Epidemiology of blood component recipients in hospitals of Yazd, Iran

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SUMMARY

Background and Objectives: Blood recipient and blood product utilisation data are needed for assessment of current transfusion practice in hospitals. Such data can help monitoring blood use, improving blood transfusion practice and estimating future blood use.

Materials and Methods: In this cross sectional study, the rate of blood consumption has been evaluated in three randomly selected hospitals of Yazd, Iran in 2011–2012. Data of blood recipients including patient identification number, age, sex, principal diagnoses, date of transfusion, type and number of transfused blood components and indication for transfusion were prospectively collected.

Results: The dataset included information about 814 patients (53% males) who received 1110 RBCs, 410 plasma and 1484 platelet (PLT) units. Transfusion rate per 1000 population per year was 24, 10 and 15 for red blood cells (RBCs), plasma and PLT units, respectively. Age group 17–64 years had the highest consumption of blood components (55%). Most of the RBCs and PLT units were transfused to patients with neoplasm (42 and 82%, respectively). Cardiovascular surgery was the diagnosis category with most plasma usage (32%). The category with highest haemoglobin level before transfusion was surgery; Orthopaedic and ENT surgeries were at the top of ranking (11.96 ± 1.85 g.dL⁻¹). PLT count before transfusion was 11·160 ± 5·282 × 10⁹ L⁻¹ in neoplasm category and 12·3637 ± 6·2267 × 10¹⁰ L⁻¹ in neonatal disease.

Conclusion: Study results showed the first epidemiological data of blood recipients on a regional basis in Iran. It is suggested to study blood utilisation at the national level to assist in improving transfusion practice in hospitals.

Key words: blood component, blood transfusion, epidemiology.

Blood transfusion has a central therapeutic role in medical care. High-dose chemotherapy regimens for haematological and solid organ malignancies, major surgeries and trauma management would not be possible without supportive care including blood component transfusion (Liumbruno & Rafanelli, 2012, Seifried et al., 2013). However, blood transfusion is not without risk. Blood recipients are prone to various complications caused by infectious or noninfectious factors and blood transfusion should be prescribed only in conditions that cannot be managed effectively by other means (Leal-Noval et al., 2011, Liumbruno & Rafanelli, 2012). On the other hand, the increased demand of population, a diminished donor pool and the increasing preparation cost of blood components, cost-ineffectiveness of screening tests and resource restrictions place unfavourable impact on the health care systems. These issues have heightened the interest for the review of transfusion practices in hospitals to ensure the rational use of blood products (Ansari & Szallasi, 2012, Weltert et al., 2013). Many studies have shown interventions, monitoring and auditing blood transfusion practice could lead to reduce the amount of blood transfused particularly the inappropriate transfusions (Tinmouth et al., 2005, Tinmouth, 2007, Gallagher-Swann et al., 2011, Ansari & Szallasi, 2012). The first step to achieve this goal is investigation of documented data on blood recipients and transfusion practice in hospitals. Although information on blood collection, testing and component preparation is carefully documented by blood establishments in many countries, there is limited data on blood utilisation from the developing countries (Borkent-Raven et al., 2010, Marwaha, 2010).

In Iran, Iranian Blood Transfusion Organisation (IBTO) with regional branches throughout the entire country is the only nationally accredited organisation that performs the first part of blood transfusion chain procedures ranging from blood donor recruitment to delivery of blood products to the hospitals. IBTO has achieved many improvements to ensure safe and adequate blood supply such as 100% voluntary non-remunerated blood donations with annual donation index of 27 per 1000 population, implementation of good manufacturing practice (GMP) throughout the entire system and documentation of all information on blood donors, donations and blood product issuing.
to the hospitals (Gharehbaghian et al., 2008, Cheraghali, 2012). However, there is limited information on the fate of blood products issued to the hospitals. Hospitals do not have any regulations for monitoring blood utilisation and registration of personal and clinical information of blood recipients. Transfusion recipient data are needed for clinical management of the patients such as investigation of poor outcome, look back and also for reducing inappropriate blood transfusions and maintaining the limited blood supply for those patients really in need. In this study, we investigated the demographic pattern and clinical features of blood recipients in hospitals of the city of Yazd situated in the centre of the country.

MATERIALS AND METHODS

Study design

In this prospective study, three hospitals in Yazd, Iran were randomly selected using computer random number generator. The study was performed during a period of 9 months from the beginning of July 2011 to the end of April 2012. Any 10-day period of each month was assigned to one hospital. Blood usage of the hospitals during the study period was multiplied by three and then 12/9 for estimating annual blood consumption. Patients were included in the study if they had received any blood product during the selected period of time.

Data collection

Experts responsible for collecting the information referred to the hospitals and completed a special questionnaire prepared for all blood recipients during the period. The questionnaire included information such as the patient’s identification number, age, sex, diagnosis, the type and number of transfused blood products and indication for blood transfusion. The source of data included the hospital blood bank documents, the clinical information retrieved from the transfusion request form and the patient clinical records. Any missing data was obtained from attending physician of the patient. The study was approved by the ethics committee in Blood Transfusion Research Centre, Tehran, Iran.

Blood components

Yazd blood transfusion centre was the only blood component provider for hospitals of Yazd. Allogenic RBCs, plasma and platelet (PLT) units were derived from whole blood donations. PLT units were not pooled before storage or transfusion and the amount of transfused PLTs was measured in units. It should be mentioned that in neonates and small children, only a fraction of a blood component unit was transfused and the remainder could not have been used again.

One unit of RBCs contains approximately 200 mL RBCs and 45 g haemoglobin. A single unit of PLT is derived from a whole blood donation. The volume of one PLT unit is 40–70 mL and contains $5 \times 10^{10}$ PLT. The volume of plasma in a single unit of fresh frozen plasma (FFP) is 200–300 mL and it contains all coagulation factors in normal concentrations.

Statistical analysis

After completing the questionnaires, data was analysed using spss 17-5 software (IBM Corporation, New York, NY, USA). The data were entered in spss and then, the summary statistics and descriptive tables were tabulated.

RESULTS

Completed questionnaires were received from three hospitals that had transfused at least one blood component during the study period. The data included recipients of 1110 RBC units, 410 plasma units and 1484 PLT units. By using the following formula: number of blood component transfused × 3 × 12/9, the estimated annual consumption of RBCs, plasma and PLT units in the three hospitals were 4440, 1640 and 5936 U, respectively. Considering the fact that these three hospitals utilise approximately 18, 16 and 40% of RBCs, plasma and PLT units of the blood components that Yazd blood transfusion centre, as the only blood supplier in the region, issues to the hospitals annually, it is estimated that the total annual usage of blood products in Yazd is 24666 U of RBCs, 10250 U of plasma and 14840 U of PLTs. Yazd region has a population of about 102333. Therefore, utilisation per 1000 population per year is 24 U of RBCs, 10 U of plasma and 15 U of PLTs. Of the 814 patients transfused with at least one blood component, 433 (53%) were males and 381 (47%) females. Most of patients (73%) received RBCs, either alone (46%) or with other blood components: 26-1% and 26-4% received plasma and PLT units, respectively. The proportion of all blood recipients who received only plasma or PLTs were 8-5% for plasma and 15-2% for PLTs.

Table 1 shows the frequency of blood component recipients by sex and age. The age group 41–64 was the most frequent group for receiving RBC or plasma units. Age group 17–40 years had the highest consumption of PLTs.

The mean number of transfused RBCs units for each patient was 1.87 ± 2.95 U. Disease categories with highest haemoglobin level before transfusion were cardiovascular and other surgeries. Orthopaedic and ENT surgeries had the highest haemoglobin levels before transfusion (11.96 ± 1.85 g dL⁻¹). Table 2 shows the distribution of RBCs recipients according to the category of the diagnosis and haemoglobin levels before transfusion. Approximately half of the RBCs recipients were associated with the neoplasm category (42%). The second category with high RBCs utilisation was cardiovascular surgery (20%).

Cardiovascular surgery, internal disease, neonatal disease and neoplasm were the categories with the highest plasma usage. Eighty percent of PLT units were transfused to patients with neoplasm (Table 3).

Table 4 shows how the number of blood products transfused relates to the number of transfusion episodes. A transfusion episode means one transfusion event. 42-5% of RBC units and
DISCUSSION

study, recipients of blood component were younger than other studies. Fifty seven percent of RBCs recipients were in the range of 17–64 years. In Bosch et al. (2011) study, half the RBCs units were transfused to patients older than 70 years. Also in other developed countries most of red cell products were used by patients older than 65 years (Cobain et al., 2007, Borkent-Raven et al., 2010). The difference could be because of lower percentage of old population in Iran in comparison to western countries. Likewise, it could be due to earlier age of cardiovascular or malignancy in developing countries (Reddy and Yusuf, 1998, Kanavos, 2006, Wallis et al., 2006, Gaziano et al., 2010, Van Der Poel et al., 2011).

Utilisation of RBCs by diagnosis in Yazd was similar to that reported from other countries with neoplasm and cardiovascular surgeries ranking at the top of RBC utilisation (Cobain et al., 2007, Borkent-Raven et al., 2010, Bosch et al., 2011). Approximately half the RBCs were transfused to patients with neoplasm (42.2%). Cardiovascular surgery was also important in receiving RBCs (20%). In Cobain et al. (2007) study, the use of RBCs was predominated in cardiovascular surgery. Neoplasm and digestive disorders were also prevalent. In Borkent-Raven et al. (2010) study, the diagnosis group that used most RBCs was neoplasm (22.2%) or circulatory system (21.5%). In a regional Iranian study, surgery and blood diseases such as thalassemia were the categories with predominant RBCs utilisation (21% and 19%, respectively) (Rafieemehr, 2010). High prevalence of neoplasm in the province of Yazd as well as the presence of specialised centres for treatment of cancer that led many patients from other regions to refer to the province could lead to the high utilisation of blood product transfusion in neoplasm category.

RBCs were transfused in doses of 1 (42.5%) or 2 (52%) units in this study. In Australia, most of transfusion episodes (43.7%) required 2 U of RBCs (Cobain et al., 2007, Tinegate et al., 2013). Study results showed transfusion of RBCs was not according to appropriate transfusion guidelines. In category of surgeries, the level of haemoglobin before transfusion (11.57 ± 2.81 g.dL⁻¹) was much higher than standard levels. Transfusion guidelines recommend a lower haemoglobin limit of 7 g.dL⁻¹ below which transfusion would always be indicated and an upper limit of 10 g.dL⁻¹ above which a RBC transfusion is generally considered inappropriate.
practitioners and they are largely unaware of developments try, transfusion medicine is still practiced traditionally by in the city of Rasht, Iran, the level of haemoglobin in blood approximately 25% of RBCs unit recipients. Therefore considering these TABLE 4

Table 3. Distribution of plasma or platelet recipients according to diagnosis category

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Plasma</th>
<th>Platelet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transfused</td>
<td>Transfused</td>
</tr>
<tr>
<td></td>
<td>units (X ± SD)</td>
<td>units (X ± SD)</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>27 (12-6) 3.74 ± 6.66</td>
<td>174 (81.7) 7.70 ± 3.51</td>
</tr>
<tr>
<td>Cardiovascular surgery</td>
<td>70 (32-6) 1.27 ± 0.74</td>
<td>– –</td>
</tr>
<tr>
<td>Internal diseases</td>
<td>41 (19-1) 1.85 ± 1.26</td>
<td>7 (3.3) 2.00 ± 1.15</td>
</tr>
<tr>
<td>Blood diseases</td>
<td>14 (6-5) 2.36 ± 1.08</td>
<td>17 (8-0) 5.29 ± 3.61</td>
</tr>
<tr>
<td>Surgery</td>
<td>6 (2-8) 1.50 ± 0.54</td>
<td>1 (0-5) 1.00 ± 0.00</td>
</tr>
<tr>
<td>Obstetrics and gynecologic diseases</td>
<td>8 (3-7) 3.13 ± 1.55</td>
<td>– –</td>
</tr>
<tr>
<td>Neonatal diseases</td>
<td>32 (14-9) 1.53 ± 2.47</td>
<td>11 (5-2) 3.18 ± 5.63</td>
</tr>
<tr>
<td>Other</td>
<td>17 (8-1) 1.80 ± 0.40</td>
<td>3 (1-4) 1.00 ± 0.00</td>
</tr>
<tr>
<td>Total</td>
<td>215 (100) 1.90 ± 1.96</td>
<td>213 (100) 6.97 ± 3.92</td>
</tr>
</tbody>
</table>

Table 4. Distribution of blood components transfused per episode

<table>
<thead>
<tr>
<th>Number of products transfused per episode</th>
<th>% products transfused</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red cells</td>
</tr>
<tr>
<td>1</td>
<td>42.5</td>
</tr>
<tr>
<td>2</td>
<td>51.8</td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>2.7</td>
</tr>
<tr>
<td>5</td>
<td>0.7</td>
</tr>
<tr>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0.15</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0.15</td>
</tr>
<tr>
<td>11–20</td>
<td>0</td>
</tr>
<tr>
<td>21–30</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

(Barr et al., 2011). In the study of Gharehbaghian et al. (2007) in the city of Rasht, Iran, the level of haemoglobin in blood recipients before surgery was 10.84 ± 2.64 g.dL−1. In our country, transfusion medicine is still practiced traditionally by practitioners and they are largely unaware of developments in transfusion medicine (Gharehbaghian et al., 2009). In our study, patients undergoing surgeries accounted for approximately 25% of RBCs unit recipients. Therefore considering these guidelines in practice could lead to a significant reduction in RBCs utilisation. Tinegate et al. (2013) reported a significant decrease in RBC use in the northern region of England from 45 to 36 per 1000 population that was because of a reduction in surgical procedures as a result of the implementation of blood management strategies.

According to our findings, plasma was largely used in cardiovascular surgery (33%). This finding was in agreement with other epidemiologic surveys of plasma utilisation (Cobain et al., 2007, Borkent-Raven et al., 2010). Other diagnosis categories with prominent plasma usage were neoplasm, neonatal and internal diseases. In the study of Mirzamani et al. (2009) in Gorgan, northern part of Iran, the largest proportion of plasma was used for patients with GI bleeding, neoplasm, patients who had undergone surgery or neonatal diseases.

In our study, 27% of plasma recipients were less than 1-year-old. Because this group needs small volume of plasma, use of paediatric plasma bags instead of common blood bags could lead to reduction in plasma utilisation.

Plasma units were most often transfused in doses of 1 (61%) or 2 (24%) units (Table 4). In Australia, 44–3% of transfusion episodes required 2 U of plasma. In Denmark, the average plasma units per transfusion were 4 U (Cobain et al., 2007). In Gorgan, Iran, 1–2 plasma units were transfused to 51% of adult patients; the mean number of units per transfusion episode was 2.6 U. The therapeutic dose of plasma is 10–20 mL.kg−1 of body weight. Therefore, the plasma usage in most adult patients seems to be inadequate (Mirzamani et al., 2009).

Transfusion rate per 1000 population was 10 U of plasma in our study that was higher than plasma transfusion incidence rate in Catalonia, Spain (6 U per 1000 population-year) and other European countries (England 4·8 U, Denmark 5·2 U) but lower than United States (13·8 U of plasma per year) (Cobain et al., 2007, Bosch et al., 2011). Because use of plasma usually coinciding with the RBCs and RBCs capita consumption is lower than in other studies, high plasma use in comparison to RBCs use in our study may be because of the lack of broad access to all coagulation factors in our country or it may be because of inappropriate use of plasma. In Gorgan, a high rate of plasma usage (53% of transfusion episodes) was inappropriate. However, investigation of appropriate plasma transfusion was out of the scope of our study and further research is needed focusing on appropriate plasma transfusion practice in our hospitals.

The incidence rate of PLT transfusion was 15 per 1000 population per year. In other epidemiologic surveys, the transfusion rate per 1000 population was 2–6 U of PLTs per year (Cobain et al., 2007, Bosch et al., 2011).
In this study, one dose of PLT consisted of one whole-blood-derived PLT whereas in other studies one dose of PLT was determined as one apheresis, one pooled buffy coat or five whole-blood PLTs (Cobain et al., 2007, Bosch et al., 2011). Therefore, the rate of PLT units transfused was similar to other studies.

PLT units were mainly transfused in doses of 10 (40%) or 5 (38%), in this study. In Australia, 49-7% of transfusion episodes required 6 U of whole-blood-derived PLTs and in Denmark, on average, equivalent to 12-9 whole-blood-derived single units of PLTs were transfused per episode (Cobain et al., 2007).

Neoplasm was the only diagnosis category at the top of ranking with more than 80% PLT utilisation. In other studies, the results showed the diagnosis group that used most PLT units was the group of patients with neoplasm including hemato-oncological diseases (Cobain et al., 2007, Borkent-Raven et al., 2010, Bosch et al., 2011). Most PLT units were transfused as prophylaxis, to increase low PLT counts and decrease the risk of bleeding. However, the degree to which prophylactic PLT transfusions benefit patients with severe thrombocytopenia has been unclear. The results of a recent study supported the need for the continued use of prophylaxis with PLT transfusion and showed the benefit of such prophylaxis for reducing bleeding, as compared with no prophylaxis (Stanworth et al., 2013). The threshold of prophylactic PLT transfusion in guidelines is counts less than 10 x 10^9 L^{-1}. However, it varies depending on the clinical condition of individual patients. Although, we did not investigate specific conditions of recipients for PLT transfusion, in neoplasm category, the mean PLT count before transfusion (11-160 ± 5-282 x 10^9 L^{-1}) was vaguely in accordance with guidelines.

In neonates, PLT count before transfusion was 12-363 ± 6-226 x 10^10 L^{-1} which was higher than recommendations for PLT transfusion in neonates. Thresholds for PLT transfusion range from 20 x 10^9 L^{-1} in stable thrombocytopenic neonates to 10 x 10^10 L^{-1} in critically ill premature neonates with active bleeding (Liumbruno et al., 2009). We have limited studies about the transfusion of PLT units in Iran. In one study in the teaching hospitals of Qazvin, Iran, 40% of PLT requests were inappropriate (Sheikholeslami et al., 2010). In developing countries a considerable heterogeneity exists for PLT transfusion practices in hospitals which can be explained by factors such as individual preferences or lack of any hospital transfusion policy with regard to PLT transfusion (Verma & Agarwal, 2009). There is a need to implement PLT transfusion guidelines in hospitals to decrease inappropriate transfusions.

CONCLUSION

In summary, our study showed current epidemiology of blood recipients on a regional basis and can be used for planning of production and also improving transfusion practice. It may be more efficient to undertake a study of blood product utilisation in a coordinated manner at the national level. However, data collection can be very difficult because of incomplete records of blood recipients in hospitals. Therefore, as for blood donors, integrated software is needed for documenting blood recipient data all across the country. Also it can help monitor blood utilisation. On the other hand, implementation of standard guidelines for appropriate transfusion and regular audits can also improve transfusion practices in our hospitals.

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CONFLICT OF INTEREST

The authors have no competing interests.


