



**BBGuy Essentials 068:
Transfusion in Cardiac Surgery with Pierre Tibi
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Pierre: Hi! My name is Pierre Tibi, and this is Blood Bank Guy Essentials Podcast.

Joe: Hey everyone, welcome to Blood Bank Guy Essentials, the podcast made to help you learn the essentials of Transfusion Medicine. Today's episode is another in a series that I've been doing on occasion regarding transfusion in specific clinical situations. I talked to a practicing cardiothoracic surgeon whose name is Dr. Pierre Tibi about transfusion and blood management in cardiac surgery, and I am really excited for you to hear this interview!

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You know, cardiac surgery can be a very, very big deal for us in blood bank world. I think most of us that work in Transfusion Medicine are very well aware of the fact that patients undergoing open heart surgeries can require incredibly large amounts of blood in very short time-frames. But at the same time, it's undeniably true, in fact, the research shows this clearly, that transfusion practice varies widely, and sometimes "wildly," I guess I would say, not only between individual cardiac surgeons, but also individual hospitals. So I wanted to explore that topic and really a lot more with Dr. Tibi.

Dr. Pierre Tibi, my guest today, is a board-certified cardiothoracic surgeon who is president of Phoenix Cardiac Surgery, and he's also the chair of Cardiovascular Surgery at Yavapai Regional Medical Center in Prescott, Arizona. Pierre has over 20 years experience in cardiac surgery, and he also has a very long-standing interest in patient blood management, which, I guess I would say, is a little unusual among cardiac surgeons! He's had a hand in developing PBM programs throughout Arizona. In fact, his interest in patient blood management is so strong that he is actually the current president of the Society for the Advancement of Blood Management, or "SABM" (and you're probably familiar with SABM if you've listened to this podcast before). Pierre has lots of thoughts and opinions on how to understand and improve transfusion practice in cardiac surgery, and I'm SO excited for you to hear what he has to say.

I think that you're going to come out of this interview not only better informed on what's happening in the OR during open-heart surgery (that is incredibly important), but I think you'll also understand how we can work with cardiac



surgeons to improve transfusion care for our patients. So here's my interview with Dr. Pierre Tibi on "Transfusion in Cardiac Surgery."

Joe: Hey, Pierre, welcome to the Blood Bank Guy Essentials Podcast!

Pierre: Hey, Joe. Glad to be here. Thank you.

Joe: Thank you so much for doing this. I'm really just incredibly honored to have you here, for a lot of reasons. First, I looked the other day, and I was like, "Wait a second, a cardiac surgeon is the president of the Society for the Advancement of Blood Management?" That is kind of an amazing thing to me. I'm really curious. How did you in particular get interested in patient blood management? What is it that led you to the scenario where you're now president of a large international organization for blood management?

Pierre: Well, Joe, that's an interesting story. It actually happened maybe 25 years ago, when I was a brand new attending in Phoenix, Arizona. And one day I was approached by a Witness, a Jehovah Witness, who obviously wanted to have surgery without blood. And he came up to me, and he said, "I've been to three heart surgeons. None of them will operate on me if I don't agree to take blood. Will you operate on me?" And I said, "Sure." And really, it was not out of altruism. I really needed the work. I was brand new.

So following that, I had to figure out, "Okay, how do I operate on this patient with the least chance of have a negative outcome due to lack of blood?" Because at the time, open-heart surgery, 50 to 80% of patients were being transfused. So I went ahead and operated on him, and fortunately, he did well. And I did those obvious things, like make sure you don't lose a lot of blood, be very meticulous. And he did great. And I ended up getting more and more no-blood patients.

After about three or four years, I started to have a hint to myself that, "Gee, I think my non-blood patients are doing better than my patients that receive blood." At that time we actually did a coordinated study. It was a retrospective study, obviously. But in fact, my patients who did not receive blood were doing better, by far, than patients that received blood. And sure, you could say, "Well, we were being a little bit more careful," or what have you, but nevertheless I thought we were onto something. At the same time, throughout the country and the world, people were starting to look at patient blood management, as well as the effects of blood transfusions, and their findings correlated with my findings as well.

So really, it was 15, 20 years ago that I got serious about looking at things that we can do to further decrease the possibility of the use of blood in open-heart surgery. Got involved with some people with the same ideas, and joined the Society for the Advancement of Blood Management, and I guess they couldn't find anybody else to be president, so here I am.

- Joe:** Oh, don't sell yourself short, sir. That's terrific. I wonder how you would characterize how things maybe have changed in your medical community, in the cardiac surgery community, if they have changed. Either on a national level, at the society level, or locally, I think there is data to support the fact that over the years there's been pretty variable practice in regards to transfusion in the cardiac surgery community. I'm not telling stories on you; everyone's well aware of that. But how would you characterize how things have changed? Do you think things have changed?
- Pierre:** Absolutely. I think that blood transfusions, to heart surgeons back 15, 20 years ago, was nothing more complicated than filling up your car with oil when it was a quart low. And that's not the way it is. It has become more and more present in the literature. And cardiac surgeons, who I think unfortunately are one of the last ones to try to limit the use of blood in open-heart surgery, are finally realizing, actually ... since maybe the mid-2000s, with the publication of the Society of Thoracic Surgery guidelines for blood management, I think heart surgeons are now realizing that blood may not be necessary, and even may be harmful in situations which it is not absolutely necessary, can increase your post-operative morbidity, can increase your mortality, can increase your length in stay, increases the cost of the hospitalization.
- So I think that now it is much much more at the forefront in the minds of cardiac surgeons, in what we do to limit the use of post-operative blood. As you know, Dr. Art Bracey published ... and this was at least 10 or 15 years ago. He published an article that looked at multiple institutions, not only in the US but around the world, where they looked at use of blood in open-heart surgery. And believe it or not, the rate of transfusion for primary open-heart surgery varied from 9% to 100%. Some institutions, every single patient was getting at least a unit of blood. It was also similar for FFP and platelets.
- So when you look at that kind of variation in utilization of a particular therapy, at the very least, you might say, "Well, there are no clear guidelines." But really, I don't think, back then, we had any idea ... we knew what we were doing and when blood was necessary and when blood was not necessary.
- Joe:** Wow. That's ... it's very good to hear that there has been a new focus on it. I think my perspective, as a blood banker, my career started back in the 90s, and my first experience with heart surgeons was at the dearly ... well, dearly departed as it used to be, Walter Reed Army Medical Center in D.C. And the cardiac surgeons there were incredibly focused on minimizing transfusion as much as possible. They had early versions of TEG machines. They were really really focused on it.
- And then, when I got out of the military, I was somewhat stunned to see exactly what you were describing, that Art described in his paper, that there was incredibly wide variation. So what would you attribute, Pierre, the change in focus to? Do you think it's seeing PBM, patient blood management, become a big issue in other parts of the hospital, or do you think it's just ... I guess are there more outcome

studies, such as what you described for your patients, that has led cardiac surgery to be more focused on it?

Pierre: Right. Well, I think it's multi-factorial. I think there's so much more publications in the last ten years that, at the very least, say that if you use less blood it is not inferior, and probably better than if you use more blood in open-heart surgery. I think the eye that is being put on results among various institutions, among various surgeons, becomes a great impetus for surgeons to do whatever they can to improve their results. With the focus on the cost of healthcare, when you think about ... most studies say that when you add the direct and indirect costs of a unit of blood, it comes out to about 1,000 to \$1,500 per unit of blood. And the first three units of blood in cardiac surgery are not reimbursed under the DRG. So therefore, three units of blood in an open-heart patient, and they take away the entire cost benefit of an open-heart operation for a particular hospital.

So all of those things, quality, cost, and just following recommendations, has become extremely important. And proper patient blood management is one of the very important ways that we can achieve better results at lower cost.

You know, when we talk about blood transfusion, a lot of this ... or when blood transfusions are applied, a lot of it is non-evidence based. We have infectious risks, we have immunological risks, and we have risks that ... most of the risks that we don't really know about. Pathogens that we're not fully aware of. We have an immunomodulation when we give blood, that could cause a hyper or inflammatory response, and/or compensatory anti-inflammatory response. It's important for blood bankers to know, and I'm sure that all the blood bankers know, but that stored blood is not the same as fresh blood, with multiple what we call storage lesions, et cetera.

So when we take a patient to surgery, obviously surgery, with or without blood, has a stress on the overall homeopathic state of the body. Obviously, giving a foreign substance, such as blood, must have a stress to the homeostasis of the body as well. So here we are combining the stress of surgery with the stress of foreign break-down, during a time when the body can have a decreased defense. And this is where we think that morbidity, mortality, or break-down or organ systems may occur.

So with those important things in mind, it makes sense that we should try to limit, if not eliminate, the use of blood in any kind of operation. But like I said, because of cardiac surgery ... I consider cardiac surgery the poster-child of patient blood management. And why do I say that? It's because these patients are usually older and sicker, that we are now taking their blood and we ... first of all, many of these patients are on blood-thinners to begin with, which can promote blood-loss. Then we take these patients, we put them in a cold operating room, and we put them on a heart-lung machine. And we dilute the amount of blood, because we have to fill the heart-lung machine with *something*. The blood goes through the heart-lung machine and it causes a break-down of coagulation factors, as well as red cells. We cool patients. We're anticoagulating them so that the blood does not clot while

on bypass. And then we're operating on this big bag of blood, where there's blood everywhere, and there's a significant amount of blood loss.

So you can imagine that heart surgery, why I call it the poster-child, is if patient blood management is going to cause effects, it will probably cause the greatest effects in the greatest need, in open-heart surgery.

Joe: Well, I want to circle back around at the end, Pierre, to talk about a couple of recent studies that have been published, and just kind of get your general thoughts, because there's a little bit of back and forth on some of those studies. But we'll talk about that in a moment. But I wonder if now, if we could just kind of ... well, let me put it this way. We've got a large audience here of blood bankers and those who are learning transfusion medicine. And in my world, I would suggest to you, that many of us don't have a great idea of everything that you're doing in the operating room. So I wonder if we could just kind of take an overview, and just have you describe, just generally to us first, the main types of surgery that people in your profession perform. What are the general operations that you guys do? And we'll focus in on some of them in just a moment. Go ahead.

Pierre: I would say 80% of our operations are usually coronary artery bypass grafting or aortic and/or mitral valve replacements. And then there's a smaller percentage of other procedures that have to do with the pericardium, the lungs, the esophagus, et cetera. The open-heart procedures are really the procedures where we often have to rely on blood transfusions, sometimes, as necessary. We, in our institution here in Prescott, we do not do ECMO or transplants, but our group does it in our institutions in Phoenix. So those are mainly the types of procedures that we perform in cardiac surgery.

Joe: So Pierre, with that said, I wonder if you would just take us through, for those that are trying to learn and aren't really sure of all the details of what you're connecting to what, can you give us the overview of cardiac bypass? You talked about the heart-lung machine a few moments ago. What gets connected to what? How does that all fit together?

Pierre: The whole gist of cardiopulmonary bypass is to, obviously, bypass the heart and lungs. So that we can turn off the lungs, that we can stop the heart, we can open the heart, expose it to air, and work on ... oftentimes if we're in the heart, we're working on the aortic valve or the mitral valve. But certainly we're needing to stop the heart for bypass surgery so that we can sew a vein or an artery to these very small arteries, possibly two, three millimeters in diameter.

First of all, we have to anticoagulate the patient, so that when the blood is going through the heart-lung machine it doesn't clot the heart-lung machine. So we have to "over-anti-coagulate" the patient, basically. We take a tube and we put it into the right atrium, which will take out the deoxygenated blood from the heart, and it goes through a cardiopulmonary bypass machine. And that's basically a roller, or centrifugal pump, that pumps blood through. And it pumps it to something called a membrane oxygenator, which oxygenates the blood.

So here we've got the pump that's taking over the function of the heart, we've got the oxygenator that's taking over the function of the lungs. And then we pump the blood back into a tube that we put into the aorta. So all the blood going into the heart goes into the right atrium, we've taken that out. All the blood that normally goes out of the heart goes to the aorta, and we're putting it back in. So that way we can completely stop the lungs, keep the patient alive with a heart stopped and the lungs not ventilating.

- Joe:** Got it. You talked about the fact that these patients are over-anti-coagulated. I believe that's the phrase that you used. And it certainly makes sense that you wouldn't want the blood to clot in the machine. Is that generally Heparin, Pierre, or other modern alternatives to that, or is it generally Heparin?
- Pierre:** No, it's 99% of the time it's Heparin, unless the patient is resistant to Heparin or has previous Heparin-induced thrombocytopenia, at which [crosstalk 00:18:18] we could use other drugs, such as Argatroban.
- Joe:** Got it. Okay. So one question about that. And I've heard blood bankers say this very thing. So the patient is Heparinized when they're on the table, and I have heard blood bankers say, "Well, I don't know how they know how anticoagulated they are, because they haven't sent any labs to our clinical labs." So I hope ... well, I'm leading you down a path. I think you know where I'm going. Can you talk to us about you guys monitor anticoagulation status in the OR?
- Pierre:** Sure. One way to monitor is as long as there's no clot in the heart-lung machine, that's good! But that's not a very accurate way of monitoring. Most places will go by ACT, or Activated Clotting Time. We will give enough Heparin to bring the ACT to over 400. So like I said, when you're looking at PTT and so forth ... we give probably four or five more times Heparin that you would normally give if you wanted to anticoagulate a patient for other issues.
- Joe:** Right. And just to be clear, Pierre, that's in the OR generally. Is that correct? The ACT machine?
- Pierre:** Correct. Oh yeah. It's a point of care machine that's in the OR and can be run within a matter of three to four hundred seconds, obviously. Then there's other machines. I don't want to get into the trade names and all that. But there are point of care machines that tell us just how anticoagulated a patient is. And also, by that same token, when we're done with surgery, we want blood to clot, otherwise the patient would completely bleed. So we use those same point of care machines to assess the adequacy or our reversal of Heparin.
- Now, there are other things, other than residual Heparin, for a patient that can bleed. And we can talk to this, as far as the operative PBM care.
- Joe:** You bet. Okay, absolutely. We'll get to that in just a few minutes. I want to talk a little bit more about what you mentioned earlier, about the effects of the bypass machine, the heart-lung machine, on the coagulation status of the patient. In particular, you mentioned the break-down of coagulation factors, the potential

break-down of red cells, and one of the other things that I think you mentioned but is certainly a large issue, is the effect on platelets. Maybe we could start with platelets. What's your assessment of how platelets are impacted when the patient is on bypass?

Pierre: Sure. Well, let me back up a bit, and say that platelets are usually impacted even before we ever get to surgery. So many patients now are on antiplatelet drugs, or anticlotting medicines, Xa inhibitors, et cetera. 70 to 80%. And before we even take a patient to surgery, it is paramount in patient blood management to assess the degree of anticoagulation of a patient's body. Patients who are on platelet inhibitors, such as Clopidogrel, need to be assessed pre-operatively. And we do have point of care systems that will tell us exactly how inhibited platelets are or non-inhibited.

So we, before surgery, want to make sure that we know all of the drugs that a patient's on, especially those that can affect the platelets, or the clotting system. And we want to make sure that one, it's reversed, if we have the luxury of time, and two, wait for it either to be out of the system, or if we have the option of reversing whatever has anticoagulated the patient. Because if you take those patients to surgery, they WILL bleed.

Platelets have, obviously, a very important job in helping blood to clot. And unfortunately, platelets do start to stick to various components of the heart-lung machine, et cetera. One of the things that we utilize to preserve our clotting factors in our platelets during surgery is something called ANH, or "acute normovolemic hemodilution." That is a practice where we take off a unit or two of blood from the patient before they're anticoagulated, and we keep it in a citrated bag so that it doesn't clot, on a rocker panel. And then we do our surgery, and then once we've come off of bypass and closing up, we give that blood back.

Now people may say, "Well, why would you take blood off if you're just going to give it back? That doesn't make any sense." But actually, it DOES make sense, because one of the things that it does is prevent the blood from going through the negative impact that the heart-lung machine has on the blood itself. So when we give this blood back, not only do we have all of the factors, all of the platelets, all of the blood, all of the red cells, but they are fresh whole blood transfusion that is not affected by prolonged storage lesion, and is not affected by the negative aspects of cardiopulmonary bypass.

Joe: If there's one thing in my experience that I would say, that I've never met a surgeon who doesn't love the idea of fresh whole blood!

Pierre: Yeah. But it's even better when it's the patient's own.

Joe: You're exactly right. I'm curious, Pierre, do you have an idea of how widespread the use of acute normovolemic hemodilution is? Because I love it. It's been something that we've talked about for a long time. I just don't know if you're aware of how widespread it's become.

- Pierre:** I think for numerous reasons it's not as widespread as it should be, because I love it as well. I think it makes a huge difference. And I think the reasons for that is one, it is somewhat labor-intensive. Two, it does slow down the anesthesia and the cut time. Three, there are not clear guidelines, which we're working on, to establish clear guidelines of how to do it. How much blood to take off, what to support the patient with, are all patients a candidate for this, or let's say if a patient has severe aortic stenosis, or left main disease, or an emergency situation, should we not do this? So I think it's numerous reasons why it's not more wholly utilized. But it is, I think, a fantastic, cheap, and effective technique.
- Joe:** Yes. Okay. Well, so I got a little sidetracked, because you talked about ANH and my pulse rate went up because I was so happy to hear you talk about it. But back to the bypass process, one of the things that blood banks often hear are statements that "the patient is coming off bypass." And I wonder if you would help us understand why that's an important moment, and what happens as that's occurring and after that's occurring, that either puts a patient at more risk of bleeding, or maybe doesn't. I don't know. I wonder if you could describe that process for us.
- Pierre:** Sure. You know, I'm not sure that there's a specific reason, other than it's ... once a patient is off bypass, usually the problem has been dealt with, the patient is bypassed, the valve is in, et cetera, we're getting ready to close. So it's basically an important landmark in the whole of surgery. Blood may be needed. As far as blood bankers are concerned, blood may be needed even while on bypass, because although we dilute the patient significantly on bypass, if we dilute them too much, then we start seeing some negative aspects, specifically in the neurological realm. So patients may sometimes need blood transfusions while they're on bypass. One thing that I hope nobody in blood banking, or anybody in medicine, mistakes, is that most avid patient blood management people are not against blood transfusions. Blood transfusions can be part of a life-saving treatment of a patient, especially a hemorrhaging patient. But **UNNECESSARY** blood transfusions is what the impetus of patient blood management is.
- So, patients may need blood while on bypass, as well as they may need after bypass. Once again, once you're off bypass, remember, we were anticoagulated, now you have a whole bunch of cuts and nicks in a bag of blood, so that's the time that we'll usually assess a patient for not only bleeding from ... surgical bleeding, but coagulopathic bleeding. So "off bypass" would mean this is the time that we are looking very carefully at any source of bleeding, from any type of situation. So if it's surgical bleeding, that's significant. It's possible we might need blood right away. If it's a coagulopathic bleeding, it's possible we may need some factors, platelets, what have you.
- Joe:** Sure. I want to just step back for just a second. And we're talking, of course, about transfusion in cardiac surgery, with an emphasis on patient blood management in cardiac surgery. And from my perspective, it seems like we could fairly neatly divide these into pre-operative steps to optimize transfusion, intra-operative steps to optimize transfusion, and post-operative steps. So I wonder if we can, again,

step back for just a second. And you've already talked about some of this, with the platelet-inhibiting drugs. Is there anything else that you can do prior to a patient undergoing surgery, that could potentially optimize their transfusion status?

Pierre: Absolutely. So let me talk about pre-operative first. Pre-operative evaluation of the patient is probably one of the most important things that you can do, because there is nothing that predicts the use of having to use blood in a post-operative setting, intra or post-operative setting, than pre-operative anemia. So patients who are ... and that makes sense. You go in low, you're going to come out lower. So assessment of the patient pre-operatively, especially in view of their hematocrit and hemoglobin, is extremely important. So if they are anemic, and if it's not an emergency surgery, then usually we have time to improve the patient's anemia before surgery. And that requires treating a patient with erythropoietic enhancing agents, stimulating agents, as well as intravenous iron. Oral iron is not a good treatment because of numerous issues, but especially because it's quite slow.

So many ... all of our patients who come pre-operatively and are anemic are treated with intravenous iron and ESAs, until we are happy with where their hematocrit and hemoglobin stands. Obviously I mentioned about a careful assessment of anticoagulant drugs that they may be on. And patients with other comorbidities are going to be more likely to have issues with bleeding, especially patients with hematologic issues.

All of this needs to be weighed against the urgency and the complexity of an operation. For example, a patient who is going to have hypothermic arrest is going to be much more likely to bleed, and therefore will require a greater pre-operative treatment than those who haven't. So we talked about that.

Intra-operatively, obviously, I can't state enough that the most important thing in good patient blood management, and patients undergoing heart surgery, is to have a careful and meticulous surgeon. And fortunately or unfortunately, there's no good way of assessing that. You're not going to have a prospective randomized study of bloody surgeons versus non-bloody surgeons. That ain't going to happen. But that is the most important thing, in my mind. But there are lots of things that we do intra-operatively to help us with patient blood management.

One, I mentioned briefly that we have to fill the heart-lung machine with some kind of volume. And therefore that will, right off the bat, dilute a patient's hematocrit. Well, if you are able to back-bleed the patient and remove as much volume as you can, i.e. filling the heart-lung machine with as much of the patient's own blood as they'll tolerate ... and that's called "retrograde autologous perfusion." Obviously the size of the heart-lung machine, and the amount of tubing, etc...bigger machines and longer tubing will require more RAP, or retrograde autologous perfusion, than what we call "mini-circuits." So mini-circuits are a good way of decreasing the amount of hemodilution that we use in heart surgery.

We talked about intra-operative autologous donation, that's IAD, (it's other name is ANH, acute normovolemic hemodilution), we talked about accurate heparin

management. There are things that ... we can treat specific areas of bleeding with topical hemostatic agents, and there are numerous. My only caveat to that, there's probably about 40 or 50 topical hemostatic agents on the market, and it's important to know that some work in very different ways than others, and indications for some are very different than others. So one hemostatic agent doesn't take care of all bleeding.

We can also, in the realm of hemostatic agents, we can actually (and we do this as well), we take about 40 or 50cc of the patient's own blood, and we spin it down in the centrifuge. And that gives us two products: "Platelet-poor plasma" and "platelet-rich plasma." Both of these are somewhat hemostatic. The platelet-rich plasma is not only hemostatic, but it's very vasoconstrictive, which also helps with hemostasis. So we can use that, as opposed to topical hemostatic agents, and it's somewhat cheaper, a patient's own blood, etc.

Another option intra-operatively is antifibrinolytics, such as Amicar or Tranexamic Acid. And we give it routinely intravenously, as well as topically. And that should decrease the incidence of fibrinolysis in the operative wound, so that patients bleed less post-operatively.

So those are just a few of the multi-modality way of applying patient blood management to open-heart surgery.

Joe: Couple of quick questions on that, Pierre. Your statement about the use of platelet-rich plasma surprised me. Not because I'm opposed to it, just because I wasn't aware that was ... you surprised me there. That was new for me. Is that something, again ... do you have a perspective on if that's fairly widespread, or is that unique to your practice? What's your feeling on that?

Pierre: It's not necessarily unique, but it's not widespread either. A lot of times what we do in surgery comes from a long amount of years and years of experience. And I've had a couple ... in fact, in the early episodes ... so we take down the mammary artery to bypass usually the left anterior descending artery on the heart. It's one of the bypasses. It's an artery that comes from the chest wall, and it provides a rough surface in the operative field. I had a couple of incidences, a long time ago, where even though you either coagulated or clipped the branches of this mammary artery, it still was a raw surface, and once or twice post-operatively a coagulated branch would open, or a clip would come off.

So what I did is I decided to use a hemostatic agent on top of this raw surface. But hemostatic agents are quite expensive. And PRP and PPP, is something, like I said, that has some of the same properties of hemostatic agent. And I've never had bleeding from that raw surface ever since I started doing that and I went to that. Now other people are using it, and they use it, as you probably know, in joints, because in addition to the vasoconstrictive and hemostatic agents, it has growth factors in it. So I use that in the chest, on the sternum, as well, because it might improve the healing of the sternum.

And believe it or not, some of the people in the aesthetics industry take it and use it and inject it into the face of women. It's called a "vampire facial." I have no idea why anybody would do that, but ... and I'm not sure what-

Joe: It doesn't sound appealing, does it?

Pierre: No, it does not!

Joe: So thank you for that. My second question is regarding the use of antifibrinolytics like Tranexamic acid and Amicar, as you mentioned. Is that, in your view, more widespread in the cardio surgery community?

Pierre: It is widespread. I would say it's pretty much ... hopefully everybody uses it, because it is a ... so the STS, the Society of Thoracic Surgery, in 2007, came out with their clinical guidelines. They were updated in 2011, and actually we are ... I'm on the committee to help update them for 2019, hopefully. And antifibrinolytic agents, intravenously, is a class 1A indication.

Joe: Got it. Okay. So what about post-operative patient blood management, Pierre? What kind of things are you looking at there, and what kind of things can you do to optimize transfusion?

Pierre: Hopefully post-operative patient blood management is quite simple, because if everything's gone well so far, you're not bleeding post-operatively. And other than common sense things, such as not drawing too much blood, not wasting blood on daily blood draws or using small tubes, etc. One of the important factors, though, is that in past, when I was in medical school, we were told that if a patient's hematocrit is less than 30, then you have to transfuse not only one, but two units of blood. Because the thing is, if you're going to give one, you might as well give two. And now, it's "Why give two when one will do?" So things have changed.

Joe: Dramatically.

Pierre: And transfusion triggers are important, but they're not the end all and be all. You have to evaluate the patient as far as their hemodynamic status, etc. Meaning if they are normotensive, if they are not tachycardic, and if they are perfusing well and making urine and so forth, and their hemoglobin is 6.5, I'm not sure that I would, if it was me, I would want a blood transfusion. Because I know within several days, especially if treated ... and you can continue to treat with post-operative EPO and iron, but I know within several days I'm going to be making my own blood, and I will not have needed that blood transfusion.

Now, one scenario I would like to mention, if you don't mind, is that ... let's say I operated on one of your loved ones. And I come out after an operation, and I say, "Everything's fine, he just needs a few units of blood." Patients' families, or the lay public, believes that transfusion is an effective therapeutic treatment. That, "Oh, he just had heart surgery, it's not unusual for him to require blood." Because the risk of transfusion, I think, to the lay public, is considered small.

Whereas if I come out and say, "Patient's bleeding a little bit. We need to take him back to surgery to make sure that he's not bleeding from anything surgical," at that time, patient's family will look at you and start thinking, "Oh my God, they missed something, they did something wrong, they didn't do it right the first time, etc." Because re-operation is considered an undesirable outcome, and the risk is presumed great. But in fact, I can tell you first-hand evidence that taking a patient back in a post-operative period because there is more bleeding than expected, and you cannot prove a coagulopathy, is the absolute appropriate thing to do, and certainly less risky than just continuing to treat surgical bleeding with transfusions and hoping it's going to stop, and taking the risk of something like a tamponade, where the blood continues to bleed and presses on the heart and cause the patient's demise.

Joe: Well, I can tell you, Pierre, that my Transfusion Medicine colleagues all around the world listening to this right now are cheering that last statement! Because that's something that we've all dealt with. And I think that's a very appropriate way to look at it.

I do want to ask you, when we're talking about transfusion triggers and thresholds, I think that might be a nice transition, Pierre, to talking about a couple of studies that have come out in the last few years, one of which that just came out in 2019. Just to kind of get your take on it. And I hear what you're saying, that a threshold is a threshold, but patients are patients, and patients need to be evaluated. I completely agree with that.

But at the same time, when we're doing prospective studies, we have to kind of figure out ways to do that. And the studies that I'm talking about, I'm sure you're aware, the first was published in the New England Journal of Medicine in March, 2015. It was called the "TITRe2" study, Liberal or Restrictive Transfusion After Cardiac Surgery, Murphy was the lead author.

And then the more recent one was Dr. Mazer's article published, also in New England Journal of Medicine, earlier this year, in 2019, Six-Month Outcomes After Restrictive or Liberal Transfusion for Cardiac Surgery. That followed up a 2018 one. That was the "TRICS III" study. People have said, "Gee, these studies seem to show slightly different things." The TITRe2 didn't show much of a benefit for a restrictive threshold, or in other words, waiting until the patient get lower to transfuse, whereas the TRICS III studies did seem to show a benefit. So I wondered if I could just get your take on those articles, and they have impacted you.

Pierre: Sure. Well, having been a proponent of patient blood management, and doing everything that I can, and even spending some money in patients, taking care of them to decrease the use of blood utilization, and a few times an article like these come up, I'm presented the article and say, "See, well, everything you're doing is silly." But you have to look at the studies in detail. And I can show you a video of ... a photo video micrograph, I don't know if you've ever seen this one. It was done in Germany. And it will show you that blood cells ... the flow of blood in the capillaries

in patients who are severely anemic, although it's sparse, they flow freely and gently. And once you give blood to this, and you look at the microcirculation, the red cells are inflamed, the microcirculation is edematous, and the flow of blood is extremely poor. Nevertheless. That's just a qualitative picture.

But getting back to these studies, first and foremost, if there is no non-inferiority of the restrictive versus a liberal scenario, why give blood? And more importantly, you have to look at these studies carefully. For example, in the TITRe2 study ... first of all, the triggers were extremely close. 9 versus 7.5. There was severe nonadherence. There was a pre-surgery transfusion rate of 25%. But most importantly, they had a rate of transfusion of over 50% in the restrictive group. And a 92% in the liberal group. So I have to say that patient ... we're just looking at small differences in something that is so overly transfused. I mean, average transfusion rate for open-heart surgery in the United States today is in the 30 to 40% range. Our transfusion rate at my institution has, for the last five years, been less than 10%. And I'm not just talking first time open-hearts. I am talking all comers, including redo operations, including dissections, etc.

If you look at the TRICS III study, low-risk patients weren't included. There's a possibility of the lower thresholds being effective, but it really didn't show any efficacy of transfusion. So these are two or three studies that show non-inferiority of a liberal transfusion, whereas there are dozens, if not hundreds, of studies that tend to show the opposite.

Like I said, first and foremost, why use this precious commodity if you don't need it? If it doesn't improve your situation? Secondly, when you look at blood transfusion, you're looking at a transplantation of a liquid organ. There are immunological changes, no doubt about it. No one will debate that, that there are immunological changes that occur. And believe it or not, they have done studies where they have looked at the genetics of blood in patients who have had transfusions, and you can still find genetic residue of transfused blood mixed in with the patient's own genetic.

Joe: Wow.

Pierre: It's not a small thing. Like I said, like I always say, "Blood is not oil!" It's not like filling your oil tank because you're a quart low. There are things to consider. And if you're not clearly producing a benefit, then there's no reason to transfuse for non-inferiority.

Joe: Got it. Thank you for taking that on. I really appreciate that. So, Pierre, I wonder if, before I give you the chance to get on your soap box and talk to us in my audience, the blood bankers of the world, I wonder if I could just take you through a couple of real quick scenarios that we sometimes deal with in blood bank world, or we hear things from heart surgeons that sometimes gives us pause. So I wonder if you could just ... again, if I hit you with a couple of these scenarios and maybe just get your quick impressions. We don't have to go into great detail.

And the first is this: I think this has been pretty thoroughly debunked, but I still get emails from blood bankers who say that their heart surgeon in their institution insists on transfusing patients platelets and plasma prophylactically prior to cardiac surgery, because of the impending coagulopathy that's going to occur from the bypass machine. Again, I think that that's been debunked, but what's your perspective on that?

Pierre: Believe it or not, people still do that. And I hired a guy once, first case, watching him operate, and all of a sudden, I see the anesthesiologist hang two of FFP and platelets, and I'm like, "What's going on?" And he said, "Yeah, your junior guy says he does this on every case." And that was the last time he did it on every case. But it is. It's pure ... I mean, the proof is ... like I said, I operate on hundreds of patients a year, and my transfusion rate is less than 10%, and I don't use prophylactic platelets and FFP. If you look at surgeons who use prophylactic platelets and FFP, and I would imagine their transfusion rate's higher. So you really don't need it.

Joe: You would think so, yeah. The second question is in regards to re-operations. And we in the blood bank have a tendency to cringe when we see a patient who's on the schedule, and it'll say "redo cardiac bypass," "redo CABG," for example. So what is it that makes that so much worse? And does it have to be worse for you guys?

Pierre: Well, by definition, a redo will tend to be bloodier than a non-redo, simply because there's significant adhesions, the operation is more difficult, patients tend to be older for their redo. Patients that are having redos have had this before and tend to be older. The planes sometimes are good and sometimes are not good, and you get into the heart, and, God forbid, when you open the chest, you can easily cut into the right ventricle, or cut into a patent vessel, because it tends to be right under the sternum. And that's when you need blood. That's what I call "Audible bleeding." That's what I call, sometimes, audible bleeding, is when you get into that ... you need a lot of blood in a very quick way, and a way to transfuse it.

Nevertheless, having said all that, redo operations can be dealt with just as well as every operation, with good pre-, intra-, and post-operative patient blood management techniques. And once again, like I said, our transfusion rate in the last five years of less than 10% is not just for routine first-time operations, but that includes redos. So I understand the cringing. We cringe sometimes when we open the chest to make ... because that's our greatest concern, that we get into bleeding that we can't quickly arrest. But other than that, redos tend to be relatively blood-transfusion-free, if you follow things and you have a good surgeon, you have a little luck.

Joe: There you go. So the last one I want to hit you with, Pierre, is something that you alluded to a little bit earlier when you were talking about pre-operative management of patients who are on platelet-inhibiting drugs, such as Clopidogrel, such as even Aspirin. So you had mentioned that, in a perfect world, you would like to give them the opportunity to clear that from their system. And I know there

are variations in how long that takes. We won't take the time to go into that. But if I remember right, I think for Clopidogrel it's in the range of four to five days.

But if you don't have that time, if the patient comes in ... and you alluded to this. You always have to make a decision on how urgent the situation is, versus the benefit of clearing it. But what if the patient comes in, they're on Clopidogrel, they get their cardiac cath, and you've got to GO. You don't have any options. You've got to go right now. What does that mean for you, in terms of what you're going to be asking for from the blood bank?

Pierre: Right. That's a very good question, and it certainly occurs, and you just kind of have to bite the bullet and go. It still doesn't mean that you don't pay attention to all the pre-operative, intra-operative, and post-operative techniques that you can do, with the exception of reversing. It is true that if patients are on Plavix, or Clopidogrel, or any other anti-platelet, that their platelets are inhibited, and they're not going to be active for a long time. It doesn't necessarily mean that you need prophylactic platelets, but they've got to be there, and you come off, and you see that things are not working, then you're going to need to transfuse platelets.

The one thing that we didn't talk about is things like thromboelastography; that also helps in the immediate pre and post-operative setting to assess your factors. The other thing I do want to mention about anti-platelet meds, such as Clopidogrel, is that 10 to 15% of patients are non-inhibited. I had this one patient, he had been paying for Clopidogrel out-of-pocket before it was generic, for 10 years, so he'd paid something like \$80,000. He came, he needed heart surgery, we did a platelet inhibition study, point of care testing, and he was completely uninhibited. So he might as well have been taking Tic-Tacs, because it was doing nothing! So keep in mind that 10 to 15% of patients will not be inhibited, and 10 to 15% of patients will require longer than five days to clear.

Joe: When you're transfusing platelets in those who are inhibited, Pierre, are you just titrating it to effect, or how are you deciding how much to give?

Pierre: You're titrating to effect. And I've got to say that I look at the number of platelets as well. Nevertheless, if you're inhibited, you can have 300,000 platelets and none of them are working. But if I start out with 150 ... about 50,000 should be able, as you know from being a blood bank guy, 50,000 should be able to give you the coagulation that you need. So just off-hand, if I'm going in at 200, then I see bleeding and I give platelets, I'll look at effect and I'll look at if I've increased it by 50,000.

Joe: Gotcha. Okay. I think that's really helpful, to kind of give us in the blood bank a perspective on what you're thinking in those scenarios. Pierre, this has been an amazing experience for me, to get to pick your brain, to get to hear your thoughts on all this. You are obviously someone who takes blood management very, very seriously. And the fact that you're transfusing less than 10% of your cardiac bypass patients is astonishing. That's really wonderful work.

I wonder if you ... well, I am going to give you the floor. Because as I said to you earlier, you've got a big group of blood bankers, for the most part, that are listening to this, both Transfusion Medicine physicians and pathology residents, and the laboratorians that work in blood banks. So I wonder if you ... what would you like to say to us? What do you wish that we knew more about what you did, and how can we serve you better?

Pierre: Well, I appreciate it, Joe. Thank you very much. I could say to the blood bankers that even though the only time you hear from us is, "I need the blood now," yelling at you, you are our best friends. The things that you do as far as providing us the tests that we need, and the products that we need in the time that we need it, we couldn't ask for anything more. So please ... I'm issuing an apology for all cardiac surgeons, for any of us that have been not our usual jovial self, because usually it's at a time of great stress. We've got a patient who's bleeding and we don't know what to do, and we're afraid that what we've done may not have been the best, or that we didn't do it as best as possible, or simply that things are just not going our way. So a huge thank you, from us surgeons to all you blood bankers and laboratorians, for what you do.

I am extremely thrilled to see that whoever's listening to this podcast, that they have taken the time and the interest to learn about what we do, because taking care of patients ... none of us can take care of these patients, especially today, in being a solo practitioner. We need everybody, from the surgeon, to the anesthesiologist, to the blood bankers, and everybody. That's one thing that I failed to mention, is that ... and it's probably the most important thing, is that patient blood management is a multi-specialty, multi-modality therapy for patients. And we need a concerted effort by everybody involved in a patient's care to achieve patient blood management. Like I always say, patient blood management is easy, simple to understand. It's extremely difficult to do. Because it's not just one procedure, it's not just one medicine that we're giving. It's where everybody has to work together in the best interests of the patient.

So that's really all I can think of saying. Like I said, I really appreciate this time to be able to talk to you, Joe, and everybody in your audience.

Joe: Pierre, thank you so much for your thoughts, and thank you so much for being here and explaining, helping us understand what you do and how we can serve you better. This has just been an amazing experience for me. Thank you so much.

Pierre: Well, thank you. Same here. Appreciate it, Joe.

Joe: Hey, it's Joe, with just a couple of thoughts before I let you go. I've included links to the two large recent studies addressing transfusion thresholds in cardiac surgery that Pierre and I discussed on the show page for this episode at BBGuy.org/068. I hope you know, you can also find lots of other



resources at BBGuy.org. That will include glossaries, quizzes, videos, lots of other free resources.

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One other thing, I just wanted to mention, I wasn't able to get into either transfusion in cardiac transplant surgery or ECMO with Dr. Tibi. I felt like there was so much to cover just in routine cardiac surgery, I couldn't really get into that in today's discussion. Hopefully in a future episode I can at least talk about transfusion in cardiac transplant surgery, but that is not covered in today's episode, as I'm sure you know.

So, the next episode, which will be coming in two weeks, will be a continuing education-eligible interview with AABB President-elect Dr. Beth Shaz. Beth and I will discuss how to prevent transfusion-related acute lung injury. What's worked, what maybe has not worked over the years, and Beth has some very interesting statistics on that. I can't wait for you to hear that episode.

But until that day comes, my friends, as always, I hope that you smile, and have fun, and above all, never, EVER stop learning! Thank you so much for listening. I'll catch you next time on the Blood Bank Guy Essentials Podcast.