Blood Use in a Large North Eastern Italian Academic Hospital During the Period 2009-2013: What Reasons for a Decrease?

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Introduction

Blood is a precious and scarce resource and its management needs continuous efforts in order to maintain a balance between supply and demand. Considering that blood components supply depends substantially on voluntary donors, population is getting older and new measures to reduce an unnecessary donor exposure to patients are expensive, the cost to maintain a sufficient provision is notably increased [1].

In the last decade programmes and guidelines for a better use of blood have been introduced in several hospital policies [2-4]. Patient Blood Management guidelines (PBM), for example, concern about a correct preoperative transfusion management based on right preoperative identification of anaemic patient, on control of blood loss and coagulopathy during and after operation and on optimisation of anaemia tolerance during the postoperative period [5].

Recently, several countries all over the world seems to present a decrease of blood products use. American national data showed a diminution of blood components use of about 3% between 2009 and 2010 [6,7]. Australian data showed an abatement of 7% of consumed blood units after the revision of national blood use guidelines [8].

A recent report of the European Committee on Blood Transfusion revealed that in the last decade red blood cells (RBCs) use has been greatly decremented in all the Member States with an average of 37 total RBCs products per 1.000 inhabitants in 2011 [9]. A remarkable reduction has been registered in England, with a transfusions decrease in surgery due to the new techniques and to the review of the blood use national guidelines. In fact the transfusions rate was diminished from 45,5 RBCs units in “2.000’’. To 36 units per 100.000 inhabitants in 2009 [10].

Finally, also Italy showed an abatement of blood components use. The first decrement of the RBCs transfusions had been registered in 2013, with a reduction of 2% (about 50.000 units). The decrease was more evident in North regions such as the autonomous province of Bolzano [11] with a diminution of about 8% and in Friuli Venezia Giulia (FVG) with a transfusions abatement of 5.5% (from 60.453 to 57.103 units) [12].

This study consisted in comparing the trends of red cell concentrates (RCCs) consumptions in a large North Eastern Italian Academic Hospital (AH), located in FVG region, during the period 2009-2013 and in analysing some variables to reach hypothesis on reasons of decrement in RCCs use.

Materials and Methods

The study consisted in extracting, choosing and analyzing several data regards RCCs consumptions in an AH during the period 2009-2013 from different available database.

These variables were extracted by the following database:

- consumptions of RCCs units and the Maximum Surgical Blood Order Schedule (MSBOS) by the Immunotransfusion Medicine Department Clinical System (EmoNets)
- hospital outcomes [length of stay, case-mix index (CMI), 30-day readmission rates, mortality rate], Diagnosis Related Groups (DRGs) and patients’ age by the regional business intelligence software (Business Object).
- hospital activity volumes [hospitalisations, and surgeries – hospital-wide, stratified by departments and single operative units (UOs),urgent admissions (UAs) rate, UAs rate in medical UOs] and typologies of surgical interventions by the hospital informative directional system (SisInfo).
- Hospital guidelines, procedures and protocols by the hospital website (Intranet).

Data collected were analysed using the statistical software SPSS, version 20. Chi-square test and Mann-Whitney test were used. Statistical significance was defined as p≤0,05.

A multi-professional Committee for “good blood use” was present in the hospital according to the current national regulations in order to direct hospital blood utilisation coherently with hospital and regional plans.

Results

Table 1 shows RCCs units consumptions, hospital activity profile (hospitalisations, UAs rate, UAs rate in medical UOs) and outcomes (length of stay, CMI, MSBOS, 30-day readmission rates, mortality rate) during the period 2009-2013.

In detail, transfusions of RCCs were reduced of 1.067 units (5,9%) between 2012 and 2013, of 1.105 units (5,8%) between 2012 and 2011, of 484 (2,5%) units between 2011 and 2010. There was an increase of 0,1% (25 units) between 2009 and 2010. A preliminary analysis on blood consumptions in 2014 found out a use of 16.200 RCCs units with a decrease of 2,3% (396 units) compared to 2013 (Table 2 and Figures 1-3).

Report RCCs units consumptions and volumes of hospitalisations
by the major hospital blood consumers (heart surgery, orthopaedics, haematology, first aid, transfusion medicine) during 2009-2013 period. An analysis of more frequent surgeries in the hospital showed a diminution of heart surgery interventions from 774 in 2010 to 647 in 2013 (-16%). Regards to the typologies of the more frequent ones, aortocoronary bypasses (CABs) and CABs with surgical aortic valve

Table 1: Hospital activity profile and consumed red cell concentrates (RCCs) units during 2009-2013 period.

| Year | 2009 | 2010 | 2011 | 2012 | 2013 | ∆ 2013-2009/10 | % |
|------|------|------|------|------|------|----------------|---|
| Hospitalisations (n.) | 44651 | 42956 | 42044 | 41131 | 40113 | -4538 | -10.2% |
| Urgent admissions rate | 45.4% | 45.4% | 46.1% | 46.4% | 48.6% | -764 | -3.9%† |
| UA* rate in medical units | 34.3% | 33.4% | 32.7% | 32.7% | 32.6% | -555 | -4.8%† |
| Surgeries (n.) | 29894 | 30543 | 30433 | 29945 | 27896 | -1998 | -6.7% |
| Length of stay (mean) - days | - | 8.9 | 9.0 | 8.6 | 8.7 | -0.2 | -2.2% |
| Case-mix index | - | - | - | 1.17 | 1.18 | - | - |
| MSBOS ≥4‡ | 661 | 688 | 675 | 643 | 731 | 70 | 10.6% |
| 30-day readmission rate | 5.0% | 4.0% | 4.1% | 4.1% | 4.2% | -526 | -1.1%† |
| Mortality rate | - | 4.0% | 4.1% | 4.3% | 4.3% | -68 | +3.8% |

* urgent admissions; † p<0.05 ‡ Maximum Surgical Blood Order Schedule

Table 2: Red cell concentrates (RCCs) units, hospitalisations and surgeries per year stratified by hospital departments during 2009 and 2013.

| Department | 2009 | 2013 | ∆ 2013-2009 | % |
|------------|------|------|-------------|---|
| Hospitalisations (n.) | 2248 | 1667 | -581 | -25.8 |
| RCCs units | 501 | 507 | 6 | 1.2 |
| Cardiothoracic Surgery Department | 3396 | 2409 | -987 | -29.1 |
| Hospitalisations (n.) | 3800 | 3546 | -254 | -6.7 |
| Surgeries (n.) | 1041 | 995 | -46 | -4.4 |
| General Surgery Department | 4228 | 3689 | -539 | -12.7 |
| Hospitalisations (n.) | 10137 | 9309 | -828 | -8.2 |
| Surgeries (n.) | 12010 | 11032 | -978 | -8.1 |
| Surgical Specialities Department | 124 | 189 | 65 | 52.4 |
| Hospitalisations (n.) | 6315 | 5005 | -1310 | -20.7 |
| Surgeries (n.) | 2019 | 2079 | 60 | 3.0 |
| Maternity Department | 323 | 407 | 84 | 26.0 |
| Hospitalisations (n.) | 6801 | 6506 | -295 | -4.3 |
| Surgeries (n.) | 213 | 98 | -115 | -54.0% |
| Medicine Specialities Department | 2571 | 2353 | -218 | -8.5% |
| Hospitalisations (n.) | 3054 | 2699 | -355 | -11.6% |
| Neuroscience Department | 201 | 296 | 95 | 47.3 |
| Hospitalisations (n.) | 3309 | 3318 | 9 | 0.3 |
| Surgeries (n.) | 1383 | 1345 | -38 | -2.7 |
| General Medicine Department | 3822 | 2936 | -886 | -23.2 |
| Hospitalisations (n.) | 11378 | 10283 | -1095 | -9.6 |
| Oncology Department | 180 | 126 | -54 | -30.0 |
| Hospitalisations (n.) | 1569 | 1559 | -10 | -0.6 |
| Day Hospital | 1160 | 1125 | -35 | -3.0 |
| Discharges (n.) | * | 11175 | -1812 | -13.9 |

*omitted data because not reliable

Table 3 shows the percentages of medical DRGs on total hospitalisations stratified by surgical OUs.

Table 4 reports age averages of transfused patients, means of RCCs units per patients and cases treated with a single RCCs unit stratified per year stratified by hospital departments during 2009-2013 period.

An analysis of more frequent surgeries in the hospital showed a diminution of heart surgery interventions from 774 in 2010 to 647 in 2013 (-16%). Regards to the typologies of the more frequent ones, aortocoronary bypasses (CABs) and CABs with surgical aortic valve
Figure 1: Red cell concentrates (RCCs) stratified by hospital departments during 2009-2013 period.

Figure 2: Hospitalisations per year stratified by hospital departments during 2009-2013 period.
replacements (AVRs) was abated respectively from 201 to 177 and from 64 to 44, AVRs and heart transplants incremented respectively from 41 to 83 and from 0 to 23. Also global orthopaedics interventions decremented from 3.261 in 2010 to 2.397 in 2013: neurolysises of the median were reduced from 463 to 370 while plate and screw osteosynthesises and intramedullary osteosynthesises increased respectively from 0 to 313 and from 94 to 172.

During the period 2008 to 2013, the transfusion department, coordinated by “good blood use” Committee wrote and implemented eleven guidelines about PBM.

**Discussion**

This study represents the first Italian attempt to analyse reasons of recent reduction in blood use in a hospital setting. Results showed a decrease of consumed RCCs units in accordance with regional and national data and also with international ones [1,6,13,14]. Between 2014 and 2009 the diminution of consumed RCCs units was of 17%,
while between 2012 and 2013 was of (5.9%), higher than global regional value of (5.5%) [13]. Also in 2014 blood consumptions were abated but with a percentage of (2.3%), half of the previous year.

Over the years general surgery department kept the first place regards to RCCs consumptions followed by internal medicine OUs. A special mention should be addressed to cardiothoracic department. In fact, in 2009 and 2010 it was 17% of the global hospital one and then it decremented to 15%. Cardiothoracic surgery areas contributed significantly to global hospital reduction in the RCCs use. This trend was in part due to a decrease of surgeries (-16%), but on the other hand it was in agreement with the Transfusion Requirements After Cardiac Surgery (TRACS) that had recently demonstrated the safety of a restrictive strategy of transfusion compared with a liberal strategy in patients undergoing elective cardiac surgery [15]. The appropriate use of blood was also confirmed by the statistically significant diminution in the consumptions of RCCs units per patient over the years (from 5 to 3.6) while typology of cardiac interventions became more complex. In fact heart transplants and AVR's increased at the detriment of CABs. Also in orthopaedics surgery the more complexity became more complex. In fact heart transplants and AVRs increased at the detriment of CABs. Also in orthopaedics the more complexity of surgeries increased, such as plate and screw osteosynthesises and intramedullary osteosynthesises incremented.

In the anaesthetic area the abatement in blood use could be due to the application of the international guidelines for transfusions in trauma patients [16]. The hypothesis can be confirmed by the fact that the volume of admissions in the anaesthesia department was maintained during the years and, at the same time, the hospital represented the hub for traumatic pathology in FVG region.

In the medicine department an important aspect was the possible correlation between RCCs consumptions and the volumes of UAs from the first aid. The trend during the considered period was fluctuating. In fact between 2009 and 2010 there was a decrement in UAs of 4%, in the following years the absolute number of them remained constant, while the fraction of UAs on the global hospital admissions incremented from 45% in 2009 to 48% in 2013. One third of the UAs resulted in a hospitalisation. In an internal medicine OUs. A consideration about this trend is that the hospital represented a point of regional reference for acute internistic illnesses instead of planned interventions or of high specialty performances. The hypothesis was confirmed by the percentage of patients with a medical DRGs discharged by surgical OUs. The overall hospital value was of 30% with a range from 13% in cardiac surgery OU to 64% in maxillofacial surgery OU.

This study also showed that the global reduction in blood utilisation occurred with a concurrent statistical significant decrease of the wide hospital activity. A detailed analysis showed an important diminution of discharges (10,2%) and a lower abatement of surgeries (6,7%). The decrement of hospitalisations and surgical interventions, stratified by hospital departments, kept pace with the reduction in blood consumptions of each one. The decrease in hospitalisations during the years could be correlated with regional and national policies that aimed to diminish hospital patients' admissions by using other health settings (i.e. Day Hospital, long-term health facilities, outpatient services). The abatement of surgeries could be explain by the introduction of alternative therapies to surgery, the spread of cancer screening, the rationalisation of resources use and the hospital turnover of surgeons with different expertise in blood use during interventions.

Incremented consumptions in blood use were observed for the department of surgical specialties, neuroscience and oncology, but consumed RCCs units were few. Therefore the increase could be due to the management of single cases required a large amount of blood.

The mean of RCCs transfusions units per patients was evaluated for the major RCCs consumers. The higher decrement in the average number of RCCs units per patient were recorded in cardiac surgery and in haematology. The percentages of patients transfused with a single unit of RCCs incremented in the years even if the absolute numbers were stable. The World Health Organization strongly discourages single unit transfusions in adults and many countries regarded them as a bad practice [17,18].

| YEAR | 2009 | 2010 | 2011 | 2012 | 2013 |
|------|------|------|------|------|------|
| **Hearth Surgery** | | | | | |
| RCCs units per patient mean (SD) | 5.0 (5.6) | 4.6 (4.5) | 4.4 (4.4) | 4.1 (4.6) | 3.6 (3.1) |
| Cases transfused with a single unit of RCCs [% (n)] | 9.8 (47/477) | 11.2 (56/498) | 9.1 (40/438) | 15.2 (66/435) | 14.3 (50/350) |
| Patients' age mean (SD) | 72.6 (9.2) | 70.1 (10.7) | 70.3 (11.2) | 71.7 (10.4) | 67.0 (11.6) |
| **Orthopaedics** | | | | | |
| RCCs units per patient mean (SD) | 2.9 (1.5) | 2.9 (1.7) | 2.9 (2.2) | 3.1 (1.9) | 3.0 (2.0) |
| Cases transfused with a single unit of RCCs [% (n)] | 3.0 (11/380) | 4.4 (16/361) | 4.4 (14/316) | 2.9 (10/347) | 4.5 (16/358) |
| Patients' age mean (SD) | 80.8 (13.4) | 79.3 (14.1) | 77.7 (15.7) | 79.5 (14.5) | 76.3 (13.5) |
| **Haematology** | | | | | |
| RCCs units per patient mean (SD) | 11.6 (12.2) | 10.2 (9.4) | 11.8 (13.2) | 9.4 (10.6) | 8.8 (9.7) |
| Cases transfused with a single unit of RCCs [% (n)] | 6.9 (11/160) | 13.7 (25/182) | 9.0 (17/168) | 17.1 (36/210) | 14.8 (29/196) |
| Patients' age mean (SD) | 56.9 (12.8) | 54.3 (15.0) | 56.7 (14.7) | 56.3 (14.9) | 53.4 (14.2) |
| **First Aid** | | | | | |
| RCCs units per patient mean (SD) | 3.9 (7.3) | 4.6 (9.7) | 4.1 (7.8) | 4.1 (7.3) | 4.2 (7.7) |
| Cases transfused with a single unit of RCCs [% (n)] | 9.1 (32/353) | 5.1 (16/353) | 9.4 (31/328) | 10.6 (31/292) | 14.1 (39/276) |
| Patients' age mean (SD) | 75 (13.7) | 72.3 (16.8) | 71.8 (17.7) | 69.5 (17.8) | 70.2 (15.3) |
| **Transfusional Medicine** | | | | | |
| RCCs units per patient mean (SD) | 9.9 (14.1) | 8.4 (13.2) | 10.6 (14.6) | 9.7 (12.8) | 10.5 (16.4) |
| Cases transfused with a single unit of RCCs [% (n)] | 4.8 (5/103) | 10.7 (11/103) | 6.7 (7/104) | 4.4 (5/114) | 4.0 (4/100) |
| Patients' age mean (SD) | 78.8 (11.6) | 76.6 (12.6) | 76.9 (11.4) | 76.4 (12.8) | 74.8 (12.2) |

*p* standard deviation; † p<0.01; § p < 0.05

**Table 4:** Red cell concentrates (RCCs) units per patient, cases transfused with a single unit of RCCs and average patients' age in the five major blood consumers during 2009-2013 period.
A result of this study in contrast with literature, reported that elderly patients are transfused at higher rates than younger patients, was the significant statistically reduction of average age of transfused patients especially in heart surgery (from 73 to 67 years) and in first aid (from 75 to 70 years) [19-21]. Furthermore transfusion guidelines from several national societies emphasized the need to consider the clinical setting and patient symptoms, but none mentioned age as a primary factor to consider [22-24].

The analysis of clinical patient outcomes demonstrated that length of stay, mortality and 30-day readmission rates were stable during the years despite the decrease of RCCs utilisation, while CMI and number of complex interventions with a MSBOS ≥ 4 incremented. This finding was in accordance with clinical recent clinical trials demonstrating that more restrictive transfusion practices were associated with equivalent or improved patient outcomes, when compared to more liberal transfusion practices [15,25-29].

Finally, over the years the transfusion department with the contribution of “good blood use” Committee wrote guidelines and procedures to implement patients’ safety, to limit the exposure to RCCs transfusions (with their inherent risks) and to contain the costs [6,30]. Literature confirmed that mandatory hospital-wide programs to improve transfusion practices should be an effective method leading to success in reducing blood use [31].

In conclusion this study represents a starting point to investigate the reduction of blood use in a hospital setting during a period of five years. The analysis of the data explained the phenomenon by the decrease of hospital activities, in terms of admissions and surgeries, associated to a “good blood use” through implementation of specific guidelines and to application of specific correct procedures especially in cardiothoracic surgery and anesthetic departments.

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