Studying the Effects of Systemic Inflammatory Markers and Drugs on AVF Longevity through a Novel Clinical Intelligent Framework

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***Abstract*—Although arteriovenous fistula is the preferred vascular access method, it has challenges in three phases of planning, maturation, and maintenance. We looked at the root of fistula challenges in the maintenance phase and found traces of inflammation. Accordingly, we investigated the role of systemic inflammation in this phase to understand its effects on post-maturation function and extract knowledge to help extend fistula longevity. Previous studies on longevity of fistula have focused entirely on statistical tests, and since they put limitations on data, we also used a data mining framework for data analysis. For prediction, we used Decision Tree, Random Forest, and Support Vector Machines, and for inferential analysis, we used Wilcoxon and Chi-squared tests. We analyzed the archived data of 119 hemodialysis patients. In these data, independent variables were serum inflammatory markers, serum metabolic values, anti-inflammatory drugs, and demographic characteristics, and the dependent variable was fistula longevity separated in classes of equal to or greater than four and less than four years. Both predictive and inferential approaches have shown that serum inflammatory markers had no significant involvement in fistula longevity, but some anti-inflammatory drugs were effective. The results have shown that blood tests and drug variables, alone or together, could predict longevity class by 100% accuracy. This prediction can help surgeons make better decisions in selecting patients for fistula creation. Also, the extracted knowledge can provide guidelines for post-maturation disorders.**

***Index Terms*—Arteriovenous fistula, Fistula longevity, Inferential analysis, Predictive analysis.**

I. Introduction

ALTHOUGH arteriovenous fistula (AVF) is the preferred vascular access method, it has challenges in three phases:
(1) The planning phase, which relates to creating AVF at the right time,
(2) Maturation phase, which deals with creating a high-quality AVF, and
(3) Maintenance phase, which tries to maintain AVF function [1]–[3].

These challenges result in AVF disorders, which are among the foremost causes of mortality in hemodialysis (HD) patients [4]. The expense of maintaining the function of an impaired AVF is much higher than the cost of its creation [5]. Therefore, it is necessary to assess the chance of AVF longevity before its construction.

For assessment, we looked for predictors with the least intervention and cost of collection. As HD patients frequently test for blood, blood tests seemed to be appropriate for this purpose. In the following, we looked at the root of AVF disorders in the maintenance phase to find traces of possible blood factors.

In the maintenance phase, as the spotlight of this study, AVF suffers from late venous stenosis, which is the major challenge for its longevity [1]. The pathogenesis of venous stenosis involves a hierarchy of functions classified into upstream and downstream levels. Upstream events damage endothelial and smooth muscle cells, which trigger downstream events and result in intimal hyperplasia (IH) and stenosis [1], [6], [7].

The biochemical processes behind downstream events are not fully understood; nevertheless, researchers have shown that pro-inflammatory factors have a role in stimulating IH at this level [7], [8]. Accordingly, we developed a hypothesis that serum inflammatory markers may have a destructive role in AVF longevity.

This study explores the relationship between available systemic inflammatory and metabolic markers and AVF longevity. Its goal is to extract knowledge to help extend the AVF longevity and assess it before the operation; this will help vascular surgeons make an individualized choice of vascular access method for new patients. In this study, for the first time to our knowledge, we have utilized a data mining (DM) framework for analyzing the relationship between metabolic markers and AVF longevity.

This manuscript was submitted on April 03, 2020.

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