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Original article

Utilisation of emergency blood in a cohort of South African emergency centres with no direct access to a blood bank

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ABSTRACT

Introduction: The transfusion of emergency blood is an essential part of haemostatic resuscitation. Locally, where direct access to a blood bank is limited, emergency blood is stored within emergency centres. It was previously suggested that stored blood provides inadequate volumes compared to what is needed. Minimal data are available regarding indications for emergency blood usage. We aimed to describe the utilisation of emergency blood in selected Cape Town emergency centres.

Materials and methods: A cross-sectional study was carried out at three secondary level emergency centres (no blood bank), and one tertiary centre (with a blood bank). Data from emergency blood recipients were recorded over a three-month study period. Indications for transfusion, number of units and location of transfusion were recorded. Indications and usage location were described in numbers and proportions.

Results: A total of 329 emergency blood units were transfused to 210 patients. Trauma accounted for 39% (n = 81) of cases and other surgical conditions for 22% (n = 47), particularly upper gastrointestinal 11% (n = 24) and perioperative bleeding 8% (n = 16). Medical conditions accounted for 15% (n = 31), with anaemia 13% (n = 27), the most prevalent indication. Gynaecological conditions accounted for 15% (n = 32), mostly ectopic pregnancy 8% (n = 17). The majority of emergency blood, 77% (n = 253) were used in the emergency centres or operating theatres, 6% (n = 21).

Conclusion: Trauma remains a major indication for emergency blood transfusion in this setting. This study questions the use of emergency blood for certain non-urgent diagnoses (i.e. anaemia). Given the scarcity of this resource and limitations to access, appropriate use of emergency blood needs to be better defined locally. Ongoing monitoring of the indications for which emergency blood is used, improved transfusion stewardship and better systems to access emergency blood should be a priority in this setting.

Introduction

The historical and philosophical association between blood and life is borne out in the critical role that blood and blood products currently play in modern haemostatic resuscitation. This holds true irrespective of the setting, whether a high-income, or low- to middle-income country. As always, the difference is availability and access. In sub-Saharan Africa blood donation levels are nearly ten times lower than in more developed regions [1]. Not only that, but blood products are often transfused for the wrong indications, increasing the risk of transfusion-related reactions and depleting already dwindling blood stocks [1]. Emergency blood is a particular problem given the issue of access to a blood bank to obtain it in an emergency in this region. Whereas it goes without saying that nearly all emergency centres in high-income countries will have direct access to a blood bank to obtain emergency blood in an emergency, this is fairly unlikely to be the case in low- and middle-income countries. Despite this, there is a paucity in the literature describing utilisation of emergency blood in this region. We found but one study at a single site that concluded that emergency blood from their blood fridge were inadequate for trauma haemorrhage, and volumes didn't reflect the need for other causes of haemorrhage [2].

In the Cape Town Metropole, public patients undergo their initial resuscitation at emergency centres at five secondary and three tertiary level hospitals. According to the Western Cape Blood Transfusion Service, only the three tertiary hospitals have 24-hour staffed blood banks to provide direct access to emergency blood and other blood products. The remaining hospitals are provided with a modest supply of Group O blood to be transfused as uncrossmatched emergency blood

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until crossmatched blood can be obtained from the nearest blood bank, or the patient is transferred to a facility with a blood bank on site. None of these facilities have direct access to other blood products. Distances to the nearest blood bank vary between 5 and 25 km. A round trip to replenish emergency blood stock can take anything from two to three hours depending on traffic. To accommodate this lack of a 24-hour staffed blood bank, emergency blood is stored in dedicated fridges in strategic areas within these hospitals, typically the emergency centre, labour ward or theatre. These fridges are stocked by the Western Cape Blood Transfusion Service according to predetermined levels of anticipated use (written communication, Western Cape Blood Transfusion Service, 18 September 2014).

At present, emergency blood is transfused at the discretion of the treating physician. There are no formal guidelines directing the use of this resource due to perceived wide variations in local circumstances and patient presentations. While doctors are required to complete request forms for the use of crossmatched blood from the blood bank, the same process is not required for emergency blood. This is mainly because emergency blood is immediately at hand and record keeping is therefore less robust. The result is that whilst blood taken from the fridge for emergencies can usually be traced to whom it was transfused, there are little data on the indications for which emergency blood is being utilised. Without this data it is difficult to define a reference standard regarding its use in emergency situations. There is currently little accountability for inappropriate use, despite the unnecessary risk and cost resulting from uncrossmatched transfusions using emergency Group O blood [3–7].

Understanding the way emergency blood is utilised may provide the first step towards implementing local guidelines and monitoring that will encourage safe and effective use of emergency blood. Our study aimed to address this information gap by describing the utilisation of emergency blood in a cohort of emergency centres in the Cape Town Metropole. The main objective was to determine the indications for which, and locations where emergency blood was transfused from the stock kept at the emergency centres of three secondary level hospitals and one tertiary hospital. Although it is unlikely that this study will improve direct access to blood banks in our setting, it will provide the information required to better manage the limited emergency blood available by improving transfusion stewardship. We hope that this study will prompt emergency centres in other low- and middle-income countries to replicate our simple methodology to the same effect.

Methods

A cross-sectional study was conducted from 1 August 2016 to 31 October 2016. Ethics approval was obtained from the Stellenbosch University Health Research Ethics Committee and additional permission to collect data at the specific study sites was obtained from the Western Cape Provincial Health Research Committee. Data from the blood bank at Groote Schuur Hospital was supplied with the consent of the Western Province Blood Transfusion Service. Individual staff or patient consent was not a requirement for the ethics approval.

The setting included the three public secondary level hospitals in the Cape Town Metro West drainage area; New Somerset Hospital (site A), Mitchells Plain Hospital (site B) and Victoria Hospital (site C) and the tertiary Groote Schuur Hospital (site D). These hospitals serve the western part of the city of Cape Town as well as some of the surrounding suburbs and informal settlements. Private hospitals in this area were not included as we specifically wanted to describe the public setting perspective.

Subjects included from sites A to C were patients that were administered emergency blood from a blood fridge located in the emergency centre, whilst subjects included from the tertiary hospital, site D, were patients that were administered emergency blood from an onsite, 24-hour staffed blood bank. Site A has a blood fridge in the emergency centre and labour ward; site B has a blood fridge in the emergency centre, labour ward and theatre; and site C has a blood fridge in the emergency centre only. As the study was emergency centre focussed, data from the labour ward or theatre were not collected, unless patients in labour ward or theatre required blood from the emergency centre fridge. The converse, that blood from the labour ward or theatre be used for a patient in the emergency centre, is not practised at any of the enrolled facilities. Site D differs from the other sites in so far it does not have a single emergency centre model, but receives and stabilises patients in several separate areas (trauma, non-trauma, etc.). None of these areas makes use of the blood fridge model. The blood bank at site D supplies all three of these hospitals of emergency blood. Site A is 8 km away, site B is 21 km away and site C is 11 km away.

Data were collected at sites A to C by means of study registers which were created de novo for the study by the study team. During the study, these study registers replaced the regular registers used to capture emergency blood usage details. After the study, the study registers became part of the emergency blood usage record kept at respective study sites. Variables collected in addition to patient information included the indication for which blood was transfused, the location of the patient at the time the transfusion was initiated and the number of units transfused. Staff were familiarised with the correct use of the registers and regular follow-up telephone calls and site visits were used to encourage compliance in data collection. Incomplete data were supplemented from patients' electronic hospital records. Conversely, at the tertiary hospital blood is obtained directly from the blood bank, making the same strategy impractical. The blood bank provided records of all emergency blood issued during the study period and included the same variables as for secondary hospitals, except for the indication which is not captured in their records. To obtain the indication for which the emergency blood was required, patients' electronic hospital records were reviewed.

Data were captured in Excel 2013 spreadsheets (Microsoft Office, Redmond, USA) and were analysed using Stata version 14 (StataCorp LLC, College Station, USA). Demographic details were calculated for the study population as a whole. Age was calculated as a mean with standard deviation and gender was directly compared. A transfusion episode was defined as a discrete clinical event or presentation for which a participant was transfused emergency blood. This may have included multiple units of emergency blood. In rare cases where a single participant had more than one separate transfusion episode during the study period, these were counted separately. ICD-10 codes were not used to describe indications as these were generally not available to the staff completing the study register at the time of transfusion. Indications were divided into the categories trauma, surgical, gynaecological, obstetric and medical, with each category containing further subcategories to better describe the sample. The number of transfusion episodes was calculated for each indication, and for the categories these were divided into. The number of units of emergency blood was also calculated for each indication, as were the mean number of units per transfusion episode for each indication.

Given the small numbers a measure of spread was not calculated. The total number of units per hospital location was calculated, to reflect where in the hospital the emergency transfusions are being initiated. Finally, to reflect differences between the various hospitals, the frequency of transfusion for the major indications at each site were individually calculated and represented as a bar chart.

Results

A total of 329 units of emergency blood were transfused to 210 patients over the three month study period. Of these, 141 transfusion episodes occurred at the secondary hospitals: site A n = 53 (25%), site B n = 70 (33%), site C n = 18 (9%), and the tertiary site, site D n = 69 (33%). Age and gender data for each indication category group are reflected in Table 1. The indications for which emergency blood was transfused as well as the volumes are presented in Table 2.

Table 1
Age and gender for each category of indications.

	Mean age in years (SD)	Male n (%)	Female n (%)
Trauma	33 (13,8)	69 (85)	12 (15)
Surgical	56 (16,8)	29 (62)	18 (38)
Gynaecology	29 (6,7)	n/a	32 (100)
Obstetric	29 (7,3)	n/a	10 (100)
Medical	44 (21,8)	16 (52)	15 (48)
Unknown	53 (17,1)	3 (38)	5 (62)

SD, Standard deviation.

At site A, 74 units of blood were used: 47 (64%) were used in the emergency centre, 15 (20%) in theatre, 5 (7%) in the surgical ward, 3 (4%) in the labour ward and one unit in the medical, paediatric, gynaecology and ICU wards each. At site B, 89 units of blood were used: all blood dispensed from the emergency centre blood fridge was used in the emergency centre. At site C, 23 units of blood were used: 17 (74%) were used in the emergency centre, 5 (22%) in theatre and 1 (4%) in the surgical ward. At site D, 143 units of emergency issue blood were issued from the blood bank: 100 (70%) were used in the trauma centre, 15 (11%) in the labour wards, 10 (7%) in the surgical wards and 18 (12%) in a number of unspecified general wards (Fig. 1).

Discussion

In keeping with the existing literature, trauma was the major indication for the use of emergency blood both in the secondary level emergency centres and in the tertiary hospital [2,8,9]. Trauma also accounted for the largest volumes of blood used. Victims of trauma were likely to require a higher volume of emergency blood in their acute resuscitation (mean 1.9 units) than those receiving blood for other reasons (mean 1.3 units). Trauma patients managed at the tertiary hospital tended to receive larger volumes of emergency blood (mean 2.1 units) than those at the secondary level emergency centres (mean 1.6 units) despite the presence of a blood bank on site to crossmatch blood. A number of factors may play a role in this observation. The prehospital triage of severely injured patients to the tertiary hospital is intended to match patient requirements to the available resources, including blood and blood products. The availability of larger volumes of emergency blood at the tertiary hospital and the familiarity of doctors working at a trauma centre with the use of large volumes of blood may lead to the administration of larger volumes of blood by the doctors at the tertiary hospital. The availability of advanced imaging to detect occult bleeding at the tertiary hospital may also predispose these patients to a larger volume of blood transfused. These factors remain speculation and further research is needed to better define the factors leading to the use of larger volumes of emergency blood. Another possible consequence of the prehospital triage policy in practice is the higher proportion of polytrauma and gunshot wound victims seen requiring transfusion at the tertiary hospital compared to the secondary level hospitals, which saw a larger proportion of stab wounds. The burden of penetrating trauma; 61 of the 81 trauma cases (84%), reflects the prevalence of interpersonal violence, particularly gang-related violence, in the region. Finally, it may simply be that secondary level emergency centres simply ran out of emergency blood to give [2].

The use of emergency blood for patients with anaemia is probably the most contentious finding of this study. While we did not attempt to define appropriate and inappropriate use, this is an indication that many would deem inappropriate for most of the wide variety of underlying conditions. Concerns about the use of emergency blood in this

Table 2
Comparison of the indications for and volumes of emergency blood transfused.

Indication categories	Sites A to C			Site D (tertiary)		
	Transfusion episodes n (%)	Units n (%)	Units/episode	Transfusion episodes n (%)	Units n (%)	Units/episode
Total	141	186	1,3	69	143	2,0
Trauma	36 (26)	58 (31)	1,6	45 (65)	96 (67)	2,1
Gunshot abdomen	1	1	1,0	1	3	3,0
Gunshot chest	1	1	1,0	4	9	2,3
Gunshot head	1	1	1,0	1	2	2,0
Gunshot limb	1	2	2,0	0	0	–
Multiple gunshots	1	1	1,0	6	11	1,8
Multiple stabs	7	12	1,7	3	5	1,7
Stab abdomen	0	0	–	1	1	1,0
Stab chest	14	20	1,4	9	23	2,6
Stab heart	2	5	2,5	0	0	–
Stab neck	1	3	3,0	3	7	2,3
Stab limb	2	4	2,0	1	1	1,0
Blunt assault	3	4	1,3	2	4	2,0
Road traffic polytrauma	2	4	2,0	14	30	2,1
Surgical	38 (27)	49 (26)	1,3	9 (13)	15 (10)	1,7
Upper gastrointestinal bleed	20	25	1,3	4	7	1,8
Peri-operative bleeding	13	16	1,2	3	5	1,7
Acute abdomen	3	4	1,3	1	2	2,0
Malignancy	1	1	1,0	1	1	1,0
Bowel obstruction	1	3	3,0	0	0	–
Gynaecological	29 (21)	39 (21)	1,3	3 (4)	4 (3)	1,3
Ectopic pregnancy	17	26	1,5	0	0	–
Miscarriage	6	6	1,0	0	0	–
Gynaecological not specified	5	5	1,0	3	4	1,3
Abnormal uterine bleeding	1	2	2,0	0	0	–
Medical	30 (21)	32 (17)	1,1	1 (1)	1 (1)	1,0
Anaemia	27	29	1,1	0	0	–
Haemoptysis	2	2	1,0	1	1	1,0
Medical not specified	1	1	1,0	0	0	–
Obstetric	4	4	1,0	6 (9)	15 (10)	2,5
Postpartum haemorrhage	4	4	1,0	0	0	–
Obstetric not specified	0	0	–	6	15	2,5
Unknown	4 (3)	4 (2)	–	5 (7)	12 (8)	–

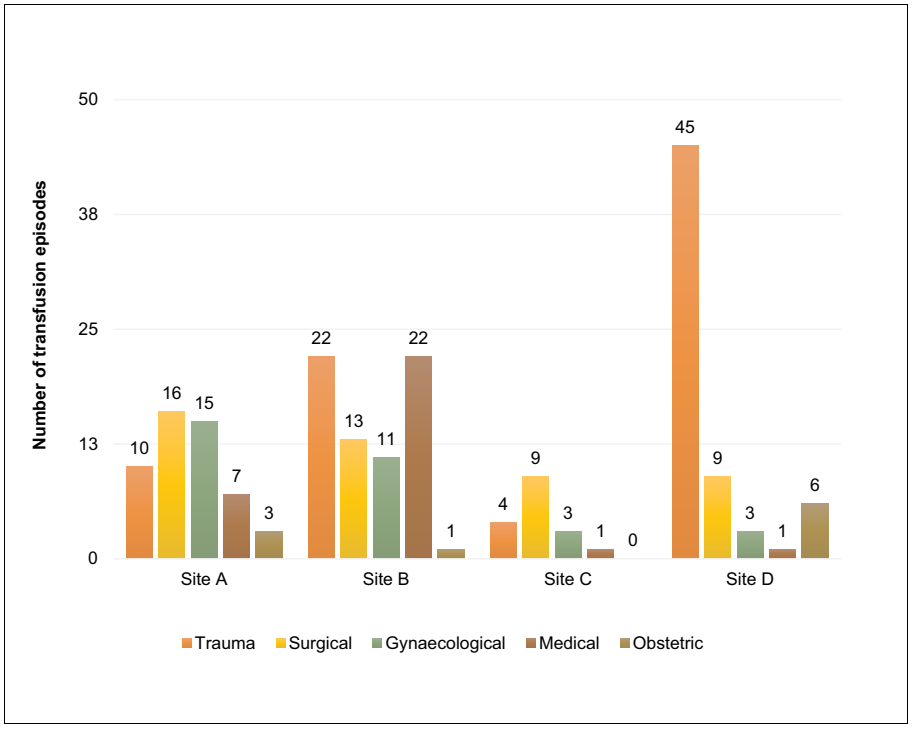

Fig. 1. A comparison of the indications for transfusion at the individual study sites.

population include the expected need for repeat transfusions and the increased prevalence of allo-immunisation, raising the risk of transfusion reactions [6,7,10]. The major objection, however, is that the condition has often been present for a long period of time and should be managed in a planned fashion that limits the need for transfusion in general and emergency transfusion in particular. The tertiary hospital used no emergency blood for this indication, while there were 27 such episodes at the secondary level emergency centres, with one emergency centre in particular recording this indication frequently. It was beyond the scope of this study to record additional data such as the haemoglobin value and vital signs of these patients, but these data would help to ascertain whether emergency blood was indeed indicated or whether it would have been more appropriate to wait for crossmatched blood. The transport times, both real and perceived, of samples to and blood from the blood bank may also play a role, with the emergency centre using the most emergency blood for anaemia located furthest from the blood bank. Combined with the desire for prompt patient care and disposition from a busy emergency centre, a long blood transport time may influence doctors to utilise blood from the emergency blood fridge, although it remains difficult to justify. Further investigation is warranted into the use of emergency blood for patients with anaemia and perhaps the implementation of a guideline or gatekeeper strategy is necessary to limit the potentially avoidable transfusion of emergency blood.

Limitations of this study included the small sample size, short duration of the study period and timing of the sampling. While this limited the confidence of the infrequent indications, certain indications tended to occur commonly and at all study sites lending credibility despite these limitations. The study was largely dependent on clinical staff to complete the study registers and record the indications for which emergency blood was transfused as these data are not routinely collected. While they were familiarised with the study and encouraged to confirm indications with the responsible doctor, this remained a potential source of misinformation. The small size of the study did not allow for dedicated research staff for the purpose of data collection. The variety of methods required to recover missing data would make the study difficult to replicate until such time as the study data sample becomes a part of routine data collection by the blood bank or the individual emergency centres. The tertiary hospital included in this study does not offer a paediatric service, leading to significant underrepresentation of the paediatric population. There is a dedicated tertiary paediatric hospital within the study area to which the majority of paediatric trauma patients are transported directly. Children with less severe injuries and those presenting directly are treated at the secondary level emergency centres, which were included in the study. This limits the generalisability of the results with regards to the need for emergency blood in paediatric emergency care.

The strength of this study is that it traces the outlines of an area of practice that was hitherto uncharted. The results lay a foundation on which further research can build and to which similar studies can compare. The information can be used in drawing up local clinical guidelines for the use of emergency blood, planning a massive transfusion protocol for settings with limited direct access to blood (and none to other blood products) and improving record keeping and accountability towards emergency transfusion practice. It may be useful to specifically explore the time taken to replenish emergency blood or deliver non-emergency blood, describe the subgroup perceived to be used unnecessary, or the reasons for use for non-emergency indications to get a better understanding of the various issues contributing to incorrect usage. The Western Province Blood Transfusion Service's knowledge of the clinician's use of their products may be expanded.

Conclusions

Trauma was the major indication for the transfusion of emergency blood in this study. Other frequent indications included upper gastrointestinal bleeding, ectopic pregnancy and anaemia. The volumes of emergency blood transfused per episode were highest in trauma patients, and higher at the tertiary hospital compared to the secondary level facilities. The majority of emergency transfusions were commenced in the emergency centres, with a small amount of the emergency blood stock being used in other areas of the hospitals, particularly theatre. Further research is needed to evaluate the clinical outcomes of the recipients of emergency blood as well as to describe the

use of associated blood products in emergency transfusions. Appropriate use of this limited resource needs to be defined for each facility, and ongoing monitoring of the indications for which emergency blood is transfused at an individual hospital level should be encouraged. Replication of this work after adjusting for the limitations is strongly encouraged in emergency centres situated in low- and middle-income countries. A better understanding of access to, and utilisation of emergency blood will not only improve management of the limited emergency blood resources available but ultimately improve the quality of care provided to patients in resource restricted settings.

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Authorship contributions

All authors contributed to the conception and design of the work. DM performed the data collection and initial analysis. All authors contributed to interpretation of data for the work. DM wrote the first draft and all authors contributed to revising it critically for important intellectual content. All authors approved the submitted draft to be published and agree to be accountable for all aspects of the work.

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Conflicts of interest

Prof Stevan Bruijns and Dr Melanie Stander are editors of the African Journal of Emergency Medicine. Prof Bruijns and Dr Stander were not involved in the editorial workflow for this manuscript. The African Journal of Emergency Medicine applies a double blinded process for all manuscript peer reviews. The authors declare no further conflict of interest.

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