Available online at www.sciencedirect.com
ScienceDirect
Transfusion and Apheresis Science 39 (2008) 151–154
TRANSFUSION AND APHERESIS SCIENCE
www.elsevier.com/locate/transci

Red cell transfusion triggers

Jonathan P. Wallis

Freeman Hospital, Newcastle Upon Tyne, UK

Abstract

The epidemiology of red cell transfusion is changing. Surgical use has decreased due to reduced transfusion triggers and better operative techniques. Medical use increases partly due to the increasing age of the population. The evidence for and against transfusion at different levels of anaemia is discussed. The appropriate level of haemoglobin at which to recommend transfusion depends on the indication for transfusion, the patient's co-morbidities and the quality of the red cells available.

1. Introduction

Red cell transfusion has become an accepted part of medical practice. There is no doubt that red cell transfusion saves lives. Patients with post-partum haemorrhage or severe trauma who would otherwise die survive with the benefit of transfusion. It enables us to perform complex surgery that we would otherwise not contemplate. In patients with bone marrow failure it improves the quality and length of life. As a result of such therapeutic successes it is perhaps inevitable that transfusion has become overused by clinicians. At the same time costs have soared with increasing safety measures until transfusion consumes as much as 1.5% of the budget of an average hospital. The safety measures have reduced infectious risks to very low levels, but we are increasingly aware of non-infectious risks that may be particularly important in the critically ill.

Blood donation is a gift, and should not be squandered. As suppliers or prescribers of transfusion, it is part of out job to study the effects of transfusion, maximise its benefit and to know where the blood we supply is being used.

2. Who we transfuse

Use of blood can be broadly divided into surgical use, associated with operations and management of trauma, and medical use, usually for GI bleeding or failure of erythrocytosis. For many years surgery was the largest user. Over the last 5 years we and others have observed and documented a shift towards medical use. This change has been driven both by a reduction in use for many surgical operations, due to better operative techniques, cell salvage and reduced transfusion thresholds, and to an increasing use in an increasingly elderly population with more medical and haematological diseases. In the north of England we have seen a 25% fall in overall surgical use over the 5 years from 1999 to 2004. At the

E-mail address: jonathan.wallis@nuth.nhs.uk

1473-0502/$ - see front matter
doi:10.1016/j.transci.2008.06.004

same time there has been a 10% increase in medical use. The result is that now over 60% of red cells transfused in our region are for medical indications, 33% for surgical indications with 5% for obstetrics and gynaecological diseases [1].

Demographics show that most transfusion recipients are elderly patients, with a median age of 66 years. Only 25% of red cells go to patients of less than 55 years. The rate of transfusion rises rapidly with age. Less than 20 units are transfused per year per 1000 population between the ages of 40 and 50 years. This figure rises dramatically to more than 200 for those older than 80. Despite the fall in surgical use it is likely that the ageing populations in many western countries will lead to a rise in demand in due course.

3. Why we transfuse

We have carried out surveys of more specific reasons for transfusion in our region in the North of England. 18.2% of blood is given to patients with haematological disease, 13.9% for patients with GI haemorrhage and 8.8% for non-haematological cancer. Surgical blood use is split between specialities with orthopaedics using 6.3%, trauma 5.8%, cardiothoracic 5.2%, abdominal surgery 5.5% and vascular surgery 3.9%. Urology uses 2.1%, solid organ transplant 1.4%, neurosurgery 1.2% and other 1.7%. 5% of blood is used for obstetric and gynaecology with the majority of this being used in young obstetric patients [2]. These figures are not dissimilar to surveys from other countries suggesting a similar pattern of use elsewhere in the western world.

These uses of blood can be broadly be broken down into

1. Transfusion for acute anaemia (e.g. traumatic blood loss): to prevent death or organ damage and to improve haemostasis and speed recovery.
2. Transfusion for chronic uncorrectable anaemia (e.g. bone marrow failure): to maintain quality of life, adequate activity, physical growth.
3. Transfusion for chronic correctable anaemia (e.g. iron deficiency): To relieve symptoms, prepare a patient for surgery and speed up discharge from hospital.

4. The function of the transfused red cell

The chief function of the red cell is oxygen carriage but it has a number of other physiological roles. It carries carbon dioxide from tissues to the lungs. It has been suggested that it may act as a carrier of ammonia from tissues to the kidneys. It has an important role in nitric oxide metabolism, though whether as scavenger, carrier or producer is subject to much controversy (it may also act as a regulator of plasma arginine levels) [3]. Via nitric oxide, ATP or possibly other molecules it modulates flow through blood vessels and may also modulate platelet function. The physical contribution of the red cell to blood viscosity and thus to shear forces acting on the endothelial cell may be critical in modulating vasoconstriction or dilation such that blood of very low haematocrit may cause paradoxical vasoconstriction [4]. However our decisions about transfusion are mainly based on considerations of oxygen transport. It is therefore instructive to consider which tissues are most vulnerable to anaemia.

Oxygen extraction varies between different tissues. Some such as skin and kidneys extract only a small proportion (<10%) of the oxygen carried by the perfusing blood. This is because their blood supply is controlled for different reasons. The skin is primarily a temperature regulator. The kidneys are a plasma filter. The brain at about 30% extracts rather more, but the heart extracts nearly 60% of the delivered oxygen. Because a tissue extracts only a small proportion of the delivered oxygen does not mean that it has a high tissue pO_2. Micro-vascular beds are complex with arteriole to venule shunting and countercurrent gas exchange between afferent and efferent vessels. It is not uncommon for the mixed venous pO_2 to be higher than the tissue pO_2. In such tissues it may be possible to increase the oxygen extraction from perfusing blood by altering microvascular blood flows, thus maintaining a stable tissue pO_2 despite a lower venous pO_2. The heart is less able to do this because it is already extracting a large amount of oxygen. When the heart requires more oxygen to perform more work it is necessary to increase coronary blood flow. Coronary blood flow has been shown to increase linearly in a 1:1 ratio with cardiac work/output up to about a maximum of fivefold.

Tissues with a high blood flow to oxygen demand, such as the kidneys, are more susceptible to failing perfusion than to anaemia. The heart is uniquely susceptible to anaemia. Anaemia will reduce the oxygen delivery per unit volume of blood flowing through the coronary arteries (although the lower viscosity of the thinner blood increases flow and partly compensates for the reduced oxygen