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Review of neonatal outcomes following new blood transfusion guidelines

A. Urbaniak[1], F. Zulfiqar[1], A. Pavel[1,2], M. Kenosi[1,2]

1. Department of Neonatology, Cork University Maternity Hospital, Cork, Ireland
2. Department of Paediatrics and Child Health, University College Cork, Ireland

Abstract

Aims

To assess adherence to new blood transfusion guidelines in Cork University Maternity Hospital neonatal unit and to compare transfusion practice and outcomes before and after guideline implementation.

Methods

This is a retrospective audit of transfusion practice within the CUMH neonatal unit. Babies who received red cell transfusion over 6 months prior to guideline update (April 2021) and 6 months post update were identified and relevant perinatal data were extracted using electronic health records.

Results

Guideline adherence following implementation was 56.8%. In the pre-update group, there were 26 babies who received red cell transfusion with a total of 73 transfusions given. Post-update there were 22 babies, receiving a total of 37 transfusions. Both groups were similar in terms of gestational age, cord clamping time, maternal age, and parity. The average age at discharge, excluding babies who died, was 91.4 days in the pre-update group and 82.7 in the post-update group, 7 babies (26.9%) died in the pre-update group compared to 1 baby (4.5%) in the post update group.

Conclusion

Since the introduction of neonatal transfusion guidelines in CUMH, there have been fewer red cell transfusions, while the number of babies receiving transfusion remained similar. There was no observable negative effect on outcomes in the post update group.

Introduction

Neonates requiring intensive care, in particular extremely low birth weight (ELBW) infants, often undergo blood transfusion, with more than 90% of ELBW infants receiving at least 1 red

cell transfusion[1]. These babies are often critically ill, with ventilatory support requirement and high blood sampling loss in comparison to their body weight. Red blood cell transfusion is most frequently indicated for correction of anaemia of prematurity and treatment of acute haemorrhagic shock in the context of perinatal blood loss[2]. Risks associated with blood transfusion in the neonatal period include metabolic, immunologic, and infectious complications[3]. Due to small circulating blood volumes in neonates, these patients are at a higher risk of haemodynamic instability4. Studies have also found associations between neonatal red cell transfusions and conditions such as necrotising enterocolitis and bronchopulmonary dysplasia[5, 6]. Careful consideration of risk benefit ratio is required prior to red cell transfusion in the neonatal period, taking into account the baby's clinical condition and laboratory values. Multiple studies investigating high versus low haemoglobin threshold transfusion strategies have been carried out. A 2011 meta-analysis showed no difference in terms of morbidity, mortality and serious developmental impairment between restrictive (low haemoglobin threshold) and liberal (high haemoglobin threshold) approaches. The restrictive approach lead to a decreased rate of transfusions and donor exposure[7].

It has been recommended that all neonatal units have established a locally agreed transfusion protocol. Following such protocols leads to safer, standardised care and fewer transfusions overall. Each case should be considered individually with a senior clinician involved in decision making. The red blood cell transfusion guideline in Cork University Maternity Hospital has been recently updated (April 2021) to include a table of neonatal transfusion thresholds. Prior to this update, decision to transfuse had been made at the clinician's discretion. The purpose and objective of this audit is to assess if current practice is in line with the recent update of recommended haemoglobin thresholds (table 1).

Table 1: Haemoglobin thresholds for red blood cell transfusion in Cork University Maternity Hospital (updated 12/04/21)

	Ventilated	CPAP/O2	SVRA
<1 week	11	10	9
>1 week	10	9	8
>3 weeks	9	8	7

Methods

This audit is a retrospective study of transfusion practice within the CUMH neonatal unit. A list of babies who have received red cell transfusion over six months prior to the update in April 2021 and six months following the update was obtained from Cork University Hospital Blood Transfusion Laboratory. A data collection sheet was used to extract relevant data using

electronic health record, (medical record number, gestational age, sex, diagnosis, age at time of transfusion, haemoglobin level prior to transfusion, respiratory support, number of transfusions required, documented indication for transfusion, cord clamping time, history of maternal bleed, maternal age, maternal gravidity and parity, maternal blood group, delivery type, reason for delivery if preterm). Data on all identified babies was collated and analysed using Microsoft Excel. Adherence was assessed by reviewing the haemoglobin levels recorded immediately prior to transfusion and comparing to guideline values. Neonatal outcomes were assessed using days to discharge or death.

For the purpose of this audit, babies receiving BiPAP respiratory support were classified within the CPAP/O2 subgroup. The audit was approved by the Cork Clinical Research Ethics Committee (CREC).

Results

In the 6 months prior to guideline update there were 26 babies who received red cell transfusion with a total of 73 transfusions given. Post guideline update there were 22 babies, receiving a total of 37 red cell transfusions.

Population differences and similarities

There were 26 babies requiring blood transfusion in the 6 month period prior to transfusion guideline update and 22 babies in the 6 month period following the update (table 2). Both populations were largely made up of premature babies with 77% of babies being less than 32 weeks gestation at birth in the pre-update group and 86.3% in the post-update group. There was a higher proportion of extremely premature babies (<25 weeks gestation at birth) in the pre-update group. There was a similar distribution of cord clamping times between the two groups with approx. 50% of babies having less than 30 seconds of delayed cord clamping time in both groups, suggesting poor condition at time of delivery. Maternal age and parity following delivery was similar between the groups. A maternal antepartum haemorrhage was documented in 5 babies, including 2 placental abruptions, in the pre-update population and in 6 babies, including 1 abruption, in the post-update population.

Table 2: Patient demographics

	Pre – guideline update	Post – guideline update
Total Transfusions	73	37
Total Babies	26	22
Infant sex		
Male	10 (38.5%)	12 (54.5%)

Female	16 (61.5%)	10 (45.5%)
Gest. Age at delivery		
Extreme preterm <25 weeks	12 (46.2%)	5 (22.7%)
Very preterm 25+0 to 31+6	8 (30.8%)	14 (63.6%)
Moderate preterm 32+0 to 33+6	1 (3.8%)	1 (4.5%)
Late preterm 34 to 35+6	3 (11.5%)	1 (4.5%)
Term >36 weeks	2 (7.7%)	1 (4.5%)
Cord Clamping		
<30s	14 (53.8%)	12 (54.5%)
30-59s	5 (19.2%)	2 (9.1%)
60s	7 (26.9%)	8 (36.4%)
Maternal age		
<20	0	0
20-29	8 (30.8%)	5 (22.7%)
30-39	15 (57.7%)	16 (72.7%)
40+	3 (11.5%)	1 (4.5%)
Maternal parity		
1	11 (42.3%)	8 (36.4%)
2	7 (26.9%)	8 (36.4%)
3	7 (26.9%)	5 (22.7%)
>3	1 (3.8%)	1 (4.5%)
Mode of delivery		
Vaginal (SVD/instrumental)	12 (46.2%)	7 (31.8%)
C-section	14 (53.8%)	15 (68.2%)
Days to discharge/transfer		
<30	4 (15.4%)	3 (13.6%)
30-99	5 (19.2%)	10 (45.5%)
100-150	7 (26.9%)	7 (31.8%)
>150	3 (11.5%)	1 (4.5%)
Death	7 (26.9%)	1 (4.5%)

The average age at time of transfusion was 22 days pre-update and 19.7 days post update. Average number of transfusions received, including transfusions received at other centres (babies born in other hospitals and babies transferred to other centres for treatment) prior to final discharge from CUMH was 3.2 prior to guideline update and 2.05 following the update.

The average age at discharge or transfer to local hospital, excluding babies who died, was 91.4 days in the pre-update group and 82.7 in the post-update group.

Table 3: Transfusion guideline adherence

	Pre – update (N=73)	Post-update (N=37)
Guideline adherence	32 (43.8%)*	21 (56.8%)

Table 3 compares adherence to the current neonatal transfusion guidelines before and after the update in April 2021. Due to the data collection methods, these values do not capture babies who did not receive blood transfusion despite meeting transfusion thresholds, therefore, adherence could not be fully assessed, however given the relatively restrictive values within the guideline this cohort is likely to be very small.

*It is important to note that prior to the official update haemoglobin transfusion thresholds were at the leading clinician's discretion, guided by the current practice in CUMH, clinical condition of the baby and values outlined in literature, and there were no strict values to follow within internal CUMH guidelines. The figure of 43.8% refers to babies who received blood transfusion within the haemoglobin parameters of the later proposed guidelines.

Discussion

Since the introduction of internal neonatal transfusion guidelines within Cork University Maternity Hospital, there have been fewer red cell transfusions (73 pre- and 37 post-guideline), while the number of babies who received transfusion remained similar. This reduction in transfusion rate and average number of transfusions per baby did not have any observable negative effects on outcomes. The average length of hospital stay has decreased and there have been fewer neonatal deaths observed in the 6-month period post-update. The results of this study are in line with a 2011 Cochrane systematic review7, which included 5 randomised and quasi-randomised clinical trials comparing low and high haemoglobin thresholds. The haemoglobin thresholds used in the new CUMH guidelines are similar to low (restrictive) thresholds used in these trials. The outcomes considered in the systematic review include death, morbidity and mortality, developmental delay and developmental outcomes as well as days to discharge. The review found restrictive haemoglobin thresholds to be non-inferior to high (liberal) thresholds. The restrictive approach was not seen to reduce the number of babies who received at least one red cell transfusion which was also observed in this audit.

The study design and data availability are this study's main strengths. This is a retrospective cohort study taking into account all babies who have received at least one red cell transfusion

in the studied period, therefore eliminating selection bias. Due to the tracking process involved in blood product transfusion, a reliable record of patients was obtained from the Blood Transfusion Laboratory within Cork University Hospital. The electronic patient record system (Cerner) provided access to patient demographics and clear documentation on oxygen support and haemoglobin levels at time of decision making regarding blood transfusion. The study is limited by small sample size within both groups. A longer observation period including more babies requiring transfusions would be needed to assess if any differences between the two populations were significant. The post update period was affected by the HSE cyber attack, limiting access to electronic data8. Required information on babies transfused during this period was obtained from paper charts, scans of paper documents available on Cerner and discharge summaries. All relevant data was obtained and there is no missing data which could affect results to the best of the authors' knowledge.

In conclusion, the rate of adherence in the 6-month period following guideline introduction was 56.8%, leaving scope for improvement. However, it is important to note that each case should be assessed individually considering the baby's clinical condition, diagnosis, and prognosis as well as laboratory values. The low adherence rate is likely related to the more restrictive values used in the guideline which may have caused substantial clinical anxiety. The results of this study showed no increase in adverse events since guideline introduction and should contribute to increasing adherence among clinicians. All staff working within the NICU setting and involved in decision making around neonatal blood product transfusion should be aware of the availability of internal CUMH transfusion guidelines. The guidelines should be adhered to where possible, taking into account the nuances of each individual case. The guidelines should be revised to include BiPAP ventilation in one of the oxygen support categories. A re-audit of updated guidelines should be carried out to assess for improvement in adherence.

Declarations of Conflicts of Interest:

None declared.

Corresponding author:

Mmoloki Kenosi,
Cork University Maternity Hospital,
Wilton,
Co. Cork,
Ireland
E-Mail: Mmoloki.kenosi@hse.ie.

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