



# Hazards of Heparin

## 2 Contact Hours

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## Acknowledgments

*RN.com acknowledges the valuable contributions of...*

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**Note:** All dosages given are for adults unless otherwise stated. The information on medications contained in this course is not meant to be prescriptive or all-encompassing. You are encouraged to consult with physicians and pharmacists about all medication issues for your patients.

## Purpose and Objectives

Given the severity of the consequences of heparin errors, it is important that nurses and pharmacists adhere to standard medication safety procedures during preparation and administration of heparin and other high alert drugs. The purpose of this course is to review the administration, monitoring and subsequent dangers of heparin.

### ***After successful completion of this course, you should be able to:***

- Describe normal mechanisms of homeostasis.
- Define laboratory monitoring of unfractionated (UFH) and low molecular weight heparins (LMWH).
- Identify how to adjust heparin based upon protocol orders.
- Identify situations that increase the risk for heparin associated errors.

**IMPORTANT NOTE:** In this course, the term "heparin" refers to both LMWH and UFH, unless otherwise specified.

## Introduction

### **Risks of Anti-Coagulation:**

- Anticoagulation therapy has been highlighted in the media frequently over the past decade, and much of the coverage has been negative.
- Between the years 2006 – 2008, at least three highly-publicized incidents of accidental heparin overdoses occurred in neonatal intensive care units. All resulted in the need for intensive treatment, some resulted in death. The most well publicized medication error involved celebrity newborn twins who received heparin for intravenous flush 1,000 times the intended dose while they were in a prominent hospital in California (Simpson, 2008).
- Thirty-two sentinel events related to anticoagulation were reported to the Joint Commission between 1997 and 2007. Twenty-eight resulted in death; six resulted in loss of function. The causes of these sentinel events were: wrong drug, wrong dose, improper monitoring, pump malfunction/error, given without an order, and medication administered without a reorder (Joint Commission, 2008).
- Unfortunately, some of the common medical errors that occur are nursing errors. The increasing complexity of providing health care requires that nurses use extreme caution when administering medications, and even more so when administering “high-alert” medications, such as heparin.
- Two high-alert medications that have been recently scrutinized are unfractionated heparin (UFH) and the newer low molecular weight heparins (LMWH). For additional information on other high alert medications and medication safety, please refer to RN.com's course list.

## Test Yourself

Two high-alert medications that have been recently scrutinized are:

- A. Unfractionated heparin & low molecular weight heparin
- B. Coumadin & high molecular weight heparin
- C. Unfractionated heparin & fractionated heparin

The correct answer is A.

## The Joint Commission's National Patient Safety

"Anticoagulation is a high-risk treatment that commonly leads to adverse drug events due to the complexity of dosing anti-coagulation medications, monitoring their effects, and ensuring patient compliance with outpatient therapy. The use of standardized practices that include patient involvement can reduce the risk of adverse drug events associated with the use of heparin (unfractionated), low molecular weight heparin (LMWH), warfarin, and other anticoagulants."

--Joint Commission's Official Publication of the 2008 National Patient Safety Goals

## The Joint Commission Guidelines

The latest National Patient Safety Goals and Requirements itemize nursing actions that are necessary to implement with the administration of heparin, in order to safeguard the patient and minimize risk.

In order to comply with The Joint Commission's National Patient Safety Goals, all nurses should follow these guidelines when administering anticoagulation therapy:

- Each patient receives individualized management of anticoagulation therapy.
- Unit dose for oral and IV medications are used. Programmable infusion pumps are used for IV therapy.
- Protocols exist for initiation of therapy.
- Dietary is involved to manage potential food-drug interactions.
- Baseline and ongoing lab tests are outlined and followed by the facility.
- The facility provides education to prescribers, staff, patients, and families.
- The facility evaluates and improves its practice relative to anticoagulation therapies.
- Follow the facility P&P for anticoagulant management therapy.
- Perform independent verification for all anticoagulation medications per facility guidelines.
- Monitor for side effects or signs of over/under dosing of anticoagulation medications.
- Educate patient and family on the importance of ongoing monitoring, compliance issues, dietary restrictions, and potential for adverse drug reactions and interactions.

(Elements of Performance, National Patient Safety Goals, 2010)

## Review of Clotting and Coagulation

### Homeostasis: Clot Formation and Coagulation

- When we bleed, our body attempts to maintain homeostasis through a complex series of events which involves:
  - Clot formation and coagulation
  - Inhibition of coagulation
  - Dissipation of the clot
- Platelets are our primary blood component that forms clots. They originate in the bone marrow as megakaryocytes. These megakaryocytes produce platelets. When our bodies are under stress this production increases.
- Normally, the inner surface of our blood vessels does not stimulate platelets to adhere together. Pathological processes such as vascular injury related to trauma or surgery, blood flow, or plaque rupture stimulate platelet adhesion because the inner lining of the blood vessel has been damaged or disrupted. Once this damage occurs, the structures beneath the inner lining of the vessel (especially collagen) are exposed and begin the platelet bonding process at the site of the injury.

### Test Yourself

Normally, the inner surface of our blood vessels does not stimulate platelets to adhere together.

- A. True
- B. False

The correct answer is A.

### Homeostasis: The Coagulation Cascade

During the process of platelet adhesion, Von Willebrand Factor (a blood glycoprotein involved in hemostasis) links collagen to platelets, forming a platelet plug. As events progress, our platelets change shape and release various chemicals (including ADP and Thromboxane A<sub>2</sub>) that propagate the coagulation cascade, so that clotting factors will localize at the site of injury.

The coagulation cascade is a series of reactions that result in a stable fibrin mesh surrounding the platelets at the site of injury. The cascade is composed of an intrinsic, extrinsic, and a final common pathway.

In the presence of different catalysts (mainly enzymes and calcium), various clotting factors beginning with Factor XII (in the intrinsic pathway) and Factor VII (in the extrinsic pathway) are activated, ending in the activation of Factor X).

In the final common pathway, Factor X is converted to Factor Xa which combines with prothrombinase to eventually produce thrombin, fibrin, and finally a stable fibrin plug.

**Von Willebrand disease (vWD), a common inherited bleeding disorder, is due to inherited deficiency in von Willebrand factor (vWF).**

## Homeostasis: Inhibition of Coagulation

When there are elevated thrombin levels, Protein C (an anticoagulant) is activated.

Once activated, Protein C destroys Factor V and Factor VII – two key elements that potentiate the coagulation cascade. The presence of Protein C also activates tissue plasminogen activator (tPA), a potent fibrinolytic. This negative feedback mechanism is how our bodies “turn off” clotting.

Conversely, coagulation is promoted by Vitamin K, which is converted into prothrombin (Factor II) by our bodies. Vitamin K also binds with Protein C and other anticoagulants when they are in abundance, turning them “off,” allowing coagulation to continue.

Protein C deficiency is a rare, hereditary disorder that predisposes the patient to thrombus formation and recurrent spontaneous abortions.

### Test Yourself

What is promoted by Vitamin K?

- A. Coagulation
- B. Bleeding
- C. Making of fibrin
- D. Vitamin C

The correct answer is A.

## Homeostasis: Dissipation of the Clot

Clot degradation occurs by a process known as fibrinolysis.

During this process, the fibrin in the formed clot is broken down by plasmin. Plasmin is activated by plasminogen which is turned on by our own tPA or drugs such as recombinant tPA, urokinase, and streptokinase (Grace & Carter, 1996).

Other substances also activate plasminogen, such as too much Factor XII (via negative feedback mechanisms) and activated Protein C (Didy, Saade, Phelan, Hankins, & Clark, 2004). As fibrin begins to breakdown, it produces Fibrin Degradation Products (FDPs). Normal range for FDPs is 2-7 microgram/milliliter.

When excessive activation of thrombin leads to an over-activation of the fibrinolytic system, breaking down more and more fibrin, more FDPs are produced. This increase in FDPs is usually observed in Disseminated Intravascular Coagulation (DIC) or during thrombolytic therapy.

**Recombinant tPA is given to acute myocardial infarction and ischemic stroke patients to intensify clot degradation (American Heart Association [AHA], 2007).**

## Anticoagulation

Anticoagulants are medications whose use or misuse carry significant potential for injury. Anticoagulants are among the top ten drugs associated with serious Adverse Drug Events (ADEs).

**Sub**therapeutic levels can lead to thromboembolic complications in patients with atrial fibrillation or Deep Vein Thrombosis (DVT).

**Supr**atherapeutic levels can lead to bleeding complications.

## Types of Heparin

Heparin is available in two forms: **unfractionated heparin (UFH)** and **low molecular weight heparin (LMWH)**.

UFH, most commonly used in the form of heparin sodium, is an anticoagulant that is widely used in patients with massive pulmonary embolism, for patients who are unstable or may require procedures or thrombolysis.

Low molecular weight heparin (LMWH) is a newer type of heparin that has become the treatment of choice for most patients needing anticoagulation therapy.

Recent trials have found that UFH and LMWH are equally effective in preventing death, but LMWH prevented more heart attacks and caused fewer complications than UFH.

## Overview of Heparin

The primary intravenous and subcutaneous anticoagulant used in the United States inhibits action of coagulation factors (indirect thrombin inhibitor).

When thrombin is inactivated, fibrin formation is prevented and platelet activation is inhibited.

Because of its complex pharmacokinetics, it requires frequent monitoring by measuring the Partial Thromboplastin Time (PTT) to insure a therapeutic level.

Heparin is infused as a weight-based or indication-based continuous infusion and adjusted up or down based on PTT goal.

The half-life of heparin is 1.5 hours.

## Mechanism of Action

It is important to note that both types of heparin do not destroy already existing clots. Once entering our bodies, both heparins act to enhance the inhibitory actions of anti-thrombin III, resulting in the disruption of the clotting cascade. More specifically, prothrombin is not converted to thrombin and fibrinogen is not converted to fibrin (Wilson, Shannon, & Stang, 2005).

LMWH and UFH act strictly to prevent new clots from forming or to prevent the extension of already existing clots.

## Test Yourself

Both types of Heparin can destroy already existing clots.

- A. True
- B. False

The correct answer is B.

## Clinical Uses of Heparin

**Heparin has many different clinical uses. These include:**

- Prophylaxis for Deep Vein Thrombosis (DVT)
- Treatment of venous thrombosis
- Treatment of pulmonary embolism
- Prophylaxis for thrombotic complications following cardiac or vascular surgery
- Prevention of thrombosis in frostbite
- Prevention of clot extension during the acute stage of Myocardial Infarction (MI)
- Treatment of Disseminated Intravascular Coagulation (DIC)
- Treatment of atrial fibrillation with embolization
- As anticoagulant in blood transfusions, extracorporeal circulation, and dialysis procedures
- Prophylaxis for DVT in hip and knee surgery
- Maintenance of indwelling IV catheters

(Wilson, Shannon, & Stang, 2005); (Valentine & Hull, 2012)

## Heparin Complications

**Bleeding is the most significant risk associated with heparin therapy, and is influenced by:**

- Insufficient monitoring of the PTT
- Concomitant clinical disorders
- Concomitant use of other medications
- Thrombocytopenia

**Other less common and less well-known complications of heparin include:**

- Active bleeding
- Ascorbic acid insufficiency
- The presence of bleeding tendencies
- Ascorbic acid deficiency
- Inaccessible ulcerative lesions
- Continuous tube drainage of stomach or small intestines
- Open ulcerative wounds
- Visceral carcinoma
- Hepatic disease

- Supportive thrombophlebitis
- Extensive denudation of skin
- Advanced kidney, liver, or biliary disease
- Active tuberculosis
- Bacterial endocarditis
- Suspected intracranial hemorrhage
- Threatened abortion
- Severe hypertension
- Recent surgery of eye, brain, or spinal cord
- Shock

(Valentine & Hull, 2012)

### **Caution in Heparin Therapy**

#### **Heparin must also be used cautiously:**

- With any patient with liver disorders (including alcoholics and older adults) since the liver helps produce clotting factors and patients with damaged livers may already have bleeding tendencies.
- During the last trimester of pregnancy only if the benefit to the patient will be significant. Heparin is a pregnancy risk category C, which means that either studies in animals have revealed adverse effects on the fetus (birth defects or death) and there are no controlled studies in women, or studies in women and animals are not available.
- In other situations that may induce bleeding such as immediate post partum, during menstruation, in patients with indwelling catheters, patients in hazardous occupations, and those with cerebral embolism.
- In a history of asthma, hives, hay fever, or eczema due to their already over sensitive immune response.

(Wilson, Shannon, & Stang, 2005)

#### **Test Yourself**

Heparin is used cautiously in patients with damaged livers as they may already have:

- A. Clotting tendencies
- B. Overproduction of vitamin K
- C. Bleeding tendencies
- D. Underproduction of protein C

The correct answer is C.

### **Complications of Heparin Therapy**

**Listed below are the most common and potentially lethal complications associated with heparin therapy:** *(Click on each complication for a complete description.)*

#### **Spontaneous bleeding:**

This may occur because heparin acts to enhance the inhibitory actions of antithrombin III, disrupting the clotting cascade. More specifically, prothrombin is not converted to thrombin and fibrinogen is not converted to fibrin resulting in the potential for bleeding (Grace & Carter, 1996).

### **Neurovascular symptoms:**

These symptoms may occur, such as, numbness, tingling, pain, cyanosis, and pains in arms or legs (due to vasospasm).

### **Heparin associated bronchospasm and anaphylactic reactions:**

This may occur since heparin is made from either bovine lung tissue or porcine intestinal mucosa. Careful allergy history is important to obtain prior to the initiation of heparin (Wilson, Shannon, & Stang, 2005).

### **Hypoaldosteronism:**

For some individuals, aldosterone suppression occurs within a few days of initiation of heparin therapy and results in hyponatremia & possible dehydration due to enhance excretion of sodium. It is reversible, but can occur with doses as low as 5,000 units twice per day (Oster, Singer, & Fisherman, 1995).

### **Hyperkalemia:**

Heparin-induced aldosterone suppression results in the enhanced excretion of sodium and the decreased excretion of potassium in the kidneys, leading to hyperkalemia in about 7% of patients on heparin (Oster, Singer, & Fisherman, 1995).

### **Injection site reaction:**

Reactions such as pain, itching, ecchymosis, tissue irritation and sloughing may occur if injection sites are not rotated.

### **Complications: HIT or HITT**

Heparin Induced Thrombocytopenia (HIT) with or without Thrombosis (HITT) is defined as a decrease in platelet count during or shortly following administration of heparin.

Probability of HIT or HITT is determined by level of thrombocytopenia, timing of platelet fall in relation to heparin exposure, presence of thrombosis and exclusion of other causes of thrombocytopenia (i.e. infection malignancy, medications, trauma).

If a patient is at high risk for HIT or HITT, direct thrombin inhibitors may be considered. PF4 heparin dependent antibody test or Serotonin release assay may be performed to confirm diagnosis. It is associated with significant morbidity and mortality if unrecognized, making it the most frequent drug-induced, immune-mediated type of thrombocytopenia.

## Major Contraindications to Heparin Therapy

- Allergies
- Active bleeding
- Presence of bleeding tendencies

## When blood thinners are contraindicated

Patients with a DVT who cannot tolerate blood thinners may need a device called an inferior vena cava filter (IVC filter). This device is placed in the main central vein. It keeps large clots from traveling into the lung vessels (Harjit, 2010).

## Low Molecular Weight Heparin

- Two of the more common types of LMWH are Enoxaparin Sodium (Lovenox) and Dalteparin Sodium (Fragmin).
- LMWH work by increasing the inhibitory effect of anti-thrombin. They are made from split standard heparin, are up to 30 times lighter than UFH, and interfere less with platelets.
- Another advantage of LMWH is that they are very predictable, and thus they react the same way in every patient and do not require close monitoring of Activated Partial Thromboplastin Time (aPTT) or PT/INR, as UFH and Coumadin do.
- LMWH is a better option for DVT (Deep Vein Thrombosis) prophylaxis than low-dose subcutaneous UFH, in that it can be given once daily, has fewer bleeding tendencies and carries a lower risk for developing HIT (Heparin Induced Thrombocytopenia with or without Thrombosis).
- While elastic stockings and sequential compression boots work well for mild to moderate risk patients post surgery, LMWH is the top choice for DVT prophylaxis for general and orthopedic surgeries for high risk patients.
- Recent literature supports the use of higher initial doses in neonates in order to achieve therapeutic anticoagulation (Chander, 2013).
- Indication determines dose.
- Enoxaparin anticoagulant effect can last up to 12 hours.
- Cleared through the kidneys.
- No bolus or loading dose.
- Administered subcutaneously.

## Test Yourself

Low molecular weight heparins are very predictable; they react the same way patient to patient.

- True  
False

The correct answer is A.

## Enoxaparin

### Predictable dose response in most patients

- Routine monitoring usually not required
- Anti-Factor Xa level monitoring recommended in specific patient populations
  - \*ABW > 100 kg & <150 kg receiving treatment or prophylactic therapy
  - \*Pregnant patients receiving treatment or prophylactic therapy
  - \*Prolonged therapy (> 2 weeks)
  - \*Unstable kidney function

### Usual Dosage:

- DVT with or without PE 1mg/kg sq every 12 hours
- Total knee replacement 30mg sq every 12 hours
- Critical care patients 40mg sq every 24 hours

### Enoxaparin Reversal:

- In a patient who is bleeding in association of enoxaparin therapy, discontinuing enoxaparin is usually sufficient in controlling the situation
- Protamine has NOT been shown to completely reverse the effects on anti-factor Xa activity

### Transitioning & Patient Concerns

- Enoxaparin to unfractionated heparin:  
**Wait 4 hours from the enoxaparin dose to begin heparin infusion.**
- Unfractionated heparin to enoxaparin:  
**Stop the heparin infusion, wait one hour to administer enoxaparin.**

### Patient Concerns

- Bruising:  
Bruising at the injection sites is common.
- Discarding needles:  
Contact local health department or local pharmacy for correct disposal of used needles.

## Education for LMWH

### Handling missed doses:

- Instruct your patient that if they miss a dose, they should take it as soon as possible. However, if it is almost time for their next dose, they should not take the missed dose at all. In this case, it is best to go back to their regular dosing schedule.
- Instruct your patient never double the next dose as it may cause active bleeding.
- Instruct your patient to keep a record of each dose as you use it to avoid mistakes.

### Storage requirements:

- Keep the syringes away from direct heat and light.
- Do not freeze.
- Store at room temperature.
- Monitor expiration date.
- Keep away from children.

(Lovenox, 2010)

## Unfractionated Heparin

- UFH is most commonly available in the form of heparin sodium, and is derived from beef lung or pork intestinal mucosa.
- UFH acts by accelerating the formation of anti-thrombin III - Thrombin complex, and deactivates thrombin, preventing the conversion of fibrinogen to fibrin.
- UFH can be administered IV or subcutaneously, and has a half life of 1-2 hours. Half life is dose dependent and may be disproportionately prolonged at higher doses.
- It is important to educate patients that all over the counter drugs containing aspirin and other salicylates should be avoided during heparin therapy.
- **UFH and LMWH are NOT interchangeable.**

### Test Yourself

UFH acts by inhibiting the conversion of?

- A. LWMW to UFH
- B. Fibrinogen to fibrin
- C. Vitamin K to protein C
- D. aPTT to PTT

The correct answer is B.

## Dosing of UFH

- UF Heparin comes in many different concentrations, ranging from 10 units/mL to 40,000 units/mL injection.
- Post surgery, your patient may be receiving heparin for DVT prophylaxis. In this case, a common dose of subcutaneous heparin is 5,000 units every 8-12 hours. This type of heparin is usually provided from pharmacy in a 5,000 unit/1 milliliter syringe ready for administration.
- Remember that prior to administering any medication, always use the 7 rights of medication administration:
  - ✓ Right medication
  - ✓ Right dosage
  - ✓ Right client
  - ✓ Right route
  - ✓ Right time
  - ✓ Right documentation
  - ✓ Right reason

(AHRQ, 2010)

Remember to always check your organization's protocols before administration of heparin.

## Nursing Implication for Safe Practice

- Initiate intravenous therapy using standard protocols. Refer to your organization's heparin weight-based guidelines for specifics on use, dosing, and PTT goals.
- Heparin standard concentration is 25,000units/250mL of D<sub>5</sub>W.
- Heparin requires an IV pump for administration.
- Do NOT bolus from the bag.
- Follow the patient and the aPTT closely to insure there are no complications.
- Follow platelet levels in order to identify Heparin Induced Thrombocytopenia (HIT).

## Administration of Heparin

Heparin is given parenterally, as it is degraded when taken by mouth.

It can be injected intravenously or subcutaneously. Intramuscular administration is avoided because of the potential for forming hematomas.

Because UFH has a short biological half-life of approximately one hour, it must be given frequently or as a continuous infusion.

However, the use of LMWH has allowed once daily dosing, thus not requiring a continuous infusion of the drug.

In the pediatric population, recent literature supports the use of a subcutaneous catheter for heparin administration as it showed only minor complications (hematoma at injection site) compared to standard injection therapy (Márquez, 2014).

**Never piggyback other drugs into an infusion line while a heparin infusion is running, and never mix any other drug together with heparin in the same syringe when giving a bolus.**

### Observation and Assessment

The patient on heparin therapy requires close observation and assessment during therapy.

Clinical symptoms to assess throughout therapy include:

- Symptoms of Deep Vein Thrombosis (DVT)
- Compliance issues
- Bleeding
- Symptoms of Pulmonary Embolism (PE)

### Drug Interactions

Drugs that INCREASE heparin's effect include:
<ul style="list-style-type: none"><li>• Oral anticoagulants such as dicumarol or warfarin sodium.</li></ul>
<ul style="list-style-type: none"><li>• Platelet inhibitors such as acetylsalicylic acid, dextran, phenylbutazone, ibuprofen, indomethacin, dipyridamole, hydroxychloroquine and others that interfere with platelet-aggregation reactions.</li></ul>
<ul style="list-style-type: none"><li>• Note: Reduce dose when administering with Antithrombin III (human).</li></ul>








(Valentine & Hull, 2012)

Drugs that DECREASE heparin's effects include:
<ul style="list-style-type: none"><li>• Digitalis, tetracyclines, nicotine, or antihistamines.</li></ul>
<ul style="list-style-type: none"><li>• <b>Note: The use of herbs during heparin therapy is contraindicated. Garlic, ginkgo, motherwort, red clover and white willow may increase the risk of bleeding, and should be discouraged during heparin therapy.</b></li></ul>






(Valentine & Hull, 2012)

## **Laboratory Monitoring**

Prior to initiating heparin therapy, baseline labs should be drawn including: hemoglobin, hematocrit, platelet count, aPTT, and PT.

The standard laboratory test to monitor therapeutic levels of LMWH is the chromogenic anti-Xa heparin assay.

The standard laboratory test to monitor therapeutic levels of UFH is the activated Partial Thromboplastin Time (aPTT).

However, both LMWH and UFH require additional laboratory monitoring to ensure therapeutic doses are maintained without excessive side effects. These additional tests will be described later on in this course, but since they apply to both LMWH and UFH, the generic term "heparin" will be used.

### **Laboratory Monitoring: LMWH**

Although laboratory monitoring may be required during LMWH therapy, it is certainly less rigid than the monitoring required with UF heparin.

Close laboratory monitoring of LMWH therapy is recommended for high risk groups, such as infants, children, obese or underweight patients, or those with renal disease, long-term treatment, pregnancy, or unexpected bleeding or thrombosis.

LMWH is monitored by using chromogenic anti-Xa heparin assay. When collecting the blood specimen it is important to collect it four hours after the subcutaneous dose.

The target (peak) range (measured four hours after dosing) is approximately 0.6 to 1.0 iu/ml for twice daily enoxaparin. If given once a day, target is >1.0 to 1.3 iu/ml (Valentine & Hull, 2012).

Since aPTT is insensitive in LMWH, this test is not used during LMWH therapy.

### **Laboratory Monitoring: UFH**

Activated partial thromboplastin time (aPTT) is used most commonly to determine the most effective dosage of UFH and other anticoagulants.

Clinically, we are mostly interested in the aPTT to monitor unfractionated heparin therapy.

The aPTT is normally 25 – 35 seconds, but varies from lab to lab. Therapeutic anticoagulation is determined based upon your patient's weight. It is often ordered to be maintained at 1.5 to 2.5 times the upper limit of the normal values (Valentine & Hull, 2012).

Initially, the aPTT drawn prior to initiation, four to six hours after initiation of heparin, & four to six hours after a dose change. When the aPTT is within a therapeutic range for your patient's weight and disease process, the frequency of testing is decreased, usually to every 12-24 hours per hospital protocol.

Because UFH therapy causes different responses in different patients, the aPTT must be monitored during heparin therapy to monitor the effects of heparin.

## **aPTT Studies**

Partial Thromboplastin Time (PTT) and Activated Partial Thromboplastin Time (aPTT) measure the time it takes blood to clot. More specifically, they measure the functioning of the intrinsic clotting system (Factors VIII, IX, XI & XII) and the final common pathway (Factors II, V & X).

PTT is an older test that has mostly been replaced by the aPTT test. The aPTT test is most often used for monitoring therapy with UFH, and is of value in terms of adjusting dosage.

Reference values for aPTT vary among laboratories, but generally range between 25 - 38 seconds. The therapeutic goal for a patient being anticoagulated with UFH, is an aPTT approximately 1.5 - 2.5 times the mean normal value.

The standard activated Partial Thromboplastin Time (aPTT) is usually between 30 - 40 seconds.

The standard Partial thromboplastin time (PTT) is usually between 60 - 70 seconds.

## **Platelet Monitoring**

All patients receiving heparin therapy (LMWH & UFH) should have routine platelet counts performed regularly.

The normal range for platelets is 150,000 – 400,000 per microliter. Platelet counts under 50,000 put a patient at risk of severe bleeding. Additionally, platelet count <20,000 may cause spontaneous and often deadly intracranial hemorrhaging (Grace & Carter, 1996).

In Heparin Induced Thrombocytopenia with Thrombosis (HITT) you can expect to see a fall in platelet count to <50% of baseline and/or to <150,000/microliter (Fennessy-Cooney, 2011).

However, in Heparin Induced Thrombocytopenia without Thrombosis (HIT) platelets generally do not fall below 100,000/microliter (Fennessy-Cooney, 2011)

## **Platelet Aggregation Studies**

Platelet aggregation studies are useful if your patient on heparin becomes thrombocytopenic. Platelet aggregation studies can help diagnose or rule out Heparin Induced Thrombocytopenia with or without Thrombosis (HIT/HITT).

When exposed to heparin, platelets should not clump together for at least 15 minutes after exposure. If your patient has heparin-induced thrombocytopenia (HIT), platelets do clump or aggregate. This test is not highly sensitive for HIT/HITT, but when combined with a thorough history, review of symptoms, and physical examination, it can be very helpful (Grace & Carter, 1996).

When abnormal platelet aggregation is noted, heparin therapy should be reversed with protamine sulfate and the patient treated with low-molecular-weight dextran (known for its anti-thrombogenic effects) and an alternate anticoagulant such as raltegravir (Lepirudin) argatroban (Novastan), fondaparinux (Arixtra), bivalirudin (Angiomax), or warfarin (Coumadin) as previously discussed.

## Test Yourself

When exposed to heparin, \_\_\_\_ should not clump together for at least 15 minutes after exposure.

- A. Platelets
- B. aPTT
- C. WBC
- D. RBC

The correct answer is A.

## Activated Clotting Time (ACT) Studies

Activated clotting time (ACT) is a bedside test that is frequently used in monitoring patients during high-dose heparin therapy, such as with cardiopulmonary bypass and certain procedures such as percutaneous transluminal coronary angiography (PTCA).

ACT responsiveness increases as heparin dose increases. However, the ACT lacks reliability in values greater than 600 seconds.

A normal range for ACT is 80 - 130 seconds.

With cardiopulmonary bypass heparinization, the goal is to exceed 400 - 500 seconds (commonly >480 seconds).

## Anti-Xa Assay (Factor 10A)

The Anti-Xa is the most accurate assay for monitoring unfractionated heparin therapy and is the only test available for monitoring low molecular weight heparin therapy.

Therapeutic ranges depend upon why your patient is being anticoagulated.

## Unfractionated Heparin

The therapeutic range for unfractionated heparin is 0.3 - 0.7 anti-Xa units per milliliter of plasma.

The prophylactic range for unfractionated heparin is 0.1 - 0.4 anti-Xa units per milliliter of plasma.

## Low Molecular Weight Heparin

The therapeutic range for low molecular weight heparin is 0.5 - 1.0 anti-Xa units per milliliter of plasma.

The prophylactic range for low molecular weight heparin: 0.2 - 0.4 anti-Xa units per milliliter of plasma (UAB Coagulation Service, 2006).

## Test Yourself

The Anti-Xa Assay is the only test available for monitoring low molecular weight heparin therapy.

- True
- False

The correct answer is A.

## Management of Heparin Overdose

Protamine sulfate works to reverse heparin induced bleeding by binding to heparin ions to block anticoagulant activity.

It can be administered in a slow intravenous infusion (not greater than 20mg/min and no more than 50mg over any 10 minute period).

The appropriate dose of protamine sulfate is dependent upon the dose of heparin given and the elapsed time since the last heparin dose.

Full neutralization of heparin effect is achieved with a dose of 1mg protamine sulfate/100units of heparin. Dose varies with heparin dose and time elapsed since administration of heparin.

If heparin had been given by subcutaneous injection, repeated small doses of protamine may be required because of prolonged heparin absorption from the various subcutaneous sites.

(Valentine & Hull, 2011)

## Administering Protamine Sulfate

Tips for administering protamine sulfate include:

- Administer slowly to avoid bradycardia and hypotension
- Infusion of protamine not to exceed 50 mg per 15 minutes
- Continue monitoring PTT
- Bolus doses of more than 25 to 50 mg of protamine sulfate are seldom required

(Valentine & Hull, 2011)

## Test Yourself

What medication works to reverse heparin induced bleeding?

- A. Protein C
- B. Protamine sulfate
- C. LMWH
- D. Argatroban

The correct answer is B.

## **Discharge Instructions**

Many patients are discharged on low dose molecular weight heparin, with a caregiver to assist in administration of the drug and monitoring for potential complications. When these individuals are discharged from your care, it is critical that they understand the following:

- Administration techniques (including first dose demonstration)
- Length and frequency of treatment
- Syringe disposal
- Side effects and possible complications
- Injection site selection and monitoring
- Drug interactions

## **Avoiding Heparin Errors**

**Tips to avoid heparin associated errors include:**

- Have another nurse independently verify all of your heparin calculations independently prior to the administration of the heparin.
- Ask another nurse to verify the right drug, right dose, the right client (with two identifiers), the right route, right documentation, and the right time.
- If multi-dose supplies of heparin are still available on your nursing unit, ask your nurse manager to check into having single dose supplies ordered instead.
- Never rely on the color of a label or it being located in a familiar place. Always read the label on the vial, and check this against the order.
- Always get another nurse to review your orders if unclear.
- When unsure about a particular dose, always check with the physician and/or pharmacy.
- Know the normal doses for your patients.

## **Strategies to Reduce Sentinel Events**

**Strategies to reduce heparin related sentinel events include:**

- Remove all vials of concentrated heparin solutions (10,000 units/ml) from stock.
- Use prefilled syringes with package overwrapping color coded to the amount as well as printing with large fonts to identify the amount of heparin for administration.
- Use barcoding and scanning prior to medication administration including IV flush solutions.
- Take the time to personally check the seven rights of medication administration prior to giving medications.

(Simpson, 2008)

## **Sentinel Event: Case Review**

Dr. Lee ordered a heparin infusion for Janet Williams with directions to follow weight based protocol orders for lab monitoring and dosage changes.

Later that day, the protocol orders indicated that a bolus dose of heparin 1,400 units IV should be administered based upon Mrs. William's aPTT level.

Jackie, the patient's nurse, removed a 10 milliliter vial of heparin (1,000 units/milliliters) from an automated dispensing cabinet to prepare the dose. However, she miscalculated the volume that was needed as 14 milliliter, not 1.4 milliliter. The nurse, concerned that she would be using a second vial of heparin to prepare the bolus, quickly asked another nurse to "verify the math." The other nurse looked over the calculations, but did not actually re-calculate the math herself. She told Jackie that it seemed right to her.

The end result was that Mrs. Williams received 14,000 units of heparin. A medical student discovered the error after the patient began bleeding profusely from an abdominal incision that was previously healing.

## **Sentinel Event: Case Review**

Potential fatal flaws associated with this situation:

- The heparin the nurse removed from the automated dispensing cabinet was a multi-dose vial, requiring the nurse to calculate the correct dose.
- The nurse had to draw the correct dose of heparin into a syringe, allowing for a potential error in drawing the right amount.
- The other nurse did not recalculate the dose independently.

ISMP (Institute for Safe Medication Practices) creates and periodically updates a list of high-alert medications in an attempt to minimize medication errors. Always be familiar with the policies and procedures related to the high-alert medications used in your practice area, and the list of high-alert medications for your organization.

View the complete list of ISMP (2011) High-Alert Medications at <http://www.ismp.org/Tools/highalertmedications.pdf>.

## **Case Study: A Review of Weight Based Heparin Calculations**

### **Weight Based Heparin Calculations**

During the treatment of thromboembolism in an adult patient, the nurse should expect to see weight-based order sets as described in the following case study:

Your 59 year old patient is being treated on a medical surgical unit for pulmonary embolus following a diagnosis of neck and mouth cancer.

He has a history of consuming a 12 pack of beer per day for the past 10 years and smoking a pack of cigarettes each day for the past 44 years. Other than his newly diagnosed neck and mouth cancer he has not been to the doctor in many years.

He weighs 150 pounds. His vital signs are: BP: 140/82, T: 37.0 C, HR: 88, RR: 24. His pulse oximeter reads 92% on 2 liters of oxygen administered by nasal cannula. He is alert and oriented. He has clear but diminished breath sounds bilaterally (his right lower lobe is more diminished than his left lower lobe). Heart rate is regular, abdomen soft, non-tender with positive bowel sounds. Pulses are equal and strong bilaterally. He complains of mild pain in his mid to upper back on the right side, a 4/10 on a numeric pain scale of 1 - 10. He is admitted to your unit.

Baseline aPTT results are 22 seconds.

### **Test Yourself**

Therapeutic anticoagulation is determined based on your patient's?

- A. Initial lab values
- B. BSA
- C. Weight
- D. Height

The correct answer is C.

### **Case Study: Physician Orders**

#### **The physician orders the following:**

- Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hour.
- Draw a STAT aPTT six hours following initial bolus and any change in therapy. Once aPTT is between 46 - 70, two consecutive times in a row, then draw aPTT every 24 hours and a CBC every other day until discontinued.
- Adjust heparin infusion based on sliding scale below:
  - If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hour.
  - If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hour.
  - If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
  - If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hour.
  - If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hour.

## Question 1

### How much of a heparin bolus will you give?

*Remember that 1 kg = 2.2 lbs.*

#### Physicians Orders and Sliding Scale

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

#### **Answer:**

$$150 \text{ lbs} / 2.2 \text{ kg} = 68 \text{ kg}$$

The order says to give 80 units/kg, so:

$$(80 \text{ units}) \times (68 \text{ kg}) = 5,440 \text{ unit IV bolus.}$$

Most of the time a heparin bolus is rounded to the nearest 100.

**The bolus dose would be 5,400 units**

## Question 2

**You have two 5,000 unit heparin syringes. The concentration is 5,000 units per milliliter. How many milliliters should you draw up for the IV bolus?**

### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### **Answer:**

$$\frac{10,000 \text{ units}}{2 \text{ ml}} = \frac{5,400 \text{ units}}{x \text{ ml}}$$

X = 1.08 milliliter or 1.1 milliliter.

**Use a 1 - 3 milliliter syringe for accuracy in this case.**

### Question 3

**After the bolus, at what rate would you start the infusion?**

#### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

#### **Answer:**

The order states to administer the initial infusion at 18 units/kg/hour.

$$18 \text{ units} \times 68 \text{ kg} = 1224 \text{ units per hour}$$

Round this to the nearest 100 (or follow your hospital policy for heparin administration and rounding off).

**The rate is 1200 units/hour.**

#### Question 4

**How many milliliters per hour is 1200 units/hr on an infusion pump? You know the concentration of Heparin is 25,000 units in 250 ml of D<sub>5</sub>W.**

#### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D<sub>5</sub>W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

#### **Answer:**

$$\frac{25,000 \text{ units}}{250 \text{ ml}} = \frac{1200 \text{ units}}{x \text{ ml}}$$

$$x = 12 \text{ ml}$$

**You would program the pump to run at 12 milliliters/hour.**

Notice that the heparin concentration in this case is 100 units/1 milliliter (25,000 units/250 milliliters). You can double check your calculations in this case by knowing that if the concentration is 100 units heparin per 1 milliliter of infusion and the order states for the heparin to run at 1200 units per hour, then  $1200/100 = 12$  milliliters on the pump.

## Question 5

**If you give the IV bolus and start the infusion at 14:00, then at what time will you draw a STAT aPTT?**

### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### **Answer:**

The order states to draw the STAT aPTT six hours following the bolus, which would make the blood, draw due at 20:00.

## Question 6

**When the aPTT comes back it is 37 seconds. Based on your orders what should you do?**

### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### **Answer:**

Your order states that if APTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hour. You know your patient is 68 kg.

The order says to give 40 units/kg IV, so:

$(40 \text{ units}) \times (68 \text{ kg}) = 2,720 \text{ unit IV bolus.}$

Most of the time a heparin bolus is rounded to the nearest 100.

**The IV bolus dose would be 2,700 units.**

## Question 7

**You have a 5,000 unit heparin syringes. The concentration is 5,000 units per milliliter. How many milliliters should you draw up for the IV bolus?**

### Physicians Orders and Sliding Scale

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

**Answer:**

$$\frac{5,000 \text{ units}}{1 \text{ ml}} = \frac{2,700 \text{ units}}{x \text{ ml}}$$

**x = 0.54 milliliters or 0.5 milliliters.**

Use a 1 milliliter syringe for accuracy in this case.

### Alternate Scenario

The pharmacy has sent you a vial of heparin sodium, 1,000 units/1ml in a 10 milliliter vial. In this case, how much heparin would you administer as your 2,700 unit bolus?

**Answer:**

$$\frac{1,000 \text{ units}}{1 \text{ ml}} = \frac{2,700 \text{ units}}{x \text{ ml}}$$

**x = 2.7 ml.**

Use a 3 milliliter syringe in this case for accuracy.

## Question 8

**The second part of the order states to increase the rate by 2 units/kg/hr. What would be the new rate in units/hr and milliliters/hr?**

### Physicians Orders and Sliding Scale

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### Answer:

$(2 \text{ units}) \times (68 \text{ kg}) \times (1 \text{ hour}) = 136 \text{ unit increase per hour.}$   
The rate increase would go from 1200 units per hour to 1336 units per hour.

You know the concentration of Heparin is 25,000 units in 250 ml of D<sub>5</sub>W

$$\frac{25,000 \text{ units}}{250 \text{ ml}} = \frac{1336 \text{ units}}{x \text{ ml}}$$

**You would program the pump to run at 13 milliliters/hour.**

Remember, your heparin concentration is 100 units/1 milliliters (25,000 units/250 milliliters). You can double check your calculations in this case by knowing that if your concentration is 100 units heparin per 1 milliliter of infusion and the order states for the heparin to run at 1336 units per hour, then  $1336/100 = 13.36$  or 13.4 milliliters on the pump.

## Question 9

**You give the 2,700 unit bolus and program the pump at 1336 units/hour or 13.4 milliliters/hour at 21:00. When will the next APTT be due?**

### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### **Answer:**

APTT should be drawn every six hours following a change in therapy.

**The APTT will be due at 03:00.**

## Question 10

**The night shift nurse draws the aPTT at 03:00 and it comes back at 04:00 > 100 sec. What should she do based upon the order set?**

### **Physicians Orders and Sliding Scale**

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

- If aPTT is < 35 sec, bolus with 80 units/kg IV and increase rate by 4 units/kg/hr.
- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### **Answer:**

According to the orders, she should hold the infusion for 1 hour, then decrease rate by 4 units/kg/hour.

$$(4 \text{ units}) \times (68 \text{ kg}) \times (1 \text{ hour}) = 272 \text{ units/kg/hour.}$$

Therefore, after holding the infusion from 04:00 to 05:00, she would restart the infusion at 05:00 at (1340 units/hour) – (272 units/hour) = 1068 units per hour.

You know the concentration of Heparin is 25,000 units in 250 ml of D<sub>5</sub>W

$$\frac{25,000 \text{ units}}{250 \text{ ml}} = \frac{1068 \text{ units}}{x \text{ ml}}$$

**You would program the pump to run at 10.68 or 11 milliliters/hour (depending on your policy).**

## Question 10 Alternate

**What would you do if you gave a bolus and increased the infusion rate, then noticed that the IV was infiltrated? Would you re-bolus the patient?**

### Physicians Orders and Sliding Scale

The physician orders the following:

Heparin Bolus 80 units/kg IV followed by Heparin Infusion 25,000 units/250 milliliters of D5W with an initial infusion rate 18 units/kg/hr.

Draw a STAT aPTT 6 hours following initial bolus and any change in therapy. Once aPTT is between 46-70, two consecutive times in a row, then draw aPTT every 24 hrs and a CBC every other day until discontinued.

Adjust heparin infusion based on sliding scale below:

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- If aPTT is 36 - 45 sec, bolus with 40 units/kg IV and increase rate by 2 units/kg/hr.
- If aPTT is 46 - 70 sec, no change in therapy, then redraw APTT at next AM lab draw.
- If aPTT is 71 - 90 sec, decrease rate by 2 units/kg/hr.
- If aPTT is > 90 seconds, hold infusion for 1 hour, then decrease rate by 4 units/kg/hr.

### Answer:

In addition to calling the physician, you may have policies or protocols addressing this situation in your particular hospital. For example, it is practiced in certain institutions that if the IV has been infiltrated less than 4 hours, you would re-bolus with the amount that would have infused during the time. You would take the number of units per hour x approximate hours infiltrated and administer that dose. If your infusion was running at 1800 units per hour and you estimate that the infusion has been infiltrated or stopped due to infiltration and poor IV access for approximately 3 hours, then.

$1800 \text{ units} \times 3 \text{ hours} = 5,400 \text{ units bolus once the IV is restarted.}$

Usually, if the IV has been non-functioning for greater than 4 hours, a physician will need to determine the appropriate restart dose and bolus.

Other hospitals base the decision solely upon the physician. However, with The Joint Commission's drive for standardization of medications across healthcare settings – you may begin to see more standard protocols such as these.

## Conclusion

### In this course, you learned:

It is extremely important that nurses implement safe administration procedures when administering heparin and other high alert drugs to their patients.

Familiarity with the correct dosage and treatment protocol for patients that receive heparin will also contribute to the prevention of medicinal errors.

Learning about normal mechanisms of homeostasis and the actions that heparin exerts on coagulation and clotting can help to improve patient safety and ensure quality care.

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