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Assessment of transfusion practices in pediatrics: A case report

Lemssahli Ilham, Belmekki Abdelkader

ABSTRACT

Introduction: Pediatric patients should not be exposed to blood components and products unnecessarily. Transfusion-related risks are always present, both those we know and those that remain to be discovered. It is essential to follow good transfusion practice (GTP) procedures; although they can sometimes be quite prescriptive, evidence shows that when we ignore guidelines, errors can occur.

Case Report: We report the case of a 7-month-old infant who underwent surgery for megacolon and received emergency transfusions. The death of the infant post-surgery prompted a hemovigilance investigation to determine the imputability of the transfusion.

Conclusion: The investigation revealed deficiencies in the patient's transfusion management, some of which were critical. This indicates that nurses have a considerable knowledge deficit in blood transfusion; however, the infant's death was not attributable to transfusion and was due to post-surgical complications.

Keywords: Good transfusion practice, Nurses, Pediatric

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Lemssahli Ilham[1,2], Belmekki Abdelkader[2]

Affiliations: [1]Regional Blood Transfusion Centre – Rabat, Madinat Al Irfane, Avenue Allal Al Fassi, Rue Mfdel Charkaoui Institute, Rabat 10000, Morocco; [2]Faculty of Medicine and Pharmacy, Med V University, Rabat, Av. Mohamed Belarbi El Alaoui B.P: 6203, Rabat Institute, Morocco.

Corresponding Author: Ilham Lemssahli, MD, PhD in process in Health Sciences; Responsible for Hemovigilance in Regional Blood Transfusion Centre – Rabat, Morocco; Email: lem.ilham@hotmail.fr

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INTRODUCTION

Pediatric patients should not be exposed to blood components and products unnecessarily. Transfusion-related risks are always present, both those we know and those that remain to be discovered [1].

It is essential to check the most recent hemoglobin result and assess the patient for signs of anemia.

If the patient is not actively bleeding, then he/she does not have an infection and is hemodynamically stable, the patient should be protected. The use of blood requires a conservative approach as the safest transfusion is the one that is not given. It is essential to follow (GTP) procedures; although they can sometimes be quite prescriptive, evidence shows that when we ignore guidelines, errors can occur [2].

We report the case of a 7-month-old infant who underwent surgery for megacolon and received emergency transfusions.

The death of the infant post-surgery prompted a hemovigilance investigation to determine the imputability of the transfusion.

CASE REPORT

A 7-month-old infant was admitted to the pediatric surgical emergency unit for megacolon. The infant's physical examination noted the patient's weight at 6 kg, a distended abdomen (megacolon) and mucocutaneous pallor. His preoperative blood count (Table 1) showed anemia, which the surgical department did not investigate, while the blood ionogram was normal (Table 2).

After surgery, the physician ordered a 20 cc/kg blood transfusion based only on the intensity of the infant's mucocutaneous pallor. Two hours after the transfusion, the infant presented with bloody vomiting related to complications of the surgery. The infant had a blood

pressure of 100/60 mmHg, a heart rate of 170 bpm, and a SpO_2 of 98–100%, a febrile peak of 40°C indicating antibiotic therapy.

We found no report of the surgical procedure in the patient's file. There was a rapid aggravation of the patient's clinical condition, marked by: desaturation, disturbed consciousness, distended abdomen, hemodynamic instability, and unmanageable hypotension.

In the intensive care unit, a second request for red blood cells (RBCs), fresh frozen plasma (FFP), and platelets was made according to the intensity of the pallor, the patient's state of shock, and the inflammation marker: C-reactive protein (CRP) was at 80 mg/L.

The patient was transfused with the second RBC, which was stopped after a transfusion of 80 cc on receipt of the final control blood count (Table 3).

Subsequently, the infant presented with hemodynamic instability, severe metabolic acidosis, a significant decrease in diuresis of 0.4 cc/kg/h, a distended abdomen, bilious gastric stasis, and yellowish liquid stools. The death of the patient occurred in a state of refractory shock.

Table 1: Preoperative check-up blood count

Blood cell count	Result
Hemoglobin	10.2 g/dL
Hematocrit	33.6%
MCV	60.3 µm^3
White blood cells (WBCs)	12,900/µL
Neutrophils	29.6%
Lymphocytes	47.5%
Platelets	490,000/µL

Table 2: Preoperative check-up blood serum ionogram

Blood serum ionogram	Result
NA+	135 meq/L
K+	5.61 meq/L
CL–	109 meq/L
Alkaline reserves	21 meq/L
Urea	0.32 g/L
Creatinine	3.8 mg/L

Table 3: Blood count control

Blood count	Result
Hemoglobin	11.6 g/dL
Hematocrit	37.6%
MCV	73.9 µm^3
White blood cells (WBCs)	14,500/µL
Neutrophils	45.6%
Lymphocytes	50.8%
Monocytes	3%
Platelets	307,000/µL

Hemovigilance survey

As soon as the physician responsible for the transfusion reported the incident, a hemovigilance responsible initiated a survey at the Blood Transfusion Centre (BTC) and the health care establishment (HE).

At the BTC: The consultation of the infant's file on our computer application (ePROGESA) showed that the immuno-hematological analyses were carried out on two samples sent simultaneously as the blood request. Blood grouping of the infant was negative for A RH+/Phenotype C-E-K-, Coombs test (CT), and irregular agglutinin test (IAT), all labile blood products delivered were ISO group, ISO phenotype for both blood requests (Table 4).

The consultation on the compliance of the request for labile blood products revealed shortcomings mainly in the notification of the patient's transfusion history, the transfusion indication, and the date and time of the transfusion.

Table 4: Requested blood products

Requested blood products	Results
Blood request No 1	RBCs: A+/Phenotype: C-E-K-
Blood request No 2	RBCs: A+/Phenotype: C-E-K- Platelets: 1 Platelet concentrate A+ FFP: 1FFP A+

At the level of the health care establishment (HE): The patient's medical dossier was consulted and revealed the following information:

1. The surgical procedure was not traced
2. The infant's blood transfusion took place at night, 4 hours after the delivery of the LBPs; the transfusion was made by a self-pulsed syringe.
3. The LBPs were stored in a household refrigerator containing medicines and food products.
4. The doctor on-call discovered the incident when he was asked to review another patient.
5. Monitoring the infant's hemodynamic status before, during, and after the transfusion was not documented on the patient's file or the monitoring sheet.
6. The pre-transfusion card of the first RBCs was not well done, uninterpretable, and not correctly filled in bag number, name and signature of the operator, time of start, and end of the transfusion. As for the second RBC transfusion, the nurse transfused it without doing the final check at the patient's bed.
7. An unjustified second transfusion was decided and started despite the patient's febrile state (patient's temperature at 40°C).
8. The patient's medical file does not contain any information on the transfusion component: the

bar code of the used blood bags. We have not found traceability for the FFP and the platelet: transfused, not transfused, destroyed!

9. The physician has declared a transfusion incident 24 hour after the incident. He did not fill in the incident sheet or send the post-transfusion sample and the offending blood bag.

DISCUSSION

A transfusion is a medical act under the physician's responsibility who prescribed it and by the rules set out in the regulations [3]. The physicians are aware of the contraindications to administration but delegate the execution of the technical acts to nurses due to lack of time and practice [4].

Blood transfusion safety covers all stages from a prescription of immuno-hematological examinations until the completion of the transfusion. The nurses are the final link in the transfusion process. Therefore, the safety and adequate management of transfusion of blood and blood products depend mainly on the knowledge and skills of nurses [4].

They must carry out a series of steps to avoid risks associated with transfusion. Non-compliance with any of these steps may have harmful consequences for the patient. Each of them constitutes a safety lock that medical staff must respect. The four steps that professionals must follow methodically are [5]:

- The request for immuno-hematology tests
- Requesting labile blood products
- The reception of labile blood products
- The transfusion act (the ultimate concordance check, the ultimate compatibility check, the monitoring and traceability of the transfusion)

Our investigation about a case reported revealed several dysfunctions and anomalies, some of which were critical. These dysfunctions concern the transfusion process at different stages, from prescription, ordering of the LBP, administration of the LBP to the traceability of the transfusion act in the patient's file. It would seem appropriate to discuss this transfusion incident by following the chronology of actions.

The prescription of immuno-hemato-logical examinations and the request for LBPs

The patient received labile blood products (LBPs) based on a single blood group determination, which is a significant non-compliance with the regulations in force and the requirements of transfusion safety.

Blood transfusion is regulated by law 03/94 [3] on the donation and use of blood products of human origin. Article 1 of the law identifies the blood group determination conditions:

- On two samples taken 24 hours apart
- With two sets of reagents
- By two different technicians
- By two different techniques

Many surveys and studies have assessed the knowledge of paramedical staff in transfusion, particularly the steps involved in the transfusion process:

A university study [6] reported that out of 86 staff questioned regarding the number of ABO/Rh grouping determinations, 46 (53.5%) responded with two determinations compared to 35 (40.7%) who responded with one decision.

As for the second grouping determination, 40.7% answered that it is done simultaneously as the first, 24.4% responded that it is at a distance from the first, and 25.6% indicated that it is not obligatory.

In a Fruchart et al.'s survey [7] that evaluated the practice of transfusion medicine at four hospital sites [8], 6–16% of respondents performed the second grouping determination.

Michinov et al. report that applying the collection rules will depend on the collection conditions such as emergencies and the patient's venous capital. Thus, compliance with the collection rules is only 56%, while 32% comply sometimes and 11% never. This survey shows that even if caregivers have a favorable attitude toward these rules, there are risks of non-compliance with the collection rules [9].

Transfusion at night

Good transfusion practice only limits transfusions during duty hours, particularly at night, to critical emergencies [8]. However, the patient was transfused late when the optimal safety conditions were not met. Indeed, there is often only one doctor on duty in the service, and the number of paramedical staff is reduced.

Several studies have shown that the transfusion process cannot be risk-free [8, 10, 11]. Risks are incurred not only for the transfused patient in case of a transfusion incident but also for other patients on the unit when the nurse, often alone at night, is busy with the transfused patient.

There are reduced staff numbers during the night, so any non-essential blood transfusions should be avoided because of the increased risk of errors [12].

Serious hazard of transfusion data has shown that errors cause 87.0% of transfusion events. Most laboratory errors (40%) occur outside regular hours due to human factors that put patient safety at risk [13, 14].

Reduced paramedic staffing at night, long working hours, and multi-tasking have been identified as the main risk factors for errors in the transfusion process [13, 15].

The storage of LBPs in the HE

Preserving the viability of blood products maximizes the effectiveness of the transfusion while minimizing any risk to the patient from functional deterioration or

product contamination. Maintaining an appropriate cold chain at all times preserves the viability of LBPs [2].

Good transfusion practices specify the correct conditions for the temporary storage of LBPs in the care units before transfusion. Red blood cell storage in refrigerators with temperature control systems between 4 and 6°C. Platelets kept at room temperature must be transfused as soon as they are received, and FFP must not exceed 6 hours before transfusion [16].

However, in the reported case, major non-conformities were detected in the storage conditions of the blood products, which could lead to risks of quality deterioration or even bacterial contamination with defective storage conditions, putting the patient's life at risk [17].

During the knowledge assessment surveys, Fruchart et al. [7] reported the storage of platelets in the health care unit is often at 4°C at the same time as the RBCs as for Mayaki et al. [17]; 26.1% considered that a conventional household refrigerator is a place to store whole blood bags. Of the 63.9% who knew the refrigerator specifications, only 20% knew the storage temperature (+2 to +6°C) of RBCs. As for the storage temperature of platelets and FFP, only 11% and 8% of respondents, respectively, knew this storage temperature. Those surveys reveal knowledge gaps in blood transfusion among the caregivers surveyed.

The transfusion act

The final control at the patient's bed and monitoring of transfusion is the last lock-in transfusion safety. It is mandatory before any red cell transfusion. A pre-transfusion control card accompanies each bag of whole blood or red cells. This control consists of a final check at the patient's bed before the transfusion of any blood product, including in emergencies [3]. Three conditions must be respected when carrying out this procedure [18, 19].

- A unit of location is performed at the patient's bed.
- A unit of time, the identification of the recipient and the product is carried out simultaneously.
- A unit of action: the same person executed all checks.

The most common cause of adverse transfusion reactions is patient identification errors [20, 21].

Data from the UK Serious Hazards of Transfusion (SHOT) show that approximately 1 in 13,000 units of blood is administered to the wrong patient, sometimes with fatal outcomes. Incidents of transfusing the wrong blood to the wrong patient are preventable and are always due to human error [22].

The patient's vitals (temperature, pulse, respiration, and blood pressure) should be recorded shortly before transfusion and after the first 15 minutes and compared to baseline values for signs and symptoms of transfusion reaction.

The nurse should observe the flow rate of transfusion and regulate it according to the physician's orders.

It is often in this short period that signs with a potentially profound impact on the patient appear.

The nurse's physical presence at this time for early detection of suspicious signs such as fever, chills, pain, nausea, vomiting, hypotension, or dyspnoea justifies stopping the transfusion [23].

Upon completion of the transfusion, the patient's vital signs (temperature, pulse, respiration, and blood pressure) should be recorded and compared with the previous values [23].

The nurse in charge of transfusion should report to the doctor any abnormality, feeling of discomfort or difficulty in breathing on the patient's part and should stop the transfusion.

However, in this survey, there are enormous deficiencies in the transfusion process; from the final check at the patient's bedside to the follow-up of the patient, the control of the different steps mentioned above was not respected, the nurse did not cross-check patient's identification details with those on the blood bag. No patient's constant check-up before, during, and after the transfusion was mentioned in the patient's file nor on the patient's follow-up sheet.

The transfusion was carried out based on an ultimate control which was poorly done, uninterpretable, not completed and did not include any validation by the doctor on duty, which represents a significant non-compliance. The transfusion of the second RBCs was without any final pre-transfusion control.

The doctor on duty had discovered the incident when the nurse solicited him for another patient. The nurse in charge had explained it by the workload, the lack of staff on duty, the lack of knowledge in blood transfusion, and the lack of practical training.

The Mayaki et al. survey reported the same finding; 45% of respondents did not stay at the bedside after initiating a transfusion, explained by lack of time and staff. They also said they used to delegate this task to the person assisting the patient [17].

The survey of Lahlimi et al. has found that 50% of the respondents carry out the final checks on the trolley in the corridor.

42% of them checked the two units of RBCs at the same time and put the second unit in the refrigerator; in case of incompatibility on the ultimate check, only 55% of staff adopted an appropriate attitude while 45% of them interpreted the results and transfused if compatible [24].

Transfusion by syringe infusion pumps (SIPs)

Electronic infusion devices such as syringe infusion pumps (SIPs) have brought innovation to intravenous therapy.

Through rigorous fluid controlling security in pressure and air alarms, a blood administration set incorporating a 170–200 μm filter must be used to infuse blood components through a volumetric infusion pump. As per hospital guidelines, any adverse outcome resulting from

using a pump to transfuse blood must be notified to the appropriate authority [2].

Despite their benefits, the safety of this equipment in blood transfusions remains to be proven [25]; many studies have shown that SIPs can cause red cell damage during blood administration, increasing the rate of hemolysis [26]. According to health service policy, staff using volumetric infusion pumps must demonstrate knowledge and competency in using such pumps. Both pump settings and volume delivered must be monitored hourly throughout the infusion to ensure that the expected volume is delivered [2].

However, the nurse in charge of the infant transfusion revealed a lack of knowledge of this device.

The service concerned could request a pediatric RBCs bag in place of the adult bag. In surgery, for low-weight children, the pediatric preparations of RBCs consist of an aseptic division of a product with an adult unit's characteristics.

The practice of the single-donor protocol, “fresh” RBCs fractionated into pediatric preparations dedicated to the same recipient, has been developed to reduce the transfusion risks of viral contamination. Outside the neonatal period, the main indications are all transfusions of pediatric medical specialities for which the prescribed volume allows the constitution of at least two compliant fractions.

This practice allows sequencing of deliveries at the different surgical stages, per- or post-operative, and secondary intensive care [27].

Traceability and hemovigilance

The person in charge of the transfusion must record every transfusion procedure carried out on the service's transfusion register and the patient's transfusion record. The scope of traceability covers both the BTC and the transfusion service and requires implementing procedures to collect and exchange information throughout the transfusion chain. The objective is to trace the history of the donor and recipient(s) from a donation number while preserving the donor's anonymity and the medical confidentiality of the recipient. The traceability of LBPs is a vital part of transfusion safety. The reporting of Recipient Adverse Reactions (RARs) is an integral part of transfusion safety. It enables the identification of risks related to the transfusion of LBPs and taking corrective measures to control and prevent them [28].

An assessment study of transfusion needs in pediatric hematology-oncology service showed low rate traceability in pediatric service. The return of information on the LBPs transfused in patients concerns only 10% of a total of 3203 LBPs delivered. For adverse reaction reports, the incidence recorded did not exceed 1.31/1000 LBPs, compared to the incidence reported in France. This low rate is due to under-reporting and not decreased RARs [29].

Another retrospective study conducted in the Ibn-Sina Hospital of Rabat showed the average rate of traceability was 13.4% [30].

The study reported that health care staff are not involved and consider traceability to be a workload, an administrative constraint rather than a tool for improving transfusion quality.

CONCLUSION

Our survey specifically concerning the transfusion aspect of the patient revealed several abnormalities in the nurses' transfusion practice in terms of non-compliance with the regulations in force and the negligence of the specificity of this age group. All of these anomalies were due to a lack of knowledge of transfusion. This lack of knowledge suggests the need for an effective communication system, awareness-raising and continuous training, and adequate supervision. Hospitals should develop local transfusion policies based on national guidelines. Ensure that all staff involved in the clinical transfusion process are adequately trained. Transfusion facilities should monitor health care providers through regular audits. Finally, particular attention should be given to blood transfusion in the primary medical curriculum, especially its practical aspect.

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Author Contributions

Lemssahli Ilham – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Belmekki Abdelkader – Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission

The corresponding author is the guarantor of submission.

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Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.