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Original Article

Blood transfusion in hip arthroplasty: a laboratory hematic curve must be the single predictor of the need for transfusion?☆,☆☆

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ARTICLE INFO

Article history:
Received 23 July 2012
Accepted 23 November 2012

Keywords:
Arthroplasty, replacement, hip
Blood transfusion
Hemoglobin

ABSTRACT

Objective: to determine whether the laboratory hematic curve must be the single predictor of postoperative blood transfusion in total hip arthroplasty.
Methods: the laboratory blood samples of 78 consecutive patients undergoing total hip arthroplasty was analyzed during five distinct moments: one preoperative and four postoperative. There was a count of hemoglobin, hematocrit and platelets of the patients samples. Other catalogued variables ascertain possible risk factors related to transfusional practice. They characterized the anthropometric, behavioral and co morbidities data in this population. The study subjects were divided and categorized into two groups: those who received blood transfusion during or after surgery (Group 1, G1), and those who did not accomplish blood transfusion (Group 2, G2). Transfusion rules were lead by guidelines of American Academy of Anesthesiology and the British Society of Hematology.
Results: a total of 27 (34.6%) patients received blood transfusions. The curves of hemoglobin, hematocrit and platelet transfusions between G1 and G2 were similar ($p > 0.05$). None of the analyzed risk factors modified the rate of transfusion rate in their analysis with p value > 0.05, except the race. The sum of clinical co morbidities associated with patients in G1 was a median of 3 (95% CI 2.29–3.40), while in G2 the median was 2 (95% CI 1.90–2.61) with $p = 0.09$.
Conclusion: the curve in red blood cells has limited reliability when used as sole parameter. The existence of tolerant patients hematimetric curve variations assumes that their assessments of clinical, functional evaluation and co-morbidities are parameters that should influence the decision to transfusion red blood cells.

☆ Please cite this article as: Roth F, Birriel FC, Barreto DF, Boschin LC, Gonçalves RZ, Yépez AK, Silva MF, Schwartsmann CR. Transfusão sanguínea em artroplastia de quadril: a curva laboratorial hemática deve ser o único preditor da necessidade de transfusão?. Rev Bras Ortop. 2014;49:44–50.
☆☆ Study conducted at the Department of Orthopaedics, Hospital Santa Casa de Porto Alegre, Porto Alegre, RS, Brazil.

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2255-4971/$ – see front matter
http://dx.doi.org/10.1016/j.rboe.2013.12.016

Transfusão sanguínea em artroplastia de quadril: a curva laboratorial hemática deve ser o único preditor da necessidade de transfusão?

RESUMO

Objetivo: verificar se a curva laboratorial hemática deve ser o único preditor de transfusão sanguínea pós-operatória em artroplastia total de quadril (ATQ).

Métodos: amostras laboratoriais sanguíneas de 78 pacientes consecutivos submetidos à ATQ foram analisadas em cinco em períodos distintos (um pré-operatório e quatro pós-operatórios). Verificou-se a contagem de hemoglobina, hematócrito e plaquetas desses pacientes. Foram analisadas características antropométricas e comportamentais e comorbidades referentes à amostra, para verificação de fatores de risco associados à prática transfusional. Os indivíduos do estudo foram divididos em dois grupos: aqueles que receberam transfusão sanguínea foram alocados no Grupo 1 (G1) e os que não a receberam, no Grupo 2 (G2). As condutas transfusionais respaldaram-se dos critérios da Academia Americana de Anestesiologia e da Sociedade Britânica de Hematologia.

Resultados: receberam transfusão de hemoderivados 27 (34,6%) pacientes. As análises das curvas de hemoglobina, hematócrito e plaquetas entre o G1 e o G2 nas cinco visitas distintas foram similares ($p > 0,05$). Todos os fatores de risco analisados, com exceção da etnia, não apresentaram repercussões nos índice de transfusão em suas análises com valor $p > 0,05$. A soma das comorbidades clínicas associadas aos pacientes no G1 foi mediana de 3 (IC 95% 2,29–3,40), enquanto no G2 a mediana foi 2 (IC 95% 1,90–2,61) com valor $p = 0,09$.

Conclusão: a curva hemática apresenta confiabilidade limitada quando usada como parâmetro exclusivo e absoluto. A existência de pacientes tolerantes às variações da curva hematimétrica pressupõe que as suas avaliações de caráter clínico, funcional e de comorbidades sejam parâmetros que devam influenciar na decisão do uso de hemoderivados.

Palavras-chave:
Artroplastia de quadril
Transfusão sanguínea
Hemoglobina

Introduction

The indication for blood transfusion in prosthetic orthopedic procedures – especially hip arthroplasty – generates disagreement among medical professionals as the management of post-surgical anemia.[1–4] The standardization of transfusional procedures in the post-operative management with laboratory thresholds was initially done in 1942,[5] because of the fear of complications such as fatigue and inability to recover and rehabilitate the patient, together with the high costs and with the morbidity and long hospital stays. Further understanding of human physiology brought greater doubt about the use of preset laboratory thresholds for transfusion. Because of the risk of bleeding during and after surgery, and of drainage and secretion of the surgical wound, its imposition as routine practice was countered by the risks related to the consequences of its use. We report an association of this practice with highest rates of surgical site infection,[4,6] and increase of post-operative pneumonia index and mortality in the short term, and vascular events, besides autoimmune reactions, systemic inflammatory response syndrome, and transmission of contagious diseases.[6–8]

Numerous guidelines depict the local experience of specific centers, or demonstrate the scenario of medical groups' procedures in several countries,[9–11] but there is no support or specific worldwide standardization for these conducts.[12] Prominent studies warn about the risk factors associated with blood transfusions, being adamant in defining optional preoperative methods for reducing the costs and morbidities related to the use of allogeneic blood products. The use before, during and after the surgical procedures of substances such as ferrous sulphate, erythropoietin, trenexamic acid, recombinant factor VII and fibrin glue, and the promotion of protocols of autotransfusion, hemodilution and rescue of red blood cells,[8] are the main approaches, although not without risks,[8] to solve this issue.[4,6,13–17]

The gaps related to the conducts regarding the use of blood products led us to define the overall functioning of the post-operatory laboratory hematic curve of patients undergoing primary total hip arthroplasty (THA) in this orthopedic referral service. The objective was to understand the real need for blood transfusions based on their laboratory results. In this study, possible factors that could influence the transfusion procedures were examined, to explain why some patients presented clinical and laboratory recovery without the use of blood transfusion, based on absolute numbers. This analysis questions and alerts about necessary precautions of routine blood transfusion.

Materials and methods

From January 2011 to June 2012 those patients undergoing THA in the Santa Casa de Porto Alegre (HSCPOA) Hospital Complex were enrolled in this prospective study. Seventy-eight participants were randomized and provided written informed consent. This study was approved by the HSCPOA institutional ethics and research board. Patients with any hematopoietic disorder, hemoglobin levels below 10 g/dL, active contagious

Table 1 – Risk factors among transfused (G1) and not transfused (G2) patients (comparison between means of parametric continuous variables and median of the nonparametric variable).

Variable (means ± standard deviation)	Transfused (G1)	Not transfused (G2)	Total	*p*
Age[a]	56.44 ± 15.07	59.58 ± 11.82	58.5 ± 13.02	0.31
Weight[a]	71.68 ± 17.53	73.18 ± 13.72	72.6 ± 15.05	0.67
BMI[a]	25.97 ± 5.58	27.59 ± 4.57	27.09 ± 4.97	0.17
MBP[a]	93.11	98.34	96.54	0.11
Preoperatory hemoglobin[a]	13.51 ± 1.55	13.60 ± 1.36	13.59 ± 1.42	0.91
Trans-operatory bleeding[a]	540 ± 272.11	414.84 ± 142.37	458.98 ± 205.08	0.019
Post-operatory bleeding[a]	262.42 ± 219. 52	218.66 ± 175.35	238.56 ± 205.27	0.09
Sum of comorbities[b] (median and CI 95%)	4 (IC 95% 2.29–3.40)	2 (IC 95% 1.9–2.61)		0.09

CI, confidence interval.

[a] Student *t*-test.

[b] Mann–Whitney *U*-test.

or infectious chronic liver disease, and with malignant tumor were excluded from the study.

Patients rigidly followed a protocol for collecting data through serial visits. The first visit (V1) occurred preoperatively (from seven to three days before surgery); in this stage, first hematimetric laboratory tests and demographics and physical data of the participants (gender, age, ethnicity, weight, height, body weight index [BMI], comorbidities, alcoholism, smoking, and vital signs) were collected; in the second visit (V2), which occurred on the first post-operative day (6–12 h after surgery), the second laboratory hematimetric sample and data regarding surgery were collected, and the drainage of the suction drain was calculated; the third visit (V3) occurred on the second post-operative day (24–48 h after surgery), with the same procedures of V2; the fourth (V4) and the fifth (V5) visits occurred in the first (between 4 and 7 days) and third weeks (14–17 days) post-operatively, respectively, and were characterized by laboratory collection and data from late post-operative period. In the laboratory evaluation, we analyzed the red series hemocytometry (hemoglobin, hematocrit and platelets). The sample collections were done during the hospital stay (V2–V3–V4) and in the outpatient clinic (V1 and V5).

All patients were operated on by the same surgical team, consisting of two surgeons and two anesthetists. The surgical routine consisted of calculating the intraoperative bleeding (through the suction volume of the drains and by weighing the pads) and of a general description of the prosthetic procedure. The anesthetic routine was similar in all patients: spinal anesthesia followed by sedation. The posterior surgical technique for access for all cases of THA was chosen. During the closure of the surgical plans, all patients received closed suction drains, which were maintained for 48 h. The mean operative time was 98.3 ± 4.2 min (range: 80–120 min). Post-operatively, all patients used prophylactic unfractionated heparin (5000 units 12/12 h) for a minimum of seven days and vacuum suction drain for two days. No patient received steroid or anti-inflammatory medication. Analgesic drugs were based on opioids and non-narcotic pirazolonic derivatives (dipyrone).

The procedures of intraoperative and post-operative transfusion of the anesthetic/surgical team were obeyed, and criteria based on guidelines were used in their conduct.[18,19] Blood products were used during surgery when there was significant bleeding that would interfere with the patient's hemodynamic status. The anesthetist was solely responsible for the use/degree of the blood product. Post-operatively, of necessity the healthy patients received blood products with Hb < 7 g/dL, whereas those with cerebrovascular disease, coronary artery disease, peripheral vascular disease and chronic pulmonary vascular disease received blood transfusions with Hb < 8 g/dL.

According to transfusion criteria, we allocate the patients into two groups: Group 1 (G1) – patients who received blood transfusion; and Group 2 (G2) – patients who did not receive blood products. In this study population, the participants had a mean age of 58.5 ± 13 (G1 = 56.4 and G2 = 15 ± 59.5 ± 11.8 ($p = 0.31$). Weight and BMI of G1 and G2, respectively, were 71.6 ± 17.5/25.9 ± 5.5 and 73.1 ± 13.7/27.5 ± 4.5 ($p > 0.05$). Preoperatively, the mean arterial pressure (MAP) was 96.54 mmHg ($p > 0.05$) for G1 (93.11 mmHg) and G2 (98.34 mmHg) groups. Preoperative hemoglobin for G1 and G2 was 13.5 ± 1.5 and 13.6 ± 1.3 ($p = 0.91$), respectively (Table 1).

Patients were sorted and analyzed by SPSS 17.0 software (Chicago, IL, USA). For continuous variables, descriptive statistics demonstrated performance characteristics (central tendency and dispersion). By the adherence test of Kolmogorov–Smirnov (K–S), with the Lilliefors correction of normality, the normality of data was tested. Analysis of variance (ANOVA) for hematological curves was adopted. Additional tests (*post hoc*) were conducted to evaluate specific differences between means, by pairs. In the analysis of risk factors, the discrete variables were assessed by Yates chi-square test, whereas for parametric and nonparametric continuous variables the Student *t* test and Mann–Whitney, respectively, were used. In all interpretations, the level of significance was set at $p < 0.05$.

Results

Twenty-seven (34.6%) patients received blood transfusions: 19 (55.6%) during surgery and 12 (44.4%) post-operatively. The average intraoperative blood loss was 458.9 ± 205 mL (G1 = 540 ± 272 mL and G2 = 414.8 ± 142.3 mL [$p = 0.019$]). Mean post-operative bleeding was 238, 56 ± 205.27 mL (G1 = 262.4 ± 219.5 mL and G2 = 218.6 ± 175.3 mL [$p = 0.09$]).

The curves of hemoglobin, hematocrit and platelets among transfused (G1) and not transfused (G2) patients displayed

Table 2 – Hemoglobin, hematocrit and platelet values among transfused (G1) and not transfused (G2) patients in five visits (V1–V5).

Hb (g/dL)	Hb (V1) (g/dL)	Hb (V2) (g/dL)	Hb (V3) (g/dL)	Hb (V4) (g/dL)	Hb (V5) (g/dL)	p^a
G1	13.57 ± 1.55	11.44 ± 1.73	9.6 ± 1.64	10.8 ± 1.53	12.55 ± 1.58	>0.05
G2	13.6 ± 1.36	11.45 ± 1.76	10.2 ± 1.52	11.1 ± 1.45	12.48 ± 1.29	
Ht (%)	Ht (V1) (%)	Ht (V2) (%)	Ht (V3) (%)	Ht (V4) (%)	Ht (V5) (%)	
G1	38.81 ± 4.48	32.85 ± 5.04	27.88 ± 4.69	31.78 ± 4.62	36.79 ± 4.4	>0.05
G2	40.08 ± 4.05	33.79 ± 4.75	30.04 ± 4.58	33.03 ± 4.07	36.93 ± 3.65	
Platelets (mm^3)	Platelets (V1) (mm^3)	Platelets (V2) (mm^3)	Platelets (V3) (mm^3)	Platelets (V4) (mm^3)	Platelets (V5) (mm^3)	
G1 (mm^3)	250.69 ± 43.23	231.92 ± 77.11	270.5 ± 77.4	466.75 ± 114.9	283.78 ± 67.99	>0.05
G2 (mm^3)	245.22 ± 66.39	215.14 ± 77.11	286.93 ± 83.73	476.4 ± 170.48	266.97 ± 105.89	

[a] Considering the curve analysis by ANOVA and at each respective visit (V1–V5) in the *post hoc* test.

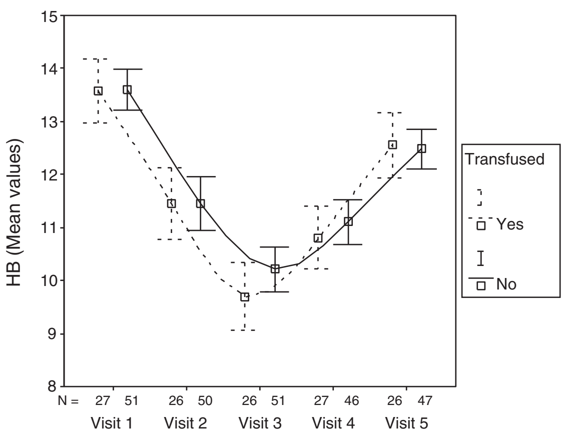

Fig. 1 – Laboratory hemoglobin curve among transfused and not transfused patients.

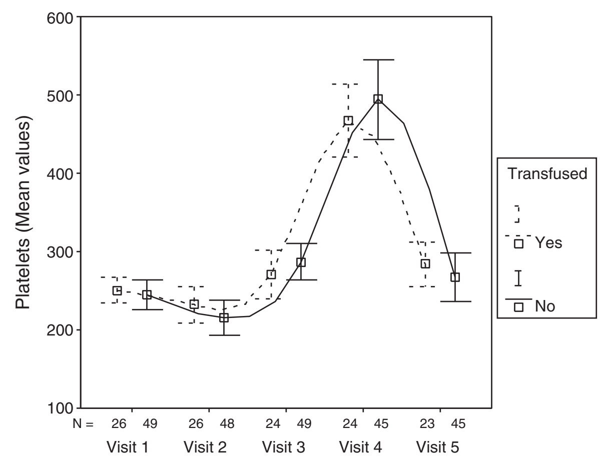

Fig. 3 – Laboratory platelet curve among transfused and not transfused patients.

normal distribution in their graphical representation. For all analyses of the curves between G1 and G2, $p > 0.05$. While the hemoglobin and hematocrit graphics data followed a parabolic normal curve, the platelet curve generated a graph with normal oscillation, represented by a curve peak during the visit 4. Their values are shown in Table 2 and Figs. 1–3.

The population risk factors were separately verified. For parametric data such as age, body weight and BMI, mean arterial pressure (MAP) and preoperative hemoglobin, $p > 0.05$ (Table 1). Except for ethnicity, nonparametric variables such as smoking, alcoholism, cemented or not cemented implant, hypertension and diabetes had an impact on rates of transfusion in their analysis, with $p > 0.05$ (Tables 1 and 3). The sum of comorbidities associated with patients in G1 had a median of 3 (95% CI 2.29–3.40), while in G2 the median was 2 (95% CI 1.90–2.61) ($p = 0.09$) (Table 1).

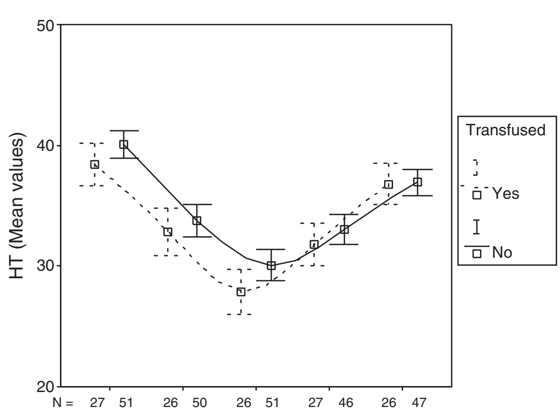

Fig. 2 – Laboratory hematocrit curve among transfused and not transfused patients.

Discussion

The standardization of transfusional conducts is still a challenging topic. In the first studies, dating from the 1940s,[5] the hemoglobin value adopted for post-surgery control of anemia was 10 g/dL. This limit was changed in the early 1990s, with the expansion of knowledge about the behavior of acute (traumatic and surgical) shock and with detailed studies of the use of blood products in patients with severe disease. The guidelines then began to orient the new transfusional conducts,[18,19] even in specific areas such as orthopedia.[20] The hemoglobin thresholds were modified, from 10 g/dL to 7 g/dL in healthy patients and to 8 g/dL in patients with a comorbidity (age > 65 years, with respiratory disease and occlusive vascular disease).[4] From these numbers, another argument, namely, the possible subjective criteria that could guide the conduct of every professional, regardless of laboratory numerical analysis, emerged. This can be seen in studies that generally collected and analyzed national or international multicentric

Table 3 – Risk factors among transfused (G1) and not transfused (G2) patients (association between discrete qualitative variables).

Discrete variables	Transfused (G1)	Not transfused (G2)	Total	*p*
Gender[a]				
Male	17 (21.8%)	26 (33.3%)	43 (55.1%)	0.31
Female	10 (12.8%)	25 (32.1%)	35 (44.9%)	
Etnicity[a]				
Caucasian	26 (33.3%)	40 (51.3%)	66 (84.6%)	0.03
Black	1 (1.3%)	11 (14.1%)	12 (15.4%)	
Tabagism[a]				
Yes	9 (11.5%)	11 (14.1%)	20 (25.6%)	0.25
Not	18 (23.1%)	40 (51.3%)	58 (74.4%)	
Alcoholism[a]				
Yes	14 (17.9%)	19 (24.4%)	33 (42.3%)	0.21
Not	13 (16.7%)	32 (41.0%)	45 (57.7%)	
Hypertension[a]				
Yes	13 (16.7%)	23 (29.5%)	36 (46.2%)	0.79
Not	14 (17.9%)	28 (35.9%)	42 (53.8%)	
Type of prosthesis[a]				
Cemented	19 (24.4%)	30 (38.5%)	49 (62.8%)	0.31
Not cemented	8 (10.3%)	21 (26.9%)	29 (37.2%)	

[a] Yates chi-squared test.

conducts.[2,12,20] Those studies portrayed divergent attitudes toward transfusion measures among different centers,[2,21] and even among medical professionals of different subspecialties. Young et al.[1] demonstrated that surgeons have a more aggressive transfusion conduct, especially when hemoglobin values ranged from 7 g/dL to 10 g/dL. In this study, from a total of 44 patients who had hemoglobin levels between 10 and 7 g/dL, 27 were not transfused with blood products. This implies that perhaps more restrict transfusional measures are adopted in the post-surgical area. We believe that objective criteria may lose its power to influence the post-operative period, by subdividing the responsibility for the recovery of the hematimetric curve with the clinic of the patients and their potential risk factors. However, this situation does not occur during intraoperative transfusions, which, although reliably quantify the necessity of blood replacement,[18,19] represented 55% of transfusions in this study. This aggressive transfusional attitude is explained by the situational and dynamic medical conduct determined by intraoperative acute events. The main reasons for transfusion selected by the anesthetists were: transient hypotension unresponsive to crystalloids and trans-operatory disturbances of cardiac and respiratory rhythm caused by transitory shock. It is important to consider that the main guidelines are categorical in their conclusions. They define that the absolute numbers are not the only decisive factors exclusively for taking perioperative decisions,[18,19] despite the tendency of most health professionals, toward keeping their conduct based solely on laboratory values.[22]

It is estimated that in the area of hip replacement surgery the rates of blood transfusions can vary between 33 and 74% of patients.[4,8] These numbers reinforce the findings of this study, in which 34.6% of patients received blood products, despite the option for the more restrictive transfusion behaviors. This demonstrates that the need for improvement of these indices remains a challenge that is awaiting for better solutions.

In order to ascertain the possible variables that influence the transfusion rates, specific studies of blood transfusion in elective orthopedic procedures preferred to stick to the main transfusion criteria, risk factors and use of optional methods,[4,6,12,14–16] failing to emphasize the importance of the behavior of the laboratory curve. In this study, we demonstrated an objective approach to the behavior of the curves of hemoglobin, hematocrit and platelets. As a result, we found behavioral similarity between the two analyzed groups, and this finding answered the question of the study: patients generally have similar recovery speed of the hematimetric values, regardless of blood transfusion. From this premise, some assumptions are evident. There is a significant number of individuals tolerant to surgical blood loss below the predetermined thresholds and these people present a satisfactory functional recovery without using blood products.[22]

In order to ascertain the possible variables influencing the transfusion rates, specific studies of blood transfusion in elective orthopedic procedures has been either complied with major transfusion criteria, risk factors and use of optional methods,[4,6,12,14–16] and did not emphasize the importance of the behavior of the laboratory curve. In this study, we demonstrated an objective approach to the behavior of the curves of hemoglobin, hematocrit and platelets. As a result, we observed behavioral similarity between the two analyzed groups, and this answered the question of the study: patients generally have similar rate of recovery from hematimetric values, regardless of blood transfusion. From this premise, some assumptions are evident. There is a significant number of individuals tolerant to surgical blood loss below predetermined thresholds and that present a satisfactory functional recovery without using blood products.[22]

In elective orthopedic surgeries, there is a need for a minimum level of preoperative Hb, with the variant value of 11 g/dL.[8] However, for the post-operative control there are no limiting requirements. Carson et al.[23,24] found that there was no benefit in functional recovery with maintaining Hb levels above 10 g/dL, even in symptomatic patients (besides vascular disease), compared with those who maintained the basal level below 8 g/dL after hip orthopedic surgeries.[23] Hebert et al.[25] found that early mortality has not changed in 838 critically ill patients who received aggressive transfusion (Hb < 10 g/dL), compared with those who had more restrict transfusions (Hb < 7 g/dL). Viele et al.[26] analyzed patients (all of them Jehovah's Witnesses) who tolerated Hb levels below 8 g/dL,[26] with adequate recovery and presented preliminary demands only when the levels reached less than 5 g/dL (in association with increased risk of morbidity and mortality). The indices of hematocrit follow a tolerance threshold for transfusion between values of 18–25%,[18] and can reach 15–20% without myocardial damage caused by lactic acid production. Cardiac failure occurs when the thresholds are close to 10%.[3,18] Regarding platelets, preoperative minimum indices are relevant when they are below 50,000 mm^3, a circumstance remote from most patients undergoing elective THA – which explains the null rate specific for platelet transfusions.

The behavior of hemoglobin and hematocrit curves followed a parabolic path with normal distribution of data and a downward peak was observed during the visit 3; regardless of transfusion, the peak had returned to the baseline threshold at visit 5. The graphical representation of platelets was peculiar, due to the characteristic oscillation between visits 2 and 4, and represented a normalized peak from the visit 5, not corroborated by any relevant clinical alteration. With respect to this characteristic behavior, we found no comparative analyses with other arthroplasty studies.

The assessment of risk factors for transfusion is of utmost importance, since it presupposes an analysis of each individual that, possibly, be a predictor of normal variation of the hematimetric curve. Consistent with the literature, this study suggests that the risk factors are synergistic and cumulative.[27] That is, the increase in the number of comorbidities of patients would probably be the variable with the greatest impact on the individual's propensity to use blood products.[27]

Risk factors are invariably discussed *per se*. Preoperatory hemoglobin (Hb),[27,28] < 12 g/dL is a predictor that influenced the Aderinto and Brenke,[18] series in up to 70% of transfused patients. In our analysis, we did not give much consideration to this important predictor of risk, because the blood transfusions occurred in equal proportions in patients with Hb < 12 g/dL (36.4%) *versus* Hb > 12 g/dL (34.3%). It is noteworthy that, at randomization, anemic patients (Hb < 11 g/dL) were excluded. Many of these patients mentioned in Aderinto and Brenkel series,[8] Salido et al.[28] and Pola et al.[27] showed hemoglobin values below 11 g/dL, implying that preoperative anemia is the decisive factor in the risk of transfusion.

The value of 12 g/dL would be a safety number for performing arthroplasties with less risk of use of blood products.[28] Other risk factors already mentioned in the literature were not correlated with the results of the present study, including advanced age, which is associated with 43% of anemia of chronic disease,[4] females,[4,6] comorbidities (*e.g.*, diabetes mellitus and systemic arterial hypertension), low body mass index – lean patients (risk near 40% in patients < 70 kg), short stature, type of anesthesia and surgical technique.[8,27] Parker et al.[29] state that post-operative anemia should not be tolerated in elderly patients' recovery, giving priority to aggressive transfusion conducts (in association with a higher rate of falls, cognitive impairment, cardiovascular risk, and decreased quality of life). Some peculiar characteristics are related to male patients who lose more blood in prosthetic procedures. Women, however, tolerate less blood loss and have a higher risk of transfusion.[27] The use of post-operative closed suction,[29] presents further evidence of transfusion risk in elective arthroplasties, as well as demonstrating little benefit in controlling infections and hematomata.[29] Until now, no study discussed alcoholism and smoking as possible risk factors, as well as ethnicity. In our study, black people had a lower tendency to blood transfusion. Bell et al.[6] associated prophylaxis for deep venous thrombosis (DVT) with unfractionated heparin to increased chances of transfusion, but with no reason established.

Interestingly, Carson et al.[24] and Pola et al.[27] were remarkable in the establishment of transfusional conducts in patients undergoing orthopedic procedures.[23,30] These authors determined that, initially, the use of blood products should precede objective parameters (laboratory indices), but that the subjective parameters (clinical and comorbidities' analysis) rationalize the practice of transfusion. With this objective, they observed a decrease in the percentage and amount of transfusion without additional risks of mortality and myocardial infarct.[30] We support this transfusion practice and, through our study, we confirm too the possibility of improving the use of blood products. Other optional methods to avoid transfusion measures with significance level still have high costs (such as recombinant erythropoietin,[4]), or gaps regarding their practicity.[4,11,13,15]

Conclusions

The rate of blood transfusion among patients treated with hip arthroplasty was 34.6%.

There is a pattern of behavior of the post-operatory hemoglobin and hematocrit curve that follows a parabola with normal distribution. However, the platelet curve follows an oscillatory path of the normal curve.

The hematimetric curve has limited reliability when used as the sole and absolute parameter.

The clinical and functional analysis of the patient and of its comorbidities constitutes the best parameter to influence the decision to use blood products, in association with laboratory evaluation.

Conflicts of interest

The authors declare no conflicts of interest.

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