Transfusion-Free Treatment and Autologous Blood Transfusion

Tetsunori TASAKI* and Hitoshi OHTO**

*Assistant Professor, Department of Clinical Pathology, Iwate Medical University
**Professor, Division of Blood Transfusion and Transplantation Immunology, Fukushima Medical University

Abstract: Various risks lie dormant in homologous blood transfusion, and measures to avoid such risks to the utmost are required for patients for whom transfusion is indicated. Coping with autologous blood transfusion is advisable, particularly in elective surgery patients, as is recommended by Japan's Ministry of Health, Labour and Welfare. Many reports have shown homologous blood avoidance rates of as high as >90% in patients undergoing an operation with autologous blood ready at hand, and the use of autologous blood contributes to saving blood and using it effectively, as a precious healthcare resource. If homologous blood is still to be used, then blood component transfusion should be undertaken at a minimum in principle. However, even in performing autologous blood transfusion, there are issues including adverse effects associated with blood drawing, contamination or disposal of autologous blood, and mistaken blood bags. The safety of homologous blood has been substantially improved, e.g., via introduction of the nucleic acid amplification test to screen out infected blood. Autologous blood transfusion, therefore, is the most ideal transfusion therapy, but requires careful consideration not only of its advantages but of its safety and inherent problems as well.

Key words: Transfusion-free treatment; Autologous blood transfusion; Homologous blood

Introduction

The current homologous blood (donated blood) has been remarkably improved with regard to safety, as compared with the situation some five decades ago when one out of every two recipients contracted post-transfusion hepatitis. However, there exists a window phase even in the superb nucleic acid amplification test (NAT), as pointed out in the article titled "Hepatitis Infection due to Donated Blood Transfusion — 31 Individuals Suspected Despite
Limitation of Transfusion-Free Treatment

The simplest measure to avoid homologous blood transfusion is dilution with parenteral fluid. The oxygen supply capacity in humans with normal cardiopulmonary function (Hb: 14 g/dl), theoretically, is about 1,000 ml/min. It is considered that the lower limit of Hb level for parenteral fluid infusion is about 4–5 g/dl since the resting oxygen consumption is approximately 250 ml/min.3) It has been experimentally proven that the oxygen transporting capacity is maintained in baboons even when the Hb level is 3–5 g/dl.4) With the recent progress in techniques of anesthesia, etc., it is common practice to withhold blood transfusion during a perioperative period insofar as the hemodynamic state is stable with the Hb value at the level of 6 g/dl. There has been a report, to our knowledge, that an intraoperative massive hemorrhage with the Hb value declining to as low as 1.1 g/dl (as against a preoperative value of 14.2 g/dl) was handled with parenteral fluid infusion alone for nearly 30 minutes until the initiation of blood transfusion.5)

The Hb level is indeed an important factor in the determination of blood transfusion, however, it is not the sole factor. It is essential to comprehensively assess the need for transfusion by careful evaluation of each patient’s condition via observation of vital signs and other clinical manifestations, such as physiological compensatory mechanisms (e.g., increases in cardiac output and oxygen extraction rate, oxygen redistribution, and rightward shift of the hemoglobin-oxygen dissociation curve), rate of bleeding, oxygen consumption, and duration of sustained critical condition. In daily medical practice, general guides for indicating blood transfusion should be set rather than waiting for the onset or exacerbation of symptoms. From the viewpoint of safety, it would be reasonable, as indicated in the Guidelines for Use of Blood Preparations (MHW/ PMSB Notification No. 715, dated June 10, 1999), to adopt...
Avoidance of Homologous Blood Transfusion with the Use of Autologous Blood

It is generally believed that the history of autologous blood transfusion began in 1818 when James Blundell, a British obstetrician, and his coworkers explored the practicability of collecting postpartum hemorrhage and reutilizing it for the patient. This was about the time an English vessel arrived at Uraga Port in Japan. Attempts to transfuse blood continued thereafter, but appear not to have necessarily been successful because the discovery of the blood group system (Landsteiner, 1900) and that of the anticoagulant effect of sodium citrate (Hustin, 1914) were yet to be made.

After the beginning of the 20th century, the use of autologous blood faded out as a result of the spread of homologous blood transfusion. The use of autologous blood was revived primarily in the United States consequent on the “AIDS panic” in the 1980s. In Japan, the Ministry of Health and Welfare adopted a policy to further the use of autologous blood in 1989, and autologous blood transfusion is clearly stated to be recommended in the “Basic policy to secure improvement of a safe and stable supply of blood preparations” (MHLW Notification No. 207, dated May 19, 2003) formulated pursuant to the “Law Concerning Security for a Stable Supply of Safe Blood Preparations” enforced as of July 30, 2003.

With the improving safety of homologous blood, it has become difficult to corroborate the superiority of autologous blood in recent years. Conversely, problems such as disposal or contamination of autologous blood, mistaken bags, and adverse effects associated with blood drawing have been pointed out. We reported that the use of homologous blood transfusion would probably have been avoidable even without predeposit of autologous blood in approximately half of the patients who donated one to two units of autologous blood. A recent report has indicated that even the dilution method alone was as equally effective as autologous blood predeposit in patients undergoing an operation of total hip arthroplasty. Reported cases of adverse effects due to predeposit autologous blood contaminated with bacteria, needless to say, stress the importance of securing the safety of autologous blood.

Autologous blood predeposit, however, is significant especially in pediatric surgery cases when infections of unknown etiology and immunological adverse effects are taken into account. Shown in Table 1 are background characteristics of patients treated for scoliosis.

### Table 1 Background Characteristics of Patients Surgically Treated for Scoliosis (January 2002 to December 2003)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients (M/F)</td>
<td>16 (3/13)</td>
</tr>
<tr>
<td>Age (year)</td>
<td>14.9 ± 3.3 (11–25)</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>48.4 ± 5.5 (40–61)</td>
</tr>
<tr>
<td>Total predeposit blood volume (ml)</td>
<td>1,431 ± 338 (1,000–2,300)</td>
</tr>
<tr>
<td>Predeposit blood collection period (day)</td>
<td>38.5 ± 11.7 (19–62)</td>
</tr>
<tr>
<td>Intraoperative blood loss (ml)</td>
<td>1,196 ± 571 (315–2,269)</td>
</tr>
<tr>
<td>No. of patients receiving rEPO</td>
<td>0</td>
</tr>
<tr>
<td>No. of patients with homologous blood transfusion</td>
<td>0</td>
</tr>
</tbody>
</table>

Data represent the mean ± S.D. (range).

Hb levels of 7 g/dl in patients with chronic anemia and 10 g/dl in patients with coronary artery disorders, pulmonary dysfunction, or cerebral circulatory disorders.
University Hospital, in the past two years. Figure 1 depicts Hb levels over time during the perioperative period in those patients. Schoolchildren with the disorder repeatedly predeposit autologous blood on the ambulatory basis, and receive an operation during a long vacation such as summer vacation. Erythropoietin (EPO) is very useful in elderly patients,\(^9\) while repetition of predeposit is practicable in juvenile patients who normally recover from anemia with the use of iron preparations alone.

A future tight supply of blood for transfusion has been recognized because of decreasing blood donation and increasing demand in the coming society, with declining birthrates and the growing elderly population. We must use donated blood effectively, a precious healthcare resource, and may have to raise the proportion of autologous blood in the supply source in the future. In 2003, we conducted a predeposit of 1,010 units\(^*\) of autologous blood for 279 patients at this hospital, which accounted for 7.8% of the donated blood to the Japanese Red Cross Society consumed in that year (13,001 units). Of these patients, 248 patients (89%) made postoperative progress with predeposit autologous blood alone. It should be remembered that plasma fraction preparations such as fibrin sealant are also derived from homologous blood. At present, clinical application of fibrin sealant comprising thrombin and all other components of autologous blood origin is under investigation. Autologous blood components/fractions, such as autologous platelet-rich plasma and hematopoietic cells, have a wide range of application.

\(^*\)In Japan, each unit consists of a volume of red blood cells from 200 ml of fresh whole blood.

**Summary and Conclusion**

Autologous blood transfusion has been performed primarily for the purpose of avoiding adverse effects/complications associated with homologous blood transfusion, and securing blood for patients with rare blood types. It is significant even from the viewpoint of quality-adjusted life years (QALYs), especially for infants and children who are to enjoy longevity. The use of autologous blood is the most ideal transfusion therapy, and contributes to the promotion of proper transfusion, however, we ought to bear in mind that the safety of autologous blood is sought all the more at the present time when the safety of homologous blood has improved.

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**REFERENCES**


