Anticoagulants

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Used *in vivo*	**Parenteral anticoagulants**	**Indirect thrombin inhibitors: Heparin, Low molecular weight heparins, Fondaparinux, Danaparoid**
		Direct thrombin inhibitors: Lepirudin, Bivalirudin, Argatroban
	Oral anticoagulants	**Coumarin derivatives:** Bishydroxycoumarin (dicumarol), Warfarin sod, Acenocoumarol (Nicoumalone), Ethylbiscoumacetate
		Indandione derivative: Phenindione
		Direct factor Xa inhibitors: Rivaroxaban
		Oral direct thrombin inhibitor: Dabigatran etexilate

Anticoagulants

Used in vitro	**Heparin**	150 U to prevent clotting of 100 ml blood.
	Calcium complexing agents: Sodium citrate	1.65 g for 350 ml of blood **(used to keep blood in the fluid state for transfusion)**
	Sodium oxalate	10 mg for 1 ml blood **(used in blood taken for investigations)**
	Sodium edetate	2 mg for 1 ml blood **(used in blood taken for investigations)**

Blood clotting factors and drugs that affect them

Component or Factor	Common Synonym	Target for the Action of:
I	Fibrinogen	
II	Prothrombin	Heparin, dabigatran (IIa); warfarin (synthesis)
III	Tissue thromboplastin	
IV	Calcium	
V	Proaccelerin	
VII	Proconvertin	Warfarin (synthesis)
VIII	Antihemophilic factor (AHF)	
IX	Christmas factor, plasma thromboplastin component (PTC)	Warfarin (synthesis)
X	Stuart-Prower factor	Heparin, rivaroxiban, apixaban, edoxaban (Xa); warfarin (synthesis)
XI	Plasma thromboplastin antecedent (PTA)	
XII	Hageman factor	
XIII	Fibrin-stabilizing factor	
Proteins C and S		Warfarin (synthesis)
Plasminogen		Thrombolytic enzymes, aminocaproic acid

Anticoagulant

- The anticoagulant drugs inhibit either the action of the coagulation factors (heparin) or interfere with the synthesis of the coagulation factors (warfarin).
- Heparin or Unfractionated heparin (UFH) is a heterogeneous mixture of sulfated mucopolysaccharides with MW 10,000 to 20,000 g/mol. Its biologic activity is dependent upon the endogenous anticoagulant **antithrombin**.

Anticoagulant

- The shorter-chain, low-molecular-weight (LMW) fractions of heparin (**enoxaparin, dalteparin, and tinzaparin**) inhibit activated factor X but have less effect on thrombin than the high-molecular-weight (HMW) species.
- **Monitoring of Heparin Effect:** Close monitoring of the activated partial thromboplastin time (aPTT or PTT) is necessary in patients receiving UFH. Levels of UFH may also be determined by protamine titration (therapeutic levels 0.2–0.4 unit/mL) or anti-Xa units (therapeutic levels 0.3–0.7 unit/mL).

Anticoagulant

- **Toxicity:** Bleeding, loss of hair and reversible alopecia, heparin-Induced thrombocytopenia.
- **Contraindications:** Heparin should be avoided in patients who have recently had surgery of the brain, spinal cord, or eye; and in patients who are undergoing lumbar puncture or regional anesthetic block.
- **Reversal of Heparin Action: Protamine** antagonize the heparin. Intravenous injection of protamine neutralises heparin weight for weight, i.e. 1 mg is needed for every 100 U of heparin.

Use of anticoagulant

- The aim of using anticoagulants is to prevent thrombus extension and embolic complications by reducing the rate of fibrin formation.
  - *Deep vein thrombosis and pulmonary embolism*
  - *Myocardial infarction*
  - *Unstable angina*
  - *Rheumatic heart disease; Atrial fibrillation*
  - *Cerebrovascular disease*
  - *Vascular surgery, prosthetic heart valves, retinal vessel thrombosis, extracorporeal circulation, haemodialysis*
  - *Defibrination syndrome*

Direct factor Xa inhibitors

- **Rivaroxaban:** It is an orally active direct inhibitor of activated factor Xa which has become available for prophylaxis and treatment of Deep Vein Thrombosis (DVT).

Oral direct thrombin inhibitor

- **Dabigatran etexilate:** It is a **prodrug** which after oral administration is rapidly hydrolysed to dabigatran, a direct thrombin inhibitor. Dabigatran reversibly blocks the catalytic site of thrombin and produces a rapid anticoagulant action.