Blood transfusion demands in a tertiary Otolaryngology, Head and Neck centre: A 5-year retrospective cohort study

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Abstract

Objectives: To analyse and report the utilisation of Red Blood Cell (RBC) transfusion in a tertiary Otolaryngology, Head and Neck Centre. Design: Retrospective cohort review. Setting: Large tertiary care centre in England. Participants: All in-patients (n = 89) admitted primarily under the care of Otolaryngology, Head and Neck service between January 2015 and December 2019 that required RBC transfusion. Main Outcome Measures: Number of units of Red Blood Cell transfused over 5 years and distribution across clinical indications. Cost of RBC transfusions over the same time period. Results: Most patients receiving transfusions are aged in their 6th and 7th decades. Epistaxis patients utilised 105 RBC units over the 5 years with 78 % being for emergency epistaxis. Post-operative Head & Neck Cancer surgery with reconstruction required 32 RBC units over 5 years in 12 patients. The cost incurred by the department has fallen by over £2000 over the 5 year period. Conclusions: Blood transfusion use has fallen over the last five years. Epistaxis and post-operative Head and Neck cancer cases account for significant use compared with other patient groups. Prehabilitation strategies will add value towards mitigating future consumption of RBC.

Key points

1. This paper discusses an unexplored variable: use of blood transfusion in a major ENT, Head & Neck Centre in the United Kingdom.
2. The paper highlights patterns associated with Red Blood Cell (RBC) transfusion use within the specialty and highlights idiosyncratic practices of surgeons.
3. The authors discuss the financial burden posed by the use of RBC transfusions by a high volume ENT centre.
4. The paper suggests a way forward to improve clinical practice which can be beneficial to patients and the health economy at large.

Introduction

Red blood cell (RBC) transfusions are common in clinical practice. In the UK, the NHS Blood and Transplant (NHSBT) health authority rely on a regular supply of voluntary contributions of whole-blood and apheresis donors to meet demand and have substantial direct and indirect costs to the health service and economy, respectively.[1]Furthermore there are risks associated with transfusion with an estimated risk of death of 1 in 117,000 components and serious harm of 1 in 21,000.[2] Between 1999 and 2017 there has been a 34% reduction in RBC demand through the implementation of guidelines and Patient Blood Management initiatives.[3] However, it is expected that the UK will need to increase the availability of blood components and utilize

strategies to ensure these are used effectively, efficiently and safely to meet the growing demands of an ageing population.[4]

In a 2014 national survey, 27% of total RBC transfusions in England and North Wales were for surgical indications.[5] Currently, there is limited literature on RBC transfusions in Otolaryngology otherwise known as Ear, Nose and Throat surgery (ENT). The available literature focuses on transfusions in Head and Neck cancer (HNC) surgery.[6–8] We performed a 5-year retrospective analysis of RBC transfusions in a large tertiary ENT, Head and Neck centre. The aims were to evaluate ENT transfusion practice in a tertiary centre in accordance with current guidelines and literature, identify and analyse "outlier" transfusion practice and suggest how local ENT transfusion practice can be improved to maintain high standards of patient care and safety as well as ensure efficiency to meet the demands on blood components.

Materials & Methods

We have followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.[9]

Ethical considerations

Ethical approval was not required for this service evaluation. Local approval was obtained [removed for blind peer review] to analyse and improve blood transfusion practice.[10]

Identification of cases

We conducted a retrospective analysis of RBC transfusion events in hospital inpatients with ENT as their primary treatment team [removed for blind peer review]. Relevant transfusion events were identified in the period January 2015 to December 2019 using the inbuilt search capability of the Trust's electronic patient administration tool: [removed for blind peer review]. The care pathway for all individuals receiving one or more RBC transfusion was scrutinized. Both emergency and elective admissions were included regardless of surgical intervention. Patients under the age of 16 years were excluded.

Data extraction

Each patient had their electronic patient records reviewed and the following parameters analysed: Indication for RBC transfusion; number of units transfused; type of operation (if performed) in preceding 30 days; elective or emergency admission; haemoglobin (Hb) before transfusion. A regression analysis was conducted for continuous variables between RBC use in HNC surgery with reconstruction and RBC use in HNC surgery without reconstruction. Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) 25 software by SPSS Inc. Furthermore, A cost-analysis of RBC units was performed for each year based on the NICE costing statement.[11]

Results

Demographics

A total of 89 patients received 187 RBC units under ENT over the 5-year period (Table 1). Majority of transfusions took place in patients aged in their 6^{th} and 7^{th} decades.

Indications for Red Blood Cell (RBC) transfusion

The indications for RBC transfusion, number of units transfused, mean units per case and mean haemoglobin (Hb) before transfusion are shown in Table 2. The most common cause requiring transfusion was epistaxis. The Head and Neck Cancer (HNC) procedures requiring reconstruction included patients undergoing mandibulotomy, maxillectomy, oesophagectomy, neck dissection and laryngectomy which required free (osseo-) myocutaneous and/or pedicled flaps for reconstruction. The HNC procedures that did not require

reconstruction included patients undergoing medial maxillectomy, laryngectomy, neck dissection, excision of parapharyngeal tumour and excision of tongue tumour. Other Head and Neck (H&N) procedures included thyroidectomy, parathyroidectomy, repair of oesophageal perforation and neck exploration for a retropharyngeal abscess. Non-ENT causes for transfusion were secondary to anaemia.

Epistaxis-related RBC Transfusions

Epistaxis accounted for more transfusion events than all other indications, individually. The number of units of blood transfused due to epistaxis overall decreased between 2015 and 2019 (Figure 1). Notably, when post-operative epistaxis is further categorised, all operation types decreased except sphenopalatine artery ligation, which increased by 8 units in total between 2017 and 2019.

Non-Epistaxis related RBC Transfusions

Between 2015 and 2019, the number of units transfused decreased or remained constant for all non-epistaxis related transfusions, except in "Post-Other Head and Neck surgery" which increased from 1 to 8 units in 2018 to 2019. This was due to an oesophageal perforation case requiring 6 units and 2 thyroidectomy cases requiring a unit each. "Post-HNC surgery with reconstruction" RBC units transfused remained constant between 2015-2018 and dropped in 2019. These cases required the most units when compared with other non-epistaxis related transfusions. Comparatively, "Post-HNC surgery without reconstruction" saw a decrease from 9 to 2 units from 2015 to 2019, with 0 units transfused in 2018. "Post-tonsillectomy bleed" transfusions reduced from 2 to 0 units between 2015 and 2019. 2 cases of temporal bone resection and fascia lata grafts had pre-operative transfusions despite a Hb of >70g/dl. 1 total thyroidectomy case received 1 RBC unit for pre-operative haemoglobin optimisation with a Hb of 74. The 3 cases of "acute blood loss secondary to H&N cancer" included patients bleeding from recurrent cancer in the tonsil, tongue base and oropharynx. "Non-ENT (anaemia)" blood transfusions included 4 patients with known chronic anaemia, a patient with suspected bleeding from diverticular disease and another with an upper gastrointestinal bleed.

Elective and Emergency transfusions

The trend concerning elective and emergency cases requiring RBC transfusions is demonstrated in Figure 2.

Cost analysis of blood transfusion in ENT

Cost analysis was conducted using the 2015 NICE cost analysis for blood transfusion. The total cost of administering the first unit was shown to be £170.14, whilst each subsequent unit cost £162.01. This included staffing, procedural and consumable costs of £48.30 and £40.17 associated with first and subsequent units, respectively.[11] The cost incurred by the department has fallen by over £2000 over the 5-year period (Table 3).

Discussion

This 5-year retrospective analysis gives an overview of blood transfusion use in our tertiary ENT, Head and Neck centre. A large proportion of patients (42.2%) and RBC units transfused (43.9%) were primarily due to emergency presentations of epistaxis. The majority of elective blood transfusions were in the post-operative period making up 40% (36/90) of total cases and 42.8% (80/187) of total units transfused. Over the study period, there has been a decrease in the overall demand for ENT RBC transfusions in our centre, which reflects the downward trend of demand for RBC transfusions nationally.[3]

ENT compared to other surgical specialties

At a local level, ENT uses the least RBC units for transfusion when compared to other specialties. For example in 2018, ENT transfused a total of 38 units whilst other specialties such as haematological oncology (2957) and transplant (2266) utilised the most RBC units. When compared to other surgical specialities, trauma surgery (633) and vascular surgery (616) used the most units.[10] This is also reflected in national data. For example in the 2014 national survey, cardiac surgery and trauma had the most units transfused in

surgery while ENT only made up 0.5% of the total.[5]This disparity could be due to a different patient demographic and caseload in ENT. Choi et al. showed a young mean age of adults (50.3 years) presenting with ENT issues, which were predominantly managed with bedside procedures (66.7%) rather than surgical intervention (16.3%). Furthermore, he found only 29.2% of emergency presentations requiring hospitalisation.[12] Conversely, patients undergoing cardiac surgery have higher rates of blood transfusions when compared to non-cardiac surgery patients, which is likely due to the patients having multiple co-morbidities including anaemia, diabetes mellitus, advanced heart and renal disease.[13,14] Another reason could be due to the reduced cancer caseload within ENT when compared to other specialties. Head and Neck Cancer only accounts for 3% of cancer cases nationally, while breast, prostate, lung and bowel cancers together account for 53% of new cases.[15]

Epistaxis

Epistaxis cases represent a significant proportion of ENT workload both at first presentation and representation with blood transfusion use found to be more common than documented in the literature.[16] Our data shows emergency epistaxis accounted for 42.2% of patients and 43.9% of RBC units transfused. Risk factors such as hypertension and being on antithrombotic medication have been shown to increase median haemostasis time in epistaxis patients and thus, likely contribute to the requirement for a blood transfusion however, no direct causal link has been established.[16] Murer et al. conducted a retrospective cohort study of epistaxis patients and identified the following risk factors for epistaxis-related transfusions: trauma, haematological disorders such as Hereditary Haemorrhagic Telangiectasia (HHT) and posterior origin of bleeding.[17] In our centre, we have seen a decrease in epistaxis-related transfusions between 2015 and 2019, which could be due to better recognition and earlier intervention in severe epistaxis cases, improved early warning systems and reduced caseload year on year. Additionally, earlier endovascular treatment in the course of a patient's management, which is available in our centre, has previously been suggested to decrease the need for blood transfusions.[18]

Head and Neck Cancer (HNC) surgery

Bleeding and subsequent RBC transfusions are relatively common in major HNC surgery. Goel et al. found a 5.4% incidence rate of bleeding and post-operative transfusion within 72 hours.[8] In our non-epistaxis related RBC transfusion patient cohort, major HNC surgery with and without reconstruction (n=20) made up 58.8% of post-operative blood transfusions and 25.1% of overall blood transfusions over the study period. These results are reflected in the available literature where one study identified 14% to 80% of patients undergoing major Head and Neck surgery required allogeneic RBC transfusions.[7]

Figure 3 shows HNC surgery without reconstruction required fewer units than with reconstruction. Additionally, the total number of units transfused declined with time and was statistically significant (P=0.01) for HNC surgery without reconstruction.

Krupp et al. validated a transfusion prediction and risk assessment (TPRA) model for a patient to receive a perioperative transfusion: higher tumour stages, use of a flap and pre-operative anaemia were associated with higher rates of peri-operative transfusions. This tool allows clinicians to appropriately counsel patients on blood transfusions and address pre-existing anaemias in the pre-operative period.[7] A similar model was also replicated by Shah et al. who additionally found female sex, underweight BMI and osseous free flap reconstructions also contributed to higher rates of transfusion.[6] However, these models have been shown to predict peri-operative transfusion risk rather than post-operative transfusion risk. Further research is required to identify if a similar model can accurately predict post-operative transfusions in HNC patients undergoing surgery. It is however our experience that this patient group harbors risk factors such as low BMI, high tumour stage, and the use of composite grafts in reconstructions.

On closer review of our HNC data, the majority of patients undergoing a laryngectomy were for radio-recurrent disease. This in itself is a risk factor as it is a procedure with higher morbidity compared with primary laryngectomy due to the need for reconstruction, poor tissue quality and unpredictable angiogenesis following radiotherapy.[19]In addition, our HNC surgery patients are either borderline or anaemic prior to

surgery, which could be secondary to the burden of their prior cancer treatment.

Outliers

Current National Institute for Health and Care Excellence (NICE) guidelines recommend using a restrictive RBC transfusion threshold of 70g/litre (80g/litre if concomitant cardiovascular disease) and a Hb concentration target of 70-90g/litre after transfusion. Furthermore, single-unit transfusions for adults who are not actively bleeding have been shown to be more clinically beneficial and cost-effective when compared to liberal RBC transfusion targets.[20] A subgroup analysis revealed a total of 57 instances out of 187 transfusion orders that were requested above the threshold advised by NICE. Of these, 20 were outliers after excluding those that were actively bleeding or symptomatic with borderline Hb levels. These can be divided into 14 outliers who were transfused due to flap formation, 5 that were transfused due to senior clinician request and 1 case having units ordered but not given.

Ensuring HNC patients only receive allogeneic blood transfusions if necessary is important, as there is growing evidence that their use is associated with worse patient outcomes. Szakmany et al. found a statistically significant increase in mortality for patients undergoing primary surgery for oral and oropharyngeal cancer with free flaps when they received three units or greater.[21] Danan et al. replicated these results in a retrospective study in patients undergoing free flap reconstruction for head and neck cancer, showing not only a reduction in overall survival but also an increase in wound infection.[22] It has also been shown that liberal transfusion practice does not improve tissue oxygenation for free flap reconstruction.[23] The individualised practices of surgeons adds colour to the results in this patient group.

HNC surgeons propose several reasons for post-operative transfusion. These include: improving the Hb concentration to optimise tissue healing, in preparation for adjuvant oncological treatment and avoid potential cardiac complications in high-risk patients. This practice is idiosyncratic and assertions to such outcomes are yet to be substantiated by robust research and appear anecdotal.[24]

Limitations

Limitations of this study include a small sample size that reflects ENT transfusion practice at a Head and Neck, tertiary centre when compared to other surgical specialties. Baseline characteristics of patients were not collected and adjusted for, which would reduce confounding factors. Patients with multiple co-morbidities are more likely to need transfusing due to anaemia of chronic disease. The blood transfusion tariffs used in the cost-analysis were from 2015, and therefore did not account for the inflation related adjustments in costs.

Conclusion

Blood transfusions in ENT have decreased in our centre over the last five years in a specialty that already uses fewer transfusions in comparison to other surgical specialties. Epistaxis is amongst the commonest presentations in ENT requiring transfusing which is likely due to patient risk factors. HNC post-operative RBC use makes up 58.8% of the overall post-operative transfusion burden. This is likely owing to the increased complexity of cases as well as advanced tumour stages, requirement for a flap and pre-existing anaemia. The majority of the outliers (in terms of threshold for transfusion according to guidelines) in our subgroup analysis were related to flap reconstruction surgery despite growing evidence this may not result in patient benefit. The future involves a need for more rigorous prehabilitation programmes in ENT, the efficacy of which have been demonstrated across several surgical domains including general, cardiothoracic and orthopaedic surgery.[25] In this current climate where optimising healthcare resources is essential, it is appropriate that thorough measures of pre-operative optimisation are implemented. This includes cost-effective supplementation with iron, folate and vitamin B12 to tackle pre-existing anaemia, which may reduce the need for blood transfusions. In addition, it may be necessary to revise highly selective individualised surgeon practices in order to optimise outcomes for our patients, reduce exposure to potential transfusion related morbidity and also further decrease the cost incurred to the health service.

Conflicts of Interest

None.

Data Availability Statement

The data that supports the findings of this study are available from the corresponding author upon request.

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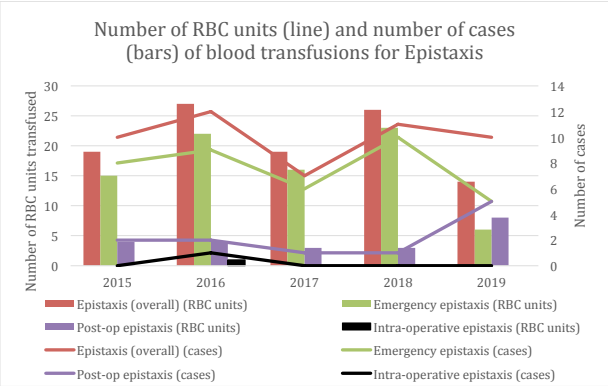

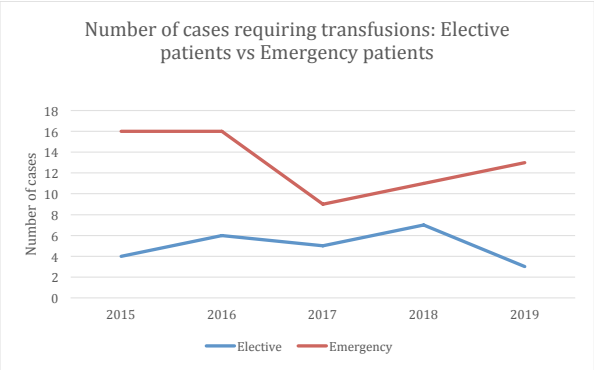

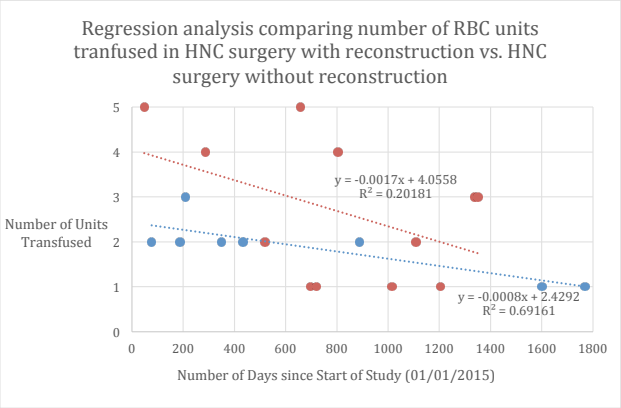

Demographics of the sample			
Year	N (M:F)	Age (Years)	
		Median	IQR
2015	20 (12:8)	60.5	24
2016	22 (13:9)	67	24.5
2017	14 (5:9)	60	36.5
2018	18 (9:9)	69.5	23.3
2019	16 (9:7)	77	14.3
NOTE: N = number in sample; F = Female; M = Male; IQR = Interquartile Range			

Indications for RBC transfusions in ENT				
Indication for transfusion	Number of cases	Number of RBC units	Mean Units per case (SD)	Mean Haemoglobin Before Transfusion (SD)
Epistaxis (overall)	50	105	2.1 (1.1)	85.9 (19.9)
Emergency epistaxis	*38*	*82*	*2.2 (1.1)*	*83.1 (19.3)*
Post - operative epistaxis	*11*	*22*	*2 (0.7)*	*90.7 (14.4)*
Intra - operative epistaxis	*1*	*1*	*1 (0)*	*139 (0)*
Post - tonsillectomy bleed	3	3	1 (0)	86.3 (8.8)
Post - HNC surgery with reconstruction	12	32	2.7 (1.5)	97.1 (26.1)
Post - HNC surgery without reconstruction	8	15	1.9 (0.6)	100.9 (25.3)
Post - Other Head and Neck surgery	5	11	2.2 (1.9)	83.6 (20.9)
Pre - operative haemoglobin optimisation	3	5	1.7 (0.9)	88.7 (10.4)
Acute blood loss secondary to H&N cancer	3	4	1.3 (0.5)	82 (6.4)
Non - ENT (anaemia)	6	12	2 (0)	73.8 (6.5)
Acute blood loss secondary to H&N cancer	3	4	1.3 (0.5)	82 (6.4)
Non - ENT (anaemia)	6	12	2 (0)	73.8 (6.5)

Cost-analysis of blood transfusions in ENT			
Year	Total RBC units transfused	Total administration cost per year (GBP)	Total cost of RBC transfusion (including administration cost) per year (GBP)
2015	42	1849.74	6967.02
2016	49	2147.19	8117.35
2017	32	1399.26	5298.14
2018	38	1624.50	6132.58
2019	26	1174.5	4342.34