Heparin Mechanisms

Heparin is an anticoagulant medication, which is a cofactor for antithrombin, working to inactivate the coagulation factors IIa (Thrombin) and Xa. It is indicated for use in acute coronary syndrome, atrial fibrillation, pulmonary embolisms, and prophylaxis in hypercoagulable states. This drug has a short half-life and is administered frequently or as a continuous infusion. Heparin works by acting as a cofactor for antithrombin activation. As antithrombin is activated, it acts to decrease activation of factor IIa, or thrombin, as well as factor Xa. Side effects of heparin administration include bleeding, as well as heparin induced thrombocytopenia, or HIT. The antidote to heparin toxicity is the positively charged reversal agent, protamine sulfate, which binds to the negatively charged heparin.

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Mechanism of Action

Short Half-life
Shorts Half-Life-clock
Heparin works very quickly, but has a short half-life of roughly 1 hour. It is for this reason it must be given frequently or administered as a continuous infusion. An exception to this is low-molecular-weight heparin (enoxaparin), which acts more on factor Xa and has a longer half-life and bioavailability.

Antithrombin Activation Cofactor
Ant-tie-trombone Activated
Heparin binds to the enzyme inhibitor antithrombin III, causing its activation. Antithrombin, now activated, leads to the inactivation of thrombin (factor IIa) and other proteases involved in blood clotting, most notable factor Xa.

Decrease Thrombin, Factor Xa
Down-arrow Trombone with 10-A-apple
Activated antithrombin, leads to the inactivation of thrombin (factor IIa) and other proteases involved in blood clotting, most notable factor Xa. Antithrombin's effects are increased 1000-fold due to the activation via heparin, leading to vastly decreased coagulability.

Side Effects

Bleeding
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Bleeding is a side effect seen with (unfractionated) heparin if administered in too large a dose. High dose administration of heparin should be monitored by following the PTT. Patients taking low-molecular weight heparin have a lesser risk of bleed and do not need the PTT to be followed.

Heparin Induced Thrombocytopenia (HIT)
Hippie-heron HIT Trombone-side-toe-peanut
A serious side effect seen 5-10 days after heparin administration is HIT, or heparin-induced thrombocytopenia. This is described as an immunological reaction leading to pathological platelet activation and clearance, causing thrombocytopenia.

Antidote

Protamine Sulfate
Potato-man with Sulfur-matches
For rapid reversal of heparin, protamine sulfate is used as an antidote. It is highly positively charged, and binds to negatively charged heparin. Low-molecular-weight heparin is not easily reversible.

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