

17b Transfusion-Associated Circulatory Overload (TACO) n=139

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With thanks to Harriet Lucero for case assessments January-August 2019

Definition:

TACO is defined as acute or worsening respiratory compromise and/or acute or worsening pulmonary oedema during or up to 12 hours[†] of transfusion, with additional features including cardiovascular system changes not explained by the patient's underlying medical condition; evidence of fluid overload and a relevant biomarker[‡].

[†]SHOT accepts cases up to 24 hours

[‡]see Table 17b.2 for details of required and additional criteria for a surveillance diagnosis

Key SHOT message

- Patients who develop respiratory distress during or up to 24 hours following transfusion where transfusion is suspected to be the cause must be reported to SHOT. The transfusion-associated circulatory overload (TACO) definition criteria can be used as guidance but this should not be restrictive. SHOT experts can transfer cases between categories

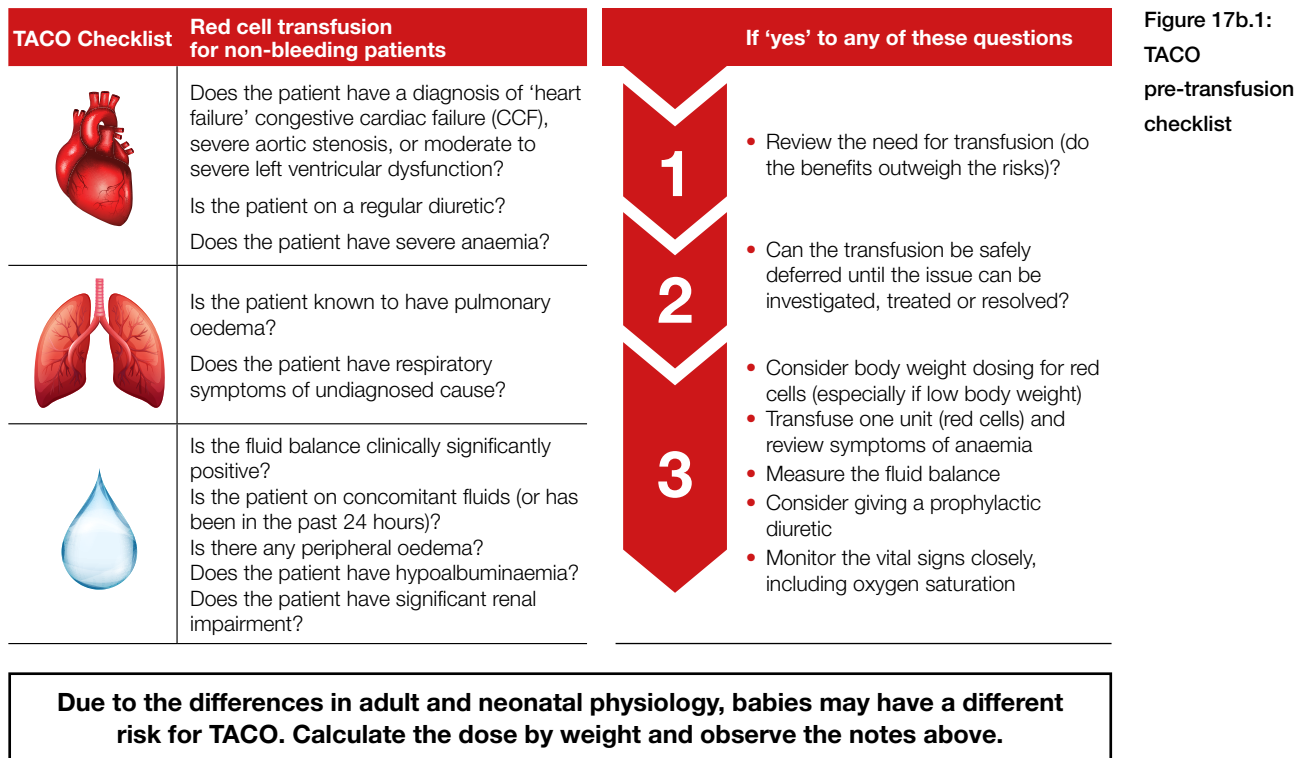
Abbreviations used in this chapter

CPAP	Continuous positive airway pressure	IHN	International Haemovigilance Network
Hb	Haemoglobin	ISBT	International Society for Blood Transfusion
NT-BNP	N-terminal-pro B-type natriuretic peptide	TACO	Transfusion-associated circulatory overload

Recommendations

- A formal pre-transfusion risk assessment for transfusion-associated circulatory overload (TACO) should be undertaken whenever possible for all patients receiving blood transfusion (especially if older than 50 years or weighing less than 50kg) and mitigating actions taken, as TACO is the most commonly reported cause of transfusion-related mortality and major morbidity
- Use weight-adjusted red cell dosing to guide the appropriate number of units required for all non-bleeding adult patients, ideally using tools which also highlight inappropriate transfusion (Grey et al. 2018, NCA 2017)

Action: All staff authorising transfusion



TACO=transfusion-associated circulatory overload

Introduction

A new surveillance definition for TACO was published in 2019 (Wiersum-Osselton et al. 2019) which was the culmination of several years of collaborative work between the International Haemovigilance Network (IHN), AABB, and the International Society of Blood Transfusion (ISBT). The new definition identifies a higher percentage of cases previously designated as TACO by haemovigilance systems compared to the former ISBT definition (ISBT/IHN 2011). This work represents a significant advance in this area and is intended to form the basis for internationally consistent reporting of TACO. It is also intended to promote the clinical recognition of TACO, while recognising the need for further research into preventative measures and mitigations and aspires to the improved understanding of patho-aetiology, and methods to distinguish the pulmonary complications of transfusion.

SHOT experts were key participants in this work, and early adopters of the new definition. The criteria for the new definition have been used to assess the TACO cases reported to SHOT in 2019 (Table 17b.2).

Death n=9

TACO resulted in patient death in 9 reported cases (all adults).

Major morbidity n=33

TACO remains the leading cause of transfusion-related combined mortality and major morbidity. There was 1 paediatric patient this year that suffered major morbidity.

Table 17b.1:
Demographic
overview of cases
reported in 2019

Demographic	Number of reports
Deaths (imputability 3 - certain)	0
Deaths (imputability 2 - probable)	6
Deaths (imputability 1 - possible)	3
Major morbidity outcome	33
Age*	Range: 27 days to 103 years Median: 76 years
Gender	Female=75 Male=64
Medical specialties with highest number of cases*	Haematology=26 Acute medicine=23, general medicine=23 Emergency medicine=9, trauma and orthopaedics=9
Bleeding patients (indication code R1 or 'massive bleeding' indicated)	20
Non-bleeding patients (other indication codes or not stated)	119

*Data provided in 138/139 cases

Commentary

TACO is more commonly reported in elderly, non-bleeding patients, but is seen across all age groups and is consistent with the data from previous years. There were 4 cases in the under-18 age group: 1 neonate and 3 paediatric cases (age 1-3 years). Haematology and adult medical specialties are again the most common specialties where TACO is reported and this should be considered when delivering TACO education and mitigation plans.

Analysis by definition criteria

Cases reported in 2019 were assessed using the surveillance criteria in Table 17b.2. It should be noted that the criteria are for the purposes of reporting and surveillance, and do not constitute a clinical diagnosis for the purpose of real-time interventions for the medical management of a patient presenting with respiratory compromise during or following transfusion. However, the surveillance criteria should promote recognition of TACO.

Table 17b.2:
TACO surveillance
definition
(adapted from
Wiersum-Osselton
et al. 2019)

Patients classified with TACO (surveillance diagnosis) should exhibit at least one required criterion* with onset during or up to 12 hours after transfusion (SHOT continues to accept cases up to 24 hours), and a total of 3 or more criteria i.e. *A and/or B, and total of at least 3 (A to E)

* Required criteria (A and/or B)

- A.** Acute or worsening respiratory compromise and/or
- B.** Evidence of acute or worsening pulmonary oedema based on:
 - clinical physical examination, and/or
 - radiographic chest imaging and/or other non-invasive assessment of cardiac function

Additional criteria

- C.** Evidence for cardiovascular system changes not explained by the patient's underlying medical condition, including development of tachycardia, hypertension, jugular venous distension, enlarged cardiac silhouette and/or peripheral oedema
- D.** Evidence of fluid overload including any of the following: a positive fluid balance; clinical improvement following diuresis
- E.** Supportive result of a relevant biomarker, e.g. an increase of B-type natriuretic peptide levels (BNP) or N-terminal-pro brain natriuretic peptide (NT-pro BNP) to greater than 1.5 times the pre-transfusion value

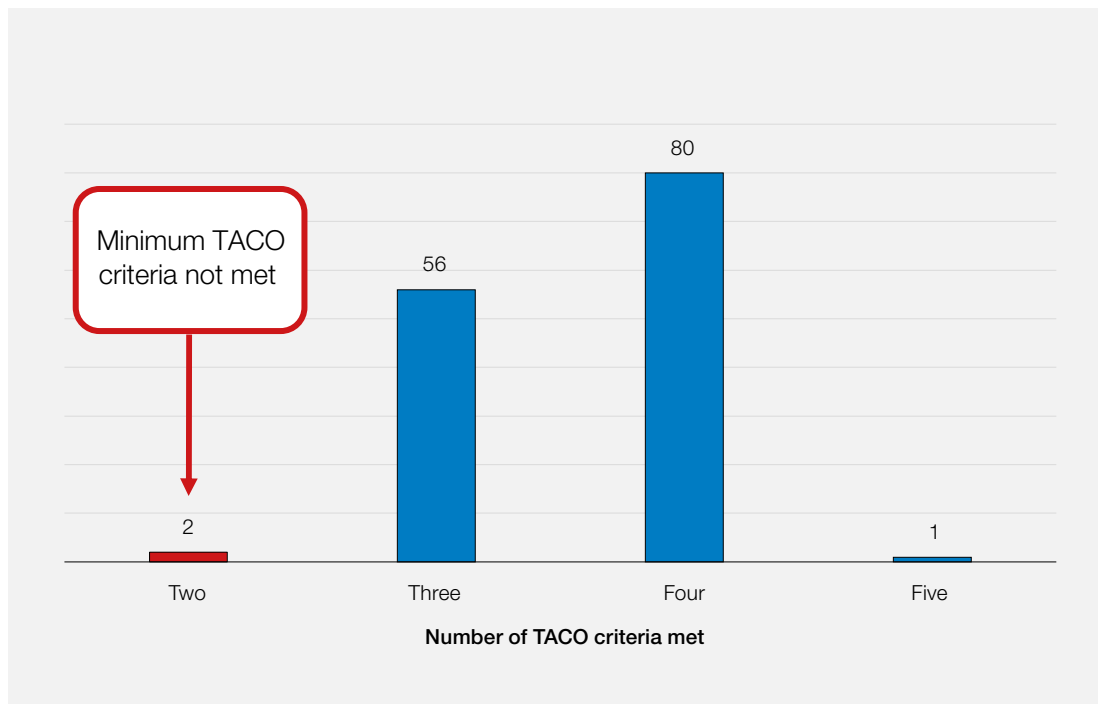


Figure 17b.2:
Number of
surveillance
criteria versus
number
of accepted
TACO cases

TACO=transfusion-associated circulatory overload

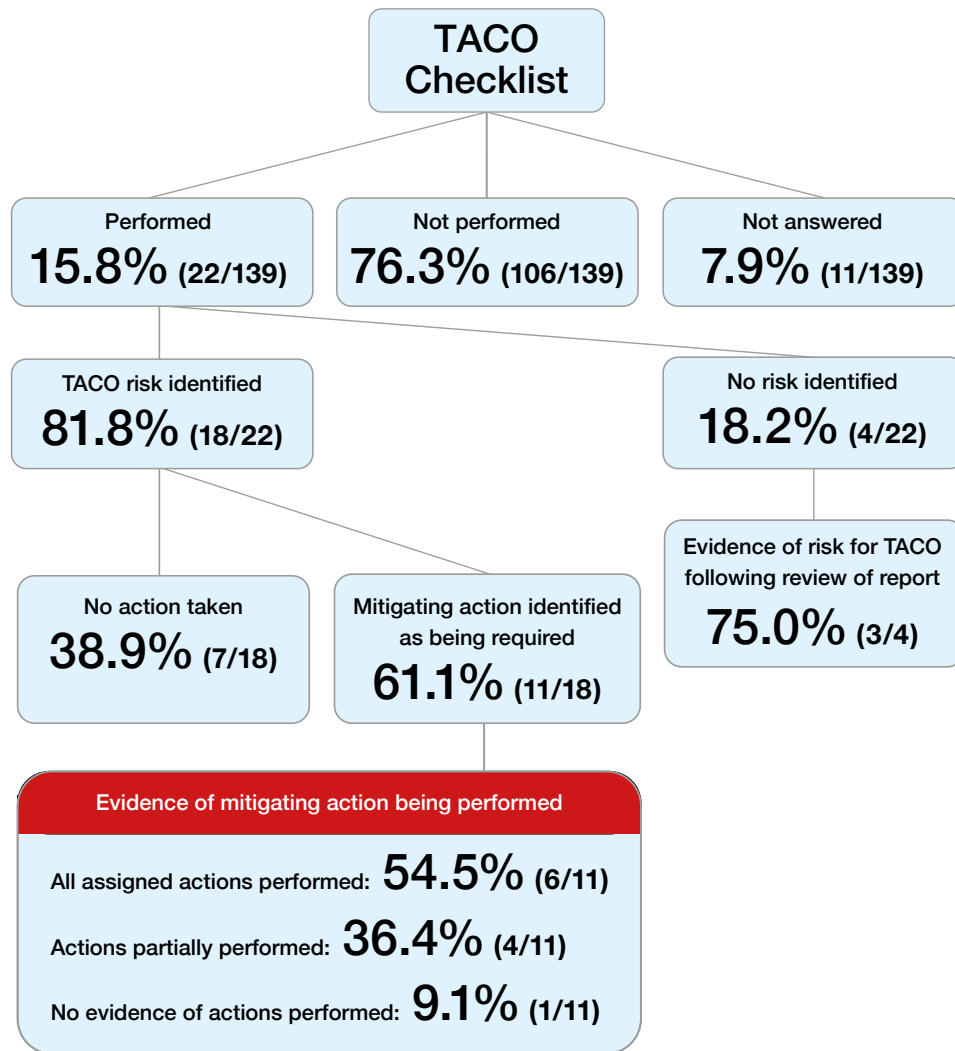
There were 2 cases that scored only two criteria but were nevertheless accepted into the TACO category as a pulmonary complication as they were otherwise clinically persuasive cases. One case had developed pulmonary oedema with temporal association with transfusion but lacked cardiovascular system changes and data relating to fluid balance and diuretic therapy was not available. The other case had worsening of respiratory symptoms following transfusion but due to lack of vital sign observation data and as diuretic therapy was withheld in this dying patient, some data for the assessment were not available. Only 1 case had all five criteria as NT-pro BNP had been tested. See the 2018 Annual SHOT Report, p.143 (Narayan et al. 2019) for further information on the utility of this test in demonstrating left atrial hypertension in the differential assessment of pulmonary complications of transfusion.

Use of the TACO checklist

The TACO risk assessment recommendation was introduced in the 2015 Annual SHOT Report (Bolton-Maggs et al. 2016). A question regarding the use of the TACO risk assessment and mitigating actions was added to the SHOT reporting questionnaire for the 2019 reporting year. An overview is shown in Figure 17b.3. The analysis shows that a TACO risk assessment was only performed in 22/139 (15.8%) cases of reported TACO. A TACO risk factor was identified in 18/22 (81.8%) of cases but only 11/18 (61.1%) of these cases had mitigating actions assigned.

Further review of these cases showed that in 1 case there was no evidence of the mitigating actions being performed and in 4 cases they were only partially performed, with only 6 having evidence of being performed in full. Of these 6 cases there was evidence that additional mitigations could have been taken: 2 improved with diuretic treatment indicating that pre-transfusion prophylactic diuretics may have prevented the TACO episode; 1 case could have had weight-adjusted red cell dosing/a single unit; and 1 case had iron deficiency anaemia with TACO developing during the second unit and therefore a single unit of red cells with intravenous iron could have prevented TACO. In 4/22 (18.2%) cases where a TACO risk assessment was performed, no risks were reported and therefore no mitigating actions assigned. However, on review of these cases there was evidence in the report that in 3 cases there were clear risk factors for TACO (positive fluid balance in 2 cases and heart failure in 1) resulting in a missed opportunity to assign mitigating actions.

Figure 17b.3:
Use of the TACO
checklist to identify
patients at risk
of TACO and
implementation of
mitigations



TACO cases with evidence of excessive red cell volume to meet the target haemoglobin (Hb)

The recommendation for weight-adjusted red cell dosing for non-bleeding patients was introduced in the 2017 Annual SHOT Report (Bolton-Maggs et al. 2018). Analysis of the 2019 data shows that this is not implemented in practice and is contributing to a significant level of overtransfusion in reported cases of TACO.

There were 61 cases where the patient was not bleeding and both the body weight and pre-transfusion Hb level were reported. Thirty-two of these cases also had a post-transfusion Hb level reported. In 10/32 (31.3%) cases their post-transfusion Hb target was exceeded (post-transfusion Hb range 103-150g/L). The number of red cell units transfused was reported in 35 cases. There were 23/35 (65.7%) cases that received more than the calculated weight-adjusted dose resulting in 6/23 (26.1%) exceeding their post-transfusion Hb target.

Case 17b.1: Omitted TACO checklist leading to overtransfusion and TACO

A female patient in her 70s weighing 54kg developed anaemia following orthopaedic revision surgery (Hb 67g/L). She had a number of risks for TACO: positive fluid balance (1215mL), and the pre-transfusion chest X-ray report was suggestive of possible infection and heart failure, however a TACO checklist was not performed before the transfusion. She was transfused two units of red cells. Following the second unit she developed shortness of breath, crackles on chest auscultation, hypoxia, tachycardia and an increase in blood pressure. The post-transfusion chest X-ray report confirmed findings were consistent with heart failure, fluid overload and possible infection.

She was transferred to the critical care unit for continuous positive airway pressure (CPAP) ventilation. Her respiratory status improved following treatment with diuretics, nitrates and fluid restriction. Her post-transfusion Hb was 108g/L.

This case highlights a missed opportunity to identify this patient as being at risk of TACO and to take mitigating actions. If the checklist had been performed before the transfusion it would have identified possible heart failure and positive fluid balance as risks for circulatory overload. Although a fluid balance measurement was already in place, albeit not identified as a risk, other mitigations could have been considered such as prophylactic diuretics and weight-adjusted red cell dosing. Based on a post-transfusion target Hb of 80-100g/L, this patient with low body weight only required 280mL (one unit) to meet her target Hb. A weight-adjusted dose may have avoided TACO and overtransfusion in this case.

Learning points

- In non-bleeding patients an excessive volume of red cell transfusion to meet a target haemoglobin (Hb) level remains a significant factor in cases of transfusion-associated circulatory overload (TACO). This can be minimised by weight-adjusted red cell dosing, and medical management of anaemia where possible

**[target Hb (g/L) - pre-transfusion Hb (g/L)] x weight (kg) x 0.4mL red cells
= volume of red cells (mL) required to meet target Hb**
(The volume of a unit of adult-specification red cells is 220-340mL)

Calculation taken from Norfolk (2013)

- A significant number of reported TACO cases do not appear to have had a TACO checklist performed, and/or TACO risk reduction measures were not implemented where risk was identified. This should be embedded into the procedure for the request and authorisation of transfusion

Conclusion

TACO is in many cases a preventable complication of transfusion but remains the leading cause of transfusion-related mortality and major morbidity. More cases than ever were reported to SHOT in 2019, but TACO continues to be under-reported. The majority of TACO cases have a recognised risk factor for circulatory overload and although there are now well-established recommendations and tools to mitigate TACO in patients with risk factors, analysis of the data unfortunately shows these are not being implemented in clinical practice, and opportunities are being missed to protect patients. There is more to learn about the pulmonary complications of transfusion which will undoubtedly advance patient safety in the future, but in the meantime we should improve practice with what we already know and have available now.

Recommended resources

Example of weight-adjusted red cell dosing implemented in clinical practice
www.rcdcalculator.co.uk

SHOT Bite No. 11: Respiratory symptoms during transfusion
<https://www.shotuk.org/resources/current-resources/shot-bites/>





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