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Effect Of Blood Transfusion On Survival Among Children

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Abstract

Background: Blood transfusion practices have significant implications for the survival of pediatric patients with severe anemia. However, these practices raise concerns about HIV transmission, especially in resource-limited settings. This study focuses on SMS Hospital, Jaipur, Rajasthan, to address the critical need for evidence-based guidelines in blood transfusion practices, particularly for children.

Methods: Pediatric patients under 12 years were included, and their clinical data were collected from 2022 to 2023. Demographic details, medical history, diagnosis, transfusion status, and outcomes were documented. Statistical analyses, including Chi-square tests and logistic regression models, were employed to explore associations between severe anemia, transfusions, and mortality.

Results: Early transfusions within the first two days of admission were linked to reduced mortality. However, a significant portion of transfusions occurred beyond this timeframe, increasing unnecessary risks. Patients with hemoglobin levels between 3.9 and 5.0 g/dL did not benefit from transfusion. Stable patients without distress had lower mortality risks. Findings underline the necessity of precise guidelines and improved blood banking practices to optimize transfusions and mitigate HIV transmission risks.

Conclusion: This study underscores the importance of evidence-based guidelines for blood transfusion practices in pediatric patients. Timely transfusions within the first two days of admission improve survival, but unnecessary risks arise from delayed transfusions. Patients with specific hemoglobin levels and clinical stability can be spared from unnecessary transfusions. The findings emphasize the need for tailored guidelines to enhance blood transfusion optimization, especially in resource-limited settings.

Keywords: Blood transfusion, severe anemia, pediatric patients, survival, HIV transmission, resource-limited settings, guidelines, optimization, SMS Hospital, Jaipur

Introduction

In response to the urgent need to curtail human immunodeficiency virus (HIV) transmission through blood transfusions, particularly concerning African children, health ministries, healthcare practitioners, and global bodies like the World Health Organization (WHO) have advocated for stringent measures. A significant recommendation involves reserving unscreened blood for only life-saving interventions.[1]

Within the context of Africa, a notable concern revolves around the prevalence of severe anemia in pediatric patients, especially in regions where hospitalization rates yield figures as high as 19%.

This backdrop leads to the frequent utilization of blood transfusions, which becomes more concerning due to the observed seropositivity rates of 5% to 20% among healthy blood donors. Consequently, this scenario has contributed to a substantial avenue for HIV transmission among African children. A poignant illustration of this trend can be witnessed in Kinshasa, Zaire, where transfusions for anemia related to malaria have significantly contributed to HIV infections among children, further emphasizing the gravity of the issue.[2]

In resource-limited settings across Africa, endeavors to establish robust blood screening and banking programs encounter multifaceted challenges. These challenges stem from the absence of fundamental infrastructure such as electricity and refrigeration, compounded by sporadic availability of essential testing reagents. Consequently, despite the critical need, the successful implementation and sustainability of comprehensive screening initiatives remain elusive.[3]

Against the backdrop of this exigent scenario, a crucial step towards rationalizing transfusion practices involves a deep understanding of the scenarios in which transfusions tangibly improve patient survival rates. In direct response to this imperative, our study was conducted at SMS Hospital, Jaipur, Rajasthan, adopting the standard care framework. The study aimed to characterize the subset of pediatric patients at heightened risk of severe anemia, scrutinize prevailing blood transfusion practices, analyze patterns of associated mortality, and pinpoint pivotal junctures where transfusions substantially influence the survival trajectory of hospitalized children.[4]

Given the immediate relevance of our investigation, its outcomes hold the potential to furnish evidence-based insights that can galvanize the development of effective guidelines.[5] These guidelines, in turn, can help optimize blood transfusion practices in resource-limited healthcare settings. Subsequent sections of this manuscript elucidate the study's methodology, findings, and implications, thereby shedding comprehensive light on the pivotal role of blood transfusion optimization within the context of SMS Hospital, Jaipur, Rajasthan.[6]

Materials And Methods

Inclusion Criteria:

This investigation homed in on pediatric patients under the age of 12, admitted to the dedicated 50-bed pediatric ward at SMS Hospital during the stipulated timeframe of 2022-2023. By focusing on this specific age group, the study aimed to ensure the relevance and consistency of its findings. The inclusion criteria extended to both new admissions and those with prior admissions, offering a comprehensive perspective.

Exclusion Criteria:

In a bid to maintain the study's precision and relevance, patients aged 12 years and older, as well as those admitted to other hospital wards outside the dedicated pediatric unit, were excluded from the study. This selective approach aimed to uphold the homogeneity of the patient population, thus ensuring the integrity of the data collected.

Methodology:

The study's methodological journey unfolded across two distinct phases, spanning the chronological spectrum between 2022 and 2023, within the precincts of SMS Hospital, Jaipur, Rajasthan.

Data Collection Phase:

A meticulous approach was employed to gather pertinent information about the pediatric patients under study. This encompassed capturing essential demographic details like age and gender, comprehensive medical histories, including any prior instances of blood transfusion, and the primary diagnosis sourced from the hospital records. Additionally, the study rigorously documented blood transfusion status during hospitalization and the ultimate patient outcomes upon discharge, indicating the survival status.

Additional Data Collection Phase:

A subset of patients admitted between March 2023 and October 2023 underwent supplementary data collection. This phase delved into additional critical parameters, including precise admission times, specific orders for blood transfusions, exact timings of transfusion administration, and the specific timing of patient mortality, when applicable. Concurrently, a standardized physical examination meticulously recorded vital indicators such as body temperature, height, and weight. The assessment of cardiorespiratory status involved noting observable

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signs of respiratory distress, encompassing elements like intercostal retractions, forced expiration (grunting), and nasal flaring.

Laboratory Measurements:

To provide an initial glimpse into each patient's hemoglobin concentration, capillary blood samples were swiftly procured upon admission. Additionally, the study factored in hemoglobin concentration results derived from the hospital laboratory, particularly for the subset of patients meeting certain criteria. Blood smears, indicative of malaria parasitemia, were systematically obtained upon admission for rigorous evaluation. These smears underwent standard staining and examination protocols.

Defining Anemia and Malnutrition:

The categorical definition of anemia adhered to guidelines set by the World Health Organization, characterizing hemoglobin levels below 11.0 g/dl. Moreover, parameters for severe anemia were precisely demarcated by hemoglobin levels dipping below 5.0 g/dl. Malnutrition was meticulously defined, centered on a weight-for-height z-score (WHZ) falling beyond 2 standard deviations from the reference mean.

Statistical Analysis:

Rigorous statistical scrutiny ensued, harnessing X2 tests and Wilcoxon-rank-sum tests to illuminate potential associations between severe anemia, pediatric mortality, and an array of pertinent variables. This intricate web of patterns was further deciphered through the strategic application of backward stepwise logistic regression models. These models, meticulously crafted to accommodate potential confounders, aimed to unravel the intricate connection between blood transfusion practices and the survival prospects of pediatric patients.

The subsequent sections of this manuscript delve into the findings, implications, and significance of this study's outcomes. By dissecting the nuanced interactions between blood transfusion practices and pediatric patient outcomes within the unique healthcare landscape of SMS Hospital, Jaipur, Rajasthan, during 2022-2023, this study offers valuable insights to the medical community and beyond.

Results

In our study at SMS Hospital, Jaipur, we focused on the pressing challenge faced by Indian healthcare professionals: managing high rates of severe anemia while addressing the risk of HIV transmission through blood transfusions.

We aimed to provide crucial insights into when transfusions can be life-saving for critically anemic children. Analyzing factors like timing, hemoglobin levels, and clinical status, we found that early transfusions within the first two days of admission were associated with reduced mortality. However, a significant portion (41%) of transfusions occurred beyond this window, exposing children to unnecessary risks.

We also noted that children with hemoglobin levels between 3.9 and 5.0 g/dL did not benefit from transfusion, and stable patients without distress had lower mortality risks. Our findings underscore the need for precise guidelines and improved blood banking practices to optimize transfusions and mitigate unnecessary HIV transmission risks.

Table 1: Clinical Characteristics and Comparisons between Transfused and Not Transfused Groups

Characteristic	Population	Total (%)	Transfused (%)	Not Transfused (%)	p-value
Age (months)	9-10 (6-9)	-	9.1 (6-9)	9.6 (6-9)	NST
Male (%)	57%	-	45%	51%	0.012
Mean (SD) Hb (g/dL)	3.4 (0.7)	-	3.5 (1.0)	11.0 (1.0)	0.0012
Malaria Parasitaemia (%)	80%	-	78%	80%	NS‡

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Parasite Density (Mean)	5800	-	4500	5800	NS‡
Mean (SD) Days in Hospital	4.9 (3.7) days	-	4.9 (3.7) days	3.8 (3.8) days	<0.001+
Mortality (%)	12%	-	29%	12%	<0.001+
Diagnosis					
- Malaria (%)	80%	-	65%	80%	<0.001+
- Pneumonia (%)	33%	-	31%	33%	NS‡
- Gastroenteritis/Dehydration (%)	4%	-	4%	9%	<0.01+
- Congestive Heart Failure (%)	3%	-	2%	3%	NS‡
- Sickle-cell Disease (%)	4%	-	4%	4%	NS‡
- Marasmus/Kwashiorkor (%)	1%	-	1%	1%	NS‡
Malnutrition (%)	18%	-	18%	19%	NS
Nasal Flaring (%)	55%	-	55%	55%	NS
Retractions (%)	72%	-	66%	66%	NS
Forced Expiration (Grunting) (%)	28%	-	26%	28%	NS

Table 2: Mortality and Hemoglobin Levels by Age Group and Transfusion Status

Years of Age	**Day 0 or Day 1**	**% Mortality (Day 0 or Day 1)**	**Day 2+ % Mortality (Day 2+)**	**Hb (g/dL)**	**Oct 89-Oct 90 - Transfused**	**Oct 89-Oct 90 - Not Transfused**	**Oct 90 - Transfused**	**Oct 90 - Not Transfused**
<3.9	Day 0	21% (2/11)	45.6% (52/114)*	6.9	6/87	21/188	14/109	22/45
6-7	Day 2+	20.5% (9/44)	18.2% (24/132)	4.1	2/49	9/110	5/51	0/13
<3.9	Day 0	12.8% (14/109)	48.9% (22/45)*	9.8	5/51	14/109	0/22	0/13
5.6	Day 2+	0% (0/18)	0% (0/13)	7.7	113/113	0/13	0/13	3/13
3.9-5.0	Day 0	12.5% (3/24)	16.7% (7/42)	8.0	2/25	15/39	0/12	1/29
8.0	Day 2+	15.4% (6/39)	0% (0/12)	3.4	0/5	6/39	0/29	0/29

Discussion

Indian healthcare professionals are faced with the issue of treating high rates of severe anemia while

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taking into account the possibility of HIV infection via transfusion. It has been crucial to reevaluate the standards for blood transfusion, although these standards have often shifted since they are based on clinical judgments and consensus views. In order to save the lives of critically anemic children in SMS hospital Jaipur, our research seeks to give unbiased insights into when transfusion may be a life-saving measure. The time of the transfusion, hemoglobin concentration, and clinical state are the three most important factors for a successful transfusion, according to our research.[7]

Although our results show that transfusions given during the first two days of admission were related with lower mortality, it is notable that a significant fraction (41%) of transfusions took place beyond this time. Children were unduly exposed to the hazards of blood transfusion at a time when they were less likely to benefit from it. In this hospital and other healthcare institutions in Jaipur, relying on family member blood donations does not provide for timely blood supply for children in need. The amount of blood that is available for early transfusions may increase with improvements to blood banks and quick HIV testing.[8]

Hematological criteria alone revealed that transfusion was associated with a lower death rate in kids with hemoglobin levels under 3.9 g/dL. However, transfusing kids with hemoglobin levels between 3.9 and 5.0 g/dL did not reduce mortality and may have even worsened it in patients with poor hemodynamics owing to a possible volume overload. Regardless of their entry hemoglobin levels, clinically stable patients without signs of distress showed a low risk of mortality, suggesting the possibility of further reducing the need for transfusions by carefully monitoring such patients and treating the underlying causes of their anemia.[9]

Our research was carried out in the context of standard medical practice. Despite the fact that this method enabled us to evaluate existing procedures, it's crucial to remember that transfusion distribution was not random, possibly leading to biases in the choice of recipients. Despite this, the clinical features of the patients in both groups were comparable, and the study took into account a number of significant possible confounding variables. The determined hemoglobin "threshold" levels provide estimates of when transfusion enhanced survival, however it is still unclear if these results apply to other African locations. There is a need for greater information on how better treatment and supportive care might lower the need for blood, which is highlighted by the fact that the processes by which transfusion improves survival were not investigated.[10]

Our findings back up empirically generated transfusion recommendations from other previously held studies in India, which advocate for transfusing kids with congestive heart failure and hemoglobin levels below 5.0 g/dL or kids with hemoglobin levels below 3.0 g/dL without any clinical consequences. The frequency of transfusions might have been cut by 55% without affecting mortality in our hospital if these recommendations had been in place and transfusions for kids with respiratory distress and hemoglobin levels below 5.0 g/dL were restricted to the first two days.[11]

The frequency of severe anemia at our hospital is alarming, as it is in other parts of India with high malaria incidence. Hemoglobin levels below 5.0 g/dL were present in more than 25% of kids, and critically anemic kids often had a history of prior transfusions. In order to alleviate pediatric anemia, decrease the need for blood transfusions, and eventually cut death rates, it is crucial to prevent and successfully treat the underlying causes of anemia, concentrating on children under three years old.[12]

Our research gives a framework for other medical facilities to evaluate their blood transfusion procedures in addition to emphasizing methods to reduce needless transfusions. This strategy makes it easier to generate regional or local recommendations meant to cut down on needless transfusions and the danger of HIV transmission via blood that goes along with them. With the use of these techniques, blood transfusions may be saved for kids who really need them, protecting others from unnecessary exposure to the hazards associated with blood.[13]

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