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REVIEW ARTICLE

Surgery and transfusion

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Abstract Even though blood transfusion saves thousands of lives worldwide, it causes complications in some patients, and must therefore be correctly administered. As there is no universally accepted consensus on blood transfusion in surgical patients, we have reviewed the latest studies and gathered the best available evidence on blood management strategies. In this study, we discuss indicators for transfusion of erythrocytes and other blood products, haemostatic agents for cardiothoracic and orthopaedic interventions where it is imperative to regulate blood loss, and alternatives in specific situations such as Jehovah's Witnesses patients. Finally, we put forward an algorithm for the preoperative management of surgery patients with low haemoglobin levels.

PALABRAS CLAVE
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Transfusión y cirugía

Resumen Si bien la transfusión de sangre ha salvado miles de vidas en el mundo, algunos otros han sido víctimas de sus potenciales complicaciones, por lo cual debe ser correctamente empleada. No existe aún consenso aceptado universalmente sobre la transfusión sanguínea en el paciente quirúrgico, por lo cual se brinda esta revisión construida con los estudios más actuales y con mejor evidencia al respecto. Se mencionarán los indicadores para transfusión de eritrocitos y otros hemoderivados, la preparación preoperatoria, manejo transoperatorio y postoperatorio, agentes hemostáticos a emplear en cirugías cardiotorácicas u ortopédicas donde es imperante regular las pérdidas sanguíneas, así como alternativas en situaciones específicas como pacientes testigos de Jehová. Por último, se brinda un algoritmo para el abordaje de pacientes con hemoglobina baja y deban ser sometidos a cirugía.

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Introduction

Although blood transfusions have saved thousands of lives worldwide, they are not without their complications. In general surgery, blood transfusions are given to improve oxygen delivery to tissues, based on the patient's physiological requirements. Under normovolaemic conditions, the body responds to a loss of haemoglobin by increasing the cardiac output. In a normal heart, increased lactate production and an oxygen extraction ratio of 50% occur at a haemoglobin level of approximately 3.5–4 g/dL, while in coronary stenosis, the anaerobic state occurs at a haemoglobin level of between 6.0 and 7.0 g/dL. For this reason, the threshold for preoperative packed red blood cell (RBC) transfusion has been discussed at length in numerous studies and clinical trials.[1] In a review of 16 reports of the surgical outcome of a series of patients of the Jehovah's Witness faith, only 1.4% of 1404 procedures resulted in death due to anaemia.[2] In another review of 61 Jehovah's Witness patients, all deaths with the exception of 3 patients that died following cardiac surgery, attributable to anaemia occurred in patients with a haemoglobin level below 5.0 g/dL.[3] On the basis on these and other studies in which haemoglobin levels of less than 8.0 g/dL have been associated with a 2.5 increase in risk for mortality, the blood transfusion threshold in surgical patients with no cardiovascular disease is now considered to be 8.0 g/dL. Other authors mention the importance of taking the anaesthesia technique into consideration, as it can reduce cardiac output. In addition to this, surgery itself often causes acute haemorrhage to a greater or lesser extent, and therefore raised the transfusion threshold to 10.0 g/dL.[1,4] The debate on the appropriate haemoglobin threshold for transfusion continues to this day. In an attempt to clarify this issue, we give a brief description of the different schools of thought and the most recent evidence-based transfusion guidelines.

To transfuse or not to transfuse

Some groups advise against preoperative transfusion in haemodynamically stable patients with low haemoglobin levels due to the considerable number of potential adverse effects, such as alloimmunization, transfusion reactions, fluid overload, infection, electrolyte imbalance. In view of this, efforts have been made to develop and implement new methods that elevate haemoglobin levels, prevent adverse reactions, and contribute to patient safety. Generally speaking, these can be divided into 2 categories: autologous blood reinfusion, and techniques aimed at limiting blood loss. Strictly speaking, these approaches can be divided into a series of strategies dubbed ''pillars of blood management'': (1) optimising haematopoiesis and appropriate management of anaemia; (2) minimising bleeding; (3) harnessing and optimising physiological tolerance of anaemia using all available modalities while specific treatment is initiated. Some examples of these strategies include: autologous transfusion, haemodilution, blood substitutes, intra- and postoperative red cell salvage, haematopoietic factors, haemostatic medication, antifibrinolytics, fibrin sealants, and conjugated oestrogens.

Another challenge for surgeons arises when, either on religious grounds or due to lack of blood compatible with a particular blood phenotype, allogeneic transfusion is not an option and other solutions must be found. First and foremost, these patients must be treated by a multidisciplinary team that can ensure their safety while respecting their beliefs. In a report published by clinicians from the ''Soonchunhyang Bloodless Center'' in Korea, a teaching hospital specialising in performing surgery without allogeneic blood transfusions (94% of its patients are Jehova's Witnesses), 1407 patients scheduled for various types of surgery were grouped by Hb level ($\leq$7.0 g/dL and >7.0 g/dL). The patients were given erythropoietin or darbepoetin together with intravenous or oral iron supplements after quantifying their levels of iron, ferritin, folic acid and vitamin B12. Overall mortality was 0.8% (11 patients) in the $\leq$7.0 g/dL group, and 0.2% in the >7.0 g/dL group. These results suggest that blood substitutes can safely be used in both these groups of patients when risk factors, comorbidities and risk of bleeding are taken into account, and each patient is correctly prepared for each type of surgery.[4–6]

The foregoing report describes elective surgery; however, whole blood is still used in modern practice for particularly serious and emergency situations, such as patients undergoing surgery to treat wounds received in combat. In this context, a study carried out in the French military hospital in Kabul between 2006 and 2009 included 15 patients receiving overall 66 units of fresh whole blood (at a mean of 3 units per patient). All blood units had been tested for HIV and other pathogens using rapid testing techniques. No complications were reported in either donors or recipients. Average time from collection to transfusion was 140 ± 197 min (mean 43 min). Mortality among recipients was 27%. It is important to stress that this technique is reserved exclusively for the military or extreme emergencies.[7] In these cases, fresh whole blood is essential for oxygen transport and adequate coagulation, since studies have shown that storing whole blood interferes with the metabolism, biochemistry, morphology and activity of red blood cells, and therefore affects the quality of the blood. It has also been reported that the longer the blood is stored, the greater the detrimental effect on coagulation. This is mainly caused by a gradual decrease in the pH of transfused RBC while the plasma buffer is overpowered due to the acidic overload.[8] Because of these changes, the mortality rate is significantly increased in comparison with packed red blood cells, which can be stored for up to 6 weeks.[9]

Allogeneic transfusion is emerging as a risk factor for many common complications in transfused patients, such as pulmonary lesion and hospital-acquired infection, and is a predictor of morbidity and mortality in critical patients. As a result, the notion of blood transfusion as a revitalising treatment capable of improving a patient's overall status and speeding up recovery has been replaced by the more rational view that use other, less risky, methods must be used. Furthermore, the increased demand in an ageing population, and a drop in the number of blood donors have made it even more imperative to take a different approach to transfusion. Studies have shown that most (up to 94%) transfusions performed in surgery patients can be attributed to one or a combination of the following factors: low preoperative haemoglobin levels, excessive intra- and postoperative