Appropriate Use of Blood Products in Pediatric Patients in a Venezuelan General University Hospital: cross-sectional study.

Arturo José Martí-Carvajal[1], Sergio Raúl Muñoz-Navarro[2], Arturo José Martí-Peña[1], Elisa del Carmen Matheus-Fernández[1], María Carolina Medina-Laurentín[1],

[1]Departmento de Salud Pública, Unidad de Epidemiología Clínica y Centro de Investigaciones Médicas y Biotecnológicas, Universidad de Carabobo, Venezuela;
[2]Unidad de Epidemiología Clínica, Universidad de la Frontera, Temuco, Chile.

Correspondencia: Arturo Martí-Carvajal,

Tel/Fax: +58-241-8712883
E-mail: amarti@uc.edu.ve ; ajmc54@cantv.net

Recibido: junio 2004
Aprobado: febrero 2005

ABSTRACT

Appropriate Use of Blood Products in Pediatric Patients in a Venezuelan General University Hospital: cross-sectional study.

Transfusion is an expensive technology because it is necessary to guarantee its safety in order to reduce the risks of transfusion-transmitted diseases. There is no research on audits of appropriate use of blood products in a pediatric population. Our main objective was to conduct such an audit. A cross-sectional study using the American Association of Blood Bank criteria was conducted. The setting was Ciudad Hospitalaria "Dr. Enrique Tejera", the main public tertiary hospital in Valencia, Venezuela. Data from 404 pediatric patients from the Clinical Medicine and Surgery Departments, Emergency Room, Neonatal Intensive Care, Preterm Room, Non-Sick Neonate Room, and Intensive Care Unit were collected. The main outcome measure was appropriate use of blood products. Prevalence of appropriate use was 60.49% for all departments. Prevalence by department was: 87.8% for Clinical Medicine, 47.4% for Surgery, 65% for Emergency Room, 55.4% for Neonatal Intensive Care, 44.0% for Preterm Room, 51.1% for Non-Sick Neonate Room, and 81.3% for Intensive Care Unit. Prevalence of appropriate use by blood products was: 76% for packed red cell, 83% whole blood, 52.6% for platelets, 38.3% for fresh frozen plasma, and 28.6% for cryoprecipitate. The main conclusions of this study are: 1) the prevalence of appropriate use of blood products was 60.9%; 2) there is a high risk of inappropriate use of platelets, fresh frozen plasma and cryoprecipitate; 3) The Clinical Medicine Department and Intensive Care Unit showed high rates (> 80%) of appropriate use of transfusions.

Key words: Audit, Transfusion, Children, Blood Products.

RESUMEN

Uso apropiado de los componentes sanguíneos en pacientes pediátricos en un hospital universitario venezolano: estudio de corte transversal.

La transfusión es una tecnología asociada con un elevado costo económico; es necesario para garantizar su seguridad para reducir el riesgo de enfermedades asociadas con la transfusión. No existen estudios que hayan evaluado el uso apropiado de los hemoderivados en población pediátrica. El objetivo fue determinar la prevalencia del uso apropiado de hemoderivados en pediatría. Utilizando los criterios de la Asociación Americana de Bancos de Sangre, se realizó un estudio de corte transversal, en la Ciudad Hospitalaria "Dr. Enrique Tejera", principal hospital universitario de Valencia, Venezuela. Se estudiaron pacientes (n = 404) hospitalizados en los servicios de medicina, cirugía, emergencia, recién nacidos enfermos, retén de prematuros y cuidados intensivos. El principal desenlace evaluado fue el uso apropiado de la sangre total y de los componentes sanguíneos. La prevalencia (PV) global del uso apropiado fue 60,49%; por Departamentos fue 87,8% en Medicina, 47,4% en Cirugía, 65% en Emergencia, 55,4% en Recién Nacidos Patológicos, 44% en Retén de Prematuros, 51,1% Retén de Recién Nacidos y 81,3% en Unidad de Cuidados Intensivos. La PV del uso apropiado por hemoderivado fue 76% para concentrado de glóbulos rojos, 83% para sangre total, 52,6% para plaquetas, 38,3% para plasma fresco congelado y 28,6% para crioprecipitado. Las principales conclusiones del estudio son: 1) La prevalencia del uso apropiado de hemoderivado fue 60,9%, 2) Existe alto riesgo de uso inapropiado de concentrado de plaquetas, plasma fresco congelado y crioprecipitado y 3) Los servicios de Medicina y Cuidados Intensivos poseen alta prevalencia (>80%) de uso apropiado de transfusiones.

Palabras clave: Componentes sanguíneos, transfusión, pediatría.

INTRODUCTION

It has been said that "technologies adding costs without a benefit take away from the resources of others in the medical systems"(1). This partly applies to the use of blood products (BP). Transfusion is an expensive technology because it is necessary to guarantee safety in order to reduce the risks of transfusion-transmitted diseases. With the purpose of avoiding the complications of infection, in some parts of the world blood banks perform screening for infective agents, virucidal treatments of blood products during the manufacturing process and white cell depletion(2-3) In Latin America, including Venezuela, such processes are not done. Screening is only one very small part of the total cost which includes donor recruitment, collection, processing and inventory management.

Since blood transfusion is a medical intervention, there is a need for continuous evaluation of the use of hemotherapy, mainly in hospitals where no Transfusion Committee (TC) exists. Moreover, the recognition in the early

1980s that transfusion of blood components carried a risk of HIV infection demanded a reevaluation of the indications and audit of their appropriate use. Based on these facts, we performed a study to determine the prevalence of appropriate use of transfusion in adults (4), which showed a prevalence of 51% of appropriate use. Because of the low prevalence of appropriate use of BP in adults, we decided to perform the same study in children. By the time we finished collecting data for both studies (adults and children), the TC still did not exist.

In this study, we report the results of a cross-sectional study designed to determine the appropriate use of transfusions in different departments of the "Ciudad Hospitalaria Dr. Enrique Tejera" involved with child hospitalization. These results provide an opportunity to improve the use of BP, and to find strategies to achieve such a goal.

MATERIALS AND METHODS

This study was conducted at the "Ciudad Hospitalaria Dr. Enrique Tejera" in Valencia, Venezuela, a 945-bed acute care hospital, out of which 145 beds are for the pediatric population. This hospital is the referral center for a population of 3 million in the North Central Region of Venezuela.

The study included patients from 1 day to 16 years of age from the Pediatric Surgery, and Clinical Medicine departments; Emergency Room, General Newborn Room, Preterm Room, Sick Newborn Room, and Intensive Care Unit. 404 consecutive transfusion requests in a 9-month period starting in September 1999 (1 unit of blood product was considered as one transfusion) were analyzed. A total of 522 transfusions were evaluated in these 404 patients.

A review of the patient's medical history was done for each request for a blood product. This review was carefully carried out by three of the authors (AMP, EMF, CML). Even though the reviewers were using the same methods and criteria, whenever a discrepancy between audit guidelines and reasons for transfusion arose, one of the authors (AM, hematologist) made the final decision. The patient records were analyzed for the following factors: age, sex, current diagnosis, department of hospitalization, type and amount of blood products, and the reasons or stated indications for the transfusion of a blood product. When the reasons for the transfusion were not clear or there was no justification written for the transfusion, it was considered inappropriate. Only the information available on the medical charts was reviewed to determine the appropriateness of the transfusion, but the efficacy of the transfusion therapy was not evaluated

According to Hume et al (5) data about controlled trials on which to base transfusion decisions for pediatric patients are scarce. Appropriate use of blood components was assessed by using the criteria established by the American Association of Blood Bank Pediatric Hemotherapy Committee. (6)

Inappropriate use of a blood product for a particular subject was considered as a violation of the established criteria shown above.

Given a wide variety of definitions of what is an appropriate rate for the use of blood products, in this paper we define a "good" rate as any rate higher than or equal to 80%.

Data Analysis. Means, standard deviations as well as medians (as appropriate) were computed on all continuous variables. Normality of continuous variables was tested using Shapiro´s test. Chi-squares were used to evaluate associations between categorical variables, and Mann-Whitney Wilcoxon test for assessing continuous variables. Kruskal-Wallis procedure was used to compare 3 or more groups with continuous data. Spearman's rank-order correlation coefficient (rho) was used when needed. Logistic regression was used to analyze the association of inappropriateness of transfusion with related factors. The "appropriate transfusion" was considered as the dependent variable, and the independent variables were sex, department and disease.

The Mexican pediatric school criterion was used to describe the variable "age": newborn: <28 days, Lactante Menor: from 28 days to < 12 months old, Lactante Mayor: from 12 to 24 months, Pre-school: 2 to 6 years of age, School ≥ 6 to 10 years of age (female), and to 12 years of age (male). Finally, teen-ager: from 10 to 18 years of age in (female), and from 12 to 18 years of age (male). All P values are two tailed, and 95% confidence intervals (95%CI) are reported. Stata 8.0 (Stata Corp, College Station, Houston, Tx) was used for statistical analysis.

RESULTS

Information regarding the age of patients, in the respective sub-groups, is shown in Table 1.

Table 1. Age of the Patients

Age	n	Mean ± SD	Med	Min	Max
Newborn (days)	182	10.67 ± 6.72	10	1	26
Lactante Menor (month)	63	4 ± 3.51	2	1	12
Lactante Mayor (years)	32	1.82 ± 0.37	2	1.06	3
Pre-school (years)	16	4.25 ± 1.34	4	3	6
School (years)	96	10.9 ± 2.03	11.5	7	14
Teenager (years)	15	15.5 ± 0.51	15	15	16

SD: standard deviation Min: minimum; Max maximum

The distribution of the patients according to hospital department was: Clinical Medicine: 18.32%, Neonatal Intensive Care: 18.32%, Surgery: 14.11%, Preterm Room: 8.91%, General Preterm: 20.79%, Emergency Room: 15.59%, Intensive Care unit: 3.96%. Blood Products were used in the following proportions: packed red cells (PRC): 52.72% (213/404), fresh frozen plasma (FFP): 29.70% (120/404), platelets: 14.11% (57/404), cryoprecipitate: 1.73%

(7/404), Whole blood (WB): 1.49 % (6/404), and clotting factor concentrates: 0.25% (1/404).

The 404 patients received a total of 522 transfusions (median: 1, range: 1 to 10). 86.4% (349/404) of them were transfused only once, 9.9% (40/404) from 2 to 5 times, and 3.7% (15/404) from 6 to 10 times. PRC was the blood component more transfused at a single time: 53% (185/349). On the other hand, platelets and cryoprecipitate were the blood products more transfused in several occasions. Age was directly correlated with the number of transfusions (rho = 0.50, p = 0.0001). Of the patients who were transfused at a single time, 53% (185/349) received PRC, followed by FFP (34.38%), platelets (9.74%), and WB and cryoprecipitate (1.43%), respectively.The Kruskal-Wallis test indicated a statistically significant difference among the departments with respect to number of transfusions. (p = 0.0001).

The overall prevalence of appropriate use of blood products was 60.89% (246/404) for all departments. Appropriateness of the use of blood products is as follows: PRC (76%), WB (83%), platelets (52.63%), FFP (38.33%), and cryoprecipitate (28.57%). It was observed that FFP and cryoprecipitate had a low rate of appropriate use. According to the hospitalization department, the prevalence of appropriate use was: Clinical Medicine (87.8%), Neonatal Intensive Care (54.4), Surgery (43.4%), Preterm Room (44.4%), General Newborn Room (51.2%), Emergency Room (65%), and Intensive Care Unit (81.3%). Appropriateness of the use of blood products by area of hospitalization is shown in Table 2.

Table 2. Appropriate Use by Section and blood components

Area Hospital	Aprop %.	PCR %	FFP %	Pt %	CP %	WB %
Medicine	87.8	93.75	66.6	95.65	100%	-1 -
NIC	54.4	78.25	59.25	-1 -	- 2 -	- 2 -
Surgery	43.4	88.9	10	- 2 -	- 2-	- 2-
Preterm Room	44.4	66.6	23.5	50	- 2-	100
GNBR	51.2	79.3	40	19	- 2-	100
ER	65.0	65	100	100	- 1 -	- 2 -
ICU	81.3	81.25	- 2 -	- 2 -	- 2 -	- 2 -
Overall	60.89	76	38.3	52.6	28.6	83.3

PCR: packed red cells; FFP: fresh frozen plasma; Pt: platelet; CP: Cryoprecipitate ; WB: Whole blood ; NIC: Neonatal Intensive Care; GNBR: General Newborn room; ICU: Intensive Care Unit; Pt: platelet; WB: whole blood; - 1- All uses inappropriate; - 2 - No demand.

CI for the odds ratio of inappropriate use of each blood product showed statistically significant differences (PRC: 0.24, 95%CI=0.15 to 0.37, p = 0.0001; WB: 0.3, 95%CI=0 to 2, p= 0.25; platelets: 1.48, 95%CI=0.84 to 2.59, p=0.15; FFP: 3.83, 95%CI=2.45 to 5.98 , p= 0.0001; cryoprecipitate: 3.98, 95% CI=0.87 to ∞, p= 0.07). Using PRC as the reference group, Confidence Intervals (CIs) for the odds ratio of inappropriate use of blood products are shown in Table 3.

Table 3. Odds of inappropriate use of blood components

Blood component	**OR (95%CI)**	***P***
Packed red cell*	1	
Platelets	2.85 (1.55 - 5.22)	0.0005
Fresh frozen plasma	5.10(3.15 - 8.28)	0.0001
Cryoprecipitate	7.49 (1.7 - ∞)	0.004
Whole Blood	0.53 (0 -4.2)	0.57

**: reference group; OR: Odds Ratio; 95%CI: 95% Confidence Interval*

CIs for the odds ratio of inappropriate use of blood products by department of hospitalization show statistically significant differences; Clinical Medicine was used as the reference group (Table 4).

Table 4 Odds of inappropriate use of blood components by Section

Area of hospitalization	**OR**	***95%CI***	***P***
Medicine*	1		
Neonatal Intensive Care	5.81	2.55 - 13.18	0.0001
Surgery	8.02	3.4 - 18.8	0.0001
Preterm room	9.02	3.5 - 23.23	0.0001
General newborn room	5.88	30.7 - 15.3	0.0001
Emergency	3.87	1.5 - 9.08	0.0015
Intensive care unit	1.55	0.43 - 5.59	0.48

**: reference group; OR: Odds Ratio; 95%CI: 95% Confidence Interval*

CIs for the odds ratio of inappropriate use of blood product for the most frequent diseases are shown in Table 5.

Table 5 Odds of inappropriate use of bloodcomponents by diseases

Disease	n	OR (95%CI)	*P*
Sepsis	115	2.35 (1.51 - 3.55)	0.0001
Intestinal Obstruction	22	5.81 (2.17 - 15.49)	0.0002
Major Trauma	21	0.24 (0.07 - 0.79)	0.01
Esophageal atresia	13	2.57 (0.85 - 7.51)	0.09
Acute leukemia	19	0.08 (0 - 0.48)	0.002
Anemia	25	1.74 (0.79 - 3.85)	0.17
Lymphoma	15	0 (0 - 0.37)	0.0015
Jaundice	16	0.5 (0.15 - 1.5)	0.23
SDH	26	0.57 (0.29 - 1.55)	0.35
Necrotizing Enteritis	16	2 (0.77 - 5.45)	0.15

SDH: superior digestive hemorrhage; OR: Odds Ratio ; 95%CI: 95% Confidence interval

DISCUSSION

This audit of transfusions determined that the prevalence of appropriate use of BP was 61.5 %. Studies similar to this were not available at the time this study was performed. Each blood product will be discussed separately given the variety of reasons for transfusing red blood cells, platelets, FFP and cryoprecipitate, despite the paucity of papers about appropriateness use of transfusion in pediatric population. According to Hume et al(5) most associations, except for the AABB, have developed transfusion guidelines that were not specific to a pediatric population.

Evaluation studies on the appropriate use of blood components in adults exist (4-7), but not with respect to pediatrics. Using combinations of the words: child, children, pediatric, audit, appropriate, blood component, blood products, hemotherapy, transfusion, use, and impact, we found only four papers about

audit of appropriate uses of blood products in pediatric populations in MEDLINE (1966 to May 2004) (8-10)

Red Blood Cell. We found a prevalence of appropriate use of RBC transfusion ranging from 66.6% to 93.75%. Hamoudi et al10 in a study where the authors did not establish criteria for evaluating appropriateness of use of BP, reported 11% inappropriate RBC transfusions, while Hume et al9 reported 80% as appropriate and 6% inappropriate. Hume et al9 developed their criteria from published research. RBC transfusion practice in small premature infants varies among neonatologists (11) Given that the hospital of the study has a postgraduate pediatric school, higher transfusion rates should be expected.

Another explanation for this finding is that in many instances a low hematocrit is used to determine a request for a transfusion of packed red cells. The correct approach is to combine the laboratory criterion and the symptoms of the patient. Yet, the Transfusion Committee in our hospital does not work full time. Grindon et al (12) point out that the presence of a TC assures consultation in hemotherapy: it evaluates the effectiveness of transfusion practices and corrects ineffective practices with blood products.

The practice of neonatal RBC transfusion therapy remains controversial (13) despite considerable amount of published information that should reduce uncertainty. Furthermore, the audit criteria designed from the American Association of Blood Banks (AABB) showed some disagreement in the Hb concentrations suggested as “transfusion triggers”.

According to pre-established criteria, transfusions of PRC in our patients with chronic renal failure were appropriate, but from a risk-benefit point of view, erythropoietin should have been used for managing anemia in these patients (14)

Fresh Frozen Plasma. In their study, Hume et al (9) also found a greater prevalence of inadequate use of FFP (42% appropriate transfusion). In our series, in no case was a prior determination of a patient´s coagulation deficiency made in order to decide the application of FFP. In addition, despite the fact that there is no evidence to justify the use of FFP as a volume expander, we found this as an erroneous indication. This reflects little knowledge about the rational use of this blood product, since FFP has risks and the use as volume expander is contraindicated in children.(15) In a report by Hume et al5, pediatric transfusion practice “at least in the 1980’s was often inappropriate”. The use of FFP in neonatal sepsis in the absence of disseminated intravascular coagulation is an indication of unproven benefit under investigation; however, in our study this disorder has a high risk for inappropriate transfusion. Drastic reduction in the use of total blood has been reported as the origin of inappropriate use of FFP.(16)

Platelets According to preset criteria, this study showed, for all services, a low prevalence of appropriate use of platelets, mainly in general newborn and neonatal intensive care. In Malaysia, Jamal et al also found a low incidence of appropriate platelet transfusions (18.5%).(17) Cahill and Lilleyman (18) suggest that, for children with nonmalignant disease, platelet transfusion must be done on a “case-by-case” basis, when clinically significant bleeding is

present. Bone marrow failure (e.g., aplastic anemia, as a result of chemotherapy) is the main indication for platelet transfusion (19) There is a narrative review regarding pediatric transfusion therapy(20) however, at least in the pediatric population, there are no controlled trials of platelet transfusion to practice evidence-based transfusion.

From the results of a study on efficiency of blood usage for elective surgery, Lim et al (8) suggest that the improvement of efficiency of blood utilization include the introduction and ongoing monitoring of guidelines. Moreover, studying evidence, guidelines and practice related to perioperative red-cell transfusion, McClelland (21), based on the paucity of evidence about the influence of anemia and transfusion on outcomes for the surgical patient, suggested the possibility of developing a general consensus about many aspects of management. This should be linked with randomized controlled trials. In the same way, strategies such as a "single and simple transfusion request sheet"(22), pospective monitoring of request form"(23), and the use of a quality assurance program 4-25) have been proposed with the purpose of increasing the rate of appropriate use of blood components.

We believe that this study could have had two limitations, and therefore its results must be interpreted taking such limitations into account. First, defining the rate of appropriate use is controversial for the reasons mentioned in the material and method section. Therefore, the inappropriate rate may be overestimated. Secondly, there is a likely bias in the process of data gathering, since we used a retrospective review. It was easy to determine the wrong reasons to explain inappropriate use. But, in many cases, the reasons to decide on the transfusion were not clearly defined in the medical chart. However, in our hospital this is the first time that an audit of blood products in a pediatric population has been carried out; thus, these results represent the starting point for an improvement of this medical technology. The implications of this study are the need to design an educational program about appropriate use of blood products and to encourage the continuing work of a TC.

According to Brand (26) in many cases blood transfusion remains as an experimental intervention with respect to the benefit / risk balance. So this author makes emphasis on the fact that there are differences in liability and responsibilities between transfusion providers and transfusion prescribers; consequently, transfusion providers associated with the hospital Transfusion Committee must design, conduct and monitor clinical audits using guidelines for pediatric transfusion. In others words, the Hospital has the obligation of conducting blood banking practices, and the right to do it for the protection of the patient.

In summary, educational programs addressing appropriate use of blood products should be continued in our hospital. Any efforts to change patterns of use of BP must be encouraged.

Acknowledgments: We thank peer-reviewers for helpful comments.
Conflicts of interest: None

References

1.- Fleisher LA, Mantha S, Roizen MF. Medical technology assessment: an overview. Anest Analg 1998;87:1271-1282.

2.- King DJ. Transfusion and the use of blood products. Baillieres Clin Haematol 1991;4:545-569.

3.- Luban NL. An updated on transfusion-transmitted viruses. Curr Opin Pediatr 1998;10:53-59.

4.- Martí –Carvajal AJ, Muñoz-Navarro SR, Peña-Marti GE, Comunian G. An audit of appropriate use of blood products in adult patients in a Venezuelan general university hospital. Intern J Qual Health Care 1999;11:391-395.

5.- Hume HA, Kronick JB, Blanchette VS. Review of the literature on allogeneic red blood cell and plasma transfusions in children. Can Med Assoc J 1997;156(11 suppl):S41-S49.

6.- Strauss R, Blanchette VS, Hume H, Levy GJ, Scholz L, Blazina JF, Werener AL, Sotelo-Avila C, Barraso C, Hines D. National acceptability of American Association of Blood Bank Pediatric Hemotherapy Committee guidelines for auditing pediatric transfusion practices. Transfusion 1993; 33:168-171.

7.- Hasley PB, Lave JR, Kapoor WN. The necessary and the unnecessary transfusion: a critical review of reported appropriateness rates and criteria for red cell transfusion. Transfusion 1994;34:110-115.

8.- Lim EJ, López CG, Veera SN, Menaka N, Aminah A. Efficiency of blood usage for elective surgery in the University Hospital Kuala Lumpur. Malays J Pathol 1996;18:107-112.

9.- Hume HA, Ali AM, Decary F, Blajchman MA. Evaluation of pediatric transfusion practice using criteria maps. Transfusion 1991;31:52-58.

10.- Hamoudi AC, Cecalupo AJ, Wolf ML, Coe SA, Menke JA. The use of LIS for blood usage review: experience in a children´s hospital. Am J Clin Pathol 1991;95:389-392.

11.- Strauss RG. Practical issues in neonatal transfusion practice. Am J Clin Pathol 1997;107 (4 Suppl 1):S57-63.

12.- Grindon AJ, Tomasulo PS, Bergin JJ, Klein HG, Miller JD, Mintz PD. The Hospital Transfusion Committee. Guidelines for improving practice. JAMA 1985;253:540-543.

13.- Strauss RG. Data-driven blood banking practices for neonatal RBC transfusions. Transfusion 2000;40:1528-1540.

14.- Brandt JR, Avner ED, Kickman RO, Watkins SL. Safety and efficacy of erythropoietin in children with chronic renal failure. Pediatric Nephrol 1999;13:143-147.

15.- Chalmers EA, Gibson BES. Clinical aspects of paediatric and perinatal transfusion: plasma products. Vox Sang 1994;67(suppl 5):54-58.

16.- Blumberg N, Laczin J, Mellican A, Heal J, Arvan D. A critical survey of fresh-frozen plasma use. Transfusion 1986;26: 511-513.

17.- Jamal R, Hoe TS, Ong LC, Afifah I, Khuzaiah R, Doraisamy G. A clinical audit on the practice of platelet transfusions at a tertiary paediatric referral centre. Malays J Pathol. 1998;20:35-40.

18.- Cahill MR, Lilleyman JS. The rational use of platelet transfusions in children. Semin Thromb Hemost 1998; 24:567-575.

19.- Davies SC, Kinsey SE. Clinical aspects of paediatric blood transfusion: cellular components. Vox Sang 1994;67(suppl 5): 50-53.

20.- Kulkarni R, Gera R. Pediatric transfusion therapy: practical considerations. Indian J Pediatr 1999;66:307-317.

21.- McClelland B. Perioperative red cell transfusion: evidence, guidelines and practice. Vox Sang 1998;74 Suppl 2: 3-10.

22.- Rehm JP, Otto PS, West WW, Grange JJ, Halloran BG, Lynch TG, Baxter BT. Hospital-wide educational program decreases red blood cell transfusions. J Surg Res 1998;75;183-186.

23.- Tuckfield A, Haeusler MN, Grigg AP, Metz J. Reduction of inappropriate use of blood products by prospective monitoring of transfusion request forms. Med J Aut 1997;167;473-476.

24.- Joshi G, Mc Carroll M, O´Rourke P, Coffey F. Role of quality assessment in improving red blood cell transfusion practice. Ir J Med Sci 1997;166:16-19.

25.- Marconi M, Almini D, Pizzi MN, Riccardi D, Bergamaschi W, Giovanetti AM, Rebulla P, Sirchia G. Quality assurance of clinical transfusion practice by implementation of the privilege of blood prescription and computerized prospective audit of blood request. Transfus Med 1996;6:11-19.

26.- Brand A. Immunological aspects of blood transfusions. Blood Rev 2000;14:130-144