Evaluation of Plasminogen Activator Inhibitor-1 in End-Stage Renal Disease Patients

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BACKGROUND

Fibrinolysis is the physiologic process responsible for dissolving fibrin clots and maintaining vascular patency. Plasminogen Activator Inhibitor-1 (PAI-1) is the principal inhibitor of fibrinolysis; excessive PAI-1 promotes a hypofibrinolytic, pro-thrombotic state.

End-Stage Renal Disease (ESRD), defined as a glomerular filtration rate (GFR) < 15 mL/ min/1.73 m^2, is associated with chronic inflammation, oxidative stress, and endothelial dysfunction. These processes upregulate PAI-1 expression, contributing to vascular fibrosis, thrombo-inflammation, and cardiovascular morbidity.

OBJECTIVES

The purpose of this research was to quantitatively evaluate plasma PAI-1 levels in ESRD patients undergoing hemodialysis compared to healthy controls and determine whether altered PAI-1 reflects fibrinolytic imbalance.

CLINICAL SIGNIFICANCE

What is the significance of measuring PAI-1 in ESRD patients?
Cardiovascular disease remains the leading cause of mortality in ESRD patients. Measuring PAI-1 is clinically significant because:

CLINICAL SIGNIFICANCE

- PAI-1 reflects fibrinolytic capacity
- Elevated or dysregulated levels indicate a thrombo-inflammatory imbalance
- It may identify patients at higher risk of vascular access thrombosis
- It provides insight into endothelial dysfunction
- It may serve as a potential biomarker for risk stratification and therapeutic targeting

Understanding PAI-1 dynamics in ESRD could improve early identification of patients at increased thrombotic risk.

METHODS

Study Design: Prospective cohort study
(1) Participants:
- 72 ESRD patients undergoing hemodialysis
- 50 age-matched healthy controls

(2) Sample Processing:
- Blood collected in 3.2% sodium citrate tubes
- Double-centrifuged to obtain platelet-poor plasma
- Stored at -80°C until analysis

(3) PAI-1 Measurement:
- Quantified using Sandwich ELISA (Molecular Innovations Inc.)

(4) Statistical Analysis:
- Normality testing performed
- Mann-Whitney U test for group comparisons
- Spearman correlation for inflammatory markers (CRP, D-dimer)
- Significance is defined as $p < 0.05$

RESULTS (Figure 1)

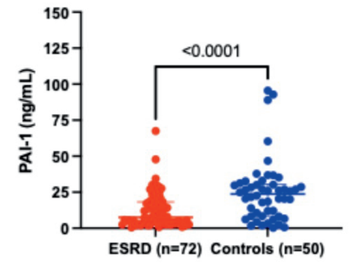

Figure 1: Scatterplot showing plasma PAI-1 concentrations in ESRD patients (red, n = 72) and healthy controls (blue, n = 50). Distributions differ significantly between groups ($p < 0.0001$), with ESRD patients showing greater variability consistent with impaired fibrinolysis.

CONCLUSION

PAI-1 levels in ESRD patients demonstrate significant distributional differences and greater variability compared to healthy controls, reflecting disrupted fibrinolysis and endothelial stress.

These findings support PAI-1 as a relevant biomarker of thrombo-inflammatory imbalance in ESRD.

Incorporating PAI-1 into clinical evaluation may improve identification of patients at increased risk for vascular complications. Future studies including longitudinal monitoring and dialysis-related correlations may further clarify its diagnostic and therapeutic utility.