Prevalence of anaemia in patients discharged from the Paediatric Intensive Care Unit

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Minimal fall in haemoglobin post-PICU admission

Anaemia is prevalent in patients who are admitted to the paedaitric intensive care unit (PICU), increases during PICU stay and remains at PICU discharge (Bateman et al 2008; Demaret et al 2017). The adoption of evidence-based restrictive transfusion thresholds of 70g/L in stable PICU patients (Lacroix J et al 2007) has the potential to increase this burden of anaemia at PICU discharge. This may be relevant as a large proportion of children admitted to PICU have a complex chronic or life-limiting condition (Edwards JD et al 2012; Fraser L et al 2018), and have a high risk of anaemia at baseline. In addition, many PICU survivors are discharged with significant disability (Namachivayam P et al 2010): this poses a further risk of developing anaemia (Perenc L et al 2015). Given the association between anaemia and adverse long-term outcomes (Larson et al 2019), it is important to recognise the prevalence of anaemia post-PICU in order to intervene and improve outcomes. One study reports follow-up data from children 6-months post PICU discharge that describes resolution of anaemia, but the numbers studied were small with a low follow-up rate (Ngo et al 2013).

While much of the focus has been on describing the prevalence of anaemia at PICU admission or PICU discharge, it is not known to what extent this persists to hospital discharge. It is possible that a restrictive transfusion strategy may no longer be followed within hospital outside PICU, especially in those children with complex chronic conditions. To explore this, we undertook a single-centre, retrospective observational study of haemoglobin levels (Hb) discharged from a tertiary children's hospital following a PICU admission. We collected data on Hb levels in all patients (0-18 years) admitted to Great Ormond Street Hospital PICU over a 12-month period (1st January 2015 to 31st December 2015) and discharged to a ward within the hospital. These children are more likely to have chronic illness, all needing ongoing tertiary-level specialty care. Data were collected at three time-points – admission to PICU (T1), discharge from PICU (T2) and discharge from hospital (T3). Hb measurements taken closest to these time-points were used (Hb measurements up to 12-hours prior to admission were considered). Anaemia was defined as Hb <2 standard deviations below the age-associated mean according to WHO reference ranges for normal Hb levels (Marks PW, Glader B 2009). The distribution of Hb at the three time-points was compared using the Friedman two-way ANOVA for ranks to account for non-parametric data (following a test for normality using the Shapiro-Wilks test).

Three-hundred and eighty-nine children were admitted to PICU and discharged to a ward within the hospital, with a median age of 14 months (inter-quartile range 1-70 months). Twelve children did not have Hb measurements during PICU – they were excluded from analysis. Overall, 224/377 (59.4%) children had anaemia at T1, compared to 255/377 (67.6%) at T2 and 235/377 (62.3%) at T3. The Hb distribution was significantly different between the time-points following the Friedman two-way ANOVA (p-value=8×10^{-5}) (Figure 1). The median Hb decreased from 106.0g/L (IQR 91.0-127.0) at T1 to 100.0g/L (IQR 90.0-115.0) at T2, but increased to 102.0g/L (IQR 90.0-117.0) at T3 – although statistically significant, the median values are not clinically significantly different.

Anaemia is highly prevalent in PICU in the UK. There is an increase in rates of anaemia between PICU admission and discharge. However, Hb levels do not decrease further prior to hospital discharge in these children, nor is their evidence of a large increase to suggest 'top-up' transfusions post-PICU. This burden of anaemia persists until hospital discharge. We were not able to indicate in this study whether treatable causes of anaemia were appropriately recognized, nor whether treatment of anaemia was effective.

A restrictive transfusion strategy in PICU was adopted based on no difference in PICU outcomes (new or progressive multi-organ dysfunction during PICU stay) compared to a liberal transfusion strategy. With an increasing number of children surviving PICU stay, often with chronic morbidity, it is not known whether a consequence of the restrictive strategy in PICU has a bearing on long-term outcome

in these children. Of note, TRIPICU (3) excluded many children who would be included in our cohort e.g. children with haemato-oncological disease and those post bone-marrow transplant. Several research questions follow, for example: (a) does the anaemia correct over time without affecting longer term health outcomes without any further treatment; (b) if not, can the treatment of anaemia mitigate these risks; and (c) what are the optimal tests to investigate causes for anaemia and guide appropriate treatment in the face of inflammatory illnesses and co-morbidities?

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Figure 1:

The distribution of haemoglobin levels at three time points in children admitted to PICU. Bean-plots showing the distribution of haemoglobin measurements at three defined time-points – PICU admission (T1), PICU discharge (T2) and hospital discharge (T3). A horizontal line in the bean plot denotes a data point, with the width of each line representing the number of data points with the same value. The overall shape of each bean plot represents the shape of the distribution. The horizontal dotted lines represent the median values of haemoglobin at the three time-points (106.0 g/L for T1, 100.0 g/L for T2 and 102.0 g/L for T3).The x-axis shows the time in days starting at the time of admission to PICU. The blue vertical lines represent the median times for the T1, T2 and T3: T1 occurs at 0, T2 at a median of 4.1 days (IQR 2.2, 7.9 days) and T3 at a median of 23 days (IQR 11, 55 days). The bean plots are positioned according to when haemoglobin was measured relative to the three time-points: haemoglobin was measured at a median of 1 hour post admission (IQR 30 min, 3 hours); a median of 22 hours before PICU discharge (IQR 10, 50 hours); and a median of 3 days prior to hospital discharge (IQR 1, 9 days).