

# Transfusion-transmitted bacterial infection and current mitigation strategies in Australia

STIR Bulletin no. 7

Dr Phillip Nguyen (Australian Red Cross Lifeblood Haematology Registrar)

**OFFICIAL**

## Summary

- Transfusion-transmitted bacterial infection (TTBI) is a rare but potentially fatal complication of blood transfusion.
- Clinical manifestations may overlap with many other adverse transfusion reactions.
- The initial management of suspected TTBI should include prompt notification to Lifeblood so that associated blood components of the implicated donation may be quarantined, recalled, and tested.
- Bacterial contamination screening (BCS) testing has significantly reduced the rate of TTBI.

## Background

TTBI is an important adverse event of blood component administration with the potential for severe life-threatening outcomes. Historically, infections account for approximately 10–20 per cent of transfusion-related deaths reported to haemovigilance systems (United Kingdom Serious Hazards of Transfusion surveillance system [SHOT], US Food and Drug Administration [FDA], French haemovigilance system), with the majority (~85 per cent) being due to septic reactions from TTBI (Vamvakas et al. 2009). More recent data from the Australian haemovigilance report documented 19 cases of TTBI (all suspected but unconfirmed) from 2016 to 2018, with no deaths occurring during this period.

The potential for blood component contamination can arise from multiple sources during the supply chain. This includes donor skin during the collection process, unrecognised bacteraemia in the donor at time of donation, environmental contamination, contamination during the preparation of components, and contamination of the ports of frozen products while thawed in a water bath.

A wide spectrum of organisms can be associated with TTBI, including skin, enteric and environmental organisms (Table 1). In a study involving 41 transfusions with proven bacterial contamination, gram-negative organisms accounted for nearly half of cases (Perez et al. 2001). This is important, as the greatest risk of death is with gram-negative bacteria, conferring an odds ratio (OR) of 7.5 (95 per cent CI 1.3–64.2) in one study (Kuehnert et al. 2001). Fortunately, the proportion of these organisms cultured has drastically reduced with contemporary mitigation strategies discussed below, accounting for ~1 per cent of cultured component (Thyer et al. 2018).

**Table 1: The proportion of organisms isolated from blood component as a percentage of all confirmed isolates and transfused units (abbreviated from Thyer et al. 2018)**

	Percentage cultured (%)	Percentage transfused (%)
<i>Propionibacterium</i> sp.	81.8	95.1
Coagulase-negative <i>staphylococcus</i>	9.2	1.2
Mixed skin flora	2.8	2.8
<i>Streptococci</i> sp.	2.4	0
Pathogenic gram-negative rods	1.0	0
<i>Staphylococcus aureus</i>	0.7	0
<i>Corynebacterium</i> sp.	0.5	0.7
<i>Enterococcus faecalis</i>	0.3	0

## Suspecting TTBI and management

Clinical manifestations of TTBI overlap with many other transfusion adverse events. These include high fever, rigors, chills, tachycardia, nausea and vomiting, dyspnoea and hypotension, which can be similarly observed in haemolytic transfusion reactions, allergic reactions, transfusion related lung injury (TRALI) and other causes.

In some TTBIs, the above symptoms may be accompanied with circulatory collapse, shock, accompanying renal failure and disseminated intravascular coagulation (DIC). TTBI's may be fatal. The median interval between transfusion completion and the onset of symptoms is approximately 30 minutes (range 0-5 hrs) (Perez et al. 2001). However, this is generally shorter with gram-negative sepsis. Importantly, some TTBI can occur without major signs or symptoms. In one study, approximately 50 per cent of confirmed cases of TTBI had only minor symptoms (Perez et al. 2001). Several factors account for the varying severity, including inoculum size, bacterial virulence, and host immune system. For these reasons, TTBI requires a high index of clinical suspicion.

Because of the clinical overlap with other adverse transfusion reactions, the initial steps in management are similar. This includes cessation of the transfusion, checking and monitoring vital signs, not flushing the existing line (a new IV line may be required), maintaining IV access, patient resuscitation, checking for clerical errors, and collection of donor (from component) and recipient blood for further testing. If the clinical suspicion of TTBI is high, the blood component pack should be sealed, and gram stain and culture performed on both the patient and the component/s implicated in the transfusion reaction. In this setting, patients may be commenced on empiric broad-spectrum antibiotics.

Immediate contact should be made with Australian Red Cross Lifeblood (Lifeblood) so that blood components associated with the implicated donation may be quarantined and recalled, and culture testing on non-transfused products initiated. If a clinically significant organism is cultured, clinician notification of other transfused components associated with this donation will be required.

## Mitigation strategies

Several strategies to mitigate TTBI have been implemented at Lifeblood in the past two decades. Changes to skin disinfection were introduced in 2004, followed by diversion pouches in 2006 that discarded the first 30 mL of blood. Universal bacterial contamination screening (BCS) of platelets was introduced in 2008 (Thyer et al. 2018).

The practice in Australia from November 2020 involves inoculating a larger volume of 8–10 mL of donor sample from either pooled or every apheresis platelet unit into both aerobic and anaerobic culture bottles. The number of bottles to inoculate will increase based on platelet dose. For instance, double apheresis units require inoculation of 4 bottles in total. These cultures are incubated for up to seven days using the BacT/ALERT 3D automated microbial detection system that relies on the colorimetric detection of carbon dioxide produced by growing microorganisms.

The time from collection to BCS inoculation has recently changed from 24 to 36 hours, reflecting the transition to a seven-day shelf life for platelets from March 2021. In the case of the pooled platelets, the 36 hours is counted from the time of the most recent platelet donation contributing to that pool. Platelets are subsequently released into the inventory once BCS inoculation is performed.

The implementation of BCS in Australia has been shown to reduce the incidence of TTBI (Thyer et al. 2018). The rate of probable TTBI from platelet transfusions fell from 1.6 per 100,000 to 0.4 per 100,000 transfused. Similarly, probable TTBI from red blood cells also decreased from 0.1 per 100,000 to 0.04 per 100,000 transfused. Most organisms from confirmed episodes were *Propionibacterium* (81.8 per cent) and coagulase-negative *Staphylococcus* (9.2 per cent) species.

An important aspect of BCS is the time to detection, which allows for components to be recalled before transfusion. Importantly, pathogenic organisms such as *staphylococcus aureus* and gram-negative rods flag positive within 15 hours on average. Consequently, blood components contaminated with these organisms are often able to be successfully recalled prior to transfusion (Thyer et al. 2018). In contrast, low-virulence *Propionibacterium* species are detected much later, with an average detection time of 145.8 and 101.8 hours in the aerobic and anaerobic bottles, respectively. The long seven-day incubation period may facilitate detection of these organisms. The recent transition to seven-day shelf-life platelets and larger-volume BCS sampling at 36 hours may further increase the detection of slow growing organisms like *Cutibacterium acnes*.

Where a blood product has been transfused prior to receiving information of potential contamination, the clinical unit caring for the patient should be informed immediately to assess the patient condition and start appropriate treatment if required.

## References

Vamvakas EC and Blajchman MA 2009, 'Transfusion-related mortality: the ongoing risks of allogeneic blood transfusion and the available strategies for their prevention', *Blood*, vol. 113, no. 15, pp. 3406–17.

Perez P, Salmi LR, Follea G, Schmit JL, de Barbeyrac B, Sudre P, et al. 2001, 'Determinants of transfusion-associated bacterial contamination: results of the French BACTHEM Case-Control Study', *Transfusion* vol. 41, no. 7, pp. 862–72.

Kuehnert MJ, Roth VR, Haley NR, Gregory KR, Elder KV, Schreiber GB, et al. 2001, 'Transfusion-transmitted bacterial infection in the United States, 1998 through 2000', *Transfusion*, vol. 41, no. 12 pp. 1493–99.

Thyer J, Perkowska-Guse Z, Ismay SL, Keller AJ, Chan HT, Dennington PM, et al. 2019, 'Bacterial testing of platelets - has it prevented transfusion-transmitted bacterial infections in Australia?' *Vox Sang.*, vol. 113 no. 1, pp. 13-20.

Authorised and published by the Victorian Government, 1 Treasury Place,  
Melbourne.

© State of Victoria, Australia, Department of Health and Human Services August  
2021.

To receive this publication in an accessible format phone 03 9694 0102, using the National  
Relay Service 13 36 77 if required, or email Blood Matters

[bloodmatters@redcrossblood.org.au](mailto:bloodmatters@redcrossblood.org.au)

ISSN 2652-6212 – Online (pdf / word).