGO PACHECO:** Yeah. The question is about the use of vasopressors in sepsis, when the patient is still pregnant. Actually, it's funny. I remember, a few years ago, same thing, we had a patient that we used dopamine. And the minute that we started the dopamine, you would see the decelerations.

So here's the thing. Dopamine actually is mainly-- it mainly will increase your blood pressure, by increasing your cardiac output and then levophed mainly by increasing your systemic vascular resistances. Having said that, they both can actually hypoprofuse the uterus.

Now, I don't know how hypotensive that patient was. We have actually a case report that we published some years ago, where we have someone-- this was not septic shock, but it was anaphylactic shock. And you see the MAP was 30. And then you can see, just the heart rate of the baby in the 40s or something.

And then, once we started epinephrine, then you can actually see how it goes back, and it improves. So I would tell you that, if you are severely hypotensive, when you start the vasopressor, you're actually going to see improving the mean arterial blood pressure. And you should see it improve in the profusion pressure to the uterus.

The main problem that happens with the vasculature of the uterus is that, if you look at the blood vessels in the uterus, they only have alpha receptors. They don't have Beta-2 receptors, which are the ones that cause vasodilation. So you know how you give benadryl to someone, and they might actually sleep for three days? Or you might give it to someone, and it doesn't touch them. It's the same thing.

When you give someone a katecholamine, you don't know how much alpha you're going to get. And it's going to vary from patient to patient. So some patients, actually, you give it. And then, since the vessels only have alpha receptors, then they might just be-- just locally, they will squeeze a lot.

Having said that, you need to start a pressor. Now, in these cases that you have, again, I don't know if you're having an MAP of 50, 60, or something. And then you only saw the side effect of the constriction in the uterine vasculature. And you didn't see the benefit of improving increasing the mean arterial blood pressure systemically.

Because you can have a pregnant patient with an MAP of 50. I mean, you see them all the time. You see this pyelonephritis that come here. They're 80 over 30, and they're peeing. And they're watching TV. And they're talking to you.

If you bring an intensivist, a pure intensivist, that has never seen a pregnant patient and see that. They will say, start a vasopressor right now. How can you be 80 over 30?

So a healthy pregnant patient probably, with an MAP of 50, might have done OK. And then, if you give the pressor, you will only get the side effect there.

In terms of delivering the baby, it depends. If you have someone in septic shock and you see the strip . And the baby is dying. And it's viable. You have no alternative to go and get it out.

But if you have someone in septic shock and the strip looks acceptable. I don't think it's probably the best moment to go and deliver them, because you're going to actually lose a liter of blood or someone who is profoundly hypotensive. Someone who has-- if they're really sick, they have DIC as well. They're going to bleed more. So I would try to keep the baby inside, provided the strip looks OK.

Yes, sir.

**SPEAKER 6:** Is it true that some states have mandated sepsis protocols in ERs? And is that a good thing? Or is there any talk about having it here, in Texas?

**LUIS DIEGO PACHECO:** The question is, is it true that some states have mandated the use of sepsis protocols in the ER. I'm not sure about mandating. What I can you is that, this protocol that we talked about at the beginning, the Rivers Trial, that has gotten widely accepted. Everyone uses it. Personally, I think it's a very good thing.

I don't know if it is the ScvO2 or if it is the dobutamine. I don't know if it's one single intervention. I think it's the fact that people are more alert about sepsis and treating it early.

It's the same thing as this massive confusion protocols for a obstetrical hemorrhage and trauma hemorrhage and everything. It's not the fresh frozen plasma to packed red cell ratio. That has been shown to not improve outcomes. It's the fact that you have a protocol. And then, early in the game, you say, I need help. And then the blood bank works. They get their best people.

When you activate the protocol in the OR, what happens? You get the best surgeons. You get the best anesthesiologists.

Everyone comes here, helps get the lines, helps with the surgery. And that's probably what improves the outcome. So I think the early recognition and treatment.

Because it is not acceptable to someone comes in thinking they have sepsis or with a bad infection, and they sit in the waiting room for three hours. The idea is, that you should be like, you go, and you have chest pain. Same thing, you think you have an infection. You go, and you get evaluated right away. Yes, sir.

**SPEAKER 7:** You know, a lot of times, if we're trying to decide if someone needs blood, postpartum or something, and we tilt them. We stand them up. We check their blood pressure and their pulse and see how they feel. And it sounds like the leg-lifting is sort of the opposite of that.

And is there something you could learn at the bedside, if you're trying to make some quick decisions on the fluid, if you don't have a Cheetah? Does their pulse pressure matter then, before and after you lift their legs?

**LUIS DIEGO PACHECO:** Yeah. If you look at it, the thing is that, when you do the orthostatics, what you're looking at is, you're looking at an empty musculature. When you do the passive leg raising, you're looking at recruitment of cardiac output. So I think they both at different parts of the equation of blood pressure.

There is some suggestion. There are a couple of articles out there saying that the plethysmography curve, you just put the pulse ox. And you know how you put the pulse ox and you actually see a waveform? So there are a couple of trials that are saying that, if you, for example, raise the legs and you increase the amplitude of the pulse ox wave form. Then you need fluid. It's the same principle as the pulse pressure variation.

So if you raise, then you will increase the volume. And you will see an increase in the amplitude. But that's not sensitive and specific enough to use. But I will probably tell you that I'd rather use that than a CVP.

Have her buy the Cheetahs for you. They're not that expensive. All right, anything else?