A Brief History of Vascular Surgery

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Vascular Care in the Military
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The Center for Vascular Awareness, Inc. is a 501(c)(3) not-for-profit organization dedicated to fostering mainstream consumer and clinical consciousness of vascular health standards, disease, prevention, and treatment. We believe that maintaining and improving vascular health is a critically important issue.

Educating the community about vascular disease is an important way to improve public health. Patients and clinicians benefit from learning about the impact of everyday lifestyle choices, vascular research, interventional surgical techniques, and other treatment options.

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Welcome to V-Aware

As chief medical editor, it is my distinct pleasure to introduce you to the first issue of V-Aware, a journal focused on your vascular health. On behalf of the Center for Vascular Awareness, Inc., we are excited to provide a comprehensive information source to the public and medical professionals on the current issues surrounding vascular health.

With the increasing older population, vascular disease has become one of the fastest-growing healthcare crises in the United States. Vascular disease affects all blood vessels in the body. If left undiagnosed and untreated, vascular illnesses can lead to severe disability, ranging from difficulty walking to more complex problems resulting in amputation, stroke, renal (kidney) failure, aneurysm rupture, and even death.

Until recently, across the United States, little focus and few resources were allocated to vascular disease and treatment. The Center for Vascular Awareness, Inc. is proud to be a not-for-profit organization whose mission is to bring public and professional attention to the important issue of vascular health.

V-Aware is a free journal that will be delivered to your home or office on a regular basis. Through this publication, you will receive comprehensive information on all aspects of vascular health, including prevention, diagnosis, and current treatment options.

We are proud to have an outstanding editorial board that is regionally and nationally recognized not only for their commitment to patient care, but also for their significant contributions to improving vascular health in the United States. This first issue of V-Aware will introduce you to most aspects of vascular health and will also share the true story of one patient’s path to vascular wellness.

Thank you for your interest in V-Aware. We wish you the best of health and welcome your comments and suggestions; feel free to write to us in care of Operations Coordinator Sharon Gillis, RN, at sharon.cillis@vaware.org.

Sincerely,

Manish Mehta, MD, MPH
President and CEO of the Center for Vascular Awareness, Inc., in Albany, NY
A Brief History of

VASCULAR SURGERY

Benjamin B. Chang, MD

Routine treatment and reconstruction of the arteries and veins has existed for less than 60 years, making vascular surgery one of the youngest surgical subspecialties.

There are many reasons why vascular medicine has been such a late bloomer. First, since vascular surgery usually treats the effects of age-related disease on the circulatory system, the average lifespan had to increase sufficiently that these diseases could affect people. Second, many developments needed to happen before surgery could even be attempted: radiologic imaging of arteries (angiography), blood thinners (such as heparin) to prevent clotting during surgery, improvements in anesthesia for very sick patients, and fine sutures that could perform the meticulous work that this specialty requires.

Paradoxically, three of the most destructive events of the 20th century—World War I, World War II, and the Korean War—are what gave surgeons the experience necessary to develop life-saving artery repair techniques. Many surgeons returned from these conflicts with new skills. The extensive management of arterial trauma during battle led to the civilian application of these techniques in the 1950s.

The growth of treatment
Arteries affected by the most common age-related diseases (atherosclerosis and aneurysm) cannot simply be repaired. Instead, the afflicted section of artery must be replaced through bypass surgery, or the blocked artery might be cleaned out via a surgical procedure called endarterectomy.

Finding the bypass solution
Bypass was performed rarely until 1948. Jean Kunlin, regarded as the father of this type of procedure, found that the patient’s own saphenous vein (from the leg) could be surgically removed and used to bypass blockages of small or medium-sized arteries. However, there were no suitable “spare parts” to replace larger arteries, such as the aorta. Surgical repair of these vessels could not be routinely contemplated until the development of an appropriate artificial conduit.

The original prosthetic grafts were made of silk sewn into a tube shape on a regular sewing machine.

Fortunately, starting with the work of Arthur Voorhees in 1948, grafts made of various kinds of fabric were developed and tested. The original prosthetic grafts were made of silk sewn into a tube shape on a regular sewing machine.

Later research into suitable materials led to the acceptance of the synthetic fiber Dacron, either knitted or woven and fashioned into tubes. This graft became the artificial bypass conduit of choice by the late 1950s. Before the use of Dacron, other materials, such as preserved umbilical vein and polytetrafluoroethylene (Gore-Tex), had been successfully used as bypass conduits.
Clearing the carotid artery

In 1946, Michael DeBakey was the first to successfully perform surgical removal of carotid artery blockage to prevent stroke. The benefit of endarterectomy was not initially established, despite several thousand of these procedures having been performed.

As late as the 1980s, there was great suspicion in the medical community about carotid endarterectomy, which was answered by several randomized trials in the 1990s. Endarterectomy has remained the treatment of choice for carotid blockage and is the most common arterial reconstruction performed today.

In recent years, stenting has been utilized in the treatment of carotid artery disease. It is fair to say that the result of using stents for this condition has been somewhat worse than the outcomes for open endarterectomy, but the technology continues to evolve and several trials are ongoing.

Managing aortic aneurysm

Treatment of aortic aneurysm was born with the development of large prosthetic aortic grafts in the 1950s. Research in the 1960s defined a relationship between the diameter of an aneurysm and its likelihood of rupture. It was determined that small aneurysms could safely be watched and not necessarily be operated on. In the 1980s, the use of a flank (side) incision for aortic surgery was found to be better tolerated by patients, especially the most infirm.

In the 1990s, the concept of an aortic endograft was introduced. This graft, made of artificial materials, could be tightly folded around a wire and introduced through a small groin incision. When placed, the endograft lies within the native arterial circulation and acts as a new liner for the diseased artery. This has proven to be highly successful; an endograft can be placed with much less trauma to the patient compared to traditional surgery and has supplanted the older procedure in many cases.

Treating extremities

Treatment of occlusive arterial disease of the legs has undergone a similar evolution. The usefulness of the surgical leg bypass procedure using saphenous vein was confirmed in the 1960s. At that time, research also established criteria for patients who require surgery and for the exclusion of those who do not.

The superiority of bypass to endarterectomy in these situations was also determined. For the next 30 years, the vein bypass was clearly the most effective means of preventing limb loss due to poor circulation. This was even clearer after the development of the in situ vein bypass by Leather and Karmody at Albany Medical Center Hospital in the 1970s.

In an effort to improve leg circulation without the rigors of open surgery, however, a plethora of devices were developed in the 1990s. These new tools utilize catheters and stents, which can improve circulation while inflicting less trauma. Other modern catheter-based devices utilize lasers or other methods to break up arterial plaque, with varying results.

TAILORED TREATMENT IS KEY

At this juncture, vascular surgery is a burgeoning field with many procedures and devices available to accomplish the goals of any particular surgery. In general, catheter-based minimally invasive procedures are better tolerated by patients, but they do not last as long, nor are they as reliable as the older open surgical procedures. Now more than ever, the selection of the proper procedure for each patient is an important part of the vascular surgeon’s role.
The ability to capture images of arteries and veins is an important part of vascular diagnosis.

As early as the 1950s, contrast arteriography and venography were the primary imaging techniques. Today, we rely on less-invasive tests, such as duplex ultrasound (duplex) and computed tomographic scanning (CT), for diagnosis, treatment planning, and follow-up studies. When there is a need for more information, contrast angiograms and venograms can confirm the findings of duplex and CT. Contrast tests require intravenous injection of dye and can also be used to deliver treatment. Here are the current recommendations for using duplex and CT scans to diagnose arterial and venous disease.

**DUPLEx SCANNING**
A duplex scan is actually composed of two functions: B-mode ultrasound and Doppler gray scale. The first medical use of Doppler ultrasound equipment occurred in the 1960s for assessment of extracranial cerebrovascular disease. The last four decades have brought numerous technological advances. Ultrasound allows us to visualize an artery’s diameter and wall thickness, as well as any plaque. The Doppler function can gauge the velocity, or speed, of blood flow and measure the change in this velocity over time to calculate the degree of stenosis or narrowing of the artery.

**COMPOnED tomOGRAphY**
In a CT scan, multiple X-ray beams are sent through the body part being examined and are collected by multiple detectors. A highly detailed picture can be generated, producing a slice-like, cross-sectional image.
Evolution of this technology has led to spiral or helical CT scanners. Using special scanning protocols and computer software programs, as well as intravenous injection of contrast agents similar to those used for angiograms (CTA), three-dimensional images can be generated. Intravenous hydration with normal saline and renal protective agents may reduce the risk of kidney dysfunction in patients at potential risk for this complication. (Article continues on next page)
Choosing Treatment

Major scientific trials (the North American Symptomatic Carotid Endarterectomy Trial and the Asymptomatic Carotid Endarterectomy Study) have compared medical management to surgery for the treatment of carotid artery disease. These studies have shown that carotid endarterectomy (surgery) is superior for the prevention of stroke and preservation of brain function. In both trials, angiograms were used to determine the severity of disease and to plan subsequent management. Angiograms, however, do present a risk for allergic reactions, arterial injury, renal dysfunction, and stroke.

For patients with carotid artery disease, duplex scanning can provide several advantages. It is cheaper than angiogram, is non-invasive, does not require an injection of dye, presents none of the risks of an angiogram, and is readily accessible. The quality of a duplex scan, however, depends on the experience of the technician doing the study. Ideally, all vascular tests are performed in a fully accredited vascular lab.

Patient selection is also crucial. When compared to angiogram for carotid blockages greater than 70%, duplex has sensitivities ranging from 80-100% and specificities of 68-99%. Ultrasound may be difficult to interpret, however, when the internal carotid artery is very small in diameter or redundant, or in situations where the carotid artery branches very close to the base of the skull.

In patients with certain arterial characteristics (including short necks, high bifurcations, or a tortuous internal carotid artery), CTA can assess the condition of the artery and measure severity of disease. Sensitivities with this technique in detecting blockages greater than 70% range from 67-100% and specificities range from 84-100%. One disadvantage of CTA, however, is the need for a large volume of contrast, raising the risk for renal dysfunction.

We currently use CTA to confirm the severity of disease in patients who have had previous carotid duplex studies performed in nonaccredited vascular labs.

Visualizing Lower Extremity Disease

Angiograms are the mainstay of diagnosis when faced with patients who have disabling leg claudication, rest pain, or tissue loss. This technology has the advantage of being able to visualize the entire relevant arterial circulation and allows a physician to plan the most appropriate course of treatment. The disadvantages of angiogram for these patients include the potential complications previously mentioned, patient discomfort, and high cost.

Other approaches, such as duplex arterial mapping and CTA, are also able to capture pictures of the arterial tree. In a duplex scan, the lab technician finds the artery with the ultrasound probe and follows its length to create a map. The amount of plaque within the artery and the degree of narrowing are noted, and this information can then be used to plan a specific bypass operation. The major advantage of duplex is that it is non-invasive and less expensive than an angiogram. Disadvantages of using ultrasound include the difficulty of getting images in obese patients and the fact that there are no well-defined standards to measure the severity of disease. The studies are also very time- and labor-intensive, and the findings may differ depending on the experience level of the technician performing the study.
Below the knee
CTAs are less invasive than angiograms and provide excellent images of the aorta and iliac arteries. Newer software provides better definition of the femoral and popliteal arteries. Some studies have even shown more accurate evaluation of femoropopliteal occlusive disease with CTA than with angiogram. Evaluation of tibial arteries (those below the knee) may be more difficult with CTA due to problems with timing the passage of intravenous contrast into these small, low-flow arteries. Contrast angiogram is best when detailed information of these vessels is required.

Renal disease
Most of the applications of duplex and CTA for renal artery occlusive disease have focused on screening patients with suspected renovascular hypertension or renal failure, evaluation of renal transplants, and as follow-up after renal artery interventions. Duplex scanning is quite reliable in evaluating the main renal arteries but may not be able to identify accessory arteries or branch renal arteries. This can be important in evaluating a renal artery cause for hypertension and lead to false-negative results. Due its non-invasiveness, duplex also provides an ideal way to follow renal artery reconstruction. Pitfalls of this technique may also stem from obesity and the presence of excessive bowel gas, making visualization of the renal arteries difficult. The dependence on the examiner’s skill may lead to a great deal of variability in studies, making lab standards and accreditation extremely important.

The visceral arteries
Duplex may also be used for the diagnosis of significant occlusive disease of visceral arteries (the celiac and superior mesenteric arteries) when chronic mesenteric ischemia is suspected. Using specific protocols, elevated velocities in these arteries have been correlated with angiographic evidence of stenosis greater than 70% with sensitivities and specificities of greater than 90%.

Duplex is also a proven method for following up patients after surgical bypass and stent placement.

CTA may also be utilized in this setting and, with accuracy of greater than 90% in some studies, it compares favorably with angiogram for preoperative evaluation of renal and mesenteric artery stenosis. In comparison to duplex, CTA is highly accurate in detecting accessory renal artery stenosis.

Aortic aneurysm
In the setting of abdominal aortic aneurysm (AAA) and thoracic aortic aneurysm, CTA has assumed a dominant role both in the diagnosis and evaluation for treatment. This technique can determine the extent of the aneurysm and involvement of renal and mesenteric vessels, which allows precise planning for either endovascular repair or judicious use of open repair when anatomic criteria are not met. In the preoperative setting, duplex is best utilized for follow-up to check size and growth of small aortic aneurysms. After endovascular aortic aneurysm repair, CTA is required every 6 months to 1 year to rule out endoleaks or graft migration. Growth of the excluded aneurysm sac measured by calculating its volume may happen before an endoleak is directly identified. Duplex scan often complements CTA in identification of sac growth and specific type and location of an endoleak. CTA is also important in follow-up after open AAA repair to identify pseudoaneurysms and aneurysmal degeneration of nearby aortoiliac arterial segments.

In the setting of femoral artery pseudoaneurysm after arterial puncture, duplex has a unique role in both diagnosis and treatment. A pseudoaneurysm is basically a hematoma overlying an arterial puncture that has failed to seal due to either inadequate pressure over the site or impaired clot formation. Once the pseudoaneurysm is found by duplex, the transducer probe is placed directly over the pseudoaneurysm. Thrombin, an enzyme responsible for the final stages of clot formation, is then injected directly into the aneurysm sac, inducing clot formation and providing successful non-invasive treatment. Success has been reported in 95% of patients. This treatment has also been used for brachial, axillary, and splenic artery pseudoaneurysms.

Deep vein thrombosis
In the setting of deep vein thrombosis (DVT), duplex is the diagnostic procedure of choice. It provides ready identification of the extent of the clot as well as its location. Distention of the vein, lack of or poor compression of the vein, and the presence of a filling defect or clot on duplex all aid in the diagnosis. Duplex can also aid in the differentiation of acute and chronic DVT.

DEPEND ON SMART CHOICES AND ACCREDITATION
Duplex scan and CTA are each important in the diagnosis of common vascular problems. Both studies are less invasive than contrast angiography and venography. The clinical situations described here by no means cover all of the uses of duplex and CTA. New uses continue to be found for these tools, giving rise to more ways to less-invasively diagnose (and in some instances, treat) vascular disease. It is important to remember, however, that accreditation of a vascular lab is necessary to maintain the standards required for the accurate performance and reporting of non-invasive vascular lab tests.
RECOGNIZING
Peripheral Arterial Disease

Paul B. Kreienberg, MD

Many people are familiar with the terms “heart attack” and “stroke.” Both are serious manifestations of hardening of the arteries, affecting the heart and the brain.

When enough fatty material builds up inside an artery to cause narrowing, it is then called a plaque. It is these hardened plaques that produce heart attacks and strokes.

A less-recognized problem occurs when plaque builds up in the leg arteries. Peripheral arterial disease (PAD) reduces blood flow to the legs, causing pain and numbness at rest. Sometimes pain will only occur with walking. In severe situations the loss of circulation may lead to tissue death (gangrene), resulting in the need for amputation.

WHAT ARE THE SYMPTOMS?
Signs of PAD include pain in the legs with walking, cramping in the thighs or calves, loss of pulses in the feet, decreased skin temperature, and poor nail or hair growth on the legs.

WHO IS AT RISK FOR PAD?
Your odds of developing PAD increase with age. Other major risk factors include smoking, diabetes, high blood pressure, and a history of heart attack or stroke.

A large study showed that patients who were more than 70 years old, or more than 50 years old with any of the other risk factors, had a 30% chance of being diagnosed with PAD.

WHY IS IT IMPORTANT TO KNOW ABOUT PAD?
PAD can lead to pain and possible limb loss—but it can also be deadly. Patients with PAD have the same increased risk of heart attack and stroke as someone who has already sustained either of these life-threatening emergencies.

WHAT TREATMENTS ARE EFFECTIVE FOR PAD?
Treatment for PAD is really two-fold. First, therapies are available to improve leg symptoms. Exercise, medication, and occasionally bypass surgery or angioplasty can be used to improve circulation.

More importantly, other steps must be taken to reduce the risk of heart attack and stroke. These include smoking cessation, controlling diabetes, decreasing blood pressure, controlling cholesterol, and possible use of anti-platelet medicines such as aspirin or Plavix.

The process of reducing your risk of serious complications from PAD starts with recognition of the disease. Your doctor can determine if you have PAD and what treatments you might need.
An aneurysm is a progressive weakening and ballooning of a blood vessel that, if not diagnosed and treated, can lead to rupture and death.

There is no medical treatment that can reduce the size of an abdominal aortic aneurysm (AAA) or halt its growth. Surgery is the only available remedy once an individual has been diagnosed with AAA, and it is absolutely necessary to prevent rupture when an aneurysm begins to cause symptoms or reaches approximately 5-5.5cm in size.

Unfortunately, even in the 21st century, AAAs mostly go undiagnosed and are usually discovered incidentally. Each year 30,000 Americans die from a ruptured AAA or from complications related to aortic surgery.

RISKS AND SCREENING

Although these aneurysms are more common in men, their overall incidence increases with age. In the United States, the chances of having an AAA are 5% at age 60 and 9% at age 79.

Recently, the United States Preventative Services Task Force reported that AAA screening reduced aneurysm-related death by 43%. In January of 2007, Congress passed the Screening Abdominal Aortic Aneurysms Very Efficiently (SAAAVE) Act, which provides Medicare coverage of ultrasound examination for detection of AAA in certain populations.

TREATMENT

Once diagnosed, AAA treatment is based on aneurysm size and the patient’s risk profile. Once the aneurysm reaches 5cm in size, the risk of rupture increases. The 1-year rupture rates can be as high as 11% for AAAs that measure between 5cm and 5.9cm, and up to 26% for AAAs as large as 6cm to 6.9cm.

Vascular surgeons currently offer several options for treating AAAs, including open surgery as well as less-invasive endovascular repair. The right treatment is determined by a detailed and thorough evaluation of the patient and all risks and benefits of either procedure. The ideal treatment for some patients can be minimally invasive endovascular care, while others are better suited for the standard surgical approach.

Surgical treatment

Surgical treatment of AAA involves entering the abdominal cavity under general anesthesia. The abdominal aorta is controlled by clamping it closed above and below the AAA. The surgeon uses a synthetic graft (an artificial aorta) to replace (bypass) the section containing the aneurysm.

The operation usually takes 3 to 5 hours and in appropriate patients the procedure is relatively safe. There are some risks, however, including an approximately 15% chance of overall complications and a 2-3% chance of death.

Most patients recover in the hospital for 5-7 days and require some physical therapy. The majority of patients return to their normal activities within 2-3 months.

Endovascular treatment

Endovascular treatment of AAA is a minimally invasive alternative that can be performed under general or local anesthesia. The surgeon gains access to the aorta by making two small incisions in the groin area and introducing a narrow sterile tube called a catheter.

A prosthetic graft is then delivered to the site of the aneurysm and anchored in place above and below the AAA. This procedure usually takes only 1-2 hours and is generally associated with fewer complications than open surgical repair. There is a 5% chance of overall complications, and 0.5% chance of death. Most patients recover in the hospital for 1-2 days and return to normal baseline activities within 2-4 weeks.
What often starts out as painful legs and feet can sometimes progress to advanced hardening of the arteries in the legs.

Peripheral arterial disease (PAD) can lead to critical limb ischemia, which is marked by foot or leg pain at rest, non-healing sores, and gangrene. If left untreated, this progressive form of PAD can lead to amputation and limb loss.

The major causes of critical limb ischemia are similar to those for the underlying PAD: smoking, high blood pressure, high cholesterol, diabetes, and obesity. The diagnosis can be easily made through a detailed history and physical examination, plus a few simple non-invasive tests such as pulse volume recordings (PVR), ultrasound, computed tomography (CT) scans, and magnetic resonance angiography (MRA). Prompt diagnosis and treatment are vital to prevent worsening of the condition and possible amputation.

There are a number of treatment options for critical limb ischemia:

• Surgical bypass around the blocked arteries has been the gold standard for treatment of critical limb ischemia. This treatment uses the patient’s own vein or a prosthetic tube to bypass the blockage.
• Minimally invasive endovascular procedures such as angioplasty and stenting now offer alternative options for treating critical limb ischemia in select patients.
PREVENTING STROKE
by Treating Carotid Blockage

Dhiraj M. Shah, MD

Stroke is usually caused by blockage or rupture of one or more blood vessels in the brain, most commonly an artery.

There are certain known risk factors for stroke: being of advanced age, obese, or a smoker; having atherosclerosis (hardening of the arteries), heart disease, diabetes, or high cholesterol; and certain genetic factors. Other conditions that increase stroke risk include high levels of blood homocystine and clotting abnormalities.

More importantly, a buildup of plaque within the carotid (neck) artery can cause narrowing or blockage leading to stroke. Embolization—clots that travel to the brain and block small blood vessels there—can also result in stroke.

WARNING SIGNS
Classically, there are five warning signs that signal the possibility of stroke:

1. Sudden loss of balance
2. Severe headache
3. Sudden temporary or permanent loss of vision in one or both eyes
4. Sudden numbness or weakness of one side of the body or one arm or leg
5. Slurring of speech

The eye is a part of the brain; therefore, any sudden eye ailment should also be recognized as a possible sign of stroke.

Despite the list of warning signs, stroke may also happen silently: One out of 10 patients may not even notice that they have had a stroke. It is important to recognize subtle signs of stroke because the event may cause loss of function in the future, be a warning sign of a more serious event to come, or could affect some cognitive aspects of the brain. Once stroke happens, it should be investigated by various tests and treated, if possible.

Obviously, the best “treatment” is prevention. You can take steps to avoid stroke by not smoking, exercising regularly, eating a low-fat diet, and, if necessary, taking cholesterol-reducing medications, controlling high blood pressure and diabetes, and treating any abnormal blood clotting. In addition, your doctor may recommend one low-dose aspirin a day and possibly the anti-clotting drug Plavix (clopidogrel).

TREATING ATHEROSCLEROSIS
Four main vessels supply the brain with blood: two carotid arteries (left and right) and two vertebral arteries. Perhaps the best way to protect the brain from stroke is to treat atherosclerotic disease of the carotid artery. Cases of atherosclerosis (plaque buildup) and stenosis (blockage) of the carotid artery are second only to heart disease. Regardless of symptoms, if a person’s carotid artery is clogged with plaque by 60% or greater, treatment is required to prevent stroke. The mainstay treatment for carotid artery blockage today is surgery.

Surgical treatment of carotid artery disease is done using carotid endarterectomy. In this procedure, the surgeon opens the artery, removes the offending plaque, and sews the artery back together. Once the surgery is complete, the blood vessel is returned to normal and is 100% open, thus reducing the risk of stroke due to blockage.

There are various ways of performing carotid endarterectomy. The procedure is usually done under local or regional block anesthesia, similar to what a dentist would use when performing dental work. This is safer for the patient, who is awake throughout the procedure. When blood flow in the diseased vessel to the brain is temporarily stopped, the physician can ask the patient to move or talk, ensuring safety and a good outcome.

A surgical technique called eversion carotid endarterectomy is commonly used. At the point where it branches, the carotid artery is peeled back over the plaque, like opening a banana. The plaque is removed from the artery walls and the artery is then pulled back down and sewn onto a larger blood vessel called the normal common carotid artery. The actual operation of removing the plaque takes approximately 10 to 15 minutes. During this time, blood flow through that artery is temporarily shut off and three other vessels take over supplying the brain with blood. (Article continues on next page)
During surgical treatment for carotid artery disease, the surgeon makes an incision in the neck to remove the plaque blockage.

A blocked carotid artery can also be opened using a stent delivered through a catheter that is inserted in a small groin incision. The mesh-like tube of the stent holds the artery open and restores blood flow.

The entire operation including anesthesia takes about 1 hour to perform. The patient stays in the hospital overnight and goes home the next morning. The incision is usually only 2 to 3 inches long, and the suture material is removed before the patient leaves the hospital. Recuperation takes about 2 weeks; during that time, patients are required to maintain their blood pressure at a predetermined healthy level.

Blockage of the carotid arteries can also be treated by placing stents inside the carotid artery that open the narrowing. The procedure is usually done with local anesthetic. The stent is inserted through a small incision in the femoral artery in the groin and, with X-ray guidance, is delivered through a narrow tube to the carotid artery in the neck. During the procedure a small filter is placed inside the artery to catch any debris that might break away from the blockage and reach the brain, potentially causing a stroke.

Carotid stenting usually takes less than an hour and recovery is quick; patients are hospitalized for 1 day and usually return to normal daily activities within a week. Similar to surgical repair of the carotid arteries, following the procedure, patients are required to maintain their blood pressure at a predetermined healthy level. The United States Food and Drug Administration (FDA) has approved several carotid stents that are not drug-coated for use in certain high risk patients.

RISKS AND BENEFITS

The overall risks of carotid endarterectomy or carotid stenting are small compared to any other major surgery in a patient with atherosclerosis. Since atherosclerosis is the main reason for carotid artery disease, the main risk is heart attack or stroke due to the stress of surgery or stenting, which may happen in 1% of cases.

After endarterectomy, the risk of plaque returning in the carotid artery is less than 2% over a 5-year period.

The vast majority of the time, however, the operation goes smoothly and the patient is free of future risk of stroke related to carotid blockage. After endarterectomy, the risk of plaque returning in this artery is less than 2% over a 5-year period. This technique is considered a very durable procedure.

As for carotid stenting, this technique has evolved over the past decade. Since it is a relatively new procedure we don’t know its long-term durability, but early results are promising. With the help of physicians, the FDA has established certain guidelines for carotid stenting patient selection, which include: 1) patients with symptoms of minor or major stroke with more than 70% carotid artery blockage, 2) patients considered high risk for carotid endarterectomy by the surgeon who performs the procedure, and 3) patients without any symptoms of stroke. These patients can have carotid stenting as part of ongoing FDA-approved clinical trials.

Following carotid surgery or stenting, the patient’s arteries are monitored by duplex ultrasound exam at various intervals, usually once a year. Ultrasound is the standard test for monitoring and diagnosing carotid artery disease. The procedure is painless and relatively quick, requiring 30 minutes to one hour. If there is any question about the ultrasound result, which may happen in 5% to 10% of patients, further tests may be necessary.

In people with some carotid artery disease who are not at high risk for atherosclerosis, ultrasound should be repeated every year. Those with a high risk for atherosclerosis should undergo ultrasound more frequently. All people over 50 years of age should be checked periodically for carotid artery disease by stethoscope or by ultrasound.

All in all, stroke is a preventable disease. In addition to reducing risk factors as previously discussed, carotid artery disease is treatable. Patients should, therefore, be aware of their risk and, if necessary, be treated.
TREATING
Thoracic Aortic Aneurysm

R. Clement Darling, III, MD

The thoracic aorta is the large artery that leads from the heart and extends across the inside of the chest. An aneurysm can occur when a section of this important artery weakens and expands, becoming dilated.

The thoracic aorta normally measures around 3cm. As the aorta swells to near twice normal size, the risk of rupture increases. Treating patients before an aneurysm ruptures is crucial, because 90% of those who experience a ruptured thoracic aneurysm will die.

Today, there are many treatments available for thoracic aneurysms, including open surgery and newer, minimally invasive procedures.

THE OPEN REPAIR OPTION
Open repair of aneurysms in the thoracic (chest) or thoracoabdominal (belly) areas involves surgically entering the chest and/or abdomen, clamping off the arteries above and below the aneurysm, and sewing a synthetic tube into the aorta to replace the section that contained the aneurysm. In patients with thoracoabdominal aneurysms, surgical bypasses to the celiac artery, superior mesenteric artery (SMA), and both renal arteries may be necessary. These operations are extremely complicated; 10% to 20% of patients may not survive, even in elective situations. Open surgery also brings a risk of paralysis, bowel death (ischemia), and kidney failure.

AVOIDING OPEN SURGERY
Fortunately, the development of endovascular “stent-graft” technology allows us to use minimally invasive techniques to treat thoracic and some thoracoabdominal aneurysms. These procedures require only a small incision in the groin, through which a physician uses a narrow tube to deliver a tiny, cage-like stent to the affected area. The stent is fixed above and below the thoracic aneurysm and is expanded in place, where it acts as a scaffolding to hold the artery open.

Before planning any intervention, whether surgical or endovascular, it is important to get a precise anatomic picture of the extent of the aneurysm. Specialized scans with three-dimensional imaging will help the physician to decide whether the patient is physically suitable for an endovascular procedure. An angiogram (imaging taken while the artery is injected with dye) may also be necessary to learn more about the extent of the aneurysm and the condition of the other arteries involved.

STENTING BRINGS GOOD RESULTS
Using endovascular technology to repair thoracic and thoracoabdominal aneurysms brings excellent results, with mortality rates less than 5% and an equally small number of other major complications. Endovascular repair of thoracic aneurysms does not usually require extensive hospitalization. Most importantly, perhaps, these minimally invasive procedures do not require a large incision in the chest, providing patients with a much shorter and easier recovery.
Intermittent claudication causes pain in your legs when you walk that is generally relieved when you rest. The condition results from an insufficient amount of blood reaching the muscles of your legs.

The most common cause of such poor circulation is atherosclerosis, or hardening of the arteries. This buildup of plaque (a mixture of fat, cholesterol, and other substances), affects 1%-2% of people under 60 years old and more than 5% of those older than 70.

The major causes of atherosclerosis (and claudication) are smoking, high blood pressure, high blood cholesterol levels, diabetes, obesity, sedentary lifestyle, and being more than 50 years of age. To diagnose claudication, your physician will first perform a history and a physical examination, paying particular attention to your feet, noting the pulses, color, and temperature. Your doctor may then order other tests depending on your potential need for treatment. The most common tests include:

- Ankle-brachial index (ABI) to compare the blood pressure in your arms and legs.
- Pulse volume recordings (PVR) to measure the blood volume at various points in your legs.
- Arterial duplex ultrasound to acquire pictures of your leg arteries using sound waves.
- Blood tests to reveal your levels of cholesterol, blood sugar, and other markers for atherosclerosis.
- Magnetic resonance angiography (MRA) to generate images using a magnetic field and a computer. MRA may or may not require an injection of contrasting dye.
- Computerized tomographic angiography (CTA) is done with special computerized equipment. A contrast dye injection is usually necessary.
- Angiography employs a catheter to inject contrast dye very close to the problematic artery segment so it can be clearly viewed on an X-ray.

**THE SPECTRUM OF TREATMENT**

Of the many treatments your physician may prescribe, the most important, regardless of the severity of your symptoms, are lifestyle changes. These important first steps include:

- Stopping smoking.
- Exercising regularly (at least 30 minutes a day, 5 days a week).
- Losing weight if you are overweight.
- Eating a healthy diet.

If your cholesterol is too high, your physician may prescribe a variety of cholesterol-lowering medications, the most common of which are known as statins. There are also specific medications approved for claudication, such as cilostazol (Pletal) and pentoxifylline (Trental). Under your physician’s supervision these medications may be useful and allow you to walk significantly farther without leg pain.
If lifestyle changes and medication do not adequately treat your intermittent claudication, your vascular physician may then recommend more invasive treatments. These generally fall into two categories.

**Endovascular procedures**

Angioplasty involves inserting a small plastic tube into your blood vessel and then delivering a tiny balloon that can be inflated to widen the narrowed or stenosed artery. Depending on the location of your blockage, your vascular physician may also insert a stent, a small metal mesh tube that can hold the blood vessel open, like a scaffold. Endovascular treatments can generally be done as outpatient procedures in a hospital or a vascular facility.

**Vascular surgery**

If angioplasty or stenting is not feasible for you or has failed before, your vascular physician may recommend surgery. This usually involves making an incision over the diseased blood vessel and bypassing the segment by surgically attaching a piece of your own vein or a length of artificial blood vessel.

**ASK ABOUT LEG PAIN**

Claudication is more than just a “pain in the leg”—it can be a sign of a more serious condition affecting your arteries. If you have leg pain, let your physician know. It may save not only your legs, but also your life.

Non-invasive testing such as pulse volume recordings measures blood volume in the legs and can help to diagnose claudication.
In 1999, Roseanne, a 60-year-old emergency medical technician (EMT), was driving an ambulance, delivering a patient to the local emergency room (ER), when she developed shortness of breath.

Thinking she had an upper respiratory infection, Roseanne asked the ER physician to prescribe an antibiotic for her. The doctor instead ordered a chest X-ray and found an ascending thoracic aneurysm, a dangerous ballooning of part of the abdominal aorta, the body’s central blood pathway. She had no other warning signs and no family history of aneurysms.

Roseanne still remembers receiving the news. “I was in shock. When I heard the diagnosis, all I could say was, what’s an aneurysm? I have heard a lot of medical terms, but I just couldn’t process the word ‘aneurysm.’”

To prevent a life-threatening rupture, the aneurysm was treated with an “open” surgical procedure. In open repair, a surgeon carefully removes the weakened, balloon-like aneurysm and sews a synthetic (man-made) graft in its place. This major surgical procedure involves a large incision and an extended recovery time.

Roseanne became depressed after the procedure. “I lost my smile. Everything was serious in my life. I had been a happy person before the surgery; I laughed all of the time. It took me a year to get my smile back.”
HISTORY REPEATS ITSELF
In 2003, Roseanne was diagnosed with an aneurysm located in a lower section of her abdominal aorta. Again, she had not experienced any symptoms; this lack of warning signs is exactly what makes aneurysms so dangerous. Roseanne underwent open surgery once more.

SHE HAD NOT EXPERIENCED ANY SYMPTOMS; THIS LACK OF WARNING SIGNS IS EXACTLY WHAT MAKES ANEURYSMS SO DANGEROUS.

A friend suggested that Roseanne listen to relaxing music in order to help prevent the depression she experienced after the first procedure. Roseanne said the music got her through the surgery and helped her recovery process, which was much quicker and free of depression.

LIFE-SAVING TREATMENT
In 2004, Roseanne suffered another major health crisis. She had finished her shift in the ER and was ready to go home. “I got into my car, and all of a sudden I developed chest pain and couldn’t move my arms,” she said. “People were walking by my car but I couldn’t get their attention. I don’t know how I got the car door opened, but I did. I yelled for help and a woman who worked for the hospital heard me and got me back to the ER.”

Roseanne had an aneurysm rupture, a life-threatening emergency. Open surgical repair was no longer an option, so she was taken by ambulance to Albany Medical Center Hospital. There, Manish Mehta, MD, of The Vascular Group performed a minimally invasive endovascular procedure to repair the aneurysm and save her life. Endovascular aneurysm repair is done without a major surgical incision; the treatment is performed through a narrow tube inserted in an artery in the groin area. Success rates are high and recovery is much faster than with traditional open surgery.

Roseanne’s vascular story doesn’t end there. She was followed regularly by the surgeons of The Vascular Group, and, because of their diligence and her compliance, a third aortic aneurysm was discovered in 2007. Roseanne had another successful endovascular repair and went back to work 2 weeks later.

TAKING CARE
Roseanne never thought she would have vascular disease and now knows that most people who have an aneurysm do not experience symptoms. But monitoring your health and avoiding bad health habits can reduce the risk for aneurysms.

“I would advise people to keep an eye on their blood pressure and get it checked periodically,” she said. “Looking back, my blood pressure had started to go up even before my first aneurysm.”

Roseanne was also a heavy smoker. “When I was younger, we didn’t know that smoking was bad for you. I smoked a pack of cigarettes a day for 25 years,” she said. “It wasn’t until I had my second aneurysm surgery that I decided to quit. It’s been 5 years now.”

Despite her successful recovery, Roseanne still has fears. “I get nervous when I go too far from the doctors of The Vascular Group,” she said. “They saved my life.” And her health status places limits on her lifestyle. Continued trouble due to a collapsed lung after her third surgery makes walking difficult.

“I also can’t travel to Utah, one of my favorite places,” she said. The altitude and decreased oxygen prohibit her from going. Roseanne is also reluctant to spend time alone with her young grandson, because of fears that something could happen to her again as it did in the past.

Roseanne continues to work in the local ER 2 days a week. She uses music to relax and manage the stress in her life. And she is thankful to be alive and to have her smile back.

- by Sharon Cillis, RN
UNCOVERING THE RISK
for Aortic Aneurysm

John B. Taggert, MD

Arterial aneurysms occur when a weakened blood vessel wall stretches well beyond its original diameter.

Unfortunately, the initial expanding process does not cause any symptoms; people with aneurysms rarely realize anything is wrong. To make matters worse, more than half of aneurysms are not detected during routine doctor visits. Too often the first sign of a problem is life-threatening rupture – a crisis that could have been avoided had the aneurysm been detected earlier and managed appropriately.

It is important to identify people at increased risk of developing an aneurysm. A variety of non-invasive tests can confirm the suspected presence or absence of an aneurysm.

MAJOR RISK FACTORS
Smoking, age, male gender, and family history are the most common risk factors associated with aortic aneurysms. Smokers are up to seven times more likely than nonsmokers to develop an aortic aneurysm. Unfortunately, ex-smokers still carry an increased risk of having an aneurysm – up to three times that of never-smokers.

Aneurysms are more common among older patients; it is estimated that 2% to 8% of people over 60 years of age harbor the condition. By contrast, aortic aneurysms are very rare in people under 50.

Men are two to five times more likely to develop an aortic aneurysm than are women. And people diagnosed with an aneurysm often have a first-degree relative (a parent, sibling, or child) who has also had this problem. If you have a close relative with an aortic aneurysm, your risk of developing an aneurysm during your lifetime is between 10% and 20%.

OTHER RISKS TO WATCH FOR
A number of other risk factors are also associated with aortic aneurysm. Hypertension (high blood pressure) is common among people with a variety of vascular problems, including aortic aneurysm. It is not clear if blood pressure medication can reduce the risk of aneurysm expansion, but given the many health benefits of blood pressure control, it is probably a worthwhile treatment. Atherosclerosis is also often associated with aneurysm, but does not appear to be a direct cause. Hyperlipidemia (high cholesterol) may play a minor role in aneurysm formation. As with blood pressure, treating high cholesterol has a number of health benefits and should be pursued in people known to have aneurysm. Traumatic injuries, infections, and connective tissue disorders can also lead to aneurysm.
Several non-invasive imaging techniques are useful when an aortic aneurysm is suspected. Ultrasound, computed tomography (CT) scan, and magnetic resonance imaging (MRI) each can provide essential information, including the diameter of the blood vessel in question and the location of an aneurysm, if present. Ultrasound is often used as the first test. The advantages of ultrasound include accuracy, low cost, and widespread availability (including right in many physician offices). In addition, ultrasound does not expose the patient to radiation and can be performed in a regular exam room—no claustrophobic scanning tunnel required. The test is performed by a technician holding a probe against the skin of the abdominal wall at several locations; it typically takes less than 15 minutes. Ultrasound is often used in screening programs and also to follow patients who have small aneurysms that do not need immediate repair.

CT scan and MRI provide more detailed anatomical information about an aneurysm than ultrasound. These two tests are especially useful when ultrasound images are inadequate. CT scanning is presently the gold standard test used for planning repair of an aortic aneurysm and can help to determine the best type of treatment. A form of MRI known as magnetic resonance angiography (MRA) can also be useful for aneurysm detection. MRA is not the test typically used to plan for aneurysm surgery; however, it can detect smaller aneurysms that may arise from side-branch blood vessels of the aorta. MRA also can show blood vessel blockages that may influence treatment.

Once an aneurysm is repaired, patients are typically followed for life, with regularly scheduled imaging tests involving one or a combination of the above techniques.
Following the tragic events of September 11, 2001, the US military became engaged in two major conflicts abroad, first in Afghanistan and later in Iraq.

These wars, dubbed Operation Enduring Freedom and Operation Iraqi Freedom, respectively, have involved hundreds of thousands of military personnel and civilians and resulted in more than 4,000 fatalities and tens of thousands of casualties. The broad range of injuries encountered strained the military medical complex, particularly because of the limited numbers of active duty medical specialists available. Volunteer practitioners have proved crucial to providing vascular care.

THE EVOLUTION OF VASCULAR TREATMENT
Treating vascular injuries has long been a fundamental element of trauma care on the battlefield. During World War II amputations were a routine part of life-saving treatment for vascular injury. Later wars have led to advances that were refined in civilian hospitals. Beginning with the MASH units in the Korean War (popularized by the famous sitcom of the 1970s), vascular repairs were performed in the field. The spectrum of wartime vascular injuries and the parallel evolution of vascular surgery were documented during the Vietnam conflict by Norman Rich, who instituted the Vietnam Vascular Registry. Vascular care was shaped even further in the ensuing years.

VOLUNTEERS PROVIDE CARE IN TODAY’S CONFLICTS
The US military has had a limited number of active duty vascular surgeons available for service during the most recent conflicts. Even with the participation of reservists, not all needs for vascular care have been met. The members of the Society for Vascular Surgery (SVS), in conjunction with the American Red Cross, agreed to organize volunteer rotations at Landstuhl Regional Medical Center (LRMC) in Germany as a way to provide vascular care to injured soldiers evacuated from the theaters in the Middle East.

Soldiers injured in combat are generally treated by forward surgical units before they are transferred to combat support units, and ultimately to the main hospitals in each theater. The initial group of practitioners might include vascular surgeons or general surgeons with some vascular experience; however, the main hospitals in Bagram (Afghanistan) or Balad (Iraq) have vascular surgeons ready to treat wounded personnel. Most often, these practitioners undertake the initial life-saving procedures as well as those aimed at limb preservation with the necessary critical care.

THE LANDSTUHL EXPERIENCE
LRMC is the largest American military medical facility outside the United States. It is located adjacent to the Ramstein Air Force Base, an expansive NATO facility serving numerous member nations. During times of peace, it provides care for American military personnel in Europe and their families. Since the start of the Afghan and Iraq wars, LRMC has been the primary destination for American and allied evacuees from Iraq and Afghanistan. The contemporary facilities provide critical care with the availability of specialists, as well as physical therapy, psychiatry, and rehabilitation.
As a vascular surgeon volunteer during the first half of September 2008, I worked as a consultant vascular surgeon as well as part of a critical care team. The surgical staff included general surgeons with critical care backgrounds as well as orthopedic surgeons, urologists, otolaryngologists, and a neurosurgeon. The plastic surgery presence was noticeably limited.

General surgeons fluctuated in number, with some leaving for days at a time for military exercises with their units. Critical care pulmonologists were vital members of the team. Flight surgeons coordinating evacuation to Landstuhl and back to the continental United States also participated. Rounding out the medical team were trainees from Walter Reed Army Medical Center including a critical care fellow and a resident in internal medicine.

A computer system connects LRMC to US hospitals, allowing access to written records and procedure reports. Imaging studies are also accessible, allowing for comparison of studies over time.

The injuries we encountered were predominantly blast injuries from improvised explosive devices (IEDs), direct penetrating wounds from gunfire, burns, head trauma, and even mustard exposure. As a result, there were numerous amputations, complex soft-tissue injuries, abdominal explorations, and repair of fractures. Vascular expertise was required to prevent venous thromboembolic disease through the placement of filters, to conduct angiography to assess ischemic extremities or neck injuries, for occasional extremity revascularization, and to assess a variety of intraoperative wounds.

THE ROUTE HOME
Our treatment goals included ongoing resuscitation and stabilization, pulmonary care, infection prevention, initiating nutrition, and preparing patients for transfer home. In the course of my rotation at LRMC, we cared for soldiers from a variety of nations including Canada, Poland, Australia, and Romania, perhaps reflecting a shift in casualty origin from Iraq to Afghanistan.

For US military personnel, flights home would generally depart twice weekly back to Walter Reed Army Medical Center for the majority of patients. Those suffering from burns would most often be sent to the Brook Army Medical Center, a recognized leader in burn care. Liaison medical officers from other allied forces would arrange transfer for their soldiers as well.

All of the practitioners I encountered in the course of my stay at LRMC expressed profound gratitude for the time they spent as military volunteers. This thankfulness was echoed by everyone I’ve met since my return—from patients to complete strangers. In fact, this experience has been both enriching and humbling. I remain in debt to those dedicated servicemen who are in harm’s way daily, as well as to the focused team of caregivers at LRMC and here in the United States.
Kidney failure is becoming common among elderly Americans. It is associated with diabetes, high blood pressure, and other ailments common in the aging population.

As the condition of the kidneys deteriorates, life-sustaining treatment to replace the lost kidney function is needed. This generally involves dialysis treatments, though in some patients, kidney transplant is possible and can end dependence upon dialysis.

Dialysis is a mechanical method of cleaning the blood when the kidneys are no longer able to do the job. It is necessary to clean all of the blood at each treatment, rather than just a portion of the patient’s bloodstream. Patients undergo dialysis for about 3 hours at a time and receive three sessions each week. The frequency of treatment means that there must be a reliable way to access the bloodstream. Establishing dependable, high-volume access involves the expertise of vascular surgeons.

Making a connection

The best form of access for dialysis patients is known as an arterial-venous fistula. This is a connection between an artery and a vein, generally constructed in the arm just under the skin. In most patients this can be constructed without the need for artificial materials. The surgeon creates a connection, or anastomosis, between the patient’s artery and vein, in order to send large volumes of blood flow through a vein just under the skin. The outpatient procedure does not require an overnight hospital stay. Many patients do not need general anesthesia and there is typically little postoperative pain.

Before the procedure, the patient’s arms are examined with ultrasound. This helps to identify an optimal location for creation of the fistula. Using this information, a successful fistula can be achieved in almost all patients. Ideally, the fistula will remain open and flowing for an extended period of time (months, years, or even decades).

Planning Ahead

After the fistula is created, most patients need a period of 2-3 months before the fistula is ready for use. The extra time allows the veins to increase in size and ability to carry the increased blood flow before beginning dialysis. For this reason, kidney doctors generally send patients to vascular surgeons well before dialysis is needed. The construction and maturation of a fistula prior to the actual need for dialysis simplifies the patient’s life. Patients who need dialysis but do not already have a fistula will require treatment through a large IV catheter in the neck (followed by construction of a fistula).

Use and Care Are Key

After the fistula is created blood flow can be heard there with a stethoscope and often can be felt with the fingers (it creates a buzzing sensation known as a “thrill”). Exercise and use of the hand and arm are considered helpful, as they promote blood flow and growth of the fistula. Needles, IVs, and blood pressure cuffs should be avoided in the arm containing a fistula in order to avoid any injury to the fistula.

The fistula always changes the blood flow pattern in the arm and directs some blood flow through the fistula rather than to the hand. In a few patients that hand will feel numb or cool. This is rarely a serious problem and can be addressed through additional procedures to normalize the blood flow.
UNDERSTANDING
Vein Disorders

Kathleen Juliette Ozsvath, MD, and Stephanie S. Saltzberg, MD

The network of veins throughout the body (the venous system) is responsible for returning circulated blood back to the heart.

Muscle contractions in the legs help “push” blood from the deep venous system against gravity toward the central venous circulation. Veins have tiny, one-way valves to keep blood flowing in one direction. If these valves become damaged, the flow slows and blood pools within the veins. This process causes the veins to become engorged with blood, which can lead to fluid seepage through the veins and out into surrounding tissues.

Problems with the venous circulation can lead to skin conditions ranging from mild to serious. Generally, spider veins are cosmetic in nature. These bluish-purple veins are located in the superficial layers of the skin and subcutaneous tissues. Varicose veins, abnormally enlarged veins found under the skin, affect 25% of the population in the United States. Risk factors include female gender, advancing age, pregnancy, genetics, obesity, and prolonged stress on the venous circulation, such as long periods of sitting or standing. Symptoms of varicose veins can include burning, itching, swelling, and throbbing near the engorged veins, particularly at the end of the day. Sometimes blood within the varicosities can clot, leading to a painful inflammation called phlebitis. Patients with prolonged elevated venous pressures can present with skin color and integrity changes, usually in the ankle region. In the most severe situations ulcers can form, which can be difficult to treat. In addition, rare venous conditions that are present at birth can also lead to significant circulatory disorders.

DIAGNOSIS
A physician will diagnose venous disease by taking a combination of patient history and family history, conducting a physical exam, and ordering imaging studies to evaluate blood flow. Ultrasound is regularly used to examine veins for blockages, also known as deep vein thrombosis (DVT). Ultrasound can also check the condition of the valves within the superficial, deep, and perforator veins. Occasionally, other imaging studies such as CT scan, MRI, or conventional venography may be helpful.

FIRST-LINE TREATMENT
At this time, there are no FDA-approved medications to directly treat venous disease. The main approach to addressing venous disease is compression, often through the use of graded compression stockings or with the use of compression wraps that are placed under a doctor’s care. Leg elevation and weight control are other key components of treatment. (ARTICLE CONTINUES ON NEXT PAGE)
**ADVANCED TREATMENT**

There are also medical procedures that can help, depending on the underlying condition. In patients with spider veins or varicosities without superficial or deep venous reflux, injection sclerotherapy can be utilized. This treatment intentionally scars the veins closed, ultimately making them less noticeable and less painful. For those patients with superficial vein reflux, treatment can include actually removing the veins from the circulation. Technological advances allow us to treat these varicose veins with venous ablation, a minimally invasive in-office procedure using either laser energy or radiofrequency. These newer treatments allow patients to return to work quickly and suffer less pain. Ambulatory microphlebectomy can also be performed in the office, in addition to venous ablation, to remove superficial varicosities with few complications and minimal postoperative discomfort. Traditional surgical techniques (vein stripping, ligation, and phlebectomy) are still an option but are rarely employed.

Abnormally enlarged veins affect one out of four people and can cause swelling and pain.

Preparation for ambulatory microphlebectomy, an outpatient procedure for varicose and spider veins, involves washing the affected leg with iodine.
THE FUTURE of Vascular Care

William John Byrne, MD, MB, BCh, BAO, MCh, FRCSI (GEN)

This year marks the sixtieth anniversary of the first successful leg artery bypass operation. Performed in 1948 by French surgeon Jean Kunlin, this procedure marked a huge medical breakthrough.

Prior to that time, treatment of severe arterial blockages of the leg had been limited to major limb amputation (effective, but drastic) or removal of the nerves controlling the arteries (less drastic, but often ineffective).

The decade following brought the first successful surgical carotid artery repairs and abdominal aortic repairs. The 1950s also saw the development of synthetic materials that could be used to replace diseased arterial segments (“plastic” arteries).

Today, those open-surgery techniques, groundbreaking as they were, have been replaced by minimally invasive treatments. Using a single puncture hole, doctors can now insert tiny mesh-like stents to widen blocked blood vessels and replace stretched and weakened arteries. Arterial diseases are now diagnosed by non-invasive imaging techniques, such as ultrasound and computed tomographic scanning, which provide detailed pictures that allow for targeted therapy. For vascular surgeons in the 1960s and 1970s, such advances would have seemed thoroughly “space age.” For surgeons from the 1940s, such treatments would have been unimaginable. Given the advances of the last 60 years, we can only wonder how much farther this type of treatment can go.

BEST GUESSES

Scientific advances usually come from unexpected sources or from the introduction of a whole new technology. For example, improvements in home lighting came not from better lanterns but from the development of a reliable electricity supply and the invention of the incandescent light bulb. Advances in music storage and playback came not from bigger cassette tapes, better-quality vinyl, or even higher-capacity compact discs, but from the miniaturization of computer hard-drives in the form of pocket-sized MP3 players. It’s almost impossible to anticipate innovation, so the following are really only best guesses of where future developments may arise. The only certainty is that these guesses are probably wrong.

Possible prevention

While advances in medical treatment are very helpful, it would be even better to prevent vascular disease from arising in the first place. Population screening is becoming a reality in the United States, using ultrasound to detect aneurysms in patients who would otherwise be unaware of their condition. With advances in our understanding of DNA and the wealth of data from the Human Genome Project, we are also beginning to understand the genetics of vascular disease. Certain genes have already been identified in patients with abdominal aortic aneurysms, confirming the observations of vascular specialists that some families are susceptible to the condition. We already know that hyperactivity of certain enzymes in the aortic wall may cause aneurysms. Blocking these enzymes could allow us to halt aneurysm growth in its tracks – or perhaps even stop them from forming in the first place.

(Article continues on next page)
Growing more perfect replacements
Stem cells are cells that retain the ability to grow into any form of specialized cell. Stem cell research is certainly topical and occasionally controversial. This work is also the most likely source of major advances in vascular therapies. Today, when vascular surgeons need to bypass blocked arteries, we often harvest a vein from the patient’s own leg or arm. This often involves a long incision that may be slow to heal. In elderly patients, the harvested vein may be too small or too diseased to use, requiring the use of a plastic substitute artery. These synthetic tubes are more prone to infection and failure. In 2007, researchers at the University of Pittsburgh reported that they had engineered artificial blood vessels from muscle-derived stem cells and an absorbable polyurethane tube. The technique involves growing a patient’s own stem cells and then spraying them inside the polyester tube, which is stored until the patient undergoes bypass. Following surgery, the tube dissolves, leaving a new blood vessel composed solely of the patient’s own cells. As such, its performance ought to be as good as the patient’s own vein and definitely better than any plastic substitute.

A company called Humacyte, founded in 2004, reports another approach. Their technique involves taking cells from a tissue bank and placing them on biodegradable scaffolds shaped into tubes of different diameters. The cells deposit collagen, the protein that provides most of the strength of arterial walls. After 8 weeks, the cells are washed away, leaving behind tubes made of protein fibers. In theory, when implanted in humans the tubes should become lined with the patient’s own cells.

Getting better pictures
New imaging technology has changed vascular surgery as much as any other area of medicine. Computerized tomography (CT or CAT scanning) and magnetic resonance imaging (MRI) allow us to look at the structure of arteries and veins in precise detail. In the future, there are likely to be even further refinements in these tests, allowing even finer detail.

There is also the possibility of the development of totally different forms of imaging. Imaging specialists are excited about a technique called EPR (electron paramagnetic resonance) oximetry, which looks at oxygen turnover in tissues and provides information about tissue function as well as structure. EPR is still only in the earliest stages of development; however, one proposed use is in vascular patients with foot wounds. Determining oxygen levels in injured tissue could allow physicians to predict wound healing and the potential need for either stenting or bypass.

Keeping pathways clear
Stents have helped tens of thousands of Americans with arterial blockages. In most cases, these devices last for years without any problems. In some patients, however, scar tissue can develop around the stents – a process called neointimal hyperplasia. This overgrowth is caused when muscle cells that are present in all arterial walls move into the area and secrete proteins. Hyperplasia can require additional stent insertion or even bypass surgery. Already, stent manufacturers have created devices containing medication that can prevent this process (drug-eluting stents) and have even looked at using small doses of radiation therapy. The results so far have been mixed and the search continues for better treatments. Undoubtedly they will come, with benefits for patients as well as the lucky pharmaceutical company that finds the answer.

Stimulating vessel growth
Gene therapy for blockages in leg arteries has been studied since 1989. Instead of stenting or bypassing diseased arteries, physicians inject genes directly into the calf or thigh with the goal of stimulating the production of new arteries.

Progress has been slow. However, recent research from the University of Michigan and University of Pennsylvania with a company called MultiGene Vascular Systems shows promise. In their technique, a short segment of vein is removed from the patient’s arm using local anesthetic. Cells are removed from the vein, mixed with genes, and made into a clear injectable solution. The cell suspension is then delivered through the arteries via a catheter, directly to the site of the blockage in the patient’s leg. The mixture stimulates new blood vessel growth, a process called angiogenesis. In animals, signs of new blood vessels appear in about 4 weeks. Human trials are already starting on a drug called fibroblast growth factor, a protein that also stimulates blood vessel growth after direct injection into the leg.

Albert Einstein never even thought of the future, because “It comes soon enough.” We can only really be certain that the future is never what we think it will be.

The Journey Ahead
Baseball great Yogi Berra once famously said, “The future ain’t what it used to be.” Albert Einstein never even thought of the future, because “It comes soon enough.” We can only really be certain that the future is never what we think it will be.

For the most part, the predictions in this article will probably not come to pass. The future vascular surgeon may need to know more about genes and pharmaceuticals and less about stents and scalpels. Regardless of the specific nature of future treatments, I’m sure they will deliver continued improvements for vascular patients. Of course, our best hope is that vascular disease can be made a thing of the past. From here to there should be an interesting journey! 

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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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