Predictors of Red Cell Transfusion in Hemodialysis Patients

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Introduction

- Anemic patients with end-stage renal disease are treated with intravenous (IV) iron and erythropoiesis-stimulating agents (ESAs) to avoid the need for transfusion.
- Analyses have suggested that anemia management practices have become increasingly reliant on IV iron and decreasingly reliant on ESAs.[1]
- The United States Renal Data System (USRDS) reported that the rate of transfusions in hemodialysis patients increased during 2011.[2]

Objective

The objective of the current study was to identify patient and treatment characteristics that predispose dialysis patients to transfusions.

Methods

- The electronic medical records of patients receiving in-center hemodialysis between 1 January 2010 and 31 May 2011 were studied retrospectively for evidence of a red cell transfusion. A random sample of nonhospitalized dialysis patients (2 controls:1 case) was identified from the same chronic population time period (1 January 2011 – 31 May 2011). The demographic and treatment data for each transfusion patient were compared at monthly aggregate-level controls selected to identify risk factors for transfusions.
- An initial list of 19 covariates was generated with available data on demographic, comorbidity, and dialysis-related characteristics believed to influence transfusion risk. These covariates were analyzed at the patient-month level for both cases (transfusion) and controls (no transfusion) (Table 1). To identify the most proximal dynamic factors that may have influenced the decision to transfuse, the previous 3 monthly values (lagged values, back to October 2010) for the collected biomarkers were identified (hemoglobin [Hb], albumin, percent saturated transferrin [TSAT], serum ferritin, and parathyroid hormone [PTH]) for each patient. Dosing of IV iron was calculated cumulatively over the 3 months prior for each patient's tranfusion event.
- Percent was calculated for each categorical variable. Means and standard deviations are provided for continuous variables. Two sample tests of differences (*t* tests with the appropriate equality of variance statistic or the chi-square test) between the transfusion patient sample and the control patient sample are presented in Table 1. Unadjusted odds ratios for differences between the transfusion patient sample and the control patient sample are presented in Table 2. Fully adjusted multivariate logistic regression models were built with both forward and backward covariate selection methods.

Results

Table 1. Patient Demographics

Characteristics	Transfusion in 2011	No Transfusion in 2011	P-Value
Sample Size (N)	3,039	6,604	NA
Gender (Female, %)	49.8	44.7	0.0001
Race/Ethnicity (% with >10% frequency)			
African American	39.1	38.6	< 0.0001
Caucasian	43.4	36.6	
Hispanic	12.0	18.2	
Primary Insurance (%)			
Medicaid	8.0	7.6	< 0.0001
Medicare	83.9	80.0	
No Insurance	0.5	1.1	
Other	7.5	9.5	
VA	0.2	1.9	
Vascular Access (%)			
Fistula	47.5	57.6	< 0.0001
Graft	21.0	21.6	
Catheter	31.5	20.8	
BMI (kg/m^2) mean ± SD	26.60 ± 6.94	27.79 ± 7.14	< 0.0001
Vintage (years)	3.60 ± 3.70	3.73 ± 3.70	0.0889
Age (years)	63.73 ± 14.90	62.00 ± 14.80	< 0.0001
Kt/V (4-month mean)	1.52 ± 0.35	1.60 ± 0.36	< 0.0001
Comorbidities (%)			
Cardiac Arrest	0.16	0.15	0.8801
MI	0.20	0.30	0.3532
Liver Disease	2.40	1.70	0.0190
COPD	5.23	3.42	< 0.0001
Cancer	4.24	2.14	< 0.0001
GI Bleed	4.24	1.11	< 0.0001
Diabetes	60.5	61.5	0.3294
Infection Hx	13.5	9.40	< 0.0001
Hypertension	32.6	32.8	0.8403
Drug/Alcohol Use	0.10	0.15	0.5118
Marrow Affecting Condition	3.86	0.81	< 0.0001

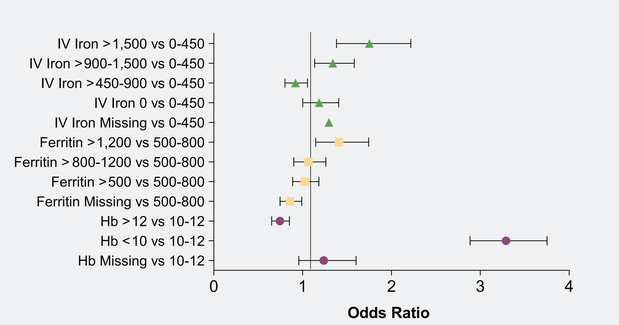
Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disorder; GI, gastrointestinal; Hx, history; MI, myocardial infarction; VA, Veterans Administration.

Table 2. Unadjusted and Adjusted Odds Ratios Estimating Transfusion Risk

Covariate	Unadjusted	95%CI	Adjusted	95%CI
Hemoglobin (g/dL)				
Missing	1.59	1.32, 1.93	1.24	0.96, 1.60
< 10	3.74	3.32, 4.22	3.29	2.89, 3.75
10–12	REF			
> 12	0.76	0.67, 0.86	0.75	0.65, 0.85
Ferritin (ng/dL)				
Missing	0.95	0.84, 1.07	0.86	0.75, 0.99
> 500	1.08	0.95, 1.23	1.03	0.89, 1.18
500 to 800	REF			
> 800 to 1,200	1.14	0.98, 1.32	1.07	0.90, 1.26
> 1,200	1.95	1.63, 2.34	1.42	1.15, 1.74
IV Iron (3-month cumulative dose, mg)				
Missing	1.59	1.36, 1.86	1.30	1.05, 1.60
0	1.24	1.07, 1.45	1.19	1.00, 1.41
0 to 450	REF			
> 450 to 900	0.86	0.76, 0.97	0.92	0.80, 1.06
> 900 to 1,500	1.25	1.08, 1.46	1.34	1.14, 1.58
> 1,500	2.1	1.723, 2.63	1.75	1.38, 2.22

Abbreviation: CI, confidence interval; IV, intravenous.

Figure 1. Adjusted Odds Ratios for Transfusion Risk



Abbreviation: IV, intravenous; Hb, hemoglobin.

Findings/Conclusions

- When the Hb target was 10-12 g/dL, a prior month below-target Hb level was highly predictive of transfusion, as expected.
- Prior month ferritin values that were high (> 1,200 ng/mL) were also highly predictive of transfusion.
- Three-month cumulative IV iron dose of > 1,500 mg, 900–1,500 mg, and no dose (0 mg) all predicted transfusion, suggesting a consistent temporal effect and a dose response effect.
- Transfusions were associated with catheter use, history of infections, and history of gastrointestinal bleed in adjusted models.
- Transfusions were weakly associated with Kt/V, Caucasian race, BMI, age, insurance, gender, and marrow affecting conditions.
- Such work may support future predictive algorithms to allow early warnings to clinicians about modifying treatment regimens for patients at risk for transfusions.

Study Limitations

- Retrospective analyses such as this one demonstrate associations and not causality between study variables.
- These hypothesis-generating data represent a first step in exploring the risk factors for transfusions.
- The data collection process for patient transfusions was limited to monthly-level collection, and thus greater level of data resolution is not possible at this time.
- Future studies will include analyses of ESA dosing patterns and transfusion risk.

References

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