Hemoglobin variability in anemic adults one and six hours after packed red blood cell (PRBC) transfusions.

Garcia-Habeych JM, MD, PGY-3[1], **Arenas-Mantilla M**, MD,[1,2,3] **Rodriguez-Amaya RM**, MD, MSc,[4] **Leal-Medrano JA**, MD[1], **Daza-Bolaño NE**, MD[1,2,3].

1. Industrial University of Santander (UIS), Department of Internal Medicine. 2. Santander's University Hospital (HUS), Hematology Service. 3. Santander's Hemocenter (HCS). 4. Industrial University of Santander (UIS), Public Health Department, Epidemiology section, GERMINA Research group. Bucaramanga, Colombia.

Introduction and Objective.

Anemia is considered a public health threat in the developing World. Its prevalence has been estimated in about 23,6% of Colombia´s general population[1], and has diverse etiologies, evolution time, and therapeutic. Immediate correction with transfusion of packed red blood cells (PRBC) is necessary in moderate to severe cases.

A deficit of close to 900,000 units of PRBCs has been reported annually in Colombia[2] requiring rational use of it. However nowadays, no clear global consensus has been achieved about when a post-transfusion, seric Hemoglobin concentration ([sHb]) control might be performed[3]. The aim of this study was thus, to evaluate the variability of the [sHb] one and six hours after finishing a transfusion of PRBCs.

Methods.

Seric concentration of Hemoglobin [sHb] levels were determined at three different points in time during transfusion of PRBC, on inpatients with an anemia diagnosis. The patients were all hospitalized at the Internal Medicine Department of the Santander's University Hospital, between September of 2015 and April of 2016, to receive the transfusions under medical surveillance.

Inclusion criteria: 1) Males and females of 18 years of age or more, 2) with an anemia diagnosis for its age and gender[4]; 3) a medical cause of the anemia at the time of the PRBC transfusion. The exclusion criteria were: 1) bleeding events during 48 hours previous to the transfusion, and 2) having received any other hematic derivative during the 24 hours previous to the transfusion. The basal [sHb] previous to the transfusion was taken from the patient's clinical chart and the remaining two values were measured after the transfusion was finished. The [sHb] values measured were drawn and processed one and six hours after transfusion in a *HemoCue B Hemoglobin*[TM] photometer, which uses the acid–metahemoglobin method, to determine the concentration of Hemoglobin in grams per deciliter (gr/dL).

The sample size was calculated for a 95% power, and, an α-error of 5%, to detect a clinically significant change of 0,5 gr/dL of the [sHb] concentrations[5]. Informed written consent was obtained from all of the patients included, and, so was approval from the Ethics committee of the Industrial University of Santander. The student-t-test was used to compare the average values of the post-transfusion samples, and a multiple logistic regression analysis was performed to evaluate the variability, using as dependent variable the variability of the [sHb].

Results

A total N=121 (95.27%) patients were included in the study, out of the 127 recruited. Two patients declined the invitation to participate in the study, another two were excluded because of a bleeding event on the upper digestive tract documented through an endoscopy, and, another patient was excluded because of insufficient data.

Demographic and other characteristics of the patients related to this study are described in Table 1. The main comorbid diagnosis found on this sample was sepsis (60,2%). In Table 2 the main hematological variables are shown, such as, the anemia type, the number of PRBCs transfused per patient, and the change on the hemoglobin values at one and six hours after transfusion. The increase between the basal and the six hours post-transfusion [sHb] values (difference = 2,24gr/dL) showed statistically significant differences, p=0.001. The [sHb] difference between one and six hours post-transfusion values did not achieve a statistically significant difference (IC95% -0,19 – 0,2 p=0,94).

Table 1. Baseline Characteristics of the Patients.

Characteristic.	Value (n=121).
Age in yrs - $\chi \pm$ SD.	56,2 $\pm$ 20
Male sex - n (%).	62 (50,4)
Weight in kgs - χ (range).	58,9 (32 - 95)
Body surface area in m²- χ (range).	1,61 (1,2 - 2,13)
Body-mass index kg/m² -χ (range).	22,3 (21,5 - 23,3)
Blood pressure - mmHg.	
Systolic - $\chi \pm$ SD.	120,5 $\pm$ 19,0
Diastolic - $\chi \pm$ SD.	72,6 $\pm$ 11,3
Mean - $\chi \pm$ SD.	88,6 $\pm$ 12,5
Heart rate beats/minute - $\chi \pm$ SD.	84,1 $\pm$ 15,9
Medical history - n. (%).	
Acute infectious disease - sepsis.	74 (61,2)
Chronic kidney disease.	38 (31,4)
eGFR (CKD-EPI) >30 <60ml/min.	12
eGFR (CKD-EPI) <30ml/min.	26
Renal replacement therapy.	16
Leukemia - Lymphoma.	31 (25,6)
Hypothiroidism.	28 (23,1)
Non-hematologic cancer.	15 (12,4)
Heart failure (LVEF <40%).	13 (10,7)
HIV/AIDS.	12 (9,9)
Acute coronay syndrome.	7 (5,8)
Cirrhosis.	5 (4,1)

Table 2. Main Hematological Characteristics.

Hematological Parameter.	Value (n=121).
Hemoglobin in gr/dL - $\chi \pm$ SD.	6,9 (2,3 - 9,2).
Hemoglobin 8 – 10 gr/dL - n. (%).	21 (17,3)
Hemoglobin <8gr/dL - n. (%).	100 (82,6)
MCV in fL - χ (range).	88,5 (51,9 - 111,1)
Microcytic anemia (MCV <80fL) - n. (%).	14 (11,5)
Normocytic anemia (MCV 80-100fL) - n. (%).	99 (81,1)
Macrocytic anemia (MCV >100fL) - n. (%).	8 (6,6)
RDW % - χ (range).	17,1 (12 - 28,3)
Leukocytes/mm³ - χ (range).	10,810 (0,0 - 86,400)
Platelets/mm³ -χ (range).	202,374 (5,000 - 768,000)
Red Blood Cell Units Transfused per patient - n (%).	
1	46 (38)
2	60 (49,6)
3	9 (7,4)
4	6 (4,9)
Seric Hemoglobin concentration [sHb] after transfusion. - χ (difference) p.	
[sHb] one hour after gr/dL.	9,2 ( )
[sHb] six hour after gr/dL.	9,1 (2.24) p=0.001

The variation on the [sHb] between the basal and the one and six hours showed a change larger than 0,5gr/dL in 68 (56,2%) patients. Finally, in the logistic regression analysis, adjusting for gender, age , number of PRBC transfused and BMI, patients with anemia and sepsis as a comorbid diagnosis showed a 5,3 times higher probability of finding a variability on the [sHb] at one and six hours higher than a 0,5gr/dL (OR: 5,3; IC 95% 1,7 – 16,4, p=0,003).

Conclusions

This study confirms the stability of the values of [sHb] after a transfusion of PRBCs in patients with moderate to severe anemia of medical origin not associated to hemorrhagic events. Patients with comorbid sepsis showed a higher probability of showing a statistically significant difference in the variability of [sHb] clinically significant with time, one and six hours post-transfusion.

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