[music]

[background conversations]

[pause 00:00:00-00:00:14]

Dr. Barbara Cockrill: Okay, let's get started. As we've said before, the only thing between you and your weekend is pulmonary emboli. It started with a change of pace here from hematologic malignancies to pulmonary emboli. There are six questions in this mini case, so by about 12:05, we want to be on question four. At the end, we may not finish that last question, and it's intended that way. If we have time, we will get to that, but it's all in your slides already, so you don't need to worry about it if we're not finishing up with number six. Someone start reading for me. We have a volunteer over here.

Speaker 1: Ayse Katenay is a healthy 29-year-old woman. Ms. Katenay is traveling from California to Boston on a seven-hour plane flight where she is presenting at a conference on Native American Health. Two weeks prior to the trip, she suffered a rock climbing accident and tibial fracture involving the articular surface of her distal femur. She is in a long-leg cast.

For the last few days prior to the trip, her leg has been more swollen and uncomfortable. She considered staying home, but this is an important presentation for both her career. She is head counsel for the Navajo Nation and the tribe. The night before her trip, she was so busy putting last-minute touches on her talk that she skipped dinner. She also got up late and had no time for breakfast.

You happen to be sitting next to Ayse on the plane. You check her pulse, it is strong. Heart rate, 110; respiratory rate, 20. You notice that her foot is quite swollen below the cast. You remember your fabulous Homeostasis I course and think about what you would do if she was your patient in the emergency department.

Dr. Barbara Cockrill: She sat down next to you, and she's complaining of some shortness of breath, she's got a swollen foot, her heart rate is-- You can take her pulse about 110, and she's breathing a little fast. Let's move on. Let's think about a screening blood test. We have a young woman, otherwise healthy, long-leg fracture, long cast, long plane flight, and we're thinking about a screening blood test that might help us evaluate her more for a pulmonary embolism. Talk about that for just a little bit, and then we'll talk about it as a group.

[background conversations]

Speaker 2: A screening blood test. What do you guys think?

Speaker 3: D-dimer. Maybe to review how that works [laughter], it breaks up fibrin. It's a degradation product of fibrin, and the D-dimer test would be positive if she had a DVT or pulmonary embolism. It's pretty nonspecific, so it can't tell you that it's a PE, but if she doesn't have it, then it will set off.

Speaker 4: Yes, not diagnostic but it's supporting.

Speaker 5: What are some of the other causes that would result in her having an elevated D-dimer?

Speaker 3: So many other things.

Speaker 4: Disseminated intravascular coagulation.

Speaker ?: You need clotted--

[crosstalk]

Speaker 3: Even trauma and surgery, which she has had.

Speaker 5: Cancer.

Speaker 2: Just hypercoag **[unintelligible 00:04:04]** . I had a question about this though because it isn't fibrin formed just like a little by clots, so why would you see breakdown?

Speaker 4: I asked Connor about this because-- [crosstalk]

Dr. Barbara Cockrill: I heard a lot of good discussions here. Let's come together as a group. Your table here had a really nice discussion going, so let's hear what your thoughts are about describing a screening blood test and would this be appropriate for this patient?

Speaker 6: We talked about the D-dimer test, which looks at breakdown products from fibrinolysis. We thought that for this particular patient, we would probably lean away from that. The D-dimer is more of a rule-out test, where, \in someone who you think probably doesn't have a VTE of some sort. If they have a negative, then you feel pretty good about them actually not having a VTE.

With her, because she has a number of risk factors, including the long-bone break, the sitting in the plane for seven hours-- there might have been a couple of more that I'm missing. We think that probably she does have a VTE, and so any negative that we got, we would have to be very suspicious of.

Dr. Barbara Cockrill: Great. Did other groups have other thoughts on that? When we say a rule-out test, what do we mean by that?

Speaker 7: Maybe it's sensitive but not specific.

Dr. Barbara Cockrill: Sensitive but not specific. When would you want to do a sensitive but not specific test? Think if we're talking about a screening test.

Speaker 7: You would do a sensitive test that's not specific when you just want to catch everyone who may have the disease. If you're trying to-- To a general screening for a population. Here, we want to really determine if this person has a DVT so we want a specific test for DVT.

Dr. Barbara Cockrill: Great. Michael, how do you think about this when you're on the words? Better give you a microphone.

Michael: Yes, this is a great idea and really good we're picking up on this now. If we think of this test as highly sensitive but not that specific, we can say for the sensitivity, if we look at patients who have PEs, all of them are going to have an elevated D-dimer or very many of them will have an elevated D-dimer.

The flip side of that though, if we look at patients who have a positive D-dimer, only a small, small portion of them are going to have PEs because that D-dimer can be elevated in a variety of other situations. If we just care about catching people in the PE category, it's good to get a highly sensitive test to start out. If it's not that specific, we can't be sure it's pointing us in the right direction.

Dr. Barbara Cockrill: In the ICU, if we're worried about someone with a PE, we don't bother with a D-dimer because they all have positive D-dimers. If you have a pregnant patient, many of them have a positive D-dimer. You want a test that's sensitive so you don't miss it, but you're going to lose specificity. You also brought up another point, why wouldn't you do this? It's not wrong to do it, it's not going to hurt her, to draw a D-dimer test, but why doesn't it really help you in evaluating this patient in whom you're really wondering about a PE? What do you guys think? I mean, we touched on it here.

Michael: I think what is helpful for this is, go through the scenarios in your mind, in a flow chart. The attending will say to me, "Okay, you want to order this test. What if it's positive? What if it's negative?" Maybe try applying it to this situation in both of those two. Do you want to say anything?

Speaker 8: I think our group mentioned before, our patient has some risk factors for VTE. When we talked before, in our previous class, we talked about how stasis endothelial injury and hypercoagulability can lead to a thrombosis event. This case, our patient has probable stasis from sitting in the plane for a long time and maybe some vascular injury from her fracture. That's two of the Virchow's triangle that might lead to a VTE event in the future.

Dr. Barbara Cockrill: Great. The issue is, if this is negative, are you going to stop? No. I mean, because you're pretest probability. I mean, you're really worried that she's going to have a PE, so you're not going to stop with a negative test. That's the whole point of having a screening test that's sensitive and not specific. Matt, do you have anything else to add on that?

Dr. Matt Haney: By doing the scoring for pretest probability, you can increase the specificity by applying tests only to certain populations that meet certain scores. For venous thromboembolism and for DVT and PE, there are lots of scores that were made over the years in internal medicine and that's because this is such a common issue to see.

Dr. Mayer: I think of it, the converse is also true though that when you do a test for which there is a low likelihood of it being positive, then your incidence of false positives goes up. If you had an otherwise totally healthy, normal person walking off the street who had a low probability of having a pulmonary embolus, and you drew the D-dimer, the likelihood of a false positive would be quite high. That's the flip side. This is Bayes' theorem, but that's the flip side. When you're doing a test for which

you have a low probability that it's likely to be positive, then the incidence of false positives goes up.

Dr. Barbara Cockrill: If you have a low probability and it's negative, you're good. That makes sense? If you don't really suspect the PE but you're just sending the test to make sure and it's negative, you've got a low prior probability and it's negative, it helps you rule out the pulmonary embolism, and you don't need to go further. The point is, this lady is not low probability. She's got a swollen leg, she's got a lot of risk factors. Even if it were negative, we wouldn't stop and we would keep moving on.

Let's just talk about what the D-dimer is which is really a fibrin split product or fibrin degradation product. All it tells you is that there is clotting going on, the body is applying plasma, and breaking down that clot. It tells you that there is some sort of clotting and fibrin degradation that's picking up those degradation products. Happens in inflammation, it can happen just in cancer, lots of things can make your D-dimer go up.

Dr. Matt Haney: You remember the whole pathway here, the whole point of the coagulation pathway is to make thrombin. One of the things thrombin cuts is plasminogen to plasmin. You're already beginning to break down your fibrin as soon as you start making thrombin before you've even made the fibrin. All those things together, you right. It's classically in sickle cell disease, even in sickle crisis, you have someone with leg pain and you think, "Maybe it's a DVT," there's no point doing a D-dimer because it's going to be positive due to that. It has a lot of false positives for sure.

Dr. Barbara Cockrill: For your boards, they love specificity and sensitivity so remember to think about that.

Dr. Matt Haney: It's worthwhile reading a little bit about positive predictive value, negative predictive value, and all those things are all put together. Bring you back to stat just to make you a little cautious.

Dr. Barbara Cockrill: Just to summarize here, the D-dimer is an excellent screening tool that has high sensitivity and a high negative predictive value in the appropriate patient, but it's not at all a specific test. Any questions on that? That's a take-home from today.

Speaker 10: Can we say it would not be appropriate to do? **[unintelligible 00:13:07]**

Dr. Barbara Cockrill: It would not hurt her to do it, but it's not really an appropriate test because no matter what you get as a result, you're still going to pursue evaluating her for pulmonary embolism. Not going to hurt her, it's just a blood test. It's going to cost a little bit of money. The point is in this patient, you would not stop with a negative D-dimer test. What would you do next? I'm going to give you guys a little bit of more time to think about this. If you were seeing this patient in the emergency room, comes in, feeling short of breath, a little tachycardic, respiratory rates up a little bit, long cast on her leg with a swollen foot, what would you do if you weren't on the airplane to further evaluate her? We'll give you about five minutes at your tables to figure that out.

Speaker 5: Chest CT angiogram.

Speaker 2: You can also do like VQ perfusion-ventilation scanning.

Speaker 4: Yes, perfusion scan.

Speaker 2: Yes.

Speaker 4: I think what you're saying is the most common one today, that now is CT. It gives the most detail.

Speaker 5: It's more cost-effective I think.

Speaker 2: It does it faster, like it's immediate versus if you have to wait.

Speaker 3: I think you could also just start her on heparin because she might not have time to get all these tests like she has this swollen leg, she's been on a plane. The heparin probably won't hurt her unless she has other-- [crosstalk]

Speaker 2: Would you want to do heparin or warfarin?

Speaker 5: Yes, the heparin's faster acting.

Speaker 2: I think it's faster?

Speaker 3: Yes.

Speaker 5: Because warfarin's the Vitamin K antagonist.

Speaker 2: Warfarin is more like a maintenance thing and then heparin is immediate relief.

Speaker 4: I think building on Anaswhini's point too, basically, it's not the first PE that gets you, it's the second one that you have. I agree, empiric treatment.

Speaker 3: I were in ED, I would start her on this treatment first and then do the testing because obviously, if she doesn't need it, she doesn't need it.

Speaker 5: I feel like starting on a heparin drip is just such a well-known precaution that people do, given her risk factor.

Speaker 3: Yes.

Speaker 2: Right.

Speaker 3: Also maybe IV fluids. I was thinking the reason the whole breakfast thing might be relevant is because if she's not eating, she's probably not drinking, and that makes her blood more viscous. Maybe IV fluids would help her as well. I think the one, Michael, that you're thinking of is the pulmonary angiogram which I didn't really understand what that was. Basically, you put a ton of radioactive dye directly in.

Speaker 4: It's like a coronary angiogram, they put a cath into you, and they're pulsing out dye, so it's super invasive. I guess, more so than the others.

Speaker 3: The other one is just like you get the contrast and then go for imaging. I think that would be the next diagnostic test, it would be the CT.

Dr. Barbara Cockrill: We have a volunteer right here. He's going to come take us through. What did you guys think? Come on up and let's talk about the things. What were the things that you were thinking about doing next?

Speaker 11: If we were in the ED, we're thinking about. at this point, doing some imaging. An option we have is a CT scan. Wow, that's terrible.

Dr. Barbara Cockrill: See, it's not that easy. You always laugh at us when we're scribbling up there. It's not that easy to do, right? It's harder than you think.

Speaker 11: Also a contrast as well too.

Dr. Barbara Cockrill: Contrast CT scan. We just happened to have a picture of one of those on the next. Before you talk to us about the findings, how does a contrast CT scan work?

Speaker 12: I don't know if you inject it, but you give contrast.

Dr. Barbara Cockrill: Injected into a vein, usually in the arm.

Speaker 12: Then you scan a chest and the vessels that-- You should see the contrast on the scan, so anything that you don't see the contrast and there should be contrast there, you know there's a blockage.

Dr. Barbara Cockrill: Great, you want to show us how that works?

Speaker 12: Yes, so on this image, the black area we can see is the lungs because it's usually filled with air. If we look closely, I guess an arrow helps us see it.

[laughter]

Dr. Barbara Cockrill: They don't come like that when they're in the emergency room.

Speaker 12: You can see like an emboli occluding the pulmonary vasculature, and that would confirm our diagnosis of a PE.

Dr. Barbara Cockrill: Great. Was there another question here?

Speaker 13: We were talking about, this 29-year-old woman. What would you do if she was pregnant?

Dr. Barbara Cockrill: What would you do if she was pregnant? Why are you worried about that?

Speaker 13: Radiation exposure from a CT is bad for the baby.

Dr. Barbara Cockrill: The baby, right. What would you do?

Speaker 14: Could you do a VQ scan instead?

Dr. Barbara Cockrill: You could do a VQ scan instead. What's a VQ scan?

Speaker 14: Ventilation-perfusion scan.

Dr. Barbara Cockrill: Yes. That one's the harder one to understand. Let's go through this, and then we'll talk about the VQ scan on the next one. You did a great job of showing us here what is going on. I inject contrast into the patients, put in an IV, you inject contrast, you time it just right so that bolus has come in, gone into the chest, you take the picture right when you think it's going to be in the pulmonary arteries. What we're looking at here is a pulmonary-- Here's the aorta here. This is the pulmonary artery coming up, going that way. The left pulmonary artery, you can't see because we're just haven't cut it right. I'm just going to erase this for a minute. What you're seeing here is the contrast looks white. You're seeing what we call a filling defect right here. That's a big one.

Where the contrast should be and now there's a black spot that tells you that there's something in that blood vessel and it's a pulmonary embolism. They're not always this obvious, in fact, they're usually not this obvious. You end up having to go up and down, back and forth, and follow all the vessels out to try to find the spot of the clot. You can see another one on this side. It's not quite as obvious here where you're seeing it should all look as white as that little spot. You're seeing a little bit of haziness or dark spots. If you went up and down on a CT scan, you could see that that would be a clot also. Go ahead.

Speaker 15: Just one quick question. We are wondering whether you start some type of anticoagulant therapy, like heparin before you even do this sort of testing?

Dr. Barbara Cockrill: That's a great question. What were you thinking?

Speaker 15: I brought Evan brought this up actually, basically you want to make sure that you're potentially treating for this so this doesn't actually happen when you're waiting for the results, or they are going through the testing.

Dr. Barbara Cockrill: Great thought. You may if you're really are concerned and worried about-- In this patient, I absolutely would do that. I would start the heparin while we're trying to figure out what's going on and before you've even made the diagnosis. If you have someone where the probability is much lower and you're not worrying about it as much, then you'd wait to start that. That's a great point.

Dr. Matt Haney: Of course, you have to think of other things too before you start any anticoagulant. Are there other risks for bleeding? Are you going to take them to surgery in the next six to eight hours, potentially? Then that would be relatively contraindicated. Few things around there but you really to start anticoagulant as fast as you can assuming there aren't other reasons why you shouldn't or contraindication.

Dr. Barbara Cockrill: Dr. Mayer.

Dr. Mayer: The only other thing I would add is that, fortunately, we have an antidote to heparin which is called protamin. If you were in that box, you had to go to the operating room, and you'd already given the patient heparin, you can always titrate it

back. That's literally what we do every time we come off bypass where we've completely heparinized the patient. Then when you don't need the heart-lung machine anymore and you want to reverse the anticoagulant effects of heparin, and so we give protamin. That's a typical sequence for essentially every open-heart operation. That's a nice thing about heparin is that you can reverse its action.

Dr. Barbara Cockrill: One more question then we'll move on to the VQ scan. Go ahead.

Speaker 16: Just a quick question. In this setting, would you jump right to a contrast CT or would you ever do like a chest X-ray? We've learned about how there's really not much probability like findings with a chest X-ray, but I don't know what the protocol is?

Dr. Barbara Cockrill: Clinically, in a patient like this, you would anticoagulate her and then you would confirm your diagnosis with some other way of evaluating her; probably with a contrast CT scan. We talked about ventilation profusion scan. In a pregnant patient, you would want to think about doing a ventilation profusion scan because there's a little bit lower radiation to the baby, but there's quite a bit less radiation to the breast tissue. You've got to balance everything. You get a young woman who you really need to make a diagnosis, you're going to get a CT scan because it happens much more quickly. If you have more time, one of these things takes about 45 minutes to an hour while you're trying to sort it out.

The way this works, let me just take you through it. This is the profusion component of a VQ scan where we take macro aggregated albumin, relatively large chunks. You injected into the patient's venous system, and then they sit under a camera for about half an hour. This is a normal one. It's in the bloodstream. It got some radiation there and it fills in the lungs. It looks nice, smooth, and perfect and you know that's normal profusion.

This is an example of an abnormal profusion. You can see that there's these blocked out areas. Trust me, we are not going to expect you to read these because they can just look like weather maps. You would look at lot more images than this, but the concept is what we want you to get.

Normal profusion versus abnormal profusion. Then we want to go on and see is the reason that they have abnormal profusion because they have abnormal ventilation. Why would I have to do that? Say I have no ventilation going to one area of my lung, what are the lungs going to do? What the blood vessels going to try to do? Constrict to decrease the profusion there. The next thing that you do is you look at the ventilation component. What this is then doing is confirming that the ventilation is normal and that there's a mismatch defect in an area with no profusion that's still being ventilated. That's considered a high probability for a pulmonary embolism. Does that make sense? Yes, go ahead.

Speaker 17: Would you still--

Dr. Barbara Cockrill: Dr. Hopkins, go ahead.

[laughter]

Speaker 17: In this example, would you still go with additional testing or imaging to find out where exactly the PE is or would you just go for treatment?

Dr. Barbara Cockrill: This is a high probability scan, and if we looked at all the images, we could figure out which segment's involved. This scan with normal-looking ventilation, the patient's breathing in, we're taking pictures, it's distributing well, and then they're breathing it out.

Abnormal profusion with normal ventilation is a high probability scan, and that's diagnostic of a pulmonary embolism with a little less radiation, but it takes a lot longer. This is just explaining that in more detail, but I'm not going to go through that. The concept is, is a mismatched area is what increases the likelihood or is a diagnostic of a pulmonary embolism.

Speaker 18: Would you ever use this for a COPD or something like that to confirm VQ mismatch?

Dr. Barbara Cockrill: That's a really good point. What are you thinking?

Speaker 18: I was just saying that where we saw the contrast, we were thinking that-- Here, you'll see that you have profusion but no ventilation, so I was just thinking that you could use that with also seeing the symptoms of what you would see in emphysema or chronic bronchitis, one of those.

Dr. Barbara Cockrill: Yes, you bring up a really good point. We don't really use it to evaluate patients with obstructive lung disease, but if you have obstructive lung disease, you can't do this test because it's going to be abnormal. You asked about whether or not you do a chest X-ray. Before you do a VQ scan, you get a chest X-ray first to make sure that it looks normal becasue you're not going to do this test if someone has abnormal lungs because you're relying on normal ventilation to make it sensitive and specific. Great point.

One last thing so that we can move on. I'm just going to point out that in the old days, not all that long ago but a little while ago, we used to do pulmonary angiograms. Did you do these Dr. Mayer? They didn't.

Dr. Mayer: We usually don't see pulmonary emboli in the [crosstalk] **[unintelligible 00:28:35]**

Dr. Barbara Cockrill: Yes, because they're all anticoagulated for one thing.

[laughter]

Dr. Barbara Cockrill: The contrast CT scan has been a big step forward. A pulmonary angiogram implies is that you've threaded a catheter up into the pulmonary arteries either through the groin, through a vein, or through the neck sometimes, and you feed it up into the pulmonary artery. Here's a pulmonary artery here, branching. This is the catheter going up into the pulmonary artery. You inject contrast and then you take a picture.

One of the confusing things for students on these is just by a convention, on a CT scan the contrast is white, and on an angiogram the contrast is black. It's just the

way it's done. I don't know why that is. On this you can see-- we hardly ever do these anymore, but you'll see it in the book. In this, there is-- these are the easiest ones to see down here. You see the outline of the blood vessel here. Then you see these whiter areas here which are the filling defects, so those are pulmonary emboli sitting in those arteries.

Again, it's the same concept that if you have area that should be full of contrast and you lose the contrast from a filling defect, that's consistent with pulmonary embolism. This is super invasive-- not super invasive, but it's invasive, so we tend to do CT angios. Good? Who can read for me then the next part of the case, which is-- Yes, right. Michael.

Speaker 5: You are quite worried about Ayse and recommend that she goes to the emergency room as soon as she lands. You offer to accompany her. During the descent, Ayse has an abrupt onset of severe dyspnea and distress. She's having trouble talking and looks like she might pass out. You check her pulse again.

Her heart rate is 138, but now it's hard to feel. You check her carotid pulse and it is also barely palpable. You ring the call button for the flight attendant and clearly state, "Please get some oxygen immediately. I am a physician in training, she is having a medical emergency. The plane needs to land as soon as possible, and an ambulance needs to be waiting to take Ayse to the hospital."

[laughter]

Dr. Barbara Cockrill: Don't laugh. This will happen to all of you a number of times. How many times has this happened to you on an airplane?

Dr. Mayer: At least three or four times.

Dr. Barbara Cockrill: Yes, not exactly like this. The dreaded call is, "Is there a doctor on the plane?" Then you look around to see who else is getting up, jumping, and running over there. It happens a lot.

Here's the question, what is the role of the physician health care professional in the non-clinical setting? Let's just talk about this together. I just bring this up, two years ago in flying back from Montana, there was a young guy who had a first time ever seizure in his army fatigues. He probably was dehydrated and had a sodium of 110 or something like that. I was on the plane, and I had to tell them that they needed to land. Let me tell you, they were not happy at all.

Dr. Matt Haney: "Are you sure, Dr. Cockrill?"

Dr. Barbara Cockrill: Yes.

Dr. Matt Haney: "That's $50,000 I have to spend in fuel. Are you sure?"

Dr. Barbara Cockrill: That's right, and I didn't get a thank you. [laughter] This will happen. What will we do with this young woman? You got to let somebody know.

Speaker 11: I was really wondering because in theory, we don't have as much experience, but if something is happening, I assume it's reassuring to a patient on the plane.

Dr. Barbara Cockrill: I think it's something for you all to think about. I think the main thing we could do is stay calm. No one else can stay calm on the plane, but you learn that then you triage. If there's somebody more experienced than you, you let them take over. If they were having a pneumothorax and you needed to stick a ballpoint pen in their chest and Dr. Mayer were there, I'd probably step aside and let him do that.

Dr. Mayer: I'm ready.

[laughter]

Dr. Matt Haney: Only go on planes that have 300 seats, there's a good chance an interventional cardiologist is on the plane with you.

Dr. Barbara Cockrill: That's right. Okay, a little sidetrack, I'll keep reading here. The plane is met on the tarmac at Logan, and she's brought to the emergency room by ambulance. A large-bore IV is started, and she receives a liter of normal saline before reaching the emergency room. I just want to say, Connor, you're probably better off with an EMT almost on the airplane than you are with-- No?

[laughter]

Dr. Barbara Cockrill: Has that happened to you on an airplane or somewhere? Many places.

Connor: There was one time where they did call for someone on a plane I was on, but fortunately, there were like five doctors.

Dr. Barbara Cockrill: Good. Usually, if you're coming to Boston, there's lots of doctors on the plane. They give you the following information. She's in a long cast immobilizing her knee. She takes oral contraceptives but no other medications, and she does not smoke. A focused physical exam; she is in marked respiratory distress, respiratory rate, 26; blood pressure, little dwindly; heart rate, 110; her oxygen saturation is 97% on supplemental oxygen. She got a few crackles at the right base. Neck veins are elevated, tachycardic.

Normal S1, her S2 was split with a loud P2. Her right leg is normal, the left leg is in a long cast, the visible part of her left foot appear swollen. Okay, let's talk at your tables. Let's summarize the case, think about what's been going on. What are the permanent positives and negatives in her history and on the physical exam? What's the next step?

Speaker 5: One negative was her medication of taking oral contraceptives.

Speaker 2: I think that would be a positive.

Speaker 4: I think they hypercoagulate. They create a coagulable state.

Speaker 5: Won't that be a bad thing?

Speaker 3: Just to clarify, I think positives means you have something abnormal that is relevant. The negatives is you don't have something--

Speaker 2: No associated weight loss. [crosstalk]

Speaker 3: Yes.

Speaker 4: It's like a pertinent negative here would be if her foot wasn't swollen. Then you'd be like, "Maybe this isn't a DVT from her leg. It's a pulmonary embolus coming from somewhere else."

Speaker 5: It's a positive finding in the direction of her PE?

Speaker 3: Yes.

Speaker 2: Yes.

Speaker 5: Okay.

Speaker 2: Oral contraceptives, her swollen left foot. She also has crackles, a loud P2, elevated JVP.

Speaker 4: A loud P2, does that mean the afterloads up?

Speaker 3: Yes.

Speaker 4: The valve closes loud, right?

Speaker 2: Because there's like a lot of pressure basically built up against the valve when it closes.

Speaker 4: She also has the right heart failure, is the JVP?

Speaker 5: She's tachycardic.

Speaker 3: Respiratory distress.

Speaker 2: She's not hypertensive yet, but her blood glucose level is low.

Speaker 3: I don't know. I wouldn't say 92 **[unintelligible 00:37:00]**

Speaker 2: What did you say?

Speaker 3: I said I would say--

Speaker 4: She is almost in shock.

Speaker 2: Yes, Emily went over there. That's totally her resting blood pressure.

Speaker 3: Are you serious?

Speaker 2: She's my PDR partner when we were learning **[unintelligible 00:37:10]**

Speaker 3: Oh my God, that's crazy. I know Michelle has a resting blood pressure of 100 over something which is also really low.

Speaker 5: Curtis does also. Okay, anyway.

Speaker 2: O2 sat is a little bit low I guess but not significantly.

Speaker 5: Is it significant that she doesn't have any pain presenting yet? Is that a pertinent negative?

Speaker 2: I feel like we don't know that she's not in pain given that her main problem is the respiratory distress.

Speaker 5: Is there anything that's absent that you think is important?

Speaker 2: Do we think the fact that her supplemental oxygen isn't-- It's 97% on supplemental.

Speaker 3: It should be like a hundred, right? I don't know, it's okay I guess.

Speaker 5: I guess smoking could be a pertinent negative, but it's not really necessary [crosstalk] **[unintelligible 00:38:15]** because she had a broken leg or something.

Speaker 2: What else could be complications or causes of PE that we can rule out?

Speaker 3: I don't really see any pertinent negatives, to be honest. It all kind of points to PE.

Speaker 2: Hemoptysis?

Speaker 4: They say it's pretty rare though.

Speaker 3: She doesn't have pain, she doesn't have hemoptysis.

Speaker 5: She doesn't have syncope.

Dr. Barbara Cockrill: Okay, let's get started again. You're in the emergency room, you've evaluated the patient, you're attending is now asking you to present the case. How many sentences do you get an emergency room, Michael?

Michael: The emergency room? You make the sentences count.

Dr. Barbara Cockrill: Maybe five sentences or so. Who can summarize the case for us in about five or--? If it's the surgical side of the emergency room, we might even only get three sentences, right? Who can summarize what we got?

Speaker 12: If I had to do this really quick, I'd probably just say, "Pulse is barely palpable, tachycardic, low blood pressure, elevated neck vein, with a few crackles at the right base.

Dr. Barbara Cockrill: What's her presenting complaint?

Speaker 12: Respiratory distress.

Dr. Barbara Cockrill: The attending is going to say-- I'm sorry, you said she's tachycardic, she's got an elevated JVP. What else is grabbing the other--?

Speaker 12: Pulse is barely palpable.

Dr. Barbara Cockrill: Decreased pulse.

Speaker 12: Hypotensive.

Dr. Barbara Cockrill: She's borderline hypotensive. I'm going to bet that when she was in the airplane and we were feeling her pulse, it was a lot lower. I mean the blood pressure was lower. She got a liter of fluid in the ambulance, and her blood pressure was maybe a little better. Came up into the 90 over-- I forget what it was. 90/60 range but borderline hypotensive. Anything else about her physical exam?

Speaker 19: Swelling in the leg.

Dr. Barbara Cockrill: Swelling, rigth? I'm sorry. What?

Speaker 19: Swelling.

Dr. Barbara Cockrill: Swelling and a long cast. What's our next step? What are we worried about? What's the title of the talk today? We're worrying about-- We've talked a little bit about this, what are her risk factors for clotting? Someone brought up Virchow's Triad. We said she's got stasis, she's got a cast. She's been sitting on an airplane, which is actually a risk factor. Maybe some vessel wall injury, although her injury was a while ago, especially if it were an acute injury. What about hypercoagulability? What are we thinking? Everyone hear that? How does that work? Birth control pills.

Speaker 20: I think it's specific to estrogen-containing OCPs or other forms of birth control. The way that that works in my understanding is estrogen acts on transcription factor production to increase clotting factors essentially. You have a lot of these clotting factors present, and you just are more predisposed to developing a clot.

Dr. Barbara Cockrill: Dr. Haney.

Dr. Matt Haney: That's true. Generally, the estrogen-containing component of the birth control pill and mixed hormonal contraceptives, that's true. Some of the newer generation progesterones, which is the other component of usually mixed hormonal pills, it's really the third and fourth generation ones actually have a pretty significant thrombophilic effect as well. All of them are not good. To the most point, particularly the mixed oral hormonal ones. If you're really looking for contraception, you might want to use a non-hormonal, a progesterone-only, extremely low dose, or use more physical type things; IUD or more local infiltrating hormonal devices.

Dr. Barbara Cockrill: How much does estrogen alone increase your risk?

Dr. Matt Haney: It depends on the amount, but this gets back to what was mentioned in the lecture talking about relative risk and absolute risk. The way I think about these hypercoagulability risks are things that you're born with, congenital things. We talked about the Factor V Leiden for thrombin mutation. Are there rare problems of antithrombin deficiency, protein s and c deficiency?

Those will come to you and you can't change those to a certain extent. Sitting in the emergency room, we'd wonder, what's her ethnicity? If she's Caucasian of Northern European heritage, then she's got like a 5% chance of having Factor V Leiden, heterozygosity too, so you can think about those things. Really, it's the acquired risk factors, which is you add the risk factors, you multiply the relative risk. Estrogen may be a five times relative risk, which sounds like a lot but the absolute risk is still quite low until you start adding other risk factors like age, Factor V Leiden, obesity, or smoking.

Once you add those risk factors, the relative risk really turns into a significant real risk or absolute risk. I can't remember, the actual VTE risk in a healthy 29-year-old is probably one in 5,000 patient years. Then you multiply that by five, now it's five in 5,000 patients years, that's not very much. Then you add smoking to it and all of a sudden it's 105,000. More that you add these things, they multiply together those risks. Really the whole focus is, was mentioned in the lecture is to reduce the acquired risk factors as much as you can. There's not much you can do about the congenital ones or age, that happens, whether you like it or not.

Dr. Barbara Cockrill: One of the center synergistic risk factors to remember is smoking and birth control pills. I don't remember exactly what the number is, but it's not just one plus one equals two. It's more like one plus one equals 10 as far as increasing your risk of venous thrombosis.

Dr. Matt Haney: Yes, OCP, combined oral contraceptive plus smoking is about a 20 times relative risk, but then the absolute risk is becoming clinically significant at that point.

Dr. Barbara Cockrill: Great. We got three minutes left. I told you, we may not get to number six, but intravenous saline is administered, her blood pressure increases to 104/64, and her heart rate decreases to 98. She appears much more comfortable and anticoagulation is started. She came in-- What happened on the descent, you think? Let's just do this as a group. She was kind of hanging out, she was short of breath, and then she got really short of breath all of a sudden.

[background conversation]

Speaker 21: She could have had another clot.

Dr. Barbara Cockrill: Yes, that's exactly right. Another clot, that's the clot you worry about because the one that's already in the lungs is not the-- by definition, someone's already lived through it. It's the other clot hanging out, down in their leg waiting to land in the lungs. That's why as you brought up starting anticoagulation before you have the diagnosis is often appropriate in someone that you're worried about.

The way this is written, we're supposed to think that she had an acute large pulmonary embolism causing increased RV afterload. She got more tachycardic, she's trying to increase her cardiac output. The case was written that she was a little dehydrated. Remember she didn't eat dinner, she didn't have breakfast. What would dehydration do to your RV? Right ventricular preload.

Students: Decrease.

Dr. Barbara Cockrill: Decrease. This is written to save us from having to think about lysing her because she got better just by giving her saline. She was a little dehydrated, she had increased RV afterload. Then we give her a little saline, blood pressure comes up, she's feeling better. Connor.

Connor: Thinking about coagulation, the fibrin stabilizes clots right?. Is there a risk if she's got a DVT that's maybe a little unstable? We've seen that it thrown off a clot already and then you anticoagulate her, and so prevent more fibrin from binding onto those platelets. Is there a risk that she throws off more clots with that?

Dr. Barbara Cockrill: There's definitely a risk that she's going to throw off more clot. Go ahead, Matt.

Dr. Matt Haney: Really, the goal of anticoagulation in that setting is to prevent the clot from getting bigger, so, extension. You tip the balance to allow the natural anticoagulants or really the natural thrombolytics to actually reduce the size of that clot over time. You're generally not going to actually-- It's going to be still a soft clot sort of gooey. It's not going to be mature, fully formed, and have a huge amount of crosslink fibrin it. There's some risk I suppose.

We think about this more when we often will see you on imaging a clot that literally in ultrasound you can see doing this in the venous flow. They go, "What if I give some anticoagulant?" and it actually starts working on the stock and then you shoot off the whole thing. We worry about that a lot, but for the most part, it really not going to change what you do from that point.

The other thing, there's always a temptation just from a layperson is, "Hang on, I've got a big Goomba in my lung. I want Dr. Mayer to go in and scoop it out, get that thing out of me." In reality, the risk of doing that or the risk of thrombolysis has significant risks. For the most part, unless you're really an extremist, like an obstructive shock picture like she was headed towards, you're really just going to use regular anticoagulation and hope that the body's-- You tip the balance in the favor of natural thrombolysis.

Dr. Barbara Cockrill: Just to finish up, let's go through this last question. A PE protocal chest CT scan confirms multiple large bilateral pulmonary emboli with some evidence of right heart strain. A table over here asked about EKG findings and in the acute big pulmonary embolism, what did you guys ask about?

Speaker 15: Asked about EKG findings because I think you can see this thing called S1, Q3, T3 where you have like a depression of an S wave in lead one, Q wave in lead three, and some type of T wave in lead three as well.

Dr. Barbara Cockrill: I don't want us to obsess about it, but what it's telling you is it's a sign of right-heart strain. In a patient who has a big increase in RV afterload, you can have right heart strain. Let's talk about, how do the size of the pulmonary emboli in the patient's underlying cardiopulmonary reserve interact to determine that clinical presentation? If you have a small PE and good reserve, you're going to be okay and hemodynamically stable. We anticoagulate you, we're good.

You have a big, big, PE plus or minus poor reserve, you can have essentially cardiogenic shock. This is what we were trying to get you to think about when she was on the decent, she had a big PE, heart rate goes up, her blood pressure goes down. Luckily, part of that was that she was dehydrated. In these patients, it can be someone with perfectly normal heart and lung. If they have a big enough PE, it can cause sudden death. That's one that where you think about doing something major like giving him lytic therapy.

Dr. Mayer: Just to keep in mind, why would that patient who is otherwise normal not tolerate this very well. It's because the right ventricle is all of a sudden subjected to a lot more wall stress. Pressure goes up in the main pulmonary artery, which means it's going to go up in the right ventricle. You have a non-hypertrophied right ventricle, it can't stand the increase in wall stress, and it will fail.

It's because of the inherent, what you're coming into this event with, which is a right ventricle that's poorly adapted to stand an acute increase in afterload. If that patient had had repaired Tetralogy of Fallot and still had a relatively hypertrophied right ventricle, then they could stand it a lot better. It's all about Laplace again.

Dr. Barbara Cockrill: The last type is when you have someone that just comes in with unexplained shortness of breath, sometimes they have no symptoms. Actually, sometimes patients have no symptoms, and the diagnosis is made fortuitously. About 70% of patients will come in with shortness of breath. All those other things that we always talk about like hemoptysis, that's not that many, it's about 13% of patients. It's really important for you to think about this diagnosis. It's probably one of the ones that is at least in my line of work is associated with lawsuits because people don't think about it, the symptoms are so nonspecific.

Dr. Matt Haney: I bet in the Brigham ER, there's probably five or six a day. This is something bread and butter for internal medicine.

Dr. Barbara Cockrill: Right. Big PE is probably one or two, maybe five a week, and they always seem to come in at 3:00 in the morning. We didn't talk about treatment, we'll send you out the slides. Thank you for all your participation and have a great weekend. Thanks everybody. Thanks to our other people.

?Connor: I hope they get the applause on tape.

Dr. Barbara Cockrill: Yes, I know.