CHAPTER 8
SURGICAL/INTERVENTIONAL TREATMENT OF ACUTE DEEP VENOUS THROMBOSIS

Original authors: Anthony Comerota, Bo Eklof, Jorge L. Martinez, and Robert B. McLafferty

Abstracted by Michael C. Dalsing

Introduction

Acute deep venous thrombosis (DVT) is the formation of a **blood clot** in one or more of the **deep veins** of the leg and abdomen. The **calf veins** are the most common site of a thrombus (**clot**), but 40% of **DVT**s occur in the **femoral** (thigh) and **iliac** (hip) **veins** starting behind **valves** (which prevent a **reflux** or backflow of blood). Extensive **deep venous thrombosis** causes acute pain, swelling, and leg discoloration and may result in the **post-thrombotic syndrome** (chronic pain, swelling, skin discoloration, and, potentially, skin breakdown generally around ankle (ulcers). The more extensive the **deep venous thrombosis**, the more severe the **post-thrombotic syndrome** will be as one gets older. The **post-thrombotic-syndrome** is the result of both damaged **valves** and blockage to blood flow. Over time, patients with extensive **venous thrombosis** are likely to develop progressive **valvular incompetence**. This is the inability of the vein valves to keep the blood from flowing backward (**reflux**) into the legs after it has started its journey back to the heart. When a **valve** isn't doing its job in preventing **reflux**, it is called incompetent. Removing the **blood clot** is likely to preserve function of the **vein valves** and prevent later **reflux**. Removing the **blood clot** also removes the blockage to blood flow through the **veins** both at the time of the acute **clot** and to prevent the symptoms of the **post-thrombotic syndrome**. The earlier the treatment is begun after a patient develops a **clot**, the more likely the treatment will be successful.

Why Remove Acute Blood Clot? Goals of Treatment

- To prevent **pulmonary embolism** (blood clot in the lung, which can be fatal)
- To decrease pain and swelling of the affected leg
- To prevent or stop the development of **phlegmasia cerulea dolens** and **gangrene** (tissue death and even loss of the leg) from loss of blood supply cause by a total blockage of blood flow through the leg **veins**. **Phlegmasia cerulea dolens**, sometimes called **blue phlebitis**, is an **acute thrombosis** with **edema** (accumulation of fluid), **cyanosis** (blue-discolored skin), and **petechiae** (reddish or purplish spots)
- To prevent the disabling **post-thrombotic syndrome** by removing the **blood clot** (preventing blockage of blood flow) and preserving normal function of venous **valves**.

Ways (Method) of Removing Acute Blood Clot

The first choice for an early and quick removal of a **blood clot** in a **deep vein** is catheter-directed **thrombolysis**. The treatment is designed to break down (dissolve) the blood

clots by injecting a drug into a **vein** or directly into the **blood clot**. The drug used is called **plasminogen activator** and it acts by breaking down (splitting) the body's own **plasminogen** (trapped within the **clot**) into its active form called **plasmin**. **Plasmin** is an enzyme and acts breaking down the **fibrin** (the solid substance of the **blood clot**) so that it can again flow in the blood and be removed by the body. The **plasminogen activator** can be injected into any **vein** in the body by a standard intravenous needle (IV) to be delivered to all parts the body equally (**systemic thrombolysis**). But is now more commonly delivered right into **blood clot** itself by way of a needle puncture of a **vein** through which a long catheter (plastic tubing) can be pushed into the **blood clot**. The **plasminogen activator** can then be pushed (injected) right into the **clot** (**catheter-directed thrombolysis**) for fasted action. One of the risks of this method is that the **plasminogen activator** can breakdown any **clot**, any where in the body so breakdown of a **blood clot** in an area where it might cause trouble (brain, stomach, or following recent eye surgery or other major surgery) can occur. **Percutaneous mechanical thrombectomy** provides a way to improve **catheter-directed thrombolysis** by adding a mechanical mixing or stirring of the **clot** and the **plasminogen activator**. This mixing makes the breakdown of **fibrin** go faster. The devices are delivered into the **clot** in the same way the catheter is pushed into the **clot**. One device works with or without **thrombolysis** (**clot** breaking drug) using simple stirring to break up the **clot** into small pieces and to then suck the **clot** from the body.

When **thrombolysis** fails or is contraindicated (most often because of an increased risk of bleeding), **open venous thrombectomy** is a good alternative. **Open venous thrombectomy** is a surgical removal (pulling out) of a **thrombus** lodged in a **vein** by making a cut through the skin to get to a **vein** through which can be placed a catheter with a balloon on the end. The balloon tipped catheter is pushed past the blood clot; the balloon is filled with fluid to the size of the **vein** and pulled back to pull the clot from the **vein**. The hole in the **vein** used to place the catheter and remove the **clot** is closed with suture (needle and thread). Often, a small connection between a nearby artery and vein (**arteriovenous fistula**) is made to help the **vein** to stay open.

Heparin (a **blood thinner** given by **vein** or by injecting a fat part of the body) is given for several days after surgery. **Warfarin**, a **blood thinner** taken by mouth is started on the first postoperative day and continued for months. The patient walks with a **compression stockings** the day after surgery and usually leaves the hospital in a few days.

Venous narrowing (stenosis) may be seen as one cause of the blood clot

Many patients with **acute deep venous thrombosis** also have an **iliac (pelvic) vein stenosis (narrowing)**. **Thrombolysis** or surgery uncovers the vein narrowing, which can then be corrected in order to keep the vein open and to avoid repeated episodes of **deep venous thrombosis**. The **stenosis** is popped open by placing a catheter with balloon end in the narrowed vein segment and inflating the balloon with fluid, thus performing a **balloon angioplasty**. A **stent** (a slender, metallic mesh cylinder) is placed within the narrowed segment of the **vein** and dilated also. The **stent** keeps the **vein** open and prevents it from collapsing.

Risks connected to removing acute blood clot

The complication of greatest concern when using **thrombolysis** is **bleeding**. Most commonly this occurs from the puncture made in the skin to place the catheter in the **vein**. Other areas of the body, such as the stomach, kidney bladder, or muscles that may have been unexpectedly hit may be areas of **bleeding**. The most feared **bleeding** is intracranial (within the brain) leading to a stroke. Fortunately, this is rare when patients are chosen properly but can still occur. **Pulmonary embolism** is also a rare complication of **thrombolysis** since the **clot** is being broken up into pieces. These risks are also noted when **mechanical thrombectomy** devices are used. The whipping of the blood may break the blood down into its parts which can cause damage to the kidneys (kidney failure) or rarely to other parts of the body. If the open surgery is needed, there is a cut into the body which can bleed (called a **hematoma** if the blood is trapped under the skin), become infected or drain fluids. No matter the method of acute **clot** removal, the **vein** can reclot which is why **blood thinner** are used.

Expected Results

According to recently published reports, patients treated early in their course of **iliofemoral deep vein thrombosis** with **catheter-directed thrombolysis** can expect an 80% success rate compared with 18% success in patients treated with conventional **anticoagulation** (agents taken to thin the blood).

Surgery is often used only in the very symptomatic or after other methods have failed so the expected results may not be as impressive. Studies have shown that about 40% of patients who had **open thrombectomy** and normal working **veins** compared with about 10% of patients treated with **blood thinners** only. After 10 years, **reflux** of blood in the **popliteal vein** (located behind the knee and a bad event) was found in about 30% of patients who had surgery and in about 70% of the group treated only with **blood thinners**.

Conclusion

Generally, **catheter-directed thrombolysis** with or without mechanical device use is the preferred treatment option for patients with **iliofemoral deep venous thrombosis** who are otherwise healthy and have no contraindication to receiving a **thrombolytic drug**. If **thrombolysis** is too high a risk, **venous thrombectomy** is recommended. For patients who are bedridden and those who are in very poor health, treatment with **anticoagulation** agents (**blood-thinning** agents) alone may be advisable. Successful and timely **clot** removal in patients with **iliofemoral DVT** results is less **post-thrombotic symptoms** and an improved health-related quality of life.

Commonly asked questions

What is thrombolysis?

Thrombolysis is a form of treating **blood clots**, which uses a drug called a **plasminogen activator**. The drug activates the body's **plasminogen** to form **plasmin**, which is the enzyme that actively dissolves **blood clot**. **Thrombolysis** is best performed by delivering the **plasminogen activator** directly into the **blood clot**.

Which patients derive the most benefit from catheter-directed thrombolysis?

Patients who have extensive **deep venous thrombosis** benefit the most from **catheter-directed thrombolysis**. These patients usually have **iliofemoral** (pelvic and thigh) **venous thrombosis**.

What are the objectives of thrombolysis or surgical thrombectomy?

Thrombolysis is aimed at (a) preventing **pulmonary embolism** (clot moving to the lung), (b) reducing or eliminating the acute symptoms of extensive **venous thrombosis** (pain, swelling, loss of limb) and (c) reducing or avoiding **post-thrombotic symptoms** (pain, swelling, skin damage and even breakdown of the skin (ulcers).

Are there other benefits of catheter-directed thrombolysis or surgical thrombectomy?

Yes. Other benefits of **catheter-directed thrombolysis** include eliminating **obstruction** (blockage) of the **deep venous system**, potentially preserving the function of the **vein valves** (prevent **valve** damage), and identifying an underlying **stenosis** (narrowing) of an **iliac vein**, which can be corrected with **balloon angioplasty** and/or **stenting**. By correcting the **iliac stenosis**, recurrent clotting may be avoided.

What are the risks of using thrombolysis to remove free blood clot?

The main complication is **bleeding**. The most commonly occurs from the site where the skin in stuck by a needle to place a catheter or from other needle punctures that the patient may have had in other places. Serious intracranial (brain bleed with stoke) **bleeding** is rare in low-risk patients. **Pulmonary embolism** (**blood clots** moving to the lungs) is also a rare complication.

Are there alternatives to catheter-directed thrombolysis for extensive venous thrombosis?

Patients who cannot receive **thrombolytic agents** can be offered a surgical procedure called **venous thrombectomy**, which is an operation designed to physically pull the **blood clot** from the **vein**. High-risk patients who are not candidates for either **thrombolysis** or **thrombectomy** should be offered conventional **anticoagulation** (**blood thinners**).

Why are blood thinner used after thrombolysis or surgical thrombectomy?

Blood thinner are used to prevent the **vein** from clotting again. If the **vein** clots after treatment, the benefits of the procedure are lost. **Blood thinners** are usually used for 6 months. However, if this is the second or more event, or if you clot more than most people for some unknown reason then you may need **blood thinners** for life.