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VASCULAR EMERGENCY: AN EVERYDAY BATTLE IN AMERICA

What do 100 million Americans over the age 50 have in common? They are the population at greatest risk of developing vascular and cardiac health-related problems that can be limb- or life-threatening. Unfortunately, vascular and cardiac disease is elusive and often difficult to diagnose based on symptoms alone. Many Americans are exposed to risk factors such as diabetes, obesity, hypertension, hypercholesterolemia, and smoking for decades without an awareness of the implications to their vascular health. The lack of awareness leads to years of neglect that eventually manifest as complex and often unanticipated vascular disease. In the aging population the first sign of a problem is a vascular emergency.

In this issue of V-Aware I am excited to have the participation of nationally known faculty members who share their expertise and highlight the importance of early recognition and risk factor modification to optimize vascular and cardiac health. I also have the privilege of starting the discussion with a focus on thoracic and abdominal aortic emergency. Dr. John Byrne presents a detailed discussion on the importance of recognizing acute limb-threatening ischemia, Dr. Louis Papandrea highlights the importance of recognizing cardiac emergencies, and Dr. Gary Bernardini focuses his discussion on the importance of recognizing stroke symptoms and contemporary treatment options. Next, we introduce the real-life story of a father and 11 siblings who share a family trait of aortic aneurysm. This family’s struggle with their vascular health began years ago when their father and one brother died from undetected ruptured abdominal aortic aneurysm. Since that time, most of the other siblings have been diagnosed and treated for aortic aneurysms under elective and emergent circumstances, and they share their family story of aneurysm awareness and the associated hereditary risk factors. Dr. Saroj Pani and Susan Dillon take us through a tour of vascular anesthesia and the vascular intensive care unit and discuss the importance of a standardized, multidisciplinary approach to improving patient outcomes. Megan Wilcox and I discuss the importance of vascular research, and Dr. R. Clement Darling, III helps us understand the importance of regionalized comprehensive vascular care.

I hope you enjoy this issue of V-Aware, and we look forward to your comments and suggestions. Feel free to write to us at info@vaware.org.

Warmest regards,

Manish Mehta, MD, MPH
President and CEO of the Center for Vascular Awareness, Inc., in Albany, NY
September 11, 2001 was one of the most catastrophic days in the history of the United States. More than 2,500 lives were lost that day. Now consider a condition such as an “aortic emergency” that threatens tens of thousands of American lives each year—that’s equivalent to a 9/11 tragedy every other week.

Aortic emergencies are one of the most life-threatening events affecting the aorta. This urgent condition brings thousands of Americans to the emergency room each year and has been responsible for taking the lives of many famous people such as John Ritter, Betty Garrett, Harvey Korman, Lucille Ball, and Albert Einstein, to name a few.

TWO TYPES OF TEARS
The aorta is the main blood vessel that carries blood from the heart to the rest of the body and is similar in size to a garden water hose. From the heart, it travels through the chest and into the abdomen and then divides to supply each leg; along the way, the aorta gives rise to many smaller blood vessels that supply the vital organs in the body. An aortic emergency occurs when there is a tear in the arterial wall. If blood escapes from within the arterial lining (or lumen) and penetrates one of the three layers of the arterial wall, it is known as arterial dissection. If the tear breaks through all layers, this is called an aortic rupture. Aortic dissections generally occur in otherwise healthy aortas, whereas aortic ruptures tend to happen in weakened aortas that have dilated and become an aneurysm.

Aortic dissection primarily affects the thoracic aorta, and symptoms can be similar to that of a heart attack: a sudden onset of tearing, sharp, or stabbing pain in the chest and back that can radiate to the neck, jaw, and abdomen. The presenting symptoms often reflect the location and extent of the aortic tear, which can often be associated with severe abdominal and leg pain, heart failure, renal failure, or even stroke. Thoracic aortic dissections are twice as common in men as in women, and although they can occur at any age, they are most common in adults between the ages of 50 and 70. Risk factors include hypertension, atherosclerosis, smoking, family history of aortic disease and heart disease, blunt chest trauma, and genetic disorders such as Marfan syndrome and Ehlers-Danlos syndrome. Thoracic aortic dissections are often underdiagnosed and undertreated; however, once this condition is diagnosed, the patient requires immediate medical attention.

Aortic dissection generally occurs in otherwise healthy aortas, whereas aortic ruptures tend to happen in weakened aortas that have dilated and become an aneurysm.
minimally invasive endovascular means. Most aortic dissections can be managed by minimally invasive endovascular means; in these procedures, vascular surgeons gain access to the aorta by femoral arteries in the groins and under x-ray guidance advance delivery catheters and sheaths that transport stent grafts to the site of dissection. These tubular stent grafts are composed of synthetic fabric supported by a metal mesh framework that, once deployed at the site of aortic injury, diverts blood flow and takes pressure off the damaged aortic wall, reducing the risk of rupture. Sometimes, when these thoracic dissections extend in close proximity to the heart, direct aortic reconstruction takes pressure off the damaged aortic wall, reducing the risk of rupture. Sometimes, when these thoracic dissections extend in close proximity to the heart, direct aortic reconstruction through an open surgery is necessary.

AORTIC RUPTURE
An aneurysm is a progressive weakening and ballooning of the blood vessel that commonly affects the abdominal and thoracic sections of the aorta, and if undiagnosed can lead to aneurysm rupture and death. Approximately 51 million Americans are over the age of 60 and at the greatest risk of developing an aneurysm. It is estimated that 1.5 million Americans have aortic aneurysms, of which only 20% are diagnosed, and merely 3% to 5% receive treatment. Although aneurysms are more common in men, women also develop aortic aneurysms, and a significantly higher percentage of women than men present with aneurysm rupture. These astounding statistics are similar to the incidence of breast cancer in the United States, but due to a fundamental lack of aneurysm awareness, this important information mostly goes unnoticed.

Just as most aortic dissections involve the thoracic aorta, most aneurysm ruptures occur in the abdominal aorta. It is estimated that 50% of patients with ruptured aortic aneurysms die suddenly and don’t even make it to a hospital. Those that survive require immediate repair. Aneurysms generally cause no symptoms; however, patients with ruptured aortic aneurysms experience intense pain in the abdomen, the flank region over the kidneys, or back, and might have a sudden drop in blood pressure and signs of shock. In the emergency room, physicians generally make the diagnosis of rupture by a strong index of suspicion, physical examination, and noninvasive tests such as an ultrasound and CT scans. The patient’s only chance of survival is with an expeditious repair.

REPAIR FOR RUPTURES
Open surgical repair for ruptured abdominal aortic aneurysms is performed under general anesthesia. An incision is made to enter the abdomen, and the aorta is clamped above and below the aneurysm to stop the hemorrhage. A synthetic tube made of Gore-Tex or Dacron is directly sewn to the aorta using permanent sutures. All along, a coordination of efforts between the vascular surgeons, the anesthesiologists, and the nursing team is needed to carry out the procedure safely. Up to 60% of patients can survive a ruptured aortic aneurysm when treated by these techniques; recovery can take months.

Over the past decade, new endovascular techniques have allowed vascular surgeons to perform these complex procedures by minimally invasive methods shown to limit complications and improve patient survival. Endovascular repair of ruptured abdominal aortic aneurysms can be performed under local, spinal, or general anesthesia. Under x-ray guidance, the vascular surgeon gains access to the aorta through femoral arteries in the groins and then advances delivery catheters and sheaths that transport stent grafts to the site of rupture. These stent grafts are composed of synthetic fabric supported by a metal mesh framework and appear similar in shape to a pair of pants in that there is a “waist” that accommodates the healthy abdominal aorta above the site of aneurysm rupture and two “legs” that seal below the aneurysm in the iliac arteries, which provide blood flow to the patient’s pelvis and legs. Patients with massive blood loss due to aneurysm rupture sometimes require a temporary placement of an aortic occlusion balloon, similar to a clamp above the site of aortic rupture when treated by open surgical approach, to maintain hemodynamic stability while the endovascular procedure is carried out. These complex procedures have an 80% to 90% survival rate and can be offered to select patients with aortoiliac morphology suitable for endovascular procedures. Full recovery still takes time.

BE AWARE
The overarching take-home message is simple: The only way to avoid these catastrophic aortic emergencies is to be aware of your risk factors (older than 60 years of age, family history of aneurysms, tobacco use, history of heart disease, high blood pressure, or peripheral arterial disease) that might predispose you to developing an aortic aneurysm or dissection, and talk to your doctor about simple, noninvasive tests that can help detect these potential deadly conditions. If an aneurysm is diagnosed, consult with a Vascular surgeon about risk factor modification and treatment options, and don’t forget to talk to your family, as aneurysms are hereditary.

Ask Your Doctor
1. How can I modify my risk factors for developing aortic aneurysms?
2. How can I be tested for aortic aneurysms?
3. When do I need to see a vascular specialist?
During the 2008 presidential primaries, current Secretary of State Hillary Clinton ran an advertisement featuring the “3:00 AM phone call” and questioning her opponent’s ability to deal with the unexpected crisis such a call represents. In vascular surgery, our version of that urgent middle-of-the-night call is the “cold leg” (or less frequently, “cold arm”).

These colloquial terms are used to denote a sudden lack of arterial blood flow to a leg or arm (coincidently, such vascular crises also seem to occur at unsociable hours). An identical process in the brain or heart causes a stroke or heart attack.

The medical term for sudden loss of blood supply to a leg or arm is acute limb ischemia. This is a limb-threatening condition: Unless blood supply is promptly restored, the outcome is amputation of the limb. Although heart attack and stroke are justly feared and appropriately publicized, acute limb ischemia receives little coverage in the media. It is not an unusual condition, however. Acute limb ischemia typically accounts for 12% of all operations in a vascular unit. By comparison, operations for long-standing blockages of arm or leg arteries (chronic ischemia) comprise 40% of operations. Treatment for acute ischemia is often demanding. As a result, patients also do much better when treated for this condition by vascular specialists.

**WHO AND WHAT IS AT RISK**

The incidence of acute ischemia is age-related, and it is also slowly increasing. The most common risk factor today is peripheral arterial disease (PAD), which is caused by smoking, elevated cholesterol levels, and diabetes. Anecdotally, it is usually patients who do not undergo treatment (or who do not take their medications) for these conditions who have PAD. Until the early 1990s, cardiac disease was the most common cause of PAD due to the number of patients who had sustained damage to their heart valves from streptococcal infection in the pre-penicillin era. Although many physicians think of acute ischemia purely in terms of leg ischemia, arms are affected in almost one-fifth of cases. Acute ischemia rarely occurs in the young or very young patient, when it is usually related to a traumatic event.

**DIAGNOSIS**

There are many conditions in modern medicine that are referred to as “silent epidemics” or “silent killers.” Acute limb ischemia, on the contrary, is not silent and does not give the patient much time. The first symptom is pain, usually of such severity it requires narcotics to control. The affected limb is pale and cold to the touch. Due to the effect of lack of oxygenated blood (hypoxia) on nerve and muscle tissue, the limb will lack sensation and be weaker than the healthy one. The other common feature is that there are no palpable pulses in the affected arm or leg. Physicians use the aide-mémoire of the six Ps: pain, pallor, paresthesia, paralysis, perishing, and pulseless. The diagnosis is usually clinical. Once the condition is recognized, other tests such as a Doppler examination or angiograms may be used—if there is time. Depending on the severity of the situation, the patient may be sent to surgery without any other testing.
CAUSES

Put simply, there are two main causes of acute limb ischemia: an embolus or thrombosis. An embolus is a blood clot that travels in the bloodstream, lodges in a blood vessel, and obstructs flow. In arm or leg ischemia, a blood clot suddenly blocks one of the major arteries feeding that extremity. The blood clot usually comes from the heart. A common condition called atrial fibrillation causes the upper chambers of the heart to stop contracting, allowing clot to form in areas of stagnant flow. If the patient is unaware of this condition or stops taking his or her blood-thinning medication (Coumadin or Pradaxa), a clot can dislodge. Blood clots can also form on the surface of diseased heart valves and damage heart muscle after heart attacks. Clots can also arise from abdominal aortic aneurysms or plaques on the walls of major arteries.

The second cause of acute limb ischemia is acute arterial thrombosis. This condition involves the formation of clot within an artery causing an obstruction of flow through it. The most common scenario is arteries so narrowed by plaque caused by PAD that flow eventually slows to such a degree that the blood coagulates. Rarely, an already diseased artery may clot off after an intervention such as a bypass operation or a stenting procedure.

Another major cause of acute ischemia is sudden blockage of a previously placed stent or bypass graft. This occurs more frequently in patients who have a blood clotting disorder (thrombophilia). Patients who continue to smoke after initially successful stenting or surgery are also more likely to develop this complication.

NEED FOR SPEED

Acute limb ischemia is a true vascular emergency. The sooner blood flow is restored to the affected arm or leg, the better. There are gradations of severity, however. In class I ischemia, there is time to plan treatment and surgery—maybe 6 to 12 hours. In class II (considered a threatened limb), treatment must happen within 1 to 6 hours. But for class III ischemia (regarded as irreversible), any opportunity for treatment has been lost, and amputation is the outcome.

In many cases, surgeons will prefer to perform an angiogram before surgery. At night or weekends, however, ordering this test can delay crucial restoration of blood flow as on-call teams are assembled. Some surgeons may forego an angiogram in the interests of expediency. Other tests such as computed tomography scans, magnetic resonance angiograms, and ultrasound have not proven as useful in this situation.

TREATMENT

Time is of the essence when faced with acute limb ischemia. Of the tissues in the arm or leg, nerves are most sensitive to hypoxia and bone is the least. Nonetheless, the window of opportunity for restoring blood supply is measured in mere hours. After this amount of time, the tissues will become irreversibly damaged. There are a number of approaches depending on what, specifically, is causing the blockage—an embolus or a thrombosis.

(Article continues on next page)
MANAGEMENT OF EMBOLI
Because emboli are quite firm, and because the affected arteries are relatively normal, surgical removal is very effective. In 1963, Thomas Fogarty invented his eponymous embolectomy catheter. This instrument allows retrieval of clots from long segments of arteries through a small incision in the artery. Before that time, clot retrieval involved long incisions and use of a forceps to remove clot from arteries, which then had to be stitched back together. Although this innovation may seem self-evident in 2011 (as most breakthroughs do in retrospect), at the time, it was a major improvement. Embolectomy has withstood the test of time and remains the approach we most frequently use to treat peripheral arterial emboli. There are minimally invasive variations on this procedure in which catheters are used to retrieve clot, such as aspiration thrombectomy and percutaneous mechanical thrombectomy.

MANAGEMENT OF ARTERIAL THROMBOSIS
A logical question asked by many patients or their families is whether “something can be put in the arteries to dissolve the clot.” This approach is called thrombolysis and is one of the treatments for acute ischemia. A drug called recombinant human tissue plasminogen activator (rt-PA) is the only medication currently licensed for this. The rt-PA can actively dissolve clots, unlike heparin or Coumadin, which only prevent clot formation. Delivered directly into the clotted artery by a catheter through a puncture in an artery, rt-PA is infused continuously over 24 to 48 hours. This, of course, is the catch: Physicians must be certain that they have 24 to 48 hours to work with. The other catch is that these patients still have diseased arteries, and additional procedures are often needed. The final consideration is bleeding. Patients who have undergone recent surgery or have a bleeding tendency are not candidates for this treatment.

The other option for treating thrombosis is bypass surgery. This procedure is invasive, and typical incisions will extend along most of the leg. Bypass, however, may be the only option to save a leg. There was much enthusiasm for thrombolysis in the 1980s and 1990s. Several large trials, however, compared outcomes with surgery. Many of the patients undergoing thrombolysis eventually ended up with a bypass operation because of their underlying disease.

Sometimes, by the time patients seek medical treatment, their leg may not be viable. In such cases, amputation may be the only means to prolong life.

PROGNOSIS
Acute limb ischemia is a serious condition. The best population studies are from Scandinavia, where there are national databases. Even with best treatment, 10% of leg embolus patients in Finland end up with a major amputation (at the above-knee or below-knee level). For thrombosis with diseased arteries, the outlook is worse, with 26% of episodes resulting in amputation. Patients with arm ischemia do much better due to a rich network of collateral circulation and hardly ever require amputation.

It’s important to remember that life is also threatened by acute ischemia. Patients with acute leg or arm ischemia will often have either heart disease or PAD, which significantly reduce life expectancy.

PREVENTION
PAD is the most common cause of acute limb ischemia. The British vascular surgeon Charles Clyne (1946-1992) said, in order to prevent PAD one “should choose their parents carefully and avoid being male and growing old.” Luckily, there are more achievable goals. To prevent PAD and avoid acute limb ischemia, patients must choose not to smoke (always a wise decision), avoid a high-cholesterol diet, and treat hypertension and hyperlipidemia, should they develop. In the event of irregular heart rhythms (cardiac dysrhythmias), always take the prescribed medications.

SAVING LIFE AND LIMB
Improvements in technology and limb salvage techniques have been dramatic over the past 50 years. Even with improved techniques, however, only 70% of patients with leg ischemia leave the hospital with an intact limb. Of the remaining 30% of patients, half die, and half require a major amputation. Only 10% to 15% of the amputees attain any degree of independent living. Early, appropriate intervention can save life and limb, and there is compelling evidence that outcomes are better when patients are treated by vascular specialists. Although there have been impressive technological advances, assessment of the patient remains clinical, and early treatment is the best guarantee of a successful outcome.
RESPONDING TO CARDIAC EMERGENCY

Heart disease is the leading cause of death in Americans, contributing to more than 600,000 deaths per year. In fact, more people die from heart disease each year than all forms of cancer combined.

It is of paramount importance to recognize heart-related health emergencies early and institute appropriate treatment in order to save lives. The majority of cardiac emergencies arise from atherosclerotic heart disease, but there are other types of heart disease that can cause emergency situations. Most cardiac emergencies are accompanied by one or more of the following symptoms: chest pain, shortness of breath, or loss of consciousness. Chest pain and shortness of breath are very common symptoms and may or may not constitute an emergency, as we’ll discuss later on. When confronted with any potentially cardiac-related symptoms, however, the patient needs a quick and thorough evaluation that will allow the physician to make a diagnosis and reverse the causes.

LOSS OF CONSCIOUSNESS
The potentially most serious and urgent symptom is unconsciousness. The first thing to do is to determine if the patient has a pulse. If you’ve established that the patient has no pulse, then he or she is in cardiac arrest, and cardiopulmonary resuscitation (CPR) must be started immediately. If this event occurs outside of a hospital, someone needs to call 9-1-1. If you are in a hospital setting, a “code blue” is called, and the resuscitation team responds and treats the patient according to advanced cardiac life support protocols.

If the unconscious patient has a pulse, then check the blood pressure (BP). If the BP is low, start supportive treatment with intravenous fluids and medicines to increase BP, such as pressor drugs (if in a hospital setting). Once the pulse and BP are adequate, then you must differentiate cardiac from noncardiac causes. The most common cardiac cause is vasovagal syncope or “the benign faint.” This occurs due to increased activity of the vagus nerve and parasympathetic nervous system, which causes heart rate and BP to drop. Typically, patients experience the warning signs of lightheadedness, sweating, and nausea before they faint. This kind of loss of consciousness can occur at any time or place, but it is often due to a physical or mental stress or standing for prolonged periods of time. Fainting is a benign condition and does not require any treatment.

Other causes of cardiac syncope include a tachy- (fast) or brady- (slow) arrhythmia. Tachycardia can be relatively benign, such as atrial fibrillation, atrial flutter, or supraventricular tachycardia. These conditions are different forms of rapid heartbeat that may make a patient feel uncomfortable but are not necessarily an emergency. On the other hand, some forms of tachycardia, such as ventricular tachycardia, may be serious and even life threatening. The patient is typically admitted to the hospital and placed on cardiac telemetry, which constantly monitors the heart rate and rhythm.

Then, the patient undergoes a cardiac workup to determine the cause and guide treatment. Tachyarrhythmias are usually treated with medicines, unless it is a life-threatening arrhythmia, in which case the patient may receive an implantable defibrillator. Bradyarrhythmias are usually treated with pacemakers, unless a reversible cause is found.

CHEST PAIN
Chest pain is probably the most common cardiac symptom that may indeed signal an emergency. The patient must be evaluated to determine if the pain is cardiac or noncardiac. Cardiac chest pain is usually caused by a lack of blood supply to the heart muscle and is typically described as “pressure” or “tightness” in the center of the chest. The pain can radiate to the neck, jaw, back, or arms and may be accompanied by shortness of breath or sweating. If the pain occurs with exertion and is relieved by rest, it is called stable exertional angina. If the pattern of chest pain is accelerating, or if the pain occurs at rest, it is called unstable angina and constitutes an emergency. Any chest pain that sounds cardiac in origin and lasts for more than 10 or 15 minutes is an emergency, and the patient (article continues on next page)
should be brought to the hospital. An EKG and blood tests can determine if the patient is having a heart attack or if it is unstable angina.

If a heart attack is taking place, the patient typically undergoes an emergent cardiac catheterization, in which the clogged artery is opened up with a stent to restore blood flow to the heart muscle. In cases in which the hospital does not perform cardiac catheterizations, the patient will be treated with a clot-dissolving medicine and eventually transferred to a cardiac center. If the initial EKG and blood tests are negative for heart attack, the patient is admitted to the hospital and stabilized with medications such as β-blockers, nitrates, blood thinners (heparin or Lovenox), or platelet inhibitors (aspirin or Plavix). The patient may then subsequently undergo cardiac catheterization, especially if symptoms persist or if the suspicion is high for a cardiac cause.

Unfortunately, not all patients have “typical” symptoms, especially women and patients with diabetes. Therefore, all cardiac pain should be considered a cardiac emergency until proven otherwise. Another type of emergent chest pain is a sharp or “tearing” sensation that can radiate to the back. This pain may be caused by a tear in the wall of the aorta (aortic dissection), which is often a life-threatening emergency and requires surgical treatment (see Dr. Mehta’s article on page 4 for more details).

**SHORTNESS OF BREATH**

Shortness of breath is another very common symptom and may or may not indicate an emergency. If shortness of breath is chronic and stable, this is not an emergency but should be evaluated by a physician. If shortness of breath is acute or sudden and severe, this constitutes an emergency that may or may not be cardiac.

The most common cardiac emergency related to shortness of breath is congestive heart failure, which is fluid backing up from the heart into the lungs. This is also called pulmonary edema and can occur with a heart attack or may occur suddenly in any patient with a heart condition. Fluid fills the air spaces in the lungs, and the patient cannot get oxygen into the bloodstream. Fluid may also build up in the abdomen and legs. The patient requires immediate treatment to remove the fluid and restore breathing. Initial treatment includes supplemental oxygen, diuretics to remove the fluid, and possibly other medications, such as nitrates to decrease the pressure in the lungs. Occasionally, very sick patients require intubation and must be placed on a respirator to support them until they stabilize. Later, when the patient is stable, further tests can be done to discover the cause and direct further management.

Another cardiac emergency in which patients can present with shortness of breath is cardiac tamponade, which is a buildup of fluid in the pericardial space (the area between the lining of the heart and the heart muscle itself). This fluid causes increased pressure on the heart, preventing it from filling with blood. Cardiac tamponade is usually caused by pericarditis, an inflammation or infection of the heart lining. In addition to shortness of breath and possibly chest pain, the patient will have low blood pressure. This is a life-threatening emergency.

A pericardiocentesis (inserting a needle into the pericardial space to drain the fluid) can be done emergently to stabilize the patient, but definitive treatment is a surgical procedure called a pericardial window (opening a hole in the heart lining to allow fluid to drain).

**TAKE CARE**

Cardiac emergencies are not hard to recognize but present an extreme risk to a patient’s life. Obviously, it is best to avoid heart problems in the first place. Ask your doctor about the risk factors and warning signs of heart disease. Discuss any symptoms of chest pain, shortness of breath, or fainting. Also ask about your personal cardiac risk factors (family history, hypertension, diabetes, high cholesterol, and smoking), and find out about appropriate screening tests before you develop significant heart disease and end up with an emergency.
RECOGNIZING STROKE: 
Time is Brain!

Strokes is the leading cause of disability among adults and now the fourth leading cause of death in the United States, with more than 800,000 new cases each year.

Every 45 seconds, someone in the United States experiences a stroke, about one-third of stroke survivors will experience another stroke in 5 years, and, over the course of a lifetime, four out of every five American families will be touched by stroke. The risk of stroke is higher among men than women, among blacks than whites, and among older than younger age groups.

The numbers show that stroke has a widespread effect on our society. It’s important to understand the need for rapid assessment and diagnosis of stroke in order to provide immediate and emergent therapy because “time is brain,” as we’ll see.

TREATMENT IN TIME
Approximately 85% of all strokes are ischemic in origin, that is, caused by the blockage of a blood vessel that reduces blood flow to an area of the brain. In the brain, there are an estimated 22 billion neurons. Following a large vessel blockage leading to stroke, it is estimated that 1.9 million neurons are lost each minute! For this reason, the phrase “time is brain” is used when it comes to describing the damage potentially caused by stroke.

Immediate assessment and early stroke intervention are essential to prevent rapid and irreversible loss of brain tissue. Current therapies available for improving blood supply to the brain in treating stroke include direct intravenous and intra-arterial administration of declotting agents such as recombinant tissue plasminogen activator (rt-PA), declotting tools such as the MERCI and Penumbra devices, and intracranial angioplasty and stenting. All of these treatments are time-based, however; that is, they have to be given within a specific time period from the onset of symptoms to provide maximal benefit and avoid complications. Rapid assessment and diagnosis of stroke is essential for the management of acute stroke. Patients with acute stroke receive noncontrast head computerized tomography (CT) scan. Head CT is useful in determining early findings of stroke or the presence or absence of blood for assessing patients’ eligibility for thrombolytic therapy. Many stroke patients also receive CT angiography that can assess patency of blood vessels from the heart up to the brain.

Techniques such as magnetic resonance imaging diffusion-weighted imaging show stroke within minutes of occurrence. Cerebral perfusion methods such as CT perfusion or magnetic resonance imaging perfusion-weighted imaging can show brain tissue at risk, the so-called penumbra. These techniques are useful in guiding reperfusion therapies.

The clot-busting medication rt-PA is given intravenously to stroke patients within 3 hours after symptom onset. Many centers are now delivering intravenous rt-PA within an expanded treatment window of 4.5 hours from onset of symptoms, based on the safety and efficacy established by the European Council on Acute Stroke III trial. The only exception to treatment of patients within the expanded time window is in those who have had previous stroke and diabetes or who are over 80 years old. In keeping with the general rule that “time is brain,” however, the benefits of intravenous rt-PA are greatest when given earlier. Patients fortunate enough to recognize signs of stroke and get to the hospital for emergent stroke treatment have a significantly better chance of living normal lives than those who are delayed and miss the window of opportunity for advanced stroke treatments. Today, less than 10% of stroke patients arrive at the hospital in time to have the opportunity to receive these advanced treatments.

WARNING SIGNS OF STROKE:

- Numbness or weakness of face, arms, and legs, particularly on one side of the body
- Confusion and difficulty speaking or understanding
- Trouble seeing with one or both eyes
- Dizziness and loss of balance and coordination
- Severe headache of unknown origin

(Article continues on next page)
STROKE CENTERS

Tremendous interest and initiative nationally to deliver effective and timely stroke care has led to designation of hospitals with dedicated stroke teams known as stroke centers. Both the Joint Commission and the New York State Department of Health have the ability to grant primary stroke center designation and certification. Both groups named Albany Medical Center a designated primary stroke center in 2005. Monitoring how each hospital performs in delivering stroke care is essential and achieved through a Web-based service called Get With The Guidelines, established by the American Heart and Stroke Association. For example, a patient coming into the emergency room at a designated stroke center has to be seen by a physician within 10 minutes and by the stroke team in 15 minutes, must get a head CT scan and have results known by 45 minutes, and a decision must be made to deliver intravenous rt-PA within 1 hour. Monitoring through Get With The Guidelines also establishes treatment guidelines during hospitalization to prevent another stroke or its complications, as well as preventive strategies upon discharge.

BUYING TIME

Acute interruption of blood supply to the brain causing ischemic stroke can be a devastating disease and is often associated with a high likelihood of disability and death. Given that only less than 10% of patients ever make it to the hospitals within the time frame that is safe to receive these treatments, there are several ongoing research initiatives that are focused on technology and techniques that might allow doctors to offer advanced stroke treatments beyond 3 to 4 hours after stroke onset. Neuroendovascular teams are now available at many stroke centers on a 24/7/365 basis to deliver these catheter-based therapies in the angiographic suite. Such therapies include intraarterial alteplase or Retavase, mechanical thrombectomy devices (such as MERCI or Penumbra) to pull clots out of vessels, or angioplasty and/or stenting of intracranial vessels. The time window for neuroendovascular treatment is generally 6 to 8 hours after symptom onset, a slightly bigger margin than that for intravenous rt-PA. Other devices for clot retrieval or destruction include snares as well as laser- and catheter-tipped ultrasound devices. The recently completed SENTIS trial utilized an intra-aortic balloon inflated within the aorta to help increase collateral blood flow in the brain. Such novel devices may soon be readily available to treat stroke. These devices can be used in conjunction with rt-PA and neuroendovascular treatments to increase the chances of reversing the disabling effects of stroke.

SPEEDING TREATMENT

The goal for therapies in the future will be for even more rapid diagnosis and treatment of acute ischemic stroke. Conceivably, more rapid assessment for stroke could occur in the field in patients en route to a hospital or stroke center in ambulances with a CT scanner on board. Likewise, a further next step might be coordinating emergency medical services with the stroke neurologist to expedite delivery of thrombolytics and/or neuroprotective agents to patients while they are on their way to the stroke center.

Telestroke technology can now link hospitals on a “hub-and-spoke” model—stroke specialists at stroke centers (the “hub”) communicate with community hospital emergency departments (the “spoke”) to provide direct communication, visualized neurological examinations, and review of head CT scan. This allows for rapid decision making regarding rt-PA delivery to a patient who is not yet in the stroke center emergency room. Because time really is brain, earlier delivery of therapies can only benefit patients who suffer from this often-devastating disease.

Ask Your Doctor

1. Am I at risk of having a stroke?
2. What are the signs of stroke?
3. What can I do to decrease my risks for stroke?
A PATIENT'S STORY: PAUL

There were four girls and seven boys in Paul's family. Today, the oldest sibling is 90 years old, and the youngest is 73.

Paul's parents lived long lives by today's standards. His mother died from cancer at age 84, and his father died from what they believed was heart failure at age 78, although no one knows for certain what happened. Paul recalls the events of his father's death as told to him by his mother; one normal day, his mother and father went into the family room to sit in their chairs and chat. His father had just finished talking and put his head back, appearing to go to sleep. His wife called to him, but he didn't wake up. She then called to her son who was in the other room to come and help her. When he checked his father, he was already gone. Paul's father had not complained of any problems and didn't seem to have been in distress. He went quickly and quietly.

A FAMILY AFFAIR
One of Paul's brothers, Gavin, whom he considered his best friend, also died suddenly a few years ago. One day, Gavin went outside to the bird feeder to feed the birds. He came back into the house and collapsed. His wife called for an ambulance, but the nearest hospital was 62 miles away. Gavin died several hours after his arrival there. No one knew Gavin had a vascular condition until he collapsed. Gavin's wife was told by her husband's physician to contact all of Gavin's siblings and make them aware that their brother died because he had an undetected abdominal aortic aneurysm (AAA), which ruptured. Because AAAs can run in families, it was strongly suggested that all ten of Gavin's siblings over the age of 50 be screened for aneurysms. The screening is simple and painless, involving an abdominal duplex ultrasound scan.

Six of the ten siblings were found to have an AAA!
The oldest brother, John, was screened and required immediate surgery due to the large size of his aneurysm. The death of his brother and the awareness of being at risk of an AAA saved his life. Of the siblings who were found to have an AAA, one underwent an open surgical repair, and four received minimally invasive endovascular treatment for their aneurysms. The fifth sibling with an AAA is being monitored regularly because the aneurysm is not large to warrant repair at this time. All 10 of Paul's siblings grew up smoking cigarettes or pipes. At the present time, they have all quit smoking.

SUDDEN DANGER
Paul has a history of mild high blood pressure and high cholesterol and proudly states that he is now watching his diet and exercising. He was found to have an

KNOWING THE RISK

Having a family member with an AAA is a clear sign that you may be at risk, yourself. Some other risk factors associated with AAAs include:

- High cholesterol (hypercholesterolemia)
- Tobacco use
- Heart Disease
- High blood pressure (hypertension)
- Peripheral Artery Disease

(ARTICLE CONTINUES ON NEXT PAGE)
AAA during his screening. Paul had an endovascular repair of his aneurysm in 2005 and was checked by his vascular surgeon every 6 months.

In February of 2011, Paul said, “I had what I call a normal day. I felt a little tired, so I went to bed. I remember having trouble getting to sleep. I felt uptight, but I had no idea why. I kept thinking to myself, I’m not worried about anything, so why do I feel anxious?” All of a sudden, his body became tight, and pain started in his abdomen. “I knew immediately what was happening,” he said.

Paul’s sister-in-law had told the family what her husband experienced and complained of just before he collapsed and died. Years prior, Gavin had cried out about having agonizing abdominal pain. “The symptoms described by my sister-in-law made a big difference in saving my life because I knew exactly what was happening to me,” Paul said.

Paul got up out of bed quickly and found his wife in another room while he was alert. He told her to call 9-1-1 and tell them to take him to Albany Medical Center Hospital and then to call The Vascular Group; he knew that his aneurysm had burst. That was all he remembered before he collapsed. Paul believes that being aware of what was happening to his body and communicating to his wife saved precious time when he arrived at the hospital. The doctors could immediately focus on treating the rupture. “My brother saved my life a second time,” Paul added.

BE SCREENED

Paul said that he now feels fine and has no residual side effects from the aneurysm or the repair. “I am careful of what I do. I do not overdo it, and I do not lift anything heavy. I have always loved to take walks, so I walk as much as possible.”

Paul will be 85 in August and has a large family, including four daughters and six grandkids—five girls and one boy. “I am enjoying my life and my time with my wife, kids, and grandkids,” he said.

Paul would like others to learn from the death of his brother that AAAs are an extremely life-threatening condition. When an aneurysm ruptures, it happens without warning, and by the time it occurs, it could be too late to get help. You must be screened to learn if you have this condition. “You won’t regret being screened,” he said. “If you are lucky enough to receive the good news that you don’t have an AAA, great. I still recommend that you be screened again at a later time to make sure that one doesn’t develop. If you find out early that you have an AAA, it isn’t as dangerous of a condition, and the vascular surgeons can help you.” Paul went on to say, “You must think about this in terms of what you mean to those who love you. You need to repay their love by getting checked and remaining healthy.”

Because of Gavin’s death, Paul and nine other siblings, and a total of twelve children and nineteen grandchildren in his family are now aware that they are all at risk of having an AAA and will be screened.

- by Sharon Cillis, RN
VASCULAR ANESTHESIA

Anesthesia is vital to the successful treatment of any vascular emergency.

Seamless teamwork between the vascular surgeons, anesthesiologists, and operating room (OR) staff is required for doctors to manage some of the very complex emergent vascular problems that we deal with today.

Administering anesthesia is not just about putting a patient to sleep so they don’t experience the discomforts of surgery. Rather, it is a multifaceted procedure in itself that includes controlling a patient’s airway, breathing, and circulation, all while the surgeons work diligently to address the problems at hand. To understand anesthesia more, consider the analogy of getting on a plane flying from New York to Chicago: From the passenger’s (or patient’s) perspective, they are interested in getting to Chicago; from the pilot’s (or anesthesiologist’s) perspective, we need to prepare for and evaluate all the necessary steps for a safe takeoff, a safe flight, and a safe landing. The stressful parts of most flights are during takeoff and landing; during a flight, planes can at times even be on autopilot. This autopilot mode might also be the case during elective planned vascular procedures. During emergent vascular procedures, however, this imaginary plane flight can sometimes have lots of turbulence to get through.

AORTIC EMERGENCY

In common emergent vascular procedures such as life-threatening aortic emergencies, limb-threatening vascular emergencies, and stroke, the anesthesiologist and the vascular surgeon have very distinct roles in managing the patient’s course. Take, for example, an aortic emergency: The aorta is the largest blood vessel in the body, which can develop an aneurysm in up to 5% of people by age 60. If undiagnosed and untreated, an aneurysm can rupture, often resulting in death. The decision to treat a ruptured aneurysm is complicated, however. The patient’s condition may be declining on arrival and therefore considered a very high risk for surgery. Many patients are elderly and may have other diseases (such as coronary artery disease, stroke, lung disease, or poorly controlled diabetes), making a prolonged postoperative course in an intensive care unit a possibility.

Often, a realistic discussion must take place with the patient, family, surgeon, and anesthesiologist. In some cases, the family members or healthcare proxy may have to decide about treatment on the patient’s behalf. Finally, the surgeon and the anesthesiologist use their own experience and judgment when they proceed to the OR, and the appropriate staff members are alerted. Early in the procedure, large-bore intravenous catheters are placed in the patient’s arms to replace lost blood and fluids. Blood samples are drawn for typing and cross-matching, and the blood bank is notified to allocate blood and blood

(article continues on next page)
products.

The surgical and anesthesia staff must make a choice between an open vascular surgical procedure or a minimally invasive endovascular aneurysm repair. In the OR, the patient receives supplemental oxygen. Monitors such as a pulse oximeter (measuring oxygen saturation), an electrocardiogram to monitor heart rate and rhythm, and a blood pressure cuff are placed. If further venous access is needed, a central line is inserted in the neck or subclavian vein. Drugs that control blood pressure and support the heart are administered intravenously. A pulmonary artery catheter may be placed directly in the heart to measure pressures within the heart and provide more information regarding heart function. An arterial catheter is placed in the radial or brachial artery to monitor blood pressure. Most commonly, the rupture has occurred into the retroperitoneal space and may be contained. There must be a balance between managing blood pressure that is too high, which may increase the risk of breaching the wall of the aneurysm causing catastrophic bleeding and avoiding blood pressure that is too low, which can jeopardize vital organ perfusion.

**OPEN SURGICAL REPAIR**

For open surgical repair, general anesthetic is usually preferred. Powerful drugs that render the patient reversibly unconscious are given. In addition, the patient receives drugs that allay anxiety and pain and produce muscle relaxation. A breathing tube is placed in the trachea to deliver oxygen to the lungs by means of a ventilator. This step protects the lungs, is comfortable for the patient, and ensures adequate breathing. Often, the anesthesiologist places a transesophageal echocardiogram into the esophagus. This allows the doctor to image the heart and make an assessment of its function and the volume of blood in the ventricle. A urinary catheter is placed to drain the bladder and monitor kidney function. Anesthetic agents keep the patient asleep during the procedure. During surgery, the anesthesiology team maintains the patient’s body temperature and blood volume and aggressively replaces clotting factors. The patient may also require drugs to support the heart, as well as intravenous fluids to handle the massive fluid shifts that can result in metabolic imbalances and large swings in blood pressure, which need to be controlled. Sometimes, blood transfusions are necessary to replace lost blood volume and to maintain an adequate blood pressure to perfuse the body’s vital organs.

**MINIMALLY INVASIVE REPAIR**

The evolution of minimally invasive endovascular aneurysm repair has led to improvements in the treatment of elective and ruptured aortic aneurysms. If the patient’s aortoiliac morphology is favorable, an endovascular aneurysm repair is considered. In this procedure, a stent graft is inserted through incisions in the groins and delivered via an artery to
the ruptured aneurysm to seal the aneurysm from within. This minimally invasive procedure can be done under a local anesthetic and reduces many of the risks that are seen in open surgical repair.

**POSTOPERATIVE MONITORING**
Regardless of the type of repair, after surgery, the patient is transferred to the vascular intensive care unit and is carefully monitored by a team of physicians, nurses, and many other allied healthcare providers. This is a high-risk and demanding surgery. Success depends on establishing a multidisciplinary team approach. A highly trained team of emergency room physicians, anesthesiology staff, OR nurses, technologists, and vascular surgeons take on these challenges every day.

**ARTERIAL EMERGENCY**
In contrast to the patient with an aortic rupture, consider the patient who presents with intense pain, numbness, and tingling in a limb. The arm or leg is cold, looks pale, and is immobile. These signs suggest an arterial occlusion, a sudden interruption of blood flow caused by a clot (embolus). The blockage starves the tissue of blood and oxygen and may result in tissue death leading to amputation.

Emboli often arise from the heart. Atrial fibrillation (irregular heartbeats) can lead to clot formation within the chamber of the heart. These clots may become dislodged and travel in the blood stream and may end up blocking an artery downstream. Diagnosis of this condition is made by history and examination of the patient. Diagnostic tests such as arteriography (where radio-opaque dye is injected directly into the artery and special x-rays are taken) or a duplex Doppler ultrasound examination can define the blockage site.

Arterial blockage is a surgical emergency, as every minute threatens the limb’s viability. If the blood flow is not restored, the patient may end up losing parts of his or her arm or leg. The definitive treatment is surgical embolectomy during which the clot is removed. Heparin therapy is initiated to prevent further propagation of the clot.

The choice of anesthetic technique is individualized. An embolectomy can be performed under a monitored anesthesia care with standard monitors and local anesthetic infiltration over the groin incision. The patient receives sedation, while his or her vital signs are monitored. A spinal anesthetic or a regional technique can be used, provided the patient is not receiving anticoagulant or antiplatelet drugs. The anesthetic agent is injected into the spinal fluid through a fine needle inserted in the back, which provides an immobilized and pain-free field below the waist; however, the patient may not tolerate this anesthesia. If a general anesthetic is used, and if there is a high risk for aspirating gastric contents, the anesthesia team might place a breathing tube. After the procedure, the patient is usually awakened and taken to the postanesthesia care unit to be cared for by trained nursing staff during recovery.

**THE TEAM APPROACH**
A successful procedure for vascular emergencies depends on successful and safe anesthesia. Protecting a patient’s breathing and blood flow during surgery or minimally invasive procedures takes a team approach and careful attention to detail. The collaborative efforts of specially trained nurses, technologists, anesthesiologists, and vascular surgeons are all required for the “passengers” on the vascular journey to have a safe flight through even the most turbulent of emergencies.

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**Ask Your Doctor**

1. What are the risks and benefits of local, regional, or general anesthesia?
2. What risk factors can I modify to reduce the complications of anesthesia?
3. What are the residual effects of anesthesia and how long does it last?
In January 2011, in the middle of the night, 49-year-old “Mr. Z” developed sudden chest and back pain severe enough to bring him to the emergency room of a community hospital.

He was diagnosed with a ruptured thoracic aortic dissection and immediately transferred to Albany Medical Center for further management of this complex life-threatening problem; essentially a tear in his thoracic aorta and bleeding into his chest. Mr. Z had a long-standing history of hypertension and high cholesterol that were often poorly controlled. On that night, his blood pressure became high enough that it tore a hole in his thoracic aorta leading to a dissection and a rupture, which if untreated would most certainly lead to his death. The vascular surgeons performed a complex 4-hour surgical procedure and were successful in repairing the tear in Mr. Z’s aorta and saving his life.

Following the surgery, Mr. Z needed to spend the next several days recovering in the vascular intensive care unit (VICU). On arrival to the VICU, he required a ventilator for breathing, aggressive fluid resuscitation, intravenous drugs to maintain adequate blood pressure to perfuse his organs, and around-the-clock care from a staff of well-trained vascular intensive care nurses.
DELIBERING FOCUSED CARE

There is ample evidence that dedicated intensive care units (ICUs) improve patient survival, and today most hospitals have medical, surgical, and cardiac ICUs. The concept of the vascular ICU is similar in that it allows delivery of focused vascular care to high-risk patients with complex urgent and emergent medical and surgical problems. Patients with vascular emergencies often require complex surgical or minimally invasive endovascular procedures in order to save their lives or limbs. Vascular patients often have many undiagnosed and untreated risk factors that predispose them to much higher risks of complications and death following such procedures. To minimize risk, patients are placed in specialized VICUs that provide an infrastructure for advanced and invasive hemodynamic and cardiovascular monitoring.

The vascular specialty has grown significantly over the past decade, and contemporary management of today’s vascular patients requires a thorough understanding of the complexity of surgical and endovascular procedures. The aging population is increasing; the evolution of minimally invasive endovascular procedures and postoperative care in the VICUs allow vascular surgeons to treat older and sicker patients who, several years ago, would have been considered too high-risk for surgery. Patients in the VICU receive 24/7 care from a highly trained vascular team composed of vascular surgeons, nurses, and technicians skilled in the diagnosis and treatment of any potential complications following vascular surgery. The VICU is well equipped for delivering comprehensive vascular care to high-risk patients; this care includes the ability to perform and monitor invasive procedures as well as the management of simpler issues such as wound care and physical therapy. All in all, the VICU creates an environment where a dedicated staff with specialized training in vascular medicine and surgery work as a team to deliver the kind of comprehensive care that ultimately improves outcomes.

FROM VICU TO RECOVERY

When he arrived in the operating room that cold January night, Mr. Z had a 70% to 80% chance of dying. Instead, he recovered in the hospital for several weeks; during that time he was treated for multisystem organ failure, required nutritional support, and received physical therapy. He subsequently regained the function of all of his organ systems, was discharged to home, and is doing well today. It would be fair to say that hundreds of patients with complex vascular problems like Mr. Z’s have also found their way to recovery thanks to the specialized care they received in the VICU.
As early as the 11th century, there have been documented experimental guidelines with established rules for the use and testing of substances on humans.

Although clinical trials of that time were not organized or regulated in the same way they are today, there is infinite value in the principles behind what was recorded and learned.

Peripheral artery disease affects more than 12 million Americans today. It is hard to imagine that, as late as the middle of the 20th century, amputation was the only available treatment for patients with critical limb ischemia affected by peripheral artery disease and other major lower extremity traumatic injury, specifically during war times. During World War I and II, many advances in vascular techniques and technology for limb salvage were made. Improvements in arterial reconstructions, bypass surgery, and wound care grew from the work of a small group of surgeons who were interested in limb salvage and conducted many clinical evaluations for improving patient outcomes focusing on limb preservation rather than amputation.

Procedures such as arterial repair and bypass, wound care, and the use of medication to prevent clotting and improve the longevity of bypasses have since become the standard of care through rigorous clinical and basic science research. These treatments, which were then only offered to young injured soldiers with limb-threatening ischemia, became the basis for the therapies we can now offer to hundreds of millions of people worldwide. The range of options has grown to include elective and emergent management of patients with critical limb ischemia, aortic emergencies, stroke, and life-threatening venous emergencies such as deep venous thrombosis and pulmonary embolism, through advanced medical, minimally invasive endovascular, and surgical options.

**Evolving Care**

Take, for example, a catastrophic condition known as ruptured aortic aneurysm that without treatment is sure to result in the patient’s death. The first documented attempts to repair aortic aneurysms date back to 1817 when Astley Cooper ligated the aortic bifurcation for treatment of a ruptured left iliac artery aneurysm in a 38-year-old man who survived the surgery, but died the following day. Over the next century, many similar attempts were made without much success until 1923 when Rudolph Matas performed the first successful complete ligation of an aortic aneurysm. His patient, a 28-year-old female plantation worker with a ruptured syphilitic aneurysm survived 17 months.

Albert Einstein, considered to be the
The most influential person of the 20th century, had an abdominal aortic aneurysm repaired in 1949. During that time, ligation of the abdominal aorta had already proved to be ineffective through research, and replacing the aorta with a graft was still years away. The only available treatment was to attempt to reinforce the weakened aortic wall by wrapping polyethylene cellophane around the aneurysm. Einstein recovered from the procedure and continued his productive work for several more years. In 1955, almost 6 years after his original surgery, Einstein died at the age of 76 from a ruptured abdominal aortic aneurysm. Although the resection of aortic aneurysms had been practiced since 1951, because of his previous aortic wrapping procedure, surgery for Einstein’s ruptured aneurysm would likely not have succeeded.

Over the past 2 decades, significant advances in endovascular technology and techniques have yet again revolutionized vascular surgeons’ ability to treat aortic aneurysms. Now, stent grafts can be delivered into aneurysms through small incisions in remote sites, avoiding major open surgical procedures. This less-invasive procedure can be used for elective and emergent circumstances, and research has shown this approach decreases complications and improves patient survival. There are countless other examples of how advances through vascular research have allowed improvements in care for patients with painful peripheral artery disease, carotid artery stenosis that can result in stroke, and venous disorders, to name a few conditions.

TRIALS ARE ESSENTIAL
Research has many levels of responsibility that have evolved over time. The researcher’s first priority is always patient safety. Risks must be minimized through the design of the research. Once safety is considered, the team must move swiftly in the case of an emergency. Study investigators and clinical research coordinators need to efficiently screen patients in order to enroll them into the appropriate clinical trial without deviating from the protocol or delaying care.

There are currently hundreds of studies listed with the National Institutes of Health that target vascular emergencies, and more than two dozen of them focus on ruptured abdominal aortic aneurysms. Studying these issues is essential for the future.

Thanks to the diligent efforts of researchers over the past hundred years, lives have been saved, and quality of life has been maintained for people who otherwise would have faced possible amputation or even death due to vascular emergencies such as ischemia or rupture.

If you would like more information about the clinical studies that are available for vascular emergencies, visit: www.clinicaltrials.gov
Comprehensive Regionalized VASCULAR CARE

Treatment of the vascular patient has undergone a tremendous evolution over the past 2 decades.

These changes are most clearly seen in patients who present with vascular emergencies. Advances in technology enable the modern vascular surgeon to manage complex vascular problems by minimally endovascular or surgical procedures as needed, in elective as well as emergent circumstances. Our ability to provide technologically advanced care often has significant training requirements and associated costs. These limitations mean that this level of complex vascular care cannot always be accomplished in every hospital.

Limited access to cutting-edge care combined with the multiple comorbidities of many vascular patients makes it imperative that the most acutely ill patients are treated in places where a standardized multidisciplinary approach and access to the most advanced medical, endovascular, and open surgical therapies are in place. The best scenario requires not only board-certified and skilled vascular surgeons but also vascular-trained nurses, vascular technologists, and 24-hour multispecialty care including anesthesia and ICU care specifically directed toward the acutely ill vascular surgical patient.

PROTOCOL-DRIVEN CARE

This kind of comprehensive care is not a new idea. In the 1970s, the concept of a level 1 trauma center was developed after the Korean conflict and during the Vietnam War. It became apparent during these experiences that patients with significant vascular injuries would be better served at high-volume centers. These centers could coordinate care of the traumatized patients, and supportive research showed a 25% reduction in death for the severely injured patient who received care at a level 1 trauma center rather than at a nontrauma center. Education of emergency medical technicians (EMTs), emergency room doctors, and the public helped in establishing the trauma care system. The Centers for Disease Control provided the “Field Triage Decision Scheme,” the national trauma triage protocol, as a method to help healthcare professionals decide who should go to what hospital and who should go to the level 1 trauma centers.

Similarly, patients with acute vascular emergencies such as ruptured aneurysms, acute stroke, and acute limb and bowel ischemia would be best served at a tertiary care center that can provide a multidisciplinary, protocol-driven approach to vascular care. By creating protocols that standardize not only the work-up but also medical, surgical, and endovascular treatment, these patients can be treated expeditiously with state-of-the-art technology. Most importantly, they can also be followed in a database so that, over the long term, we can make sure we are providing the optimal care for these patients.

REGIONALIZATION

Over the past 2 decades, our group has established one of the largest vascular care networks in the country, which includes over 14 hospitals that span more than 100 miles and provide vascular health care to over 2 million Americans. Development of comprehensive networks within our communities and among our hospitals
has enabled us to use state-of-the-art technology for vascular patients in upstate New York. Yearly, we see thousands of patients with aortic life-threatening emergencies, critical limb-threatening emergencies, stroke, deep venous thrombosis, and pulmonary embolism.

The fundamental care of patients affected with these catastrophic conditions starts with appropriate diagnosis and triage to facilities that are best suited for treating them; take the case of a patient with an aortic emergency who presents with a ruptured abdominal aortic aneurysm and thoracic aortic dissections (a tear within the arterial wall) that are life threatening and require emergent treatment. The emergency medical technicians in the field have to first recognize the signs and symptoms: Ruptured aortic aneurysm brings a sudden onset of abdominal/back pain, a drop in blood pressure, and a palpable pulsatile abdominal aortic aneurysm. Patients with thoracic dissections present with new onset of chest pain that moves to under the shoulder blades and possibly to their arms and legs, and sometimes, uneven pulses. The emergency medical technicians will then stabilize the patient and transport him or her to the nearest hospital, where the diagnosis has to be made as well as decisions regarding the type of treatment. Hospitals with technologically advanced infrastructures enable the vascular surgery teams to handle these complex and potentially catastrophic vascular emergencies. Our vascular group has pioneered some of the minimally invasive endovascular techniques used for treating aortic emergencies, which have been shown to have a significant impact in improving patient survival.

Patients with aortic emergencies rarely survive without immediate treatment, and advances over the past 2 decades have resulted in our ability to reduce patient mortality from nearly 100% without treatment, to 50% with surgical treatment, to less than 20% with endovascular treatment. These improvements in patient care require significant resources and can only be offered at hospitals with specialized infrastructures and protocols in place to handle patients with these complex vascular problems. Often, it is safest to provide a seamless transition of patients with aortic emergencies to hospitals with capabilities to handle these complex vascular problems; hospitals with multispecialty infrastructure, advanced imaging, hybrid operating rooms available around the clock, surgical intensive care units designed to handle vascular patients, a team of vascular surgeons with significant depth in managing complex vascular problems, and a hospital administration that is willing to invest in the resources can make all this happen.

The good news is that we already have these infrastructures in place in upstate New York, with state-of-the-art capabilities for managing not only aortic emergencies but also critical limb-threatening emergencies, stroke, deep venous thrombosis, and pulmonary embolism. It is only by coordinating care from diagnosis to treatment to follow-up that we have been able to improve outcomes, find out what is most beneficial for these critically ill patients, and keep long-term data to improve our protocols and optimize our results.

**COMPLETING THE CIRCLE**

Once patients are discharged from the hospital, they can be followed in their own regional vascular surgical offices. This completes the circle and allows us to not only diagnose but to treat and follow these patients long-term, ensuring that the established protocols are performing optimally. We have found that this protocol-driven approach, much like in the trauma centers, has allowed us to treat patients with potentially fatal problems such as ruptured aneurysm, stroke, ischemic bowel, and ischemic limbs, with improved results and better outcomes.
The Vascular Group PLLC is one of the largest vascular speciality practices in the world dedicated to comprehensive vascular care. Our world-class leadership, knowledge, and experience in the treatment of vascular illnesses are unmatched.

To date we have performed more than:

- 15,000 lower-extremity revascularizations by endovascular and open surgical repair
- 12,000 carotid artery revascularizations for stroke prevention and treatment by surgery and stent
- 6,000 thoracic and abdominal aortic aneurysm repairs by endovascular or open surgical means
- 5,000 vein procedures to improve patient quality of life

The Vascular Group has been a pioneer in vascular research and has provided comprehensive and cutting-edge procedures in upstate New York over the past three decades.

- Currently offering patients opportunity to participate in over 20 vascular research trials.

For more information on the highest-quality vascular care, please contact The Vascular Group PLLC.

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www.albanyvascular.com
The Vascular Group was founded to establish a comprehensive vascular care center consisting of board-certified vascular specialists trained in endovascular, angiographic, and surgical techniques. Our physicians distinctively combine expertise in both traditional open surgery and cutting-edge, minimally invasive catheterization techniques to manage peripheral vascular disease. We are committed to promoting vascular health and delivering the highest-quality care to our patients and our community.

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