

Transfusion-Associated Circulatory Overload (TACO) Case Studies

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Inappropriate/excessive red cell transfusion contributes to a patient's death (imputability 2 – probable) (1)

- *A 64kg patient with joint sepsis and pneumonitis was transfused two units of red cells.*
- *The indication for transfusion was coded as R3 in accordance with the NBTC indication codes (i.e. acute anaemia in the presence of acute coronary syndrome).*
- *The patient's haemoglobin (Hb) was 80g/L and there was no evidence of acute coronary syndrome.*
- *The patient had cardiac comorbidities predisposing to transfusion-associated circulatory overload (TACO): heart failure, aortic stenosis and regular diuretic use.*
- *A TACO pre-transfusion risk assessment was completed, and risks identified, but no specific mitigations were implemented, including questioning the appropriateness or volume of transfusion.*

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Inappropriate/excessive red cell transfusion contributes to a patient's death (imputability 2 – probable) (2)

- *The patient developed respiratory compromise with dyspnoea, tachypnoea, and hypoxia (oxygen saturation 81%) requiring 15L of supplemental oxygen.*
- *There was tachycardia, hypotension, and a grossly raised N-terminal-pro brain natriuretic peptide (NT-proBNP).*
- *There was no pre-transfusion NT-proBNP level for comparison. The post-transfusion Hb level was 117g/L. The chest X-ray showed pulmonary oedema with possible infection.*
- *The patient initially improved following a treatment dose of diuretic but later deteriorated.*
- *TACO was cited on the death certificate.*

Excessive transfusion for chronic anaemia contributed to a patient's death (imputability 1 – possible) (1)

- *A patient on palliative care for colorectal carcinoma with heart failure, renal impairment and other comorbidities was admitted with a 2-week history of shortness of breath*
- *They were transfused two units of red cells for chronic anaemia (haemoglobin (Hb) 68g/L, mean corpuscular volume (MCV) 81fl)*
- *They had a relatively low body weight (59kg)*
- *The clinician decided to aim for a target Hb of >90g/L due to 'cardiac disease'*
- *Acute coronary syndrome was not cited in the report, and it is likely this was chronic cardiac disease*
- *The patient was on a regular diuretic, and they also had a low serum albumin level*
- *There was no current fluid balance recorded, and the patient had peripheral oedema*

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Excessive transfusion for chronic anaemia contributed to a patient's death (imputability 1 – possible) (2)

- *The pre-transfusion chest x-ray showed a small pleural effusion and atelectasis in the base of the right lung*
- *A transfusion-associated circulatory overload (TACO) pre-transfusion risk assessment was not performed and therefore the multiple risks for TACO were not identified, and mitigations were not implemented*
- *The patient developed a worsening respiratory status with tachypnoea (26 breaths per minute), oxygen desaturation to 87%, and an increased oxygen requirement (3L oxygen to maintain an oxygen saturation of 96%)*
- *The heart rate increased to 101 beats per minute, and the blood pressure had also increased from the baseline to 144/78mmHg*
- *The post-transfusion Hb was 95g/L*
- *The post-transfusion chest X-ray showed progression of the pleural effusion and new interstitial oedema*
- *The patient was treated with a steroid, bronchodilator, and multiple doses of diuretic, however the patient deteriorated and died*

TACO risks failed to be identified leading to missed opportunities and death (1)

- *A female patient weighing 52kg with a haemoglobin level of 68g/L was prescribed two units of red cells*
- *She had liver disease and sepsis with peripheral oedema*
- *The cause of the anaemia was not clear, but she was not actively bleeding, and the National Blood Transfusion Committee (NBTC) indication code assigned to the transfusion was R2 (acute anaemia)*
- *A TACO pre-transfusion risk assessment was completed, and the clinician did not identify any risks, therefore no actions were assigned to mitigate TACO*
- *The first unit of red cells was given without issue and the second unit was commenced 4 hours later without a clinical review*
- *She became acutely unwell after the first hour, and an emergency call was made*
- *She developed dyspnoea and tachypnoea with oxygen desaturation to 90% from a previously normal level and had tachycardia and systolic hypertension*

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TACO risks failed to be identified leading to missed opportunities and death (2)

- *The post-transfusion chest X-ray showed significant pulmonary oedema*
- *The NT-pro BNP was significantly raised however there was no pre-transfusion value*
- *An echocardiogram showed moderate left ventricular systolic dysfunction which had not been previously reported*
- *A fluid balance was not reported but there had been a 5kg increase in weight post transfusion*
- *Multiple doses of furosemide were given resulting in some diuresis, but respiratory symptoms remained unchanged. Intensive care unit admission was required, and continuous infusion of diuretic was administered, with morphine and antibiotics*
- *The patient unfortunately died*
- *Sepsis was clearly a major factor however the transfusion was assessed as contributory to the death*
- *A local structured review was performed in the form of an audit of the TACO pre-transfusion risk assessment completion, transfusions out-of-hours, and the single unit red cell policy*

Severe chronic iron deficiency anaemia in a patient with low body weight

- *A female patient in her 80s with a low body weight (49kg) was asymptomatic and haemodynamically stable with severe microcytic hypochromic anaemia (haemoglobin (Hb)44g/L) with no clinical signs of pulmonary oedema on the chest X-ray or clinical examination*
- *Three units of red cells were transfused over a period of 15 hours because the attending doctor was aiming for a post-transfusion Hb of 70-90g/L*
- *The patient developed respiratory compromise (desaturation from 100% on room air to 71%, with dyspnoea, wheeze, and tachypnoea)*
- *There were new cardiovascular changes: tachycardia (heart rate 131bpm) and hypertension (blood pressure 204/96mmHg)*
- *Fluid balance was not clearly documented*
- *Additional fluid was not involved. A diuretic was given but the patient deteriorated and died, therefore a diuretic response could not be evaluated*
- *There was clear evidence of overtransfusion as the post-transfusion Hb was 111g/L*
- *The patient did not otherwise have comorbidities predisposing circulatory overload*
- *The post-transfusion chest X-ray showed pulmonary oedema*

Omitted transfusion-associated circulatory overload (TACO) risk assessment led to overtransfusion and TACO, with no structured investigation performed (1)

- A male patient in his 70's weighing **64kg** was admitted to a medical ward with **severe symptomatic microcytic hypochromic anaemia (haemoglobin (Hb) 47g/L)**
- His pre-transfusion computed tomography (CT) scan showed some pulmonary fibrosis and a small pleural effusion
- He had **severe left ventricular systolic dysfunction, renal impairment, peripheral oedema** and was on a **regular diuretic**
- He was initially transfused uneventfully with two units of red cells
- A TACO risk assessment was not performed and a fluid balance chart was not in place
- His post-transfusion Hb was 65g/L
- He was then given a third unit of red cells

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Bold text = risk factors for TACO

Omitted transfusion-associated circulatory overload (TACO) risk assessment led to overtransfusion and TACO, with no structured investigation performed (2)

- *There were no signs of active bleeding*
- *He became wheezy, hypertensive, tachycardic, pyrexial and had rigors*
- *His oxygen saturations reduced to 75% and he had peripheral pitting oedema*
- *His post-transfusion chest X-ray showed consolidation thought to be caused by aspiration pneumonia and new bilateral infiltrates consistent with pulmonary oedema*
- *He received oxygen via continuous positive airway pressure, a diuretic, hydrocortisone, bronchodilator and antibiotics*
- *He was transferred to the high dependency unit (HDU) and later recovered*
- *The local procedural review identified single unit with review and not transfusing blood for iron deficiency as preventative actions*

Omitted transfusion-associated circulatory overload (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*

Rapid correction of anaemia can precipitate TACO in the absence of other comorbidities and risk factors (1)

- *A male in his 50s presented to the emergency department (ED) with a 3-4-week history of weakness and dizziness, and had felt unwell for the past 6 months*
- *He was hypotensive (blood pressure (BP) 92/47) but did not show signs of acute haemorrhage though there was some altered blood on rectal examination*
- *On admission his haemoglobin (Hb) was 34g/L, ferritin 26micrograms/L and the electrocardiogram (ECG) showed cardiac ischaemia*
- *He was transfused two units of red cells with a plan for endoscopy and intravenous (IV) iron the following day*
- *A third unit was planned if the post-transfusion Hb was <60g/L*

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Rapid correction of anaemia can precipitate TACO in the absence of other comorbidities and risk factors (2)

- *The first unit was transfused over 31 minutes and the second over 65 minutes*
- *After the second unit his oxygen saturations began to fall despite being on supplemental oxygen and his post-transfusion Hb was 51g/L*
- *A third unit was transfused over 125 minutes and he developed worsening hypoxia, dyspnoea and crackles on chest auscultation*
- *The chest X-ray showed an enlarged cardiac silhouette and pulmonary congestion*
- *He was treated with diuretics and improved*
- *Fortunately, the attending doctor cancelled the fourth unit which had been planned*

Excessive red cell volume given to an overloaded small patient where TACO was not initially suspected (1)

- *A female in her 80s was admitted with a fractured neck of femur*
- *She weighed 40kg and had a preoperative haemoglobin (Hb) of 109g/L*
- *She received 2L of Hartmann's in theatre and returned to the ward with a positive fluid balance (+2425mL)*
- *Her postoperative Hb was 65g/L and she was haemodynamically stable*
- *She was prescribed three units of red cells and her pre-transfusion vital sign observations were normal*
- *Her vital sign observations after the first unit were normal but her fluid balance was then +3454mL*

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Excessive red cell volume given to an overloaded small patient where TACO was not initially suspected (2)

- *The second unit was given after which she became shaky and developed hypertension (175/82), pyrexia (38°C), tachycardia (102 beats per minute), tachypnoea (22 breaths per minute) and her oxygen saturation was 96% on 5L of oxygen*
- *This was reported to the on-call orthopaedic doctor who requested further fluid to be administered stat (250mL Hartmann's) which resulted in a further deterioration of her respiratory status*
- *The attending doctor suspected acute lung injury or sepsis (not circulatory overload)*
- *A chest X-ray was performed on the advice of the consultant haematologist whose opinion had been sought for a possible transfusion reaction*
- *This was consistent with pulmonary oedema*

A complex presentation with difficult decision-making (1)

- *A male in his 60s with history of factor XI deficiency and chronic obstructive pulmonary disease (COPD) had been referred to the colorectal team on a two-week pathway for investigation of anaemia (haemoglobin (Hb) 82g/L, platelets $92 \times 10^9/\text{L}$)*
- *He had felt increasingly unwell and presented to the emergency department (ED)*
- *His Hb was 34g/L, platelets $27 \times 10^9/\text{L}$, neutrophils $0.58 \times 10^9/\text{L}$, he had renal failure (eGFR 36mL/min), hypoalbuminaemia, and prolonged clotting times (prothrombin time (PT) 23.1 seconds (s) and activated partial thromboplastin time (APTT) 90s)*
- *Per rectum examination showed melaena and endoscopy was planned for the following day*
- *He had tachycardia and hypotension*

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A complex presentation with difficult decision-making (2)

- *The ED consultant suspected acute gastrointestinal bleeding and the patient was transfused a total of four units of red cells, three units of fresh frozen plasma (FFP), and one dose of platelets over 9 hours (total >2L in volume)*
- *He developed hypoxia (oxygen saturations <70%) and bradycardia (heart rate 35 beats per minute), and was pale and clammy*
- *He was given oxygen therapy (15L) and diuretics which produced a good diuresis*
- *He received cardiac monitoring and was transferred to the intensive therapy unit (ITU)*
- *The chest X-ray was consistent with pulmonary oedema and peripheral blood film was reported later and showed blast cells*

An inappropriate transfusion leading to TACO and cancelled elective surgery

- *A patient in their 90s was admitted for an elective total knee replacement*
- *The patient's haemoglobin (Hb) was 95g/L and weight was 73kg*
- *Two units of red cells were prescribed for preoperative Hb optimisation*
- *A Hb check was not performed between units and a fluid balance chart was not in place*
- *At the end of the second unit the patient had dyspnoea and was hypoxic, with hypertension and tachycardia*
- *The chest X-ray was suggestive of pulmonary oedema and the post-transfusion Hb was 128g/L*
- *The patient responded to diuretic therapy*
- *The patient's surgery was cancelled due to TACO*

Lack of attention to appropriate red cell dose leads to TACO

- *A patient in their 90s weighing 75kg with a newly diagnosed haematological condition was admitted with sepsis and a Hb level of 79g/L*
- *The patient was known to have heart failure, renal impairment and peripheral oedema and therefore had risk factors for circulatory overload*
- *Two units of red cells were prescribed with prophylactic diuretics*
- *During transfusion of the second unit the patient became breathless, began coughing up frothy sputum, developed bilateral crackles, tachycardia and hypertension*
- *The chest X-ray was consistent with pulmonary oedema*

Inappropriate and excessive transfusion causing TACO in a patient without risk factors for circulatory overload

- *A patient in their 50s weighing 67kg was prescribed six units of red cells for iron deficiency anaemia after being admitted with Hb 37g/L*
- *The patient had no risk factors for TACO except for profound anaemia*
- *During the fifth unit the patient became dyspnoeic, hypoxic and hypertensive*
- *The patient recovered after diuretic therapy and had a post-transfusion Hb level of 100g/L*

Urgent transfusion in the presence of risk factors for TACO

- *A patient with renal failure weighing 37kg with pre-existing fluid overload required red cell transfusion for severe symptomatic anaemia, Hb 50g/L)*
- *The patient had clinical signs of pulmonary oedema (raised jugular venous pressure, dyspnoea and frothy sputum)*
- *The patient also had a pericardial effusion and had required multiple resuscitations*
- *One unit of red cells was prescribed and within an hour of starting the transfusion the patient began to complain of chest pain with increased work breathing, pyrexia, hypertension and tachycardia*
- *The chest X-ray showed features of pulmonary oedema*
- *The transfusion was stopped and the patient was given oxygen and underwent urgent haemodialysis with improvement in the symptoms*

Multiple positive features on the TACO checklist where TACO could probably have been prevented

- *An elderly patient weighing 51kg with pre-existing congestive cardiac failure (CCF) (ejection fraction 30%) and aortic stenosis received regular transfusions due to non-Hodgkin lymphoma*
- *She was admitted with worsening dyspnoea and epigastric/chest pain*
- *Two hours into the transfusion of a red cell unit she developed tachypnoea*
- *The chest X-ray was suggestive of some infective consolidation but also pulmonary oedema/progressive heart failure compared to the previous image*
- *She improved after diuretic treatment*
- *The post-transfusion Hb was 98g/L*

TACO when FFP used instead of PCC due to incorrect anticoagulant management rationale

- *A 75-year-old patient was admitted with suspected lower limb ischaemia*
- *He was already anticoagulated with warfarin for a metallic mitral heart valve*
- *He had a 'poor chest' making him unsuitable for general anaesthetic and therefore required regional anaesthesia*
- *The consultant haematologist was asked to give advice regarding his perioperative anticoagulant management*
- *The consultant advised that the patient was not suitable for PCC because he/she believed there was greater risk of valve-related thrombosis and so suggested FFP and vitamin K instead*
- *Two units of FFP were given on the ward and a further two were to be given in theatre*
- *On arrival in theatre his respiratory status had deteriorated with tachypnoea, reduced oxygen saturation and increased oxygen requirement*
- *Pulmonary oedema was diagnosed. He was treated with nitrates and diuretics and recovered*

Bleeding on direct oral anticoagulants

- *A 69-year-old patient with a history of CCF had persistent bleeding while anticoagulated with a direct oral anticoagulant (anti-Xa inhibitor) for atrial fibrillation*
- *His prothrombin time (PT) and activated partial thromboplastin time (APTT) were slightly prolonged*
- *He was given four units of FFP to treat the bleeding*
- *He became hypertensive and developed tachypnoea and hypoxia*
- *Pulmonary oedema was diagnosed*
- *The patient was treated with diuretics and recovered*

Red cell overtransfusion in chronic megaloblastic anaemia leading to TACO

- *A 90-year-old patient was admitted with severe megaloblastic anaemia (Hb 41g/L) and worsening peripheral oedema due to CCF*
- *The consultant haematologist recommended six units of red cells but the ward staff decided to administer three*
- *The patient developed dyspnoea, hypoxia and fever during the transfusion*
- *The duty doctor diagnosed pneumonia and then eventually fluid overload*
- *The chest X-ray showed worsening pulmonary oedema compared to the previous image performed on admission*
- *The patient was treated with diuretics and recovered*
- *The reporter stated that they felt that it was difficult to attribute fluid overload to transfusion because the X-ray suggested some patchy consolidation and the patient had peripheral oedema on admission*