# Chapter 13

## Heparin Calculations

# Heparin Calculations: Objectives

After reviewing this chapter, you should be able to

1. understand what heparin does
2. state the importance of calculating heparin dosages accurately.
3. identify errors that have occurred with heparin administration.

# Drugs Used to Maintain or Restore Circulation

- Anticoagulants: Prevent the formation of clots that inhibit circulation
- Antiplatelets (antithrombotics): Prevent platelet aggregation
- Thrombolytics: Attack and dissolve blood clots that have already formed

# Drugs used to treat Thromboembolic Disorders

**Three major classifications of drugs:**

- **Anticoagulants:**
  - Suppress the coagulation cascade
  - Heparin, warfarin

- **Antiplatelets**:
  - Inhibit platelet aggregation
  - Aspirin, clopidogrel

- **Thrombolytics**:
  - Promote lysis of fibrin strands, causing dissolution of thrombi
  - tissue plasminogen activator ie t-PA (alteplase)

# Anticoagulants

- Heparin, LMWH and Protamine sulfate
- Warfarin
- Fibrinolytics (Thrombolytics)
- Antiplatelet Drugs – Aspirin, Dipyrydamole and Clopidogrel

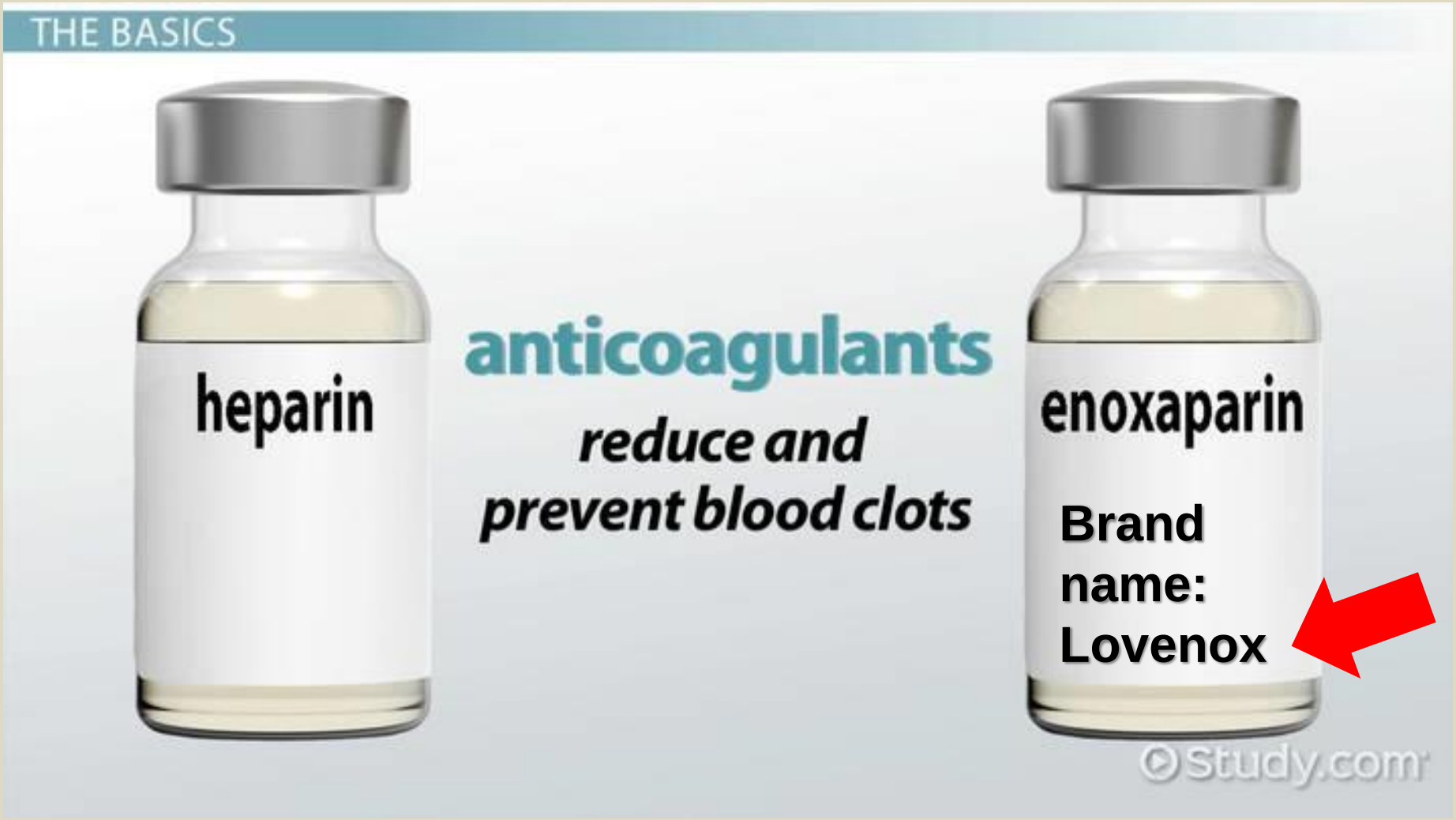
# Whats Heparin:

Heparin is an anticoagulant (blood thinner) that prevents the formation of blood clots.

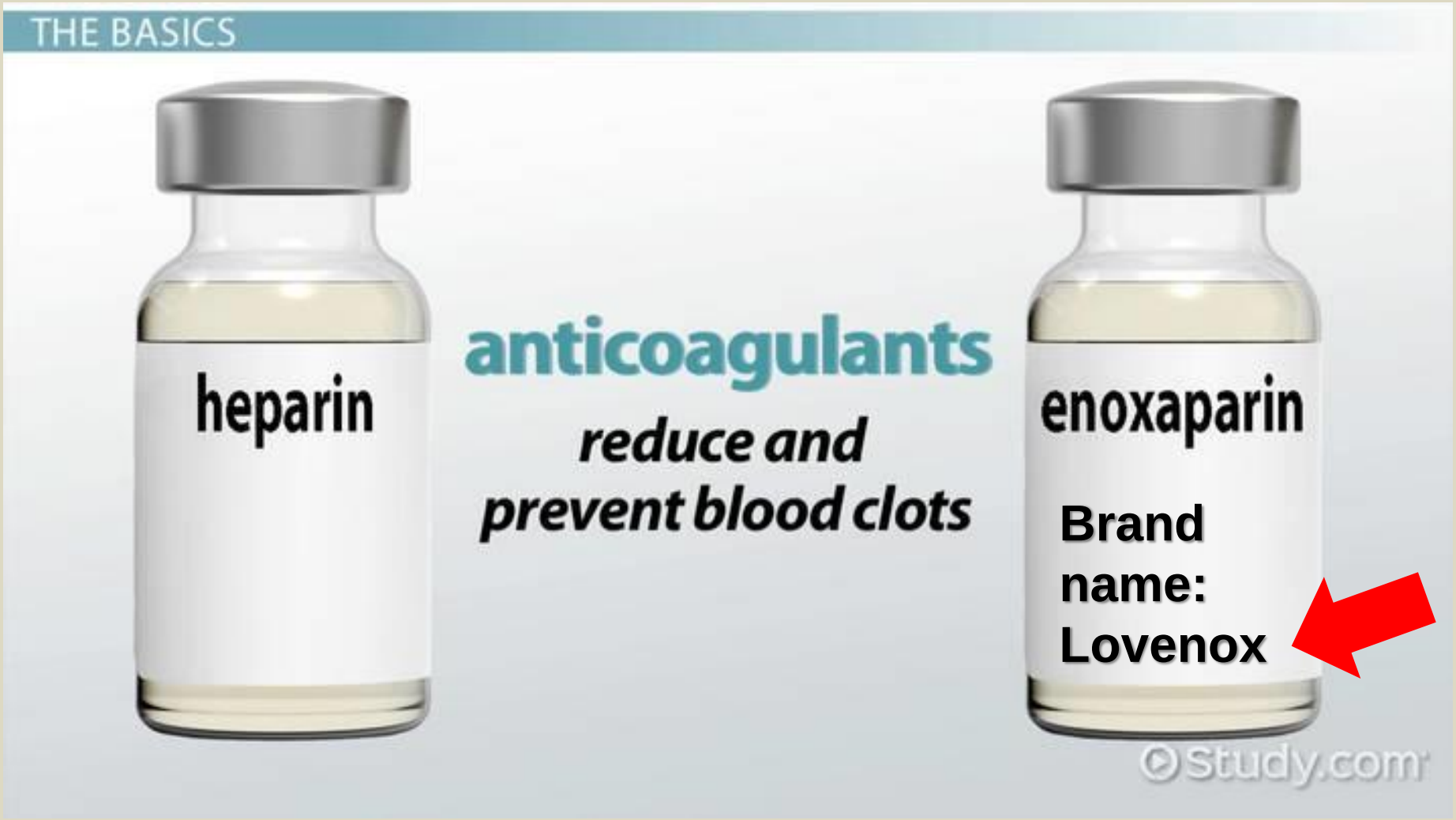
Heparin is used to treat and prevent blood clots in the veins, arteries, or lung. Heparin is also used before surgery to reduce the risk of blood clots

# ANTICOAGULANTS

- An anticoagulant is a drug that helps prevent the clotting (coagulation) of blood.
- These drugs tend to prevent new clots from forming or an existing clot from enlarging.
- They don't dissolve a blood clot.
- Anticoagulants are also given to certain people at risk for forming blood clots,




# Liquid Injectables




# Given in inpatient setting

# Other Anticoagulants

**Lovenox (enoxaparin sodium) & Coumadin/Jantoven (warfarin)**

- Blood thinners (anticoagulants) used to:
- Prevent blood clots and to reduce or prevent the chance of developing heart attacks (myocardial infarctions), strokes, and venous and other blood clots:
  - Deep Venous Thrombosis (DVTs)
  - Pulmonary Emboli

# Coumadin/Jantoven (warfarin)

- **Taken orally**
- **Primarily used in outpatient setting**
- **Vitamin K1** is the only effective **antidote** for long-term management
- But it takes several hours to reverse anticoagulation.

# Institute for Safe Medication Practices (ISMP)

# Background: Heparin

- Classified as HIGH ALERT
- ISMP reports anticoagulant medications are more likely to cause harm resulting from
  - complex dosing, insufficient monitoring, and inconsistent patient compliance.
- Changes to labeling initiated to reduce errors
  - Bolder and larger typeface and font size
  - Total unit strength and volume
  - Simplified upright text
  - “Not for lock flush” on cap of vials of heparin sodium injection


Heparin
Sodium Injection, USP
30,000 USP units per 30 mL
(1,000 USP units per mL)
For intravenous or subcutaneous use
NOT FOR LOCK FLUSH
From Porcine Intestinal


Heparin
Sodium Injection, USP
30,000
USP
units per 30 mL
(1,000 USP units per mL)
For intravenous or
subcutaneous use
NOT FOR LOCK FLUSH

# Background: Heparin (Cont.)

- Potent anticoagulant—prevents clotting
- Dosages expressed in (USP) units
- Monitor anticoagulation with aPTT in sec (activated partial thromboplastin time)
- Dosage is based on client weight in kg.
- Can be given subcut or IV
- Continuous IV infusion- dosage rate may be ordered in units/hr, mL/hr, or units/kg/hr
- Always administered by IV Pump
- Never given orally

# Forms of heparin :

1- unfractionated heparin (UF)

2- low molecular weight heparin (LMW)

# Heparin Dosage Strengths

- Available as single-dose or multidose
- 10 units per mL up to 50,000 units per mL
- Low molecular weight heparin (e.g., Lovenox) prescribed for
  - prevention and treatment of deep-vein thrombosis (DVT) following abdominal surgery, hip or knee replacement, unstable angina, and acute coronary syndromes.

# PHARMACOKINETICS

- Heparin is a large, highly ionized molecule; therefore not absorbed orally.
- Injected i.v. it acts instantaneously,but after s.c. injection anticoagulant effect develops after 60 min.
- Heparin does not cross blood-brain barrier or placenta.
- It is metabolized in liver by heparinase and fragments are excreted in urine.Heparin released from mast cells is degraded by tissue macrophages.

# Types of Coagulation Tests

**Prothrombin Time (PT)**
Evaulates ability to clot

**International Normalized Ratio (INR)**
Ensures that results from a PT test are the same from one lab to another

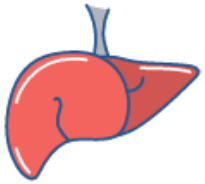
**Partial Thromboplastin Time (PTT)**
Determines if blood-thinning therapy is effective

# PTT Blood Test

## High Levels & Causes

*Time taken to clot is more than ususal*

- Pregnancy
- Nutritional Issues
- Liver Disease



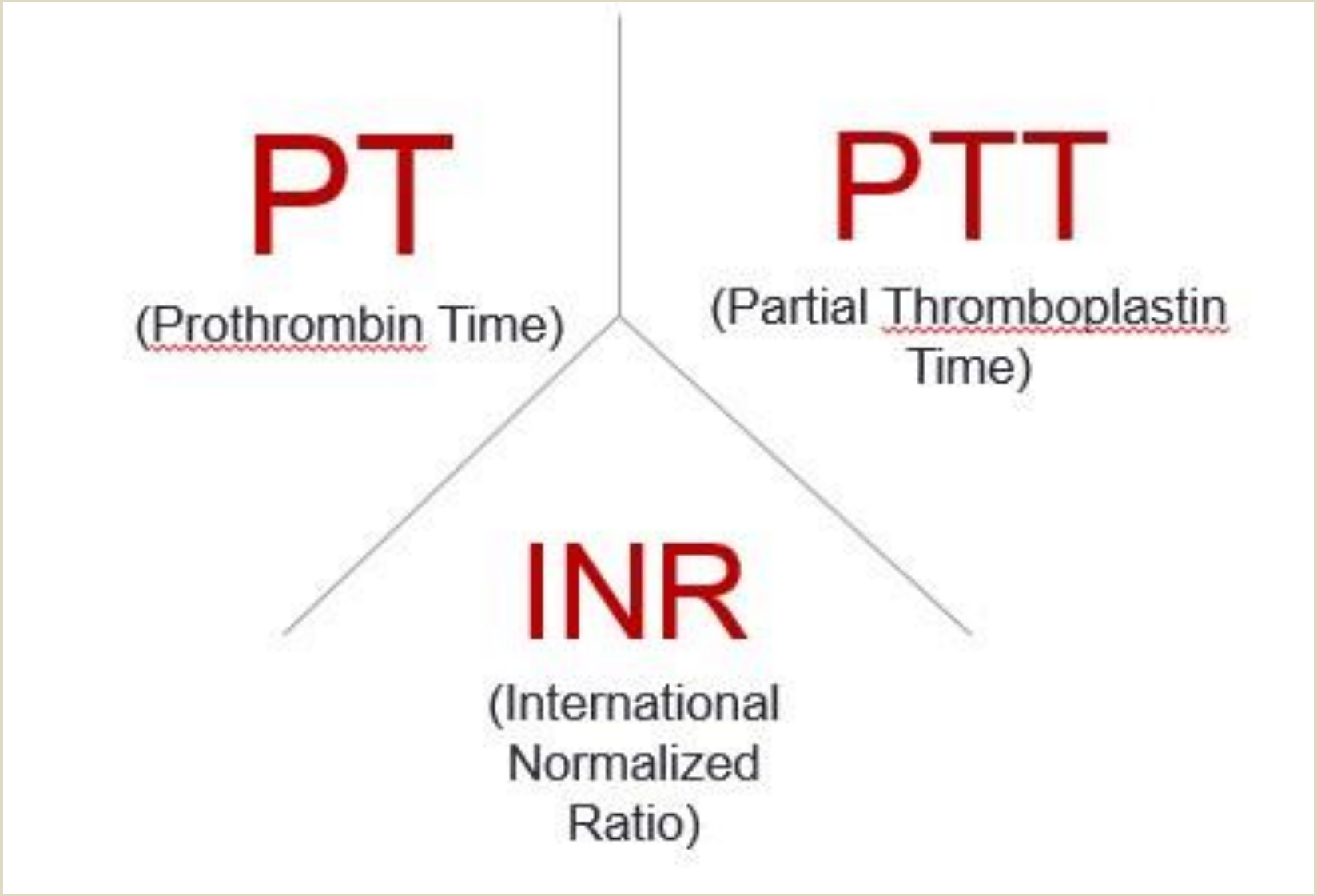
## Low Levels are not very common

DxSaver.com

- The PT/PTT is done to know the cause of unexplained bleeding or blood clots
- Normal range is 30 to 45 seconds in a healthy adult

# Anticoagulant Testing

- PT: Prothrombin time is a coagulation test performed to measure the time it takes for a firm fibrin clot to form
  - Measures clotting activity of blood
- INR: International Normalized Ratio
  - INR = patient PT results compared to normal patient average
- PT & INR are performed to ensure therapeutic amounts of oral anticoagulation medication is administered


PT
(Prothrombin Time)
PTT
(Partial Thromboplastin Time)
INR
(International Normalized Ratio)

# Partial Thromboplastin Time (PTT)

This test is performed primarily to determine if heparin (blood thinning) therapy is effective.[3] It can also be used to detect the presence of a clotting disorder. It does not show the effects of drugs called "low molecular weight heparin" or most commonly by the brand name Lovenox.

Extended PTT times can be a result of anticoagulation therapy, liver problems, lupus, and other diseases that result in poor clotting.

# Prothrombin Time (PT)

This test is done to evaluate the blood for its ability to clot. It is often done before surgery to evaluate how likely the patient is to have a bleeding or clotting problem during or after surgery. Taking Coumadin (warfarin) is the most common cause of a prolonged PT.

Other possible causes include vitamin K deficiency, hormone drugs including hormone replacements and oral contraceptives, disseminated intravascular coagulation (a serious clotting problem that requires immediate intervention), liver disease, and the use of the anticoagulant drug warfarin. [2]

Additionally, the PT result can be altered by a diet high in vitamin K, liver, green tea, dark green vegetables, and soybeans.

# International Normalized Ratio (INR)

The INR is used to make sure the results from a PT test is the same at one lab as it is at another lab. In the 1980s the World Health Organization determined that patients may be at risk because the results of a PT test would vary from one lab to another, based upon the way the test was done.[4]

The "normal" range for one lab would be different than a "normal" value from another lab, creating problems for patients who were being treated in several locations. In order to standardize the results between labs, the INR was created. The INR result should be the same, regardless of the location where the tests are performed.

# Normal Values for Coagulation Tests

There is a normal range of values seen in patients not taking blood thinners.[1] These ranges differ from the values desired when a person is taking a blood thinner.

## Normal Ranges

Normal values for people not on blood thinners:

- **PT**: 10 to 12 seconds (this can vary slightly from lab to lab)
- **PTT**: 30 to 45 seconds (this can value slightly from lab to lab)
- **INR**: 1 to 2

Blood thinners will make blood take longer to clot, so a patient taking a blood thinner would be expected to have lab results that are higher (longer) than the ones listed here.

Normal Values for Coagulation Tests

The results listed below are "normal values" seen in patients not taking blood thinners.

**Normal PT Values:** 10-12 seconds (this can vary slightly from lab to lab)

**Normal PTT Values:** 30 to 45 seconds (this can value slightly from lab to lab)

**Normal INR Values:** 1 to 2

# Coagulation Studies (Coags)

| Lab | Association | Normal |
| --- | --- | --- |
| INR | I (One): < 1 | < 1 |
| PT | Ten (T): 10 | 10-12 seconds |
| PTT | Ten (T) + Twenty/Thirty (T): 30-40 | 30-40 seconds |

# PT: INR Values

- INR = International Normalized Ratio.
- MNP = Mean Normal Plasma.

$$INR = (PT / MNP)^{ISI}$$

- An INR of 1.0 means that the patient PT is normal.
- An INR greater than 1.0 means the clotting time is elevated.

# INR

- An INR of 1.0 means that the patient PT is normal.
- An INR greater than 1.0 means the clotting time is elevated.
- INR of greater than 5 or 5.5 = unacceptable high risk of bleeding,whereas if the INR=0.5 then there is a high chance of having a clot.
- Normal range for a healthy person is 0.9–1.3, and for people on warfarin therapy, 2.0–3.0, although the target INR may be higher in particular situations, such as for those with a mechanical heart valve.

# Lab Values

Too high patient will die

Too low clots will grow

# Memory Trick:

"HePPT" the FROG

- **H** – Heparin
- **P** - Protamine Sulfate **Antidote**
- **PTT** - **46 – 70** Max range

# Heparin

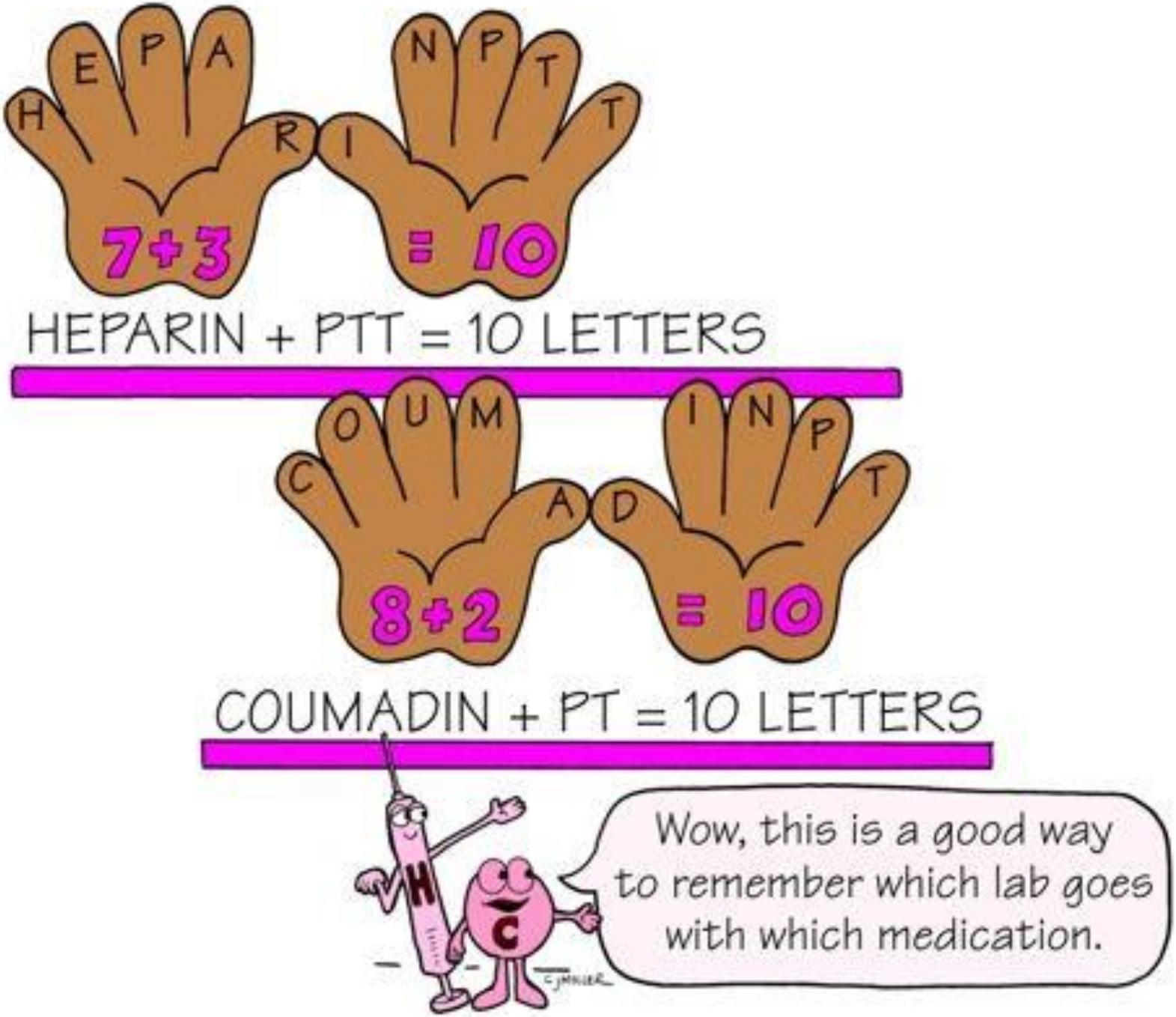
PTT above 70 

STOP THE HEPARIN !!!

Administer protamine sulfate

# Anticoagulants

- Heparin, LMWH and Protamine sulfate
- Warfarin
- Fibrinolytics (Thrombolytics)
- Antiplatelet Drugs – Aspirin, Dipyrydamole and Clopidogrel


H E P A R I N
P T T
7+3
= 10
HEPARIN + PTT = 10 LETTERS
C O U M A D I N
P T
8+2
= 10
COUMADIN + PT = 10 LETTERS
H
C
Wow, this is a good way to remember which lab goes with which medication.

# Heparin vs Coumadin (Warfarin)

- Heparin and Warfarin Difference| Anticoagulants| Blood Thinners| Explained - YouTube

  (3:34)

# Vitamin K

- Vitamin K is used to **reverse** the action of warfarin (Coumadin)
- Patients who need prompt, complete reversal of anticoagulation should receive IV vitamin K in a dose of 2.5 to 10 mg.

# Vitamin K Foods

- Liver
- Green leafy vegetables (Broccoli, Spinach)
- **Key Patient** Teaching:
  - Consistent & Moderation
    Keep K – Consistent

# Heparin Doses

# Dosage and Administration:

- intravenously (immediate effect)
  - 20 to 40 thousands units/day dose

- subcutaneously ( effect on 20-60 min )
  - 8,000 to 10,000 units every 8 h .

# Pharmacokinetics:

**Absorption:** Heparin is not absorbed from GI; must be given IV or subcutaneously,

**Metabolism:** The liver andreticuloendothelial system are the sites of biotransformation.

**Elimination:** The average half-life is 1.5 h (range, 1 to 6 h) and is dose dependent Excreted in the urine


NOT for lock flush
Rx only
Heparin
Sodium Injection, USP
5,000 USP units
per 0.5 mL
403496


Antiseptic wipes
LORIS
10 mL saline vial
5 mL syringe
Heparin solution
10 mL saline syringe
Safety needle
© AboutKidsHealth.ca

# Trade Names

. **Heparin Sodium**

. **Heparin I.V. Flush**

. **Monoject PreFill Advanced** (this form of heparin must not be used to treat or prevent blood clotting in the body )

# Heparin Lock

# Saline/Heparin lock

- Saline lock (SL)
  - also known as a heparin lock
  - is an intravenous (IV) catheter that is threaded into a peripheral vein, flushed with saline, and then capped off for later use.
  - allows easy access to the peripheral vein for intermittent IV fluids or medications

# Saline Lock

A saline lock adapter should be applied even if you are going to give IV fluids immediately

A saline lock gives you the ability to stop giving IV fluids, then start again at a later time without performing another venipuncture

# IV Flush Orders

- Practitioner must write order for heparin flushes
- Standard Adult and Pediatric flush orders
- Each device has a standard flushing protocol including 0.9% sodium chloride and heparin
- If heparin is contraindicated, consider alternative, such as argatroban or tPA
- When patient is admitted with a device, initiate the order for RN to get heparin

# Catheter Flushing

Saline Flush:

- https://www.youtube.com/watch?v=Sq-D2bbgqoM&t=35s

(2:55)

Heparin flush:

- https://www.youtube.com/watch?v=6jHqHIZY-1c

(5:20)

# Catheter Flushing

- SASH Flushing
  - This flushing method is used to ensure that medication incompatible with heparin gets flushed through the catheter with saline then is flushed with heparin
    - Saline
    - Administer medication
    - Saline
    - Heparin

# ADVERSE EFFECTS

1. Bleeding due to overdose is the most serious complication of heparin therapy.Haematuria is generally the first sign.
2. Thrombocytopenia is another common problem.
3. Reversible alopecia is infrequent.
4. Osteoporosis may develop on long-term use of relatively high doses.
5. Hypersensitivity reactions are rare.

# Heparin – Contd.

- Adverse effects:
  1. Bleeding due to overdose – haematuria is 1st sign
  2. Thrombocytopenia – aggregation of platelets
  3. Hypersensitivity – urticaria, rigor, fever and anaphylaxis etc.
  4. Alopecia and osteoporosis
- Contraindications: Bleeding disorders, Severe hypertension, GIT ulcer, Piles, SABE & malignancy, Ocular & neurosurgery, Chronic alcoholism, cirrhosis etc.
- Aspirin and antiplatelet drugs - caution

# Heparin Errors

- Has caused serious injuries and death when misused
  - Calculation errors
  - Mix-ups with concentrations of heparin
  - Confusion with the total amount in a vial of heparin and the per mL amount (i.e., a10 mL vial of heparin held a total of 1,000 units when the vial contained 10,000 units, 1,000 units per mL) which have led to fatal heparin overdoses
  - Insufficient monitoring of the client

# Dennis Quaid

November 2007

The drug **error** involving the **Quaid** twins was identified after one of the babies started to seep blood from a puncture site. Through blood tests, Cedars-Sinai staff found that three had been given excessive doses of heparin, officials said.

December 2008

Actor Dennis Quaid and his wife have reached a $750,000 settlement with a Los Angeles hospital over a life-threatening accidental overdose of their newborn twins with a blood thinner **medication**. The hospital apologized at the time of the **error**.

https://www.youtube.com/watch?v=GEDMYsm3Nxs

https://www.oprah.com/health/how-a-medical-mistake-almost-killed-dennis-quaids-twins/all

# Reading Heparin Labels

- Heparin labels must now express the strength (amount) per total volume as the primary and prominent expression on the label, followed in close proximity by the strength per milliliter
  - Bolder and larger type-face
  - The strength per total volume is expressed followed by the dosage strength per mL.
  - The statement “Not for lock flush

# Background: Heparin

SAFETY ALERT! 

The average heparin flush is 10 units per mL and NEVER exceeds 100 units per mL.  Heparin sodium for injection and heparin lock flush solution can never be used interchangeably.

SAFETY ALERT! 

TWO nurses must ALWAYS check doses on heparin before it is administered.

# Case Study

Mr. Flint is diagnosed with new-onset atrial fibrillation and is started on a heparin drip in order to prevent clots from being formed.  What are some things that need to be done when preparing to administer this medication?

# Case Study (Cont.)

ANSWER:

- Obtain an electronic IV pump.
- Weigh the client and convert to kg.
- Have another nurse independently check the dosage.
- Make sure anticoagulation labs (aPTT) are ordered.