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CLINICAL RESEARCH

Prospective Study of Routine Heparin Avoidance Hemodialysis in a Tertiary Acute Care Inpatient Practice

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Introduction: Extracorporeal circuit (EC) anticoagulation with heparin is a key advance in hemodialysis (HD), but anticoagulation is problematic in inpatients at risk of bleeding. We prospectively evaluated a heparin-avoidance HD protocol, clotting of the EC circuit (CEC), impact on dialysis efficiency, and associated risk factors in our acute care inpatients who required HD (January 17, 2014 to May 31, 2015).

Methods: HD sessions without routine EC heparin were performed using airless dialysis tubing. Patients received systemic anticoagulation therapy and/or antiplatelets for non-HD indications. We observed patients for indications of CEC (interrupted HD session, circuit loss, or inability to return blood). The primary outcome was CEC. Logistic regression with generalized estimating equations assessed associations between CEC and other variables.

Results: HD sessions (n = 1200) were performed in 338 patients (204 with end-stage renal disease; 134 with acute kidney injury); a median session was 211 minutes (interquartile range [IQR]: 183–240 minutes); delivered dialysis dose measured by Kt/V was 1.4 (IQR: 1.2 Kt/V 1.7). Heparin in the EC was prescribed in only 4.5% of sessions; EC clotting rate was 5.2%. Determinants for CEC were temporary catheters (odds ratio [OR]: 2.8; $P < 0.01$), transfusions (OR: 2.4; $P = 0.04$), therapeutic systemic anticoagulation (OR: 0.2; $P < 0.01$), and antiplatelets (OR: 0.4; $P < 0.01$). CEC was associated with a lower delivered Kt/V (difference: 0.39; $P < 0.01$). Most CEC events during transfusions (71%) occurred with administration of blood products through the HD circuit.

Discussion: We successfully adopted heparin avoidance using airless HD tubing as our standard inpatient protocol. This protocol is feasible and safe in acute care inpatient HD. CEC rates were low and were associated with temporary HD catheters and transfusions. Antiplatelet agents and systemic anticoagulation were protective.

ClinicalTrials.gov Identifier: NCT02086682.

Kidney Int Rep (2017) **2,** 695–704; http://dx.doi.org/10.1016/j.ekir.2017.03.003
KEYWORDS: acute kidney injury; anticoagulation; extracorporeal circulation; hemodialysis; no heparin

The introduction of unfractionated heparin to prevent clotting of the extracorporeal (EC) circuit was one of the key advances that led to the rapid development and expansion of hemodialysis (HD),[1] and it remains a mainstay in HD practice. However, anticoagulation during HD for patients at high risk of bleeding remains a frequently encountered problem. The need for anticoagulation to prevent clotting of the EC (CEC) and the need to prevent anticoagulation-related bleeding complications have led to the development of numerous strategies, the safest being, from a bleeding standpoint, anticoagulant-free HD.[2,3]

One strategy to achieve anticoagulant-free HD is to administer saline flushes through the dialysis circuit. This technique was first described in 1979,[4] and various saline-flushing protocols have since been

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Received 28 July 2016; revised 28 February 2017; accepted 8 March 2017; published online 15 March 2017

published.[5–7] The process generally involves infusing saline boluses of 100 to 200 ml every 15 to 60 minutes, which results in clotting events that require a change of dialyzer in 3% to 10% of sessions.[8,9] Other strategies include the use of heparin-coated dialysis membranes, regional heparin anticoagulation with protamine reversal, and regional citrate anticoagulation.[1,10,11] None of these techniques have been widely adopted because they are complex, and require additional time and personnel resources for administration and monitoring.

Factors that contribute to CEC include exposure to a foreign surface, exposure to air, and turbulent blood flow in the circuit.[1] Advancements in dialysis technology allow airless tubing systems that minimize blood–air interaction. One example is the Streamline (SL) bloodlines[12] (NxStage Medical, Inc., Lawrence, Massachusetts), which is designed to eliminate blood–air contact in 2 ways: a pressure pod measures arterial and venous pressures without blood–air contact; and a venous chamber runs without an air gap. The tubing allows blood to flow in a circular, nonturbulent manner, with less blood exposure to plastic than the conventional ReadySet (NxStage Medical, Inc., Lawrence, MA) bloodlines. Several small studies have shown that SL bloodlines improve dialysis efficiency and blood flow rates while reducing heparin usage.[13–15] None of these studies examined the rates of CEC or studied the problem in acutely ill inpatients at increased risk of both bleeding and thrombosis, because all these studies were performed in outpatient dialysis settings.[16,17]

Although quality information exists for outpatient HD procedures, robust data are lacking regarding inpatient dialysis anticoagulation and CEC practices and outcomes. Thus, the goal of this study was to prospectively examine CEC rates in our inpatient HD practice. We examined risk factors for CEC, the effect of CEC on HD efficiency, and the effects of systemic anticoagulation and antiplatelets on CEC (ClinicalTrials.gov Identifier NCT02086682).

MATERIALS AND METHODS

Study Population

We conducted a prospective cohort study of consecutive adult patients (age older than 18 years) who presented for inpatient dialysis at our facilities from January 17, 2014 to May 31, 2015 (Figure 1). The study was conducted in 2 stages, first in general care patients

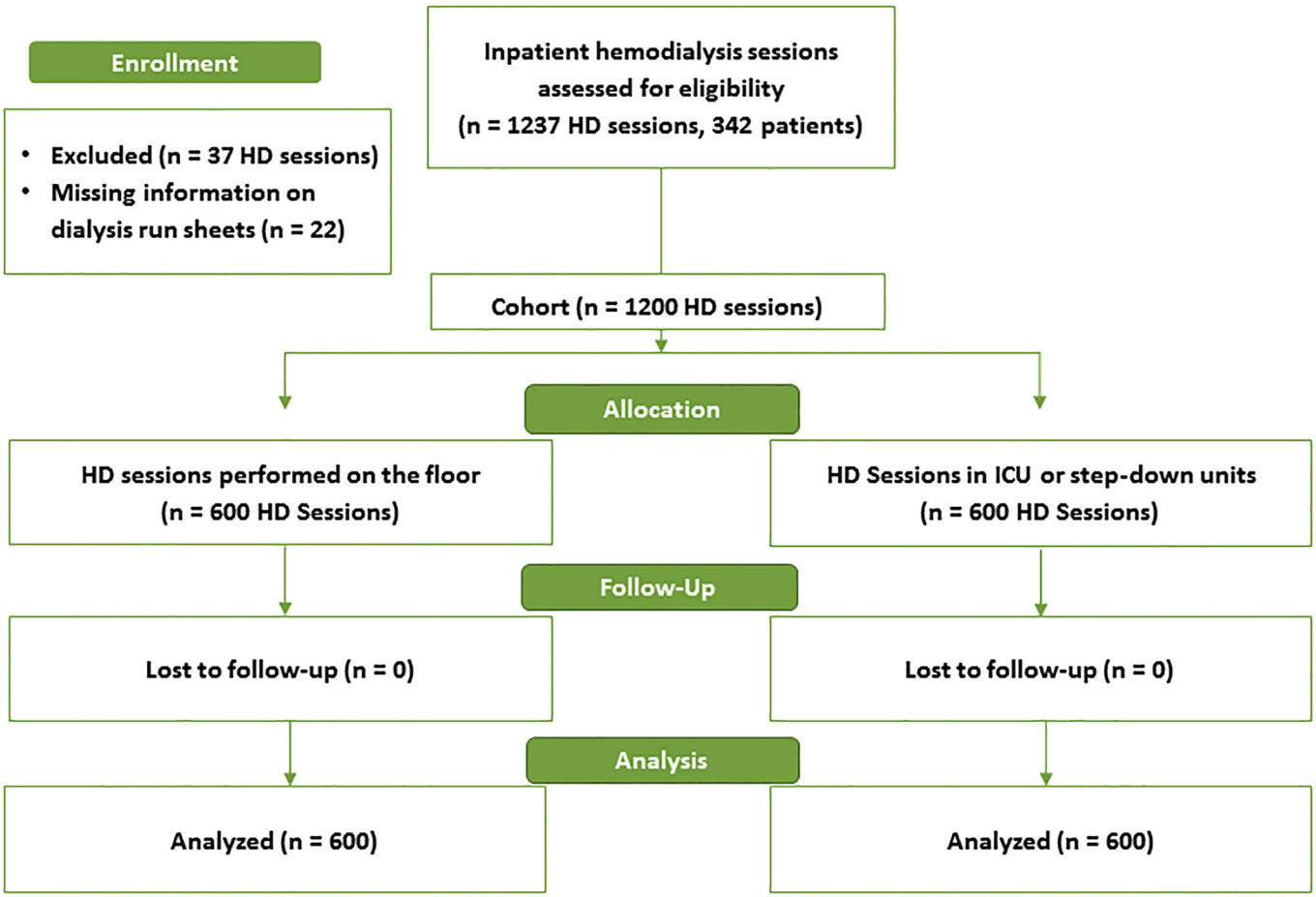

Figure 1. Study design and enrollment of subjects. No patients were lost to follow-up. HD, hemodialysis.