Difference Between Anticoagulants and Thrombolytics

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Key Difference – Anticoagulants vs Thrombolytics

Anticoagulants are the drugs that are used in preventing the undue formation of blood clots inside the circulatory system whereas thrombolytics are the drugs used for the removal of thrombi that occlude the vessels, causing various diseases such as ischemic heart diseases and stroke. The major difference between anticoagulants and thrombolytics is that **anticoagulants are used to prevent the formation of new blood clots in the circulatory system, while thrombolytics are used to remove the blood clots that have been already formed inside the blood vessels.**

What are Anticoagulants?

A blood clot is a meshwork of fibrin fibers running in all directions and entrapping blood cells, platelets and plasma. Clotting is a physiological mechanism which is initiated in response to a rupture of a blood vessel or damage to the blood itself. These stimuli activate a cascade of chemicals to form a substance called prothrombin activator. Prothrombin activator then catalyzes the conversion of prothrombin to thrombin. Finally, thrombin, which acts as an enzyme, catalyzes the formation of fibrin fibers from fibrinogen and these fibrin fibers entangle with each other forming a fibrin mesh which we call the clot.

As previously mentioned, the activation of a cascade of chemicals is required for the formation of the prothrombin activator. This particular activation of chemicals can happen via two major pathways.

- Intrinsic pathway – it is the intrinsic pathway that is activated when there is a blood trauma
- Extrinsic pathway – extrinsic pathway gets activated when the traumatized vascular wall or the extravascular tissues come into contact with the blood.

The human vascular system employs several strategies in order to prevent the formation of blood clots in the vascular system under the normal conditions.

- Endothelial Surface Factors – The smoothness of the endothelial surface helps in preventing the contact activation of the intrinsic pathway. There is a coat of glycocalyx on the endothelium which repels clotting factors and platelets, thereby preventing the

formation of a clot. Presence of thrombomodulin, which is a chemical found on the endothelium assists to counter the clotting mechanism. Thrombomodulin binds with thrombin and stops the activation of fibrinogen.

- The anti-thrombin action of fibrin and antithrombin iii.
- Action of heparin
- Lysis of blood clots by plasminogen

It is evident from these countermeasures that the human body doesn't want to have any blood clots inside it under the normal conditions. But evading these protective mechanisms blood clots can be formed inside our body. Conditions like trauma, atherosclerosis, and infection can roughen the endothelial surface, activating the clotting pathway. Any pathology that leads to the narrowing of a blood vessel also has a tendency to form clots because the narrowing of the vessel slows down the blood flow through it and consequently more procoagulants are accumulated at the site making a favorable environment for the formation of blood clots.

Basic Pharmacology of Anticoagulants

Anticoagulants are the drugs that are used in preventing the undue formation of blood clots inside the circulatory system. According to the mechanism of action of these drugs, they are categorized into different subcategories.

Indirect Thrombin Inhibitors

These drugs are called the indirect thrombin inhibitors because their inhibition of thrombin happens via the interaction with another protein called antithrombin. Unfractionated heparin (UFH) and Low Molecular Weight Heparin (LMWH) bind to antithrombin enhancing its inactivation of factor Xa.

Heparin

Antithrombin inhibits the action of clotting factors IIa, IXa, and Xa by forming stable complexes with them. In the absence of heparin, these reactions occur slowly. Heparin acts as a cofactor for anti-thrombin increasing the rate of the relevant reactions by at least 1000 folds. Unfractioned heparin markedly inhibits blood clotting by inhibiting all three factors including thrombin and factor Xa. But the anticoagulant effect of low molecular weight heparin is lesser than that of UFH due to its low affinity towards antithrombin. Enoxaparin, dalteparin, and tinzaparin are some examples for LMWH.

Close monitoring of the blood clotting mechanisms of the patients receiving UFH is extremely important. This is done by assessing the APTT of the patient usually on a monthly basis. On the other hand, such monitoring is not required in patients who are under LMWH because of its predictable pharmacokinetics and plasma levels.

Adverse Effects

- Excessive bleeding following even a minor trauma
- Heparin-induced thrombocytopenia

Contraindications

- Hypersensitivity to the drug
- Active bleeding
- Intracranial hemorrhages
- Severe hypertension
- Active TB
- Significant thrombocytopenia
- Threatened abortion

The excessive anticoagulant effect of heparin can be corrected by discontinuing the drug. If the bleeding persists the administration of protamine sulfate is indicated.

Warfarin

Warfarin is a commonly used anticoagulant with a 100% of bioavailability. Majority of the warfarin administered into the human body is bound to plasma albumin giving it a small volume of distribution and a long half-life.

Warfarin prevents the carboxylation of glutamate residues of prothrombin, clotting factors VII, IX and X. This renders these molecules inactive impairing the clotting mechanism. There is a 8- 12 hour delay in the action of warfarin due to the presence of already carboxylated molecules of the previously mentioned cofactors whose action masks the effect of warfarin.

Figure 01: Warfarin

Adverse Effects

- Warfarin can pass through the placental barrier causing hemorrhagic disorders in the fetus
- It can also cause skeletal deformations in the fetus.

Other than these frequently used anticoagulation agents, oral direct factor Xa inhibitors such as rivaroxaban and parental direct thrombin inhibitors are also used to control coagulation.

What are Thrombolytics?

Thrombolytics are the drugs used for the removal of thrombi that occlude the vessels causing various diseases such as ischemic heart diseases and stroke.

The early use of thrombolytics in the management of ischemic heart diseases is proven to be effective in reducing the size of the thrombus and in increasing the patency of the vessel.

All thrombolytic agents act by activating plasminogen to plasmin resulting in the degradation of fibrin both in the thrombi as well as in the hemostatic fibrin plugs. This markedly increases the risk of intracranial hemorrhages.

Streptokinase

Streptokinase is an enzyme produced by beta-hemolytic streptococci. It forms a complex with plasminogen and then cleaves plasminogen into plasmin. Since streptokinase is a foreign substance to the body, some patients can develop allergic reactions to it. Such patients who require thrombolysis due to various disease conditions and are hypersensitive to streptokinase should carry a drug card clearly indicating their tendency to develop an allergy against streptokinase.

Alteplase

Recombinant alteplase is developed from an endogenous fibrinolytic enzyme whose release triggers fibrinolysis. Although alteplase has a much quicker thrombolytic effect than streptokinase, it has a high risk of causing intracranial hemorrhages. On the other hand, this drug is more expensive than the other thrombolytic agents.

What is the Similarity Between Anticoagulants and Thrombolytics?

- Both groups of drugs are used in controlling the coagulation.

What is the Difference Between Anticoagulants and Thrombolytics?

Anticoagulants vs Thrombolytics	
Anticoagulants are the drugs that are used in preventing the undue formation of blood clots inside the circulatory system.	Thrombolytics are the drugs used for the removal of thrombi, which occlude vessels and cause various diseases such as ischemic heart diseases and stroke.
Use	
These are used in preventing the formation of blood clots inside the vessels.	These are used in removing the blood clots already formed inside the vessels.

Action	
They act by inactivating various components of the clotting cascade.	All thrombolytic agents act by activating plasminogen to plasmin resulting in the degradation of fibrin both in the thrombi as well as in the hemostatic fibrin plugs.
Adverse Effects	
Adverse effects of heparin • Excessive bleeding following even a minor trauma • Heparin-induced thrombocytopenia Adverse effects of warfarin • Warfarin can pass through the placental barrier causing hemorrhagic disorders in the fetus • It can also cause skeletal deformations in the fetus.	There can be allergic reactions against streptokinase. Intracranial hemorrhages are a fatal complication of thrombolytics.
Contraindications	
Contraindications for heparin are, • Hypersensitivity to the drug • Active bleeding • Intracranial hemorrhages • Severe hypertension • Active TB • Significant thrombocytopenia • Threatened abortion	The use of streptokinase is contraindicated if the patient is allergic to it.

Summary – Anticoagulants vs Thrombolytics

Anticoagulants are the drugs that are used in preventing the undue formation of blood clots inside the circulatory system. Thrombolytics are the drugs used for the removal of thrombi that occlude the vessels causing various diseases such as ischemic heart diseases and stroke. While anticoagulants are used to prevent the formation of blood clots, thrombolytics are used to remove the blood clots already formed inside the vessels occluding them. This is the major difference between these two groups of drugs.

References:

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