Blood component use in critical care in patients with COVID-19 infection: a single-centre experience

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Summary
There has been a significant surge in admissions to critical care during the coronavirus disease 2019 (COVID-19) pandemic. At present, the demands on blood components have not been described. We reviewed their use during the first 6 weeks of the outbreak from 3 March 2020 in a tertiary-level critical care department providing venovenous extracorporeal membrane oxygenation (vv-ECMO). A total of 265 patients were reviewed, with 235 not requiring ECMO and 30 requiring vv-ECMO. In total, 50 patients required blood components during their critical care admission. Red cell concentrates were the most frequently transfused component in COVID-19-infected patients with higher rates of use during vv-ECMO. The use of fresh frozen plasma, cryoprecipitate and platelet transfusions was low in a period prior to the use of convalescent plasma.

Keywords: COVID-19, transfusion, critical care, bleeding.

Since the outbreak of the coronavirus disease 2019 (COVID-19) pandemic, there has been a surge in admissions to intensive care departments. At present it has not been described whether there is an increased blood component requirement in patients with COVID-19 infection. Coagulopathy is present in 20–55% of cases and is related to disease severity and worse survival outcomes.1 Prothrombotic markers, such as fibrinogen and D-dimer, are increased with COVID-19 infection, with an absence of significant rates of disseminated intravascular coagulation (DIC), but higher incidence of thrombosis.2,3

Restrictive transfusion practice of red blood cells in critical care and extracorporeal membrane oxygenation (ECMO) has similar survival outcomes to liberal transfusion practice.4–6 There is concern that COVID-19 infection disproportionately affects the Black, Asian and Minority Ethnic (BAME) population.7 Blood group disparity between donors and recipients in the UK, particularly from different ethnic groups affected by COVID-19, may therefore be a potential issue.8

Our centre provides extensive regional critical care facilities including venovenous ECMO (vv-ECMO). Patients requiring ECMO have increased use of blood components particularly if they bleed.4,9 In anticipation of increased hospitalisations and a decline in blood donation due to social distancing measures, elective major surgery has largely been postponed in accordance with nationwide policy. In the present study, we aimed to evaluate the current blood product usage, the demographics of those requiring blood components and their requirements and indications.

Patients and methods
A prospective database of patients with COVID-19 infection admitted to critical care was reviewed to identify appropriate patients. Dates of inclusion were from 3 March 2020 to 14 April 2020 inclusive. Blood traceability is maintained on WinPath Laboratory Integrated Management System (Chertsey, UK) with transfused blood components identified from this during critical care admissions. Blood components included were red cell concentrate (RCC), platelets, fresh frozen plasma (FFP) and cryoprecipitate. Blood groups were identified from the iSOFT Clinical Manager Electronic Patient Records software (Sydney, Australia). Data were screened on 21 April 2020. Indications for blood component transfusion were evaluated against the National Blood Transfusion Committee (NBTC) Indication Code for Transfusion (June 2016). As transfusion during ECMO is not included in the NBTC policy, a RCC transfusion trigger of haemoglobin <80 g/l is adopted locally. All patients received weight- and renal function dose-adjusted chemical thromboprophylaxis, unless actively bleeding or required therapeutic anticoagulation.
Results

A total of 265 patients were identified for review in the above time period; 30 required the use of vv-ECMO and 235 were admitted to critical care but did not require ECMO support. In all, 17 patients (56\%\text{C}1\text{7}) requiring ECMO used blood components in comparison to 33 patients (14\%\text{C}1\text{4}0\%) not requiring ECMO. The clinical and transfusion details of patients requiring blood components during critical care admission with COVID-19 infection are shown in Table I.

In total, the blood component use over this 6-week period included 204 RCC, 23 platelets, 24 FFP and 10 cryoprecipitate (0\%\text{C}177, 0\%\text{C}109, 0\%\text{C}109 and 0\%\text{C}104 units per patient admission respectively). Of all the patients in critical care with COVID-19 infection, 52 (19\%\text{C}126\%) required \geq 1 unit RCC transfusion, eight (3\%\text{C}10\%) required \geq 1 unit platelets, five (1\%\text{C}19\%) required \geq 1 unit FFP and five (1\%\text{C}19\%) required \geq 1 pooled unit of cryoprecipitate. Table II compares the blood component use by patients requiring ECMO to those who did not. Convalescent plasma was not available at our Centre during the period of review.

The NBTC indications for the blood component transfusions given over the time period are shown in Table III. RCC was the predominant blood component used. There was low use of platelets, FFP and cryoprecipitate in both ECMO and non-ECMO patients. There were three episodes of non-intracranial major haemorrhages (6\% of transfused patients and 1\% of all patients). There was a mean use of 11 units RCC, 4 units FFP and 0.3 pooled unit cryoprecipitate in these patients during the bleeding episodes with no platelets transfused. Two episodes of exchange transfusion occurred for patients with sickle cell disease (each requiring 8 units RCC). The highest utilisation of platelets was in a patient with acute myeloblastic leukaemia who remained severely thrombocytopenic with sepsis following induction chemotherapy (9 units used).

Discussion

Despite the increased demands of healthcare resources at the time of the COVID-19 pandemic, it appears that the infection itself does not cause a significant increase in blood component use in comparison to previous data from critical care.\textsuperscript{11} There was a lack of other blood requirements or presence of allo-antibodies in this cohort. There was a
In comparison with ECMO in critical care prior to the COVID-19 outbreak.\(^1\) Alternative options to RCC transfusion to optimise iron dysregulation due to inflammation may be a potential cause. Although the mechanism of this remains unclear at present, iron dysregulation due to inflammation may be a potential cause. Alternative options to RCC transfusion to optimise patient blood management can be considered, such as intravenous iron and recombinant erythropoietin, but their roles in critical care are not well established.\(^{13,14}\) Concern of the increased thrombotic rates and inflammatory states in COVID-19 infection in this setting may preclude their widespread use.\(^1\)–\(^3,15\)

The use of platelet, FFP and cryoprecipitate transfusions remains low with COVID-19 infection in those who have not had episodes of major haemorrhage. Elevated levels of fibrinogen, factor VIII and platelets are demonstrated in critical illness in COVID-19 infection suggestive of why transfusion triggers for these components were not met in the present patient cohort.\(^1,15\) Given the prothrombotic tendency of COVID-19 infection, unnecessary transfusion of plasma components should be avoided in the absence of bleeding.

A significant decline in blood donation has been shown in China, although initial concerns of this in the UK have been offset by a fall in transfusion rates.\(^{16,17}\) Our present results suggest that blood component usage as a result of COVID-19 infection remains low, with a higher usage in ECMO. Optimisation of patient blood management in the critical care setting is one consideration to assist with potential shortages of blood component provision in the next few months.

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### Conflict of interest

All authors declare no conflict of interest.

### Author contributions

Andrew J. Doyle designed the research study, performed the research, analysed the data and wrote the paper. Anicee Danaee designed the research study, analysed the data and wrote the paper. Charlene I. Furtado performed the research, analysed the data and wrote the paper. Danaee designed the research study, analysed the data and wrote the paper. Andrew Rettter designed the research study, analysed the data and wrote the paper.

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**Table III. Indications for transfusion of each blood component in patients with COVID-19 infection in critical care with and without vv-ECMO.**

| Blood component | No. of units transfused to vv-ECMO patients (n = 33) | No. of units transfused to non-ECMO patients (n = 17) |
|-----------------|-----------------------------------------------|-----------------------------------------------|
| RCC             | 95                                            | 109                                           |
| R1 – Acute bleeding | 33                                               | 12                                             |
| R2 – Hb <70 g/l if stable patient | 11                                               | 55                                             |
| R3 – Hb ≥80 g/l if CVD | 51                                              | 26                                             |
| R6 – Exchange transfusion | 0                                           | 16                                             |
| Plt             | 8                                             | 15                                            |
| P2 – Plt <10–20 × 10^9 l sepsis | 0                                           | 9                                             |
| P3a – Plt <20 × 10^9 l | 0                                           | 1                                             |
| CVC insertion   | P4a – Major haemorrhage | 3                        | 2                                             |
|                 | plt <50 × 10^9/l                               |                                               |
|                 | P5a – DIC pre-procedure or bleeding | 5                        | 3                                             |
| FFP             | 16                                            | 8                                             |
| F1 – Major haemorrhage | 14                                         | 0                                             |
| F2 – INR >1-5 with bleeding | 0                                           | 8                                             |
| F3 – INR >1-5 pre-procedure | 2                                           | 0                                             |
| Cryoprecipitate | 8                                             | 2                                             |
| C1 – Significant bleeding and fibrinogen <1-5 g/l | 8                        | 2                                             |

Hb, haemoglobin; CVD, cardiovascular disease; Plt, platelets; CVC, central venous catheter; DIC, disseminated intravascular coagulation; INR, international normalised ratio.
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