Adenosine diphosphate (ADP)

see also Adenosine diphosphate receptor inhibitor.

Adenosine diphosphate (ADP) (Adenosine pyrophosphate (APP)) is an important organic compound in metabolism and is essential to the flow of energy in living cells. A molecule of ADP consists of three important structural components: a sugar backbone attached to a molecule of adenine and two phosphate groups bonded to the 5 carbon atom of ribose. The carbon molecules that make up the ring structure of a sugar can be named in a way that more specifically designates the location of the phosphate and adenosine attachments: The sugar backbone of ADP is known as a pentose sugar and consists of five carbon molecules. The two phosphate groups of ADP are added in series to the 5’ carbon of the sugar backbone, while the adenosine molecule attaches to the 1’ carbon.

The two phosphates in ADP can be correlated with ATP and AMP. ATP consists of three phosphate groups attached in series to the 5’ carbon location, whereas ADP contains two phosphate groups attached to the 5’ position, and AMP contains only one phosphate group attached at the 5’ position. Energy transfer used by all living things is a result of dephosphorylation of ATP by enzymes known as ATPases. The cleavage of a phosphate group from ATP results in the coupling of energy to metabolic reactions and a by-product, a molecule of ADP.

Being the “molecular unit of currency”, ATP is continually being formed from lower-energy molecules of ADP and AMP. The biosynthesis of ATP is achieved throughout processes such as substrate-level phosphorylation, oxidative phosphorylation, and photophosphorylation, all of which facilitating the addition of a phosphate group to an ADP molecule.

Under normal conditions, small disk-shape platelets circulate in the blood freely and without interaction with one another. ADP is stored in dense bodies inside blood platelets and is released upon platelet activation. ADP interacts with a family of ADP receptors found on platelets (P2Y1, P2Y12, and P2X1), which leads to platelet activation.

P2Y1 receptors initiate platelet aggregation and shape change as a result of interactions with ADP.

P2Y12 receptors further amplify the response to ADP and draw forth the completion of aggregation.

ADP in the blood is converted to adenosine by the action of ecto-ADPases, inhibiting further platelet activation via adenosine receptors.

Case series

Yang et al prospectively recruited patients with intracranial aneurysms undergoing stent treatment and maintained the data in a database. MRI with diffusion-weighted sequences was performed within 24 hours of stent insertion to identify acute ischemic lesions. The authors used thromboelastography to assess the degree of platelet inhibition in response to clopidogrel and aspirin. Univariate and multivariate logistic regression analysis was used to identify potential risk factors of thromboembolism.

One hundred sixty-eight patients with 193 aneurysms were enrolled in this study. Ninety-one of 168 (54.2%) patients with acute cerebral ischemic lesions were identified by diffusion-weighted MRI. In 9 (5.4%) patients with ischemic lesions, transient ischemic attack or stroke was found at discharge, and these complications were found in 11 (6.5%) patients during the follow-up period. The incidence of

periprocedural thromboembolic complications increased with resistance to antiplatelet agents, hypertension, hyperlipidemia, complete occlusion, and aneurysm of the anterior circulation. The multivariate regression analysis demonstrated that the anterior circulation and adenosine diphosphate (ADP) inhibition percentage were independent risk factors of perioperative thromboembolic complications. The maximum amplitude and ADP inhibition percentage were independent risk factors for thromboembolic complications during the follow-up period.

The ADP inhibition percentage is related to thromboembolic complications after stent placement for intracranial aneurysms. The increase of the ADP inhibition may decrease the risk of thromboembolic complications [1].

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Yang H, Li Y, Jiang Y. Insufficient platelet inhibition and thromboembolic complications in patients with intracranial aneurysms after stent placement. J Neurosurg. 2015 Nov 20:1-7. [Epub ahead of print] PubMed PMID: 26587657.