

forms in a peripheral vein, as in DVT, the patient will complain of pain and swelling of the extremity. When this clot breaks loose, the embolus can travel and cause a heart attack (MI), a pulmonary embolus (blood clot in the lung), or a stroke (blood clot in the brain). In addition, a clot that lodges in the kidney, liver, or other organ may cause damage resulting from lack of blood flow to that organ.

A patient who can be diagnosed and treated within 60 minutes of onset of symptoms of a CVA can be given a treatment called tissue plasminogen activator (tPA). This thrombolytic medication is given by the IV route and is approved for use in acute stroke. If it is given within 60 minutes of onset of symptoms, the effects of the stroke are minimized. The treatment carries the risk for intracranial and/or systemic hemorrhage and angioedema; therefore, treatment protocol may require consent from the patient's next of kin for its use.

Thrombolytics can also be used to clear IV catheters and cannulas blocked with blood, but these medications must be used with extreme caution. If the blood has been in the cannula too long, injecting the drug can break off the clot rather than dissolve it.

Uncontrolled bleeding is just as dangerous as clotting. Clots must be dissolved quickly to prevent ischemia and infarction; however, a patient can die of uncontrolled bleeding as well. Therefore, frequent testing is necessary to ensure that the dose of anticoagulants, antiplatelets, or thrombolytics is therapeutic. The most common tests are prothrombin time (PT), activated partial thromboplastin time (aPTT), and international normalized ratio (INR). These tests are also used with anticoagulant, antiplatelet, and antithrombolytic therapy. PT is a blood test used to evaluate the ability of blood to clot and is often performed before surgical procedures. The aPTT blood test is usually used to evaluate the effectiveness of heparin therapy. An INR is a blood test used to determine how long it takes blood to clot and is performed primarily in patients taking Coumadin.

Antifibrinolytic Medications

Antifibrinolytic medications have an effect opposite to that of thrombolytics in that they help form clots when the patient is losing too much blood (hemorrhaging) and thereby provide **hemostasis** (stops the bleeding). This effect is useful, for example, in women with unusually heavy menstrual bleeding because it decreases the amount of blood lost each month. “Anti” means against, and “lytic” means to break down. These drugs prevent the destruction of fibrin and thus allow fibrin to form a clot. Examples include aminocaproic acid (Amicar) and tranexamic acid (Cyklokapron).

Blood loss can also be treated with other hemostatic drugs, such as vitamin K, protamine sulfate, and desmopressin acetate (DDAVP). They help regulate the clotting process. As described earlier, vitamin K is responsible for the formation of the cofactors responsible for clotting. Vitamin K is an antidote for anticoagulant overdose because it increases the production of those cofactors. Protamine sulfate is specifically administered by the IV route as an antidote to heparin overdose. DDAVP is an artificially made hormone that naturally occurs in the pituitary gland. This medication is used specifically in the treatment of hemophilia (bleeding disorders) in which the patient is lacking factor VIII and von Willebrand factor. DDAVP can raise the levels of these necessary clotting factors without the administration of blood products.

Medications that Promote Blood Cell Development (Hematopoietic Stimulants)

Some medications stimulate the growth of blood cells. Hematopoietic stimulant medications are used to treat anemias such as sickle cell and pernicious anemia (vitamin B₁₂ deficiency). They are also used to treat patients with low blood iron levels, which decrease the ability of the red blood cells to carry oxygen. In addition, patients who are receiving chemotherapy often have lowered blood levels resulting from the bone marrow-suppressing effects of that treatment.

One example of a hematopoietic stimulant is ferrous sulfate (Feosol, Fer-in-Sol, Ferra-TD). This medication is taken by mouth and specifically treats iron-deficiency anemia. Another medication is cyanocobalamin (vitamin B₁₂) and is used in patients who cannot absorb vitamin B₁₂ in the GI tract, such as those with pernicious anemia. Therefore, injectable vitamin B₁₂ is usually administered to facilitate blood cell development for the remainder of their lifetime. This, in turn, promotes oxygen delivery to the cells and boosts the patient's energy. Medications such as filgrastim (Neupogen), pegfilgrastim (Neulasta), and sargramostim (Leukine) are given to stimulate blood cell development (see the Master the Essentials table for contraindications to and precautions for these medications).