Expert Roundtable

PANEL

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EVALUATING CANDIDACY AND OPTIONS FOR INTERVENTION

Dr. Comerota: Anticoagulation is the mainstay of care for patients with deep venous thrombosis (DVT). The type of anticoagulation, intensity, and duration all influence patient outcomes. However, anticoagulation reduces the risk of thrombus propagation and recurrence but does little to eliminate the clot. With the experience and expertise that this panel collectively has, I would like to begin by asking everyone's thoughts on the benefits of early thrombus removal.

Dr. Hennebry: This is an important topic, and I do not think that great advances in anticoagulation have made any impact compared to the surgical case series almost 20 years ago showing that thrombus reduction in the iliofemoral venous system makes a difference. That work has perhaps been validated by several registries, but we do not have the randomized trial data we often demand in order to change the way we treat patients. We believe that there is a need for something to be proven even while we defer treatment in those patients with extensive iliofemoral thrombosis. The rationale is to reduce postthrombotic syndrome (PTS) and perhaps even recurrent thromboembolic disease, as well as to restore valvular function.

Dr. Razavi: Although no randomized trial has been completed to date comparing the results of adjunctive endovascular clot removal with standard anticoagulation alone, there are data on surgical embolectomy versus anticoagulation published by Plate et al demonstrating the benefits of early clot removal over anticoagulation alone.[1] It is paramount to study the effects of early clot removal, as compared to anticoagulation alone, now that catheter-based techniques have given us effective tools for thrombectomy and thrombolysis. I agree that the primary goal of therapy would be to reduce the risk of PTS; however, we would also need to quantify the incidence of recurrent venous throm-

boembolism (VTE) and the economic impact of therapy. Unfortunately, there is a paucity of robust studies addressing these areas.

Dr. Comerota: And, Dr. Glickman, which are the patients who are at greatest risk for PTS?

Dr. Glickman: The younger patient in particular and patients with May-Thurner syndrome are the two populations we are very aggressive with. Anatomically, iliofemoral cases are the ones we treat quite aggressively.

Dr. Razavi: Anatomic distribution of clot is the best indicator of PTS risk, if not treated appropriately. The general rule of thumb is that the more cephalad the clot extends, the higher the risk of PTS without clot removal. The patients who are at greatest risk of PTS are those with thrombosis of the entire deep venous system of the extremity. These patients are also at the highest risk for phlegmasia.

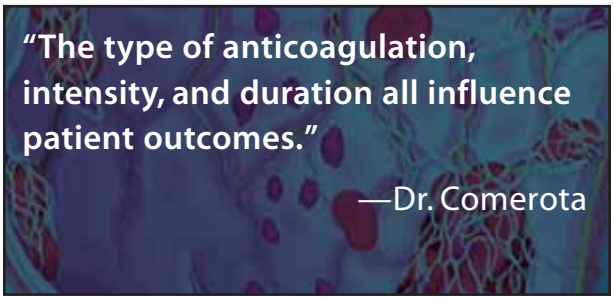
Dr. Comerota: Dr. Pollack, in your evaluation of patients when they come into the emergency department, is there anything clinically observed that tips the scales of your decision matrix toward seeking an expert to get rid of the clot?

Dr. Pollack: We are talking about a potential paradigm shift from the perspective of the emergency department, because typically, we diagnose clot, initiate anticoagulation, and then either admit patients or set them up for outpatient therapy. Currently, it is unusual for emergency department physicians—aside from a few of us who are really interested in thromboembolic disease—to consider referring the patient from the emergency department to interventional assessment. I have written a review article on this topic that will be published soon in *Annals of Emergency Medicine,* and I believe it will start prompting this question to be asked more often.

In the emergency department, we have to overcome the inertia of, "I have a diagnosis, I have an answer, let me move onto the next patient." In this new review article, I suggested some potential clinical scenarios in which it might make sense to at least offer the patient a referral to intervention from the emergency department as opposed to just hoping that happens after the patient is admitted.

Dr. Razavi: This would be a very timely publication, because a relatively large number of DVT patients are diagnosed in the emergency department, and therapy is initiated. I congratulate Dr. Pollack for bringing this matter to the attention of our emergency department colleagues.

Dr. Comerota: If you have a patient with a swollen leg that includes swollen thigh and clot that is documented in the common femoral vein, Dr. Pollack, is that the type of patient that you would wish to admit?



Dr. Pollack: Yes. The larger the clot burden, the more proximal the clot, and the sicker the patient is overall, the more likely we are to admit the patient to the hospital as opposed to considering outpatient therapy. Every case is a little different, but I think those are good general guidelines.

Dr. Comerota: Dr. Glickman, what factors do you consider when deciding on a particular method of thrombus removal?

Dr. Glickman: First, I consider the patient's habitus and ability to lie in a prone position. Then, I assess how the extremity looks and how symptomatic the patient is. Those factors are all very important. So, if the patient has a very swollen leg, is symptomatic, and can lie prone, I'm very aggressive in trying to pharmacomechanically remove the thrombus in this patient.

Dr. Razavi: The best candidates for DVT thrombolysis are those who have a reasonable life expectancy, have symptoms that are < 2 weeks old, and suffer from iliofemoral thrombosis. Although patients with contraindications to thrombolysis are classically not good candidates, we routinely push the commonly accepted boundaries for such cases by using a combination of devices and drugs. Therefore, the correct drug therapy is a moving target.

CHOOSING AN INTERVENTIONAL TECHNIQUE

Dr. Comerota: We have techniques ranging from a plain catheter drip to rheolytic infusions and double-balloon catheters with segmental thrombus removal. How do you go about deciding which to use in what circumstance?

Dr. Glickman: In an iliofemoral case, I really like the double-balloon Trellis technique (Covidien, Mansfield, MA), because it truly does get rid of a large clot burden. Using a smaller rheolytic device often just makes a channel in the clot, whereas the Trellis device removes or emulsifies a lot of the clot burden within that area. However, if the clot has not been entirely removed, we will often drip many of these patients overnight to remove as much as possible.

Dr. Hennebry: I agree with Dr. Glickman. At our institution, we have been very impressed with the isolated pharmacomechanical approach. We believe in at least preventing embolus with the two balloons isolating the thrombus, as well as with localization of the thrombolytic agent. Currently, we try to avoid drips. In our early experience, we had a few hematomas resulting from the drips that were significant, and during the last 2 years, we haven't had any since we went away from it. At that time, we also switched to perhaps a more religious approach of using only ultrasound-guided micropuncture access and a few other small changes, but we are almost exclusively using the Trellis system for the isolated pharmacomechanical approach. After using Trellis, we will sometimes use a ClearWay balloon (Atrium Medical Corporation, Hudson, NH) if there is a focal residual clot in an effort to avoid the drip. If there is some residual clot in the iliac system alone, and if it is left-sided, which so often is the case, we will usually stent. And, of course, if it is femoral, we don't wish to go down the road of stenting. The only time I would consider a drip is if there were clot remaining below the inguinal ligaments in an effort to avoid the use of stents in that region.

Dr. Razavi: Mechanical thrombectomy catheters and lytic-assisted devices have the best outcomes when there is adequate inflow and outflow from the treated (or thrombosed) segments. Ideal patients for isolated thrombolysis using the Trellis system are those with venous patency at the access point and an inferior vena cava (IVC) that is free of clot. These are the patients that we could potentially treat in a single session using a combination of Trellis and thrombolytic agents. The results of a prospective survey published by Hilleman and myself revealed that the majority of patients who are referred to interventionists for DVT therapy can be treated in a single session using the above technique.[2] I use lytic infusion therapy in patients with thrombosis of the access vein (usually popliteal) and/or extension of clot into the cava. It is important to keep in mind that the efficiency of devices with or without the use of lytic agents is reduced as the size of the thrombosed vessel increases.

To emphasize a point that Dr. Hennebry already made, venous access must be obtained under ultrasound guidance, with care taken to avoid the popliteal artery and its branches. I also make sure that my needle does not traverse any other vascular structure, including smaller veins. A careful approach can eliminate or substantially reduce the risk of access site hematoma.

Dr. Comerota: There seems to be a consensus that the prone position and ultrasound-guided popliteal vein puncture are the preferred approach to this problem.

INFORMING PATIENTS OF POTENTIAL COMPLICATIONS

Dr. Comerota: Dr. Pollack, when you talk to your patients about the potential strategies for thrombus removal, what are some of the complications you might mention to them?

> **"The patients who are at greatest risk of PTS are those with thrombosis of the entire deep venous system of the extremity."**
>
> —Dr. Razavi

Dr. Pollack: We do not ordinarily go into much detail on the specific types of therapy, because our interventional physicians will have a detailed discussion with the patient and the patient's family for informed consent. We do explain why they will be seeing someone from a different specialty and that we think their clot burden is significant enough that either their short-term risk of complications from the DVT (including pulmonary embolism [PE]) or their longer-term risk of what could be disabling PTS is such that we at least want to give them the opportunity to explore more prompt removal of the clot as opposed to only giving blood-thinning medicines and letting the body gradually dissolve the clot on its own. I'm at a teaching hospital, so I may be the third or fourth provider to speak with a patient, and then I'm telling him or her to talk to yet another provider. But, generally speaking, patients are open to that idea when it is presented in a common sense progression.

Dr. Comerota: From my perspective, it is very helpful for the physicians who have initially seen the patients to broach the subject and discuss it with them.

What are the potential complications that you discuss with the patients, Dr. Glickman?

Dr. Glickman: Bleeding. We have had some patients whom we have dripped overnight and have had bleeding complications, which is why we have somewhat aggressively moved away from the overnight drip technique. That is one of the advantages of using Trellis—locally isolated infusion of the tissue plasminogen activator so that systemic complications are reduced. I also like the idea of using the ClearWay device, which we have employed to remove residual isolated thrombus. Although we do often use overnight catheters, we talk with patients about potential bleeding complications. We also talk about the possibility of clot going to the lungs.

Dr. Comerota: What about the question of hemoglobinuria, Dr. Hennebry?

Dr. Hennebry: It is certainly a complication of endovascular techniques, although I have to say I saw this more on

the arterial side with rheolytic thrombectomy systems. That is why I have come to approach this in a retrograde fashion, so to speak, from initially being pre-eminently more interested in arterial thrombus. I had one or two devastating results with hemoglobinuria, including renal failure and hyperkalemic-related mortalities, and therefore, switched to the Trellis system in its 6-F iteration for arterial thrombus. Other physicians at our institution had been treating this problem iliofemoral DVT with a rheolytic or drip approach, and I was fairly impressed with the ability of Trellis to avoid the systemic lytic complication and systemic hemolysis and its consequences, which you have alluded to, and hence, we started using Trellis in DVT. We have not seen those complications to date in our experience with Trellis in the venous system, even with large clot burdens.

Dr. Razavi: Hemoglobinuria is a problem that is seen when rheolytic devices are used for long periods of time. It would be very unusual with catheter infusion of lytics. Appearance of bloody urine after lytic infusion is usually due to hematuria and not hemoglobinuria. As to the question of thrombolysis complications, internal bleeding, including intracranial bleeding, needs to be discussed with patients and their families. This is a rare complication that can be minimized by attention to patient selection and use of proper technique.

Dr. Comerota: I agree, and it is fair to say my institution's experience with hemoglobinuria is perhaps due to an enthusiastic use of rheolytic catheters with resultant red cell breakdown.

Dr. Pollack, in patients who present with extensive thrombosis and are undergoing thrombus removal, do we need to consider evaluating them for an underlying thrombophilia?

Dr. Pollack: We generally like to do that before we initiate anticoagulation in the emergency department unless there is an obvious reason why the patient has a clot, such as recent trauma, immobility, previous clot history and workup, or cancer. In cases in which the proclivity to clot is not obvious, we will typically send a thrombophilia panel from the emergency department before we initiate therapy simply because we know it helps our hematology staff to have that information before anticoagulants are administered. Certainly, for those patients in whom we are considering more significant intervention, it is appropriate for us to recommend a full thrombosis risk assessment, and we do try to practice that way. Because of our research interest in this area, our emergency department may be more attuned to these issues than the typical emergency department.

Dr. Razavi: Although there is a high prevalence of thrombophilia in patients with VTE, there are no clear guidelines as to when such testing is beneficial and cost effective. We screen for thrombophilia in patients with idiopathic DVT who are younger than 50 years of age, have unexplained recurrent VTE, or have VTE and a family history of VTE. Older patients with unexplained VTE should be screened for malignancy.

IVC IMAGING AND FILTER PLACEMENT

Dr. Comerota: Dr. Glickman, how important is it to image the IVC before starting thrombus removal techniques?

Dr. Glickman: We routinely image the IVC to determine the extent of the thrombus. If the thrombus is fairly high within the IVC, I will put in a removable filter before thrombolytic therapy.

Dr. Comerota: Drs. Hennebry and Razavi, what are your indications for IVC filter placement in this patient group?

Dr. Hennebry: Our filter use in this population is very low unless the patient has had a recent pulmonary embolus. Our reasoning is not based on data, just what we consider to be a cautious approach. However, we would place a filter if after the first imaging we think there is mobile thrombus in the iliofemoral system.

Dr. Razavi: We rarely use optional filters in this setting. What may persuade me to consider an IVC filter is the presence of a large polypoid or partially adherent caval thrombus.

Dr. Comerota: If placing a filter, would the panel use an optional filter and remove it as soon as it is no longer needed?

Dr. Hennebry: In this case, I would certainly use an optional filter.

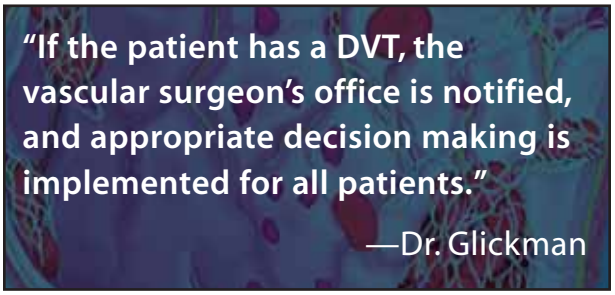
Dr. Glickman: Yes, me too.

Dr. Razavi: My answer would be no. Optional filters are preferred when protection is necessary. Filters, however, are rarely used in our practice in the setting of DVT thrombolysis. The data do not support their use, and our experience is consistent with the literature. The only exceptions would be the scenario I previously mentioned or when using AngioJet device (Medrad Interventional/Possis, Indianola, PA) in the power-pulse mode in larger veins.

PATIENT REFERRAL AND WORKUP

Dr. Comerota: How has your institution's approach to DVT developed, Dr. Razavi?

Dr. Razavi: Aggressive preventive protocols for the inpatient population have been in effect at our institution for a while with good success. Unfortunately, we lag behind in



capturing all eligible patients for catheter-based treatment of VTE. Our own criteria for intervention are not uniformly accepted by all specialists and likely won't be until level 1 data become available.

Dr. Comerota: Dr. Glickman, is there a specific treatment protocol in your health system for patients who are about to undergo these catheter-based strategies?

Dr. Glickman: Our team is involved in the preoperative assessment of every patient with DVT who comes through the system, whether it's in the peroneal vein, popliteal DVT, iliofemoral, etc., so we have a set protocol in the treatment plan for all of those patients. Postoperatively, we follow the patients very aggressively with ultrasound in just the manner you described, and we try and see what's happening with the clot. If we determine that the clot has resolved, we do not keep patients on warfarin anticoagulation for 6 months as we do everyone else. If there is no remaining clot within 4 to 6 weeks, we stop the warfarin and conservatively follow them at that point.

Dr. Pollack: I wouldn't be surprised if during the next year or 2, with the addition to our armamentarium of non-warfarin oral anticoagulants, there might be a higher comfort level with continuing prophylaxis for a longer period of time.

Dr. Comerota: According to the current American College of Chest Physicians (ACCP) guidelines, the recommendation is for at least 6 months of anticoagulation, and of course, if the patient has an idiopathic venous thrombosis, much longer than that. The guidelines are currently being rewritten, but the new guidelines probably won't be out for another year yet.

Dr. Glickman: We have begun using electronic medical records to create a program that seeks out DVT patients to alleviate waiting times and therapeutic times. We have EPIC, a system-wide electronic medical records system, in all of our hospitals and all of our primary care offices here in southeastern Virginia. When a primary care or emergency department doctor enters "DVT" as a chief complaint, a protocol or best practice appears on the physician's screen. With implementation of this "best practice protocol," our noninvasive vascular laboratory is alerted, and the proper studies are performed. If the patient has a DVT, the vascular surgeon's office is notified, and appropriate decision making is implemented for all patients. This ranges from starting low-molecular-weight heparin to more aggressive therapies. We are hoping that with this protocol, the quality of care being delivered to our patients and patient satisfaction will improve.

Dr. Comerota: It sounds as though you have a unique mechanism built into your vascular laboratory to identify patients early and initiate treatment at a very early stage.

Dr. Glickman: Yes, we are all part of the same health care system, and we were finding that our patients were in the emergency department for a long time before they would receive therapy. Many patients with iliofemoral DVT were discharged with low-molecular-weight heparin and returned within 14 days to see us because of continued swelling and pain. We were hoping to see more aggressive care of our patients and better outcomes as a result of our new protocol.

Dr. Comerota: Who specifically refers patients to you, Dr. Glickman, or am I correct in assuming this process is conducted more or less automatically through your computer system?

Dr. Glickman: Both. It is now automatic within the system that we are the first-line physicians being called for patients with DVT. A lot of it has to do with our finding that the primary care physicians in our community were very anxious in treating these patients. They didn't know how to handle DVT, and they were treating all DVT cases the same way. The primary care physicians felt there was a significant liability and stress on them about how to treat these patients. So, we are now coming in to give them direction and assurance and encouraging them to be aggressive in finding iliofemoral DVTs early so that we can reduce postphlebitic episodes.

Dr. Comerota: There are two points that Dr. Glickman made that I'd like to emphasize, the first being the family physician's perception that catheter-directed intervention causes a substantially increased risk of complications in these patients. Once we eliminate that as a major concern, these physicians are often much more agreeable to referring patients for thrombus removal. The second point to underscore is the recognition that postthrombotic morbidity can be severe, but it can be avoided.

Dr. Hennebry, do you collaborate with your institution's ultrasonographers?

Dr. Hennebry: Yes. Fortunately, we have a vascular medicine section with which I am affiliated, and there are now

five vascular internists who essentially read all of the venous and the vast majority of the arterial duplex studies. And, the emergency department will essentially automatically consult vascular medicine for DVT cases.

Dr. Comerota: What specific methods have been successful for you in developing a referral patterns DVT practice?

Dr. Hennebry: I think having your first referred cases be successful, free of complications, and illustrative of how dramatically we can help these patients is really critical for intrainstitutional acceptance and referral. That has helped us a lot. Of course, the second step was collaboration. We have collaborated with the vascular surgery department at our institution and also with the high-risk OB/GYN physicians who have many of these patients postpartum. Young women do not tolerate iliofemoral DVT very well when they have a new baby due to all the hours of being on their feet that that requires, so this was a natural referral avenue once our capabilities had been demonstrated. We have also spoken with family medicine specialists and given grand rounds. We try not to get into advertising, and luckily enough, I am fairly busy, but nonetheless, we all want these cases, because we believe we are really helping patients and making a considerable difference.

Another tool we use is a one-page PDF with an illustrative case story of a successfully treated DVT patient. We remove all names and use nonidentifiable elements, but we include some excellent pre- and postprocedure images, and we take these to the referring office. This can be helpful in a multispecialty group or even in an office with multiple providers.

DEMONSTRATING FAVORABLE OUTCOMES OF INTERVENTION

Dr. Comerota: It sounds as though there is growing enthusiasm for strategies of thrombus removal. Which patients would benefit the most following successful treatment?

Dr. Glickman: The patients who would benefit most are those with iliofemoral thrombus. They are known to have the highest rates of postthrombotic syndrome when treated with anticoagulation alone, as well as high recurrence rates. With successful thrombus removal, these patients often have minimal or no symptoms.

POSTINTERVENTION DECISIONS

Dr. Comerota: In the patient who is successfully treated, do you alter the duration of anticoagulation after successful thrombus removal?

Dr. Hennebry: This is a question I think we address every day. In some specific cases, we have shortened it to 3 months for reasons such as patients having no underlying thrombophilia, a recent surgery that involved the pelvis and may have caused local irritation, a pelvic fracture, or otherwise healthy patients who have some other issue causing them to not want to be anticoagulated. But, in general, we are staying in the 3- to 6-month range if there are no predisposing factors. We are using low-dose aspirin in the stented patients and in some of the very young people. With more extensive iliac stents, we have prescribed a 2-week course of clopidogrel as well, although that is rather empiric.

Dr. Comerota: I might add that there are data supporting the use of ultrasound monitoring of patients and D-dimer monitoring of patients after therapy demonstrating that patients who do not have ultrasound evidence of residual thrombus at the end of anticoagulation have a low risk of recurrence, whereas those with ultrasound evidence of residual thrombus have a very high risk of recurrence. This has been shown by Siragusa et al and Prandoni;[3,4] Palareti et al contributed the seminal work on the use of D-dimer in managing the duration of anticoagulation.[5]

Dr. Hennebry: I wholeheartedly second that. We are particularly careful in following the stented patients with duplex imaging, and I always perform D-dimer testing approximately 1 week after I have stopped warfarin.

Dr. Razavi: We have not yet altered the duration of our anticoagulation regimen in patients after a successful procedure. In the majority of our patients, there is tibial thrombosis in addition to iliofemoral. We have been persuaded by external forces to reduce the frequency of ultrasound follow-up. Thus, we do not get a chance to anatomically evaluate most of our patients until 3 months after the procedure unless they have recurrent symptoms.

Dr. Comerota: If there is an underlying venous stenosis after successful lysis, would this mandate venoplasty and stenting?

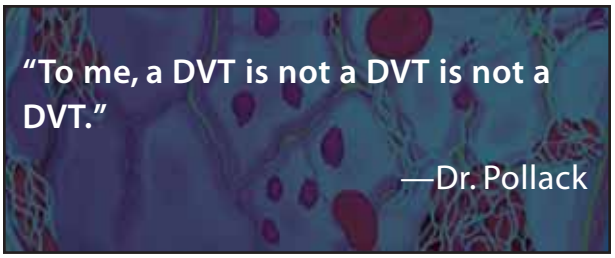
Dr. Glickman: That's correct.

Dr. Hennebry: I agree.

Dr. Razavi: Venous stenting, when necessary, should be limited to segments cephalad to the saphenofemoral junction and caudal to the jugular-subclavian confluence. Stenting peripheral to these points has been associated with poor outcome.

AXILLOSUBCLAVIAN DVT

Dr. Comerota: Suppose a patient has extensive venous thrombosis of the upper extremity—an axillosubclavian DVT—which is the upper extremity equivalent of iliofemoral DVT. Dr. Glickman, would you approach this patient with a strategy of thrombus removal?



Dr. Glickman: Yes, we are very aggressive with those patients. Many patients who develop DVT in the upper extremity are young, so we are very much in favor of using mechanical thrombolysis for these clots.

Dr. Comerota: What happens after you get rid of the clot? Any subsequent recommendations?

Dr. Glickman: A venogram is performed, thrombolysis is delivered, and then most of these patients undergo a first rib resection. We are pretty aggressive in treating these patients.

Dr. Comerota: So you would recommend a first rib resection if you see narrowing at the thoracic inlet as the subclavian vein crosses the first rib between it and the clavicle?

Dr. Glickman: That's correct.

Dr. Hennebry: I think our patient population is slightly different. We see more of those patients from the chronic dialysis segment, often in conjunction with interventional nephrologists. We also see upper extremity DVT and superior vena cava syndrome in the pacemaker implant patients and the ports for cancer treatment. But, we have been fairly aggressive. In fact, during the years before we really became more aggressive in iliofemoral cases, we were tending to treat those chronic upper extremity patients to preserve access and as much symptom relief as possible. Our success with upper extremity DVT and superior vena cava syndrome patients has encouraged me to go further. We often get into very small peripheral veins that we use to track catheters more proximally to perform good venograms and then cross lesions with the venous flow, rather than retrograde, with much success. Those cases have been very gratifying.

Dr. Razavi: The incidence of patients with primary axillo-subclavian venous thrombosis is significantly lower than is observed with secondary. The majority of patients with upper extremity DVT are those with indwelling catheters, and not all will need aggressive treatment. We intervene in severely symptomatic patients or those who cannot afford to lose their central venous catheters. As for the patients with primary axillosubclavian venous thrombosis, I agree with Dr. Glickman. After clot removal, they need thoracic outlet decompression.

Dr. Comerota: I would agree on both counts. It is important to assess if there is a stenosis of the subclavian vein, either primary or secondary, as it crosses the first rib and is between the first rib and the clavicle. One needs to eliminate the external bone, which is the first rib, before a successful dilation and before stenting can be performed. One of the worst things you can do is to put a stent in that location without decompressing the thoracic inlet.

PARTICIPATING IN ATTRACT AND OTHER CLINICAL TRIALS

Dr. Comerota: The ATTRACT trial is a National Institutes of Health–funded randomized study comparing catheter-based approaches to proximal DVT versus anticoagulation alone. Importantly, patients are being stratified to iliofemoral versus infrainguinal DVT, and the institutions involved can choose their type of catheter-based intervention, one being the drip technique alone, the second being isolated pharmacomechanical thrombolysis with a Trellis catheter, and the third being rheolytic thrombectomy with the AngioJet. Either of the pharmacomechanical techniques can be followed with a drip infusion if there is residual thrombus, and patients are randomized to either catheter-directed approaches or anticoagulation in a one-to-one fashion. This is an important study, and our institution is involved, and hopefully it will answer this very important issue of quantifying the benefit of thrombus removal in patients with proximal DVT in an objective way. Dr. Razavi's center is also participating in the trial. Does anyone have any questions or points to make about ATTRACT?

Dr. Hennebry: One difficulty we would have in participating is that our vascular medicine section is probably more interested in the primary prevention and acute treatment with various pharmaceutical agents, and therefore, the patients are often in trials before they get to that potential randomization. Secondly, do you think allowing different strategies to be used in the interventional arm rather than standardizing the choice of technique will "muddy" the results at all?

Dr. Comerota: The primary question is, "Is the strategy of thrombus removal better than anticoagulation alone?" Then, when each institution comes into the trial, they identify which of the basic strategies they will use primarily, because that is the way things are done in the real world. So this is an attempt to be as flexible as possible in a real-world setting, allowing advances in technology to be incorporated into a dynamic protocol for patient benefit, and also an attempt to observe whether there are any major differences between one technique or another. At our institution, we have seen that the use of isolated segmental pharmacome-

chanical thrombolysis improves the overall outcome in terms of thrombus removal, and it did so in a significantly shorter period of time and a with significantly lower dose of plasminogen activator. It will be interesting to see if the same observations are made in other institutions across the country. Dr. Razavi, do you have anything to add in response to Dr. Hennebry's question?

Dr. Razavi: Yes, I would emphasize that the interventional protocols in the ATTRACT trial are quite regimented. Once a center declares which device they are more proficient in (ie, AngioJet or Trellis), the rest of the protocol is standardized both in terms of technique and in dose of thrombolytic drug. There is some freedom after the initial clot removal procedures.

Dr. Comerota: Dr. Pollack, any thoughts on DVT clinical trials from the emergency department perspective?

Dr. Pollack: Emergency physicians are essentially on the fringe of the VTE prophylaxis discussion, but because of hospitals' growing interest in preventing DVT complications—above and beyond the clinical concern that has always existed—I think we are going to see emergency physicians brought more into the fold on this. We will likely be viewed, appropriately, as the first line of defense against VTE. It will take several years to become widespread, but in leading academic centers, we are already seeing emergency department involvement in initiating prophylaxis.

Dr. Comerota: We work very closely with our emergency department physicians, and we have adopted a protocol whereby patients who have occlusion of their common femoral vein, complete leg swelling, and the typical picture of iliofemoral DVT will be admitted, and we have had a very good collaboration.

Dr. Pollack: I think we will see hospitals going beyond that sort of collaboration in treating patients who are already carrying a diagnosis of DVT, with emergency physicians taking more responsibility for initiating prophylaxis in those patients who are admitted to the hospital.

I think there are two issues here. One is prevention and one is aggressive treatment. To me, a DVT is not a DVT is not a DVT. The differentiated data from ATTRACT will be important for all of us to have, because I believe that iliofemoral DVT is certainly different than popliteal vein DVT. However, many of our physicians see it all as one entity, and therefore we get different results.

Dr. Comerota: I agree, primary care physicians need to understand that iliofemoral DVT is a much different pathologic entity when it comes to severity of postthrombotic morbidity, and quality of life is certainly altered if that clot is not removed. Additionally, their perception of the risk of intervention is exceptionally high, and we can address that concern just by showing them current data.

DEFINING ROLES AND PROTOCOLS IN DVT PROPHYLAXIS

Dr. Comerota: We have all seen that the Joint Commission and the Centers for Medicare & Medicaid Services have identified hospital-acquired VTE disease as a major problem in the United States, and the importance of VTE prophylaxis in all hospitalized patients has been emphasized across the country. As Dr. Pollack mentioned, there is a great deal of attention being given to newer anticoagulants for DVT prophylaxis.

This leads into a discussion of the mechanical techniques for intermittent pneumatic compression and its role in VTE prevention, because this technique is often overlooked. Dr. Pollack, I know you are also interested in prophylaxis at a primary level.

Dr. Pollack: Absolutely. Generally speaking, our goal is to get patients who are admitted into the hospital out of the emergency department as quickly as possible. We have focused our efforts as a department toward collaborating with the in-patient physicians regarding the initiation of pharmacological prophylaxis in patients who are clearly at high risk; although the decision to admit has already been made, these patients may be in the emergency department for a while before they go to an inpatient bed. We have not extended that into initiation of mechanical prophylaxis as of yet. We see patients who are candidates for prophylaxis and have contraindications to pharmacologic prophylaxis, but to date, we do not have a protocol in place for mechanical prophylaxis at that early stage.

Dr. Comerota: How are patients evaluated for VTE prophylaxis at your facilities?

Dr. Razavi: After admission, patients undergo a VTE risk evaluation. Those at high risk will receive pharmacotherapy and intermittent pneumatic compression. This usually includes all those who are expected to be immobile, such as patients in the intensive care unit, postsurgical patients, or debilitated patients in medical wards. Such an approach, in my opinion, should be mandatory.

Dr. Pollack: Our evaluation protocol is straightforward; we merely adhere to the ACCP statement that patients with acute cardiopulmonary diagnoses who are sick enough to come into the hospital should receive prophylaxis. If the patient is admitted with pneumonia, chronic obstructive pulmonary disease, asthma, congestive heart failure, or influenza with primarily respiratory symptomatology, then they receive VTE prophylaxis. We perform a quick assessment for bleeding risk and make certain they are not already on anticoagulation for some other reason. If they pass those

very simple checkpoints, we typically give them a dose of enoxaparin once the decision to admit has been made.

Dr. Comerota: Dr. Hennebry, do you have a different VTE prophylaxis protocol?

Dr. Hennebry: No, ours is very similar to that of Dr. Pollack. I must say that I was shocked when I came to the United States in 1995 and found that DVT prevention was not taken as seriously as it had been in Dublin. In particular, there was less use of low-molecular-weight heparin at that time. I think many physicians do not jump to the sequential or compression devices perhaps as quickly as they should in patients who are compromised or unable to tolerate anticoagulation, as well as in those that are at the highest risk after having a stroke.

Dr. Glickman: That's one of the great advantages of electronic medical records. When a patient is admitted, his or her information comes up automatically, and then the physician has to assess it and initiate some level of VTE protocol.

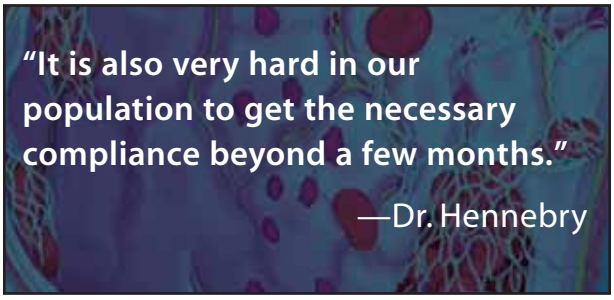
INTERMITTENT PNEUMATIC COMPRESSION DEVICES AND COMPRESSION STOCKINGS

Dr. Comerota: From my perspective, I look at it fairly simplistically. The external compression devices are designed to move blood from the leg. The measures of effectiveness for expulsion of blood can be venous blood flow velocity or overall flow, and it would seem that the more blood that is removed, the better the device will function and the better the effectiveness will be when put to the clinical test. The question then would be, "When is the best time for the device to compress the leg?" In my experience, as soon as the leg is filled with blood, you want to empty it. It's a relatively simplistic thought. Stasis alone doesn't cause thrombosis; however, it is an important "permissive" factor if there are underlying coagulation disorders. If there is underlying endothelial injury that predisposes these patients to thrombosis, stasis will permit clot to form. Obviously, we don't want stagnant blood in the leg.

We have shown that there is a hematologic benefit to intermittent pneumatic compression. Normal veins respond much better than postthrombotic veins in increasing endogenous fibrinolysis and that mechanism is through increased elimination of plasminogen activator inhibitor. But we also increase tissue factor pathway inhibitor with the use of intermittent pneumatic compression.

Suppose we're not successful in preventing DVT, how do we best handle the secondary DVT that occurs?

Dr. Hennebry: If it is iliofemoral, we will do thrombus reduction.



Dr. Comerota: What about calf vein or calf popliteal/femoral?

Dr. Razavi: Involvement of a single calf vein may safely be followed without any additional measures. If the clot extends to more segments or involves the popliteal vein, we recommend anticoagulation. Additionally, these patients benefit from compression stockings. Filters are not cost effective in popliteal or calf venous thrombosis.

Dr. Hennebry: In those cases, I use the compression stockings in addition to the usual anticoagulation. To date, that has still included low-molecular-weight heparin. Rarely have we just started using oral direct thrombin inhibitors.

Dr. Comerota: Do you treat patients with a secondary or postoperative DVT differently from those with an idiopathic DVT?

Dr. Hennebry: Absolutely. I think 3 months at most on the anticoagulation.

Dr. Comerota: How important is the use of 30- to 40-mm Hg ankle gradient compression stockings in these patients that you are treating for acute DVT?

Dr. Glickman: It is important in our postoperative stage for these patients to have the 30- to 40-mm Hg compression stockings. With our patients who have had DVT, I use them to reduce the swelling and stasis and send them home with these stockings as well.

Dr. Comerota: A number of randomized trials, including one published by Prandoni and colleagues,[6] have clearly shown that the 30- to 40-mm Hg ankle gradient compression stockings that are worn for at least 2 years result in a 50% reduction in postthrombotic morbidity. Therefore, it has received a high level of recommendation by the current ACCP guidelines.

Dr. Hennebry: I think they are great for noniliofemoral DVT in particular, even though they may also work in iliofemoral. But I don't think it requires the entire 2 years for a more simple calf proximal femoral DVT that does not extend into the common femoral or femoral iliac vein sys-

tem. It is also very hard in our population to get the necessary compliance beyond a few months. Still, others will leave the hospital and buy another kind of elastic stocking that is certainly not the 30- to 40-mm Hg gradient compression stocking.

Dr. Comerota: Should the emergency department be prescribing these, Dr. Pollack? I wonder whether or not it would confuse the matter.

Dr. Pollack: I don't know that I have an answer to that. We have not done it in the past, and there are no published data of which I am aware on this issue.

Dr. Comerota: I might suggest that those patients who are not being admitted, which will be the majority of them, are the ones who will benefit by wearing 30- to 40-mm Hg gradient stockings. Of course, when they return for follow-up, if they have been fortunate enough to spontaneously lyse and their valvular function has been preserved, then they do not need stockings, because they won't swell. But in those who will have residual thrombus with valvular dysfunction, with edema, swelling, and pain, those are the patients who will obviously benefit.

Dr. Pollack: I agree. It is an idea that should be considered going forward.

CLOSING COMMENTS

Dr. Glickman: We need to continue to work to produce good data on thrombolysis, with long-term results. Having the proper studies will really help us define the best therapeutic options for our patients. We need to continue to educate primary care physicians on the therapeutic options for treatment, and we need to be more concise and aggressive in our VTE prophylaxis. I also believe that it is essential for physicians at every stage of the DVT treatment progression to know the peer-reviewed literature.

Dr. Pollack: From my perspective as an emergency physician, someone making the diagnosis and typically either initiating therapy and referring or simply referring, the most important thing is to be aware of the suitable patient profiles for pharmacoinvasive management. Armed with this knowledge, practitioners in primary care and in emergency medicine should be urged to look ahead prospectively at where they might refer a patient, even just for consideration of invasive therapy. We are not advocating that the emergency physician or the primary care physician will be choosing patients for pharmacoinvasive management but that they must be alert to the type of patients who should be referred for consideration.

Dr. Comerota: And you certainly are in a position to identify very early on those patients who are at highest risk of severe postthrombotic morbidity. Dr. Hennebry, your closing statement?

Dr. Hennebry: First, we have to keep our message simple and continue to push the concept that the occurrence of DVT in hospitalized patients is unacceptable without either prophylaxis or documentation of why it did not occur. Second—and I have learned this from your work, Dr. Comerota—the concept that common femoral and iliofemoral DVT requires either prompt admission to the hospital or referral within a week to a vascular specialist for consideration of the alternative endovascular treatment.

Dr. Comerota: I agree that patients with occlusion of the common femoral vein confirmed objectively by duplex imaging are those patients with occlusion of the single venous outflow tract from their lower extremity, hence their accelerated morbidity related to PTS. We need to convey the message that most of these patients can be treated safely with good efficacy, and that in doing so, we preserve patency that will often in turn preserve valve function and significantly reduce, if not eliminate, postthrombotic morbidity.

As we look throughout our communities in the United States, we can do much better across the board with DVT prophylaxis, and unquestionably, our pharmacotherapy is improving, but we cannot lose sight of the efficacy of the mechanical devices that we have. In our highest-risk patients, combined therapy has proven to be highly effective compared to just one form of prophylaxis, be it compression or pharmacotherapy alone.

Dr. Razavi: Dr. Comerota's comment on the adjunctive use of mechanical devices is an important one. Progress in this area has made it possible to treat patients with DVT while minimizing hospital stay and patient discomfort. The very low complication rate of such therapies is now even lower due to the refinements in techniques and device technology. ■

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