ASSESSMENT OF PAI-1 AND PLASMINOGEN IMBALANCE AND THEIR ROLE IN ENDOTHELIAL DYSFUNCTION IN PATIENTS WITH ACUTE CORONARY SYNDROME UNDER ANTICOAGULANT THERAPY

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Introduction. Acute coronary syndrome (ACS) is caused by acute thrombus formation on a disrupted atherosclerotic plaque and is closely associated with endothelial dysfunction, inflammation, and activation of the coagulation cascade. Anticoagulant therapy is an essential component of ACS management; however, clinical outcomes depend not only on suppression of coagulation but also on the functional integrity of the fibrinolytic system. Recent evidence suggests that persistent hypofibrinolysis, driven by increased plasminogen activator inhibitor-1 (PAI-1), may limit the effectiveness of anticoagulant therapy. PAI-1 is synthesized by endothelial cells, platelets, and adipose tissue and represents a key mediator linking endothelial dysfunction, inflammation, and thrombosis. Elevated PAI-1 suppresses plasmin generation and stabilizes thrombus structure. Plasminogen, the central substrate of fibrinolysis, may increase as a compensatory response to fibrinolytic inhibition. However, in the presence of excessive PAI-1 activity, elevated plasminogen does not translate into effective fibrin degradation. Thus, the imbalance between PAI-1 and plasminogen may represent a critical mechanism of residual thrombotic risk in ACS, even under anticoagulant therapy.

Purpose of the Study. To evaluate the imbalance between PAI-1 and plasminogen in patients with acute coronary syndrome receiving anticoagulant therapy and to assess their role in the development and persistence of endothelial dysfunction.

Materials and Methods. Study design and population: A retrospective observational study was conducted using laboratory data from 45 patients diagnosed with acute coronary syndrome and treated with standard anticoagulant therapy during hospitalization. The age of patients ranged from 38 to 85 years. **Laboratory measurements:** Plasma PAI-1 levels were measured in ng/mL (reference range: 4–43 ng/mL). Plasminogen concentration was determined in IU/mL (reference range: 0.8–1.3 IU/mL) using immunochemical methods. **Assessment strategy:** Laboratory values were compared with reference ranges. Elevated PAI-1 was interpreted as a marker of fibrinolytic inhibition and endothelial dysfunction, while increased plasminogen was considered a compensatory response of the fibrinolytic system. **Data analysis:** Descriptive statistical analysis was performed with qualitative interpretation of fibrinolytic abnormalities based on individual patient data .

Results. Analysis of laboratory parameters revealed that **elevated PAI-1 levels were detected in a substantial proportion of patients**, with values exceeding the upper reference limit (43 ng/mL) in multiple cases. The highest PAI-1 concentrations reached more than 50 ng/mL, indicating pronounced suppression of fibrinolysis despite anticoagulant therapy. Plasminogen levels were **significantly increased in the majority of patients**, frequently exceeding the normal range by 2–4 times. In several cases, plasminogen concentrations approached or exceeded 5.0 IU/mL, suggesting strong activation of fibrinolytic substrate production. The **simultaneous elevation of PAI-1 and plasminogen** was a common finding and reflected a marked imbalance of the fibrinolytic system. This pattern indicates ineffective fibrin degradation, persistence of stable thrombus formation, and ongoing endothelial dysfunction under conditions of acute coronary ischemia.

Discussion. The obtained results demonstrate that standard anticoagulant therapy in ACS does not fully restore fibrinolytic balance. Persistently elevated PAI-1 levels indicate sustained endothelial dysfunction and inflammatory activation, which continue to inhibit plasmin generation and fibrin degradation. The observed increase in plasminogen should be regarded as a compensatory but functionally insufficient response. Excess plasminogen in the setting of high PAI-1 activity fails to overcome fibrinolytic inhibition, resulting in a state of “ineffective fibrinolysis.” This condition may contribute to residual thrombotic risk, impaired myocardial reperfusion, and recurrent ischemic events. Importantly, this fibrinolytic imbalance is not detected by routine coagulation tests, highlighting the additional diagnostic value of PAI-1 and plasminogen assessment in ACS patients.

Conclusion

1. Patients with acute coronary syndrome receiving anticoagulant therapy exhibit a significant imbalance of the fibrinolytic system.
2. Elevated PAI-1 levels reflect persistent inhibition of fibrinolysis and ongoing endothelial dysfunction.
3. Increased plasminogen concentrations represent a compensatory response but do not ensure effective thrombus lysis.
4. The coexistence of high PAI-1 and plasminogen defines a hypofibrinolytic, prothrombotic phenotype under anticoagulant therapy.
5. Combined assessment of PAI-1 and plasminogen may improve identification of residual thrombotic risk and support more personalized therapeutic strategies in acute coronary syndrome.