A Practical Approach to Transfusion Reactions

With a Focus on TACO and TRALI



TACO: Transfusion-Associated Circulatory Overload

TRALI: Transfusion-Related Acute Lung Injury

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Transfusion Reactions Matter

- Common, and sometimes serious
- Unfamiliar to some clinicians
- Dangerous in patients with little reserve
- May lead to escalation of care (i.e. ICU admission)
- Costly for patients, families, staff and health care system
- Often manageable, sometimes preventable

Sources: AABB Association Bulletin #15-02, revised 2026; SHOT Annual Report 2025.

Categorizing Transfusion Reactions

	ACUTE during or < 24 h post transfusion	**DELAYED** > 24 h; timing varies by complication
Immune	• Acute hemolytic (ABO) • Febrile nonhemolytic • Minor allergic, anaphylaxis • **TRALI**	• Delayed hemolytic / serologic • Red-cell alloimmunization • Post-transfusion purpura • TA-GvHD
Non-immune	• **TACO** • Bacterial contamination / sepsis • Transfusion-associated dyspnea • Hypotensive reaction; non-immune hemolysis	• Iron overload • Transfusion-transmitted infection (viral, parasitic, prion)

Sources: Bloody Easy 5.1 (ORBCoN, 2023); Canadian Blood Services Clinical Guide to Transfusion, Chapter 10: Transfusion reactions.

When Do Reactions Appear?



Fever (FNHTR)
During or within 4 h

TACO
During or up to 12 h

Delayed hemolytic reaction
24 h to 28 days

TRALI
During or within 6 h

Transfusion-associated dyspnea
Within 24 h

Post-transfusion purpura
Within about 2 weeks

The initial symptom creates the differential.

Sources: Bloody Easy 5.1 (ORBCoN, 2023); Canadian Blood Services Clinical Guide to Transfusion, Chapter 10.

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How Common Are They?

COMMON

about 1 in 100 to 1 in 300

Minor allergic (urticaria)
1 in 100

TACO
1 to 2.7 in 100 transfusion episodes

Febrile nonhemolytic
1 in 100 platelet pools; 1 in 300 RBC units

UNCOMMON

about 1 in 2,500 to 1 in 10,000

Delayed hemolytic reaction
per patient transfused,
1 in 2,500

TRALI
1 in 10,000

RARE

1 in 40,000 or less

Severe allergic / anaphylaxis
1 in 40,000

Bacterial sepsis, RBC
1 in 250,000 units

HIV transmission
about 1 in 12.9 million units

TACO is among the most common serious reactions. TRALI is less common, but both cause acute hypoxemia.

Source: Bloody Easy 5.1, Risk charts (ORBCoN, 2023). Estimates have wide confidence intervals and denominators differ (per unit, pool or episode).

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Suspected Acute Transfusion Reaction: First Actions



STEP 1

Stop the Transfusion.

STEP 2

CHECK Patient.

STEP 3

CHECK Product.

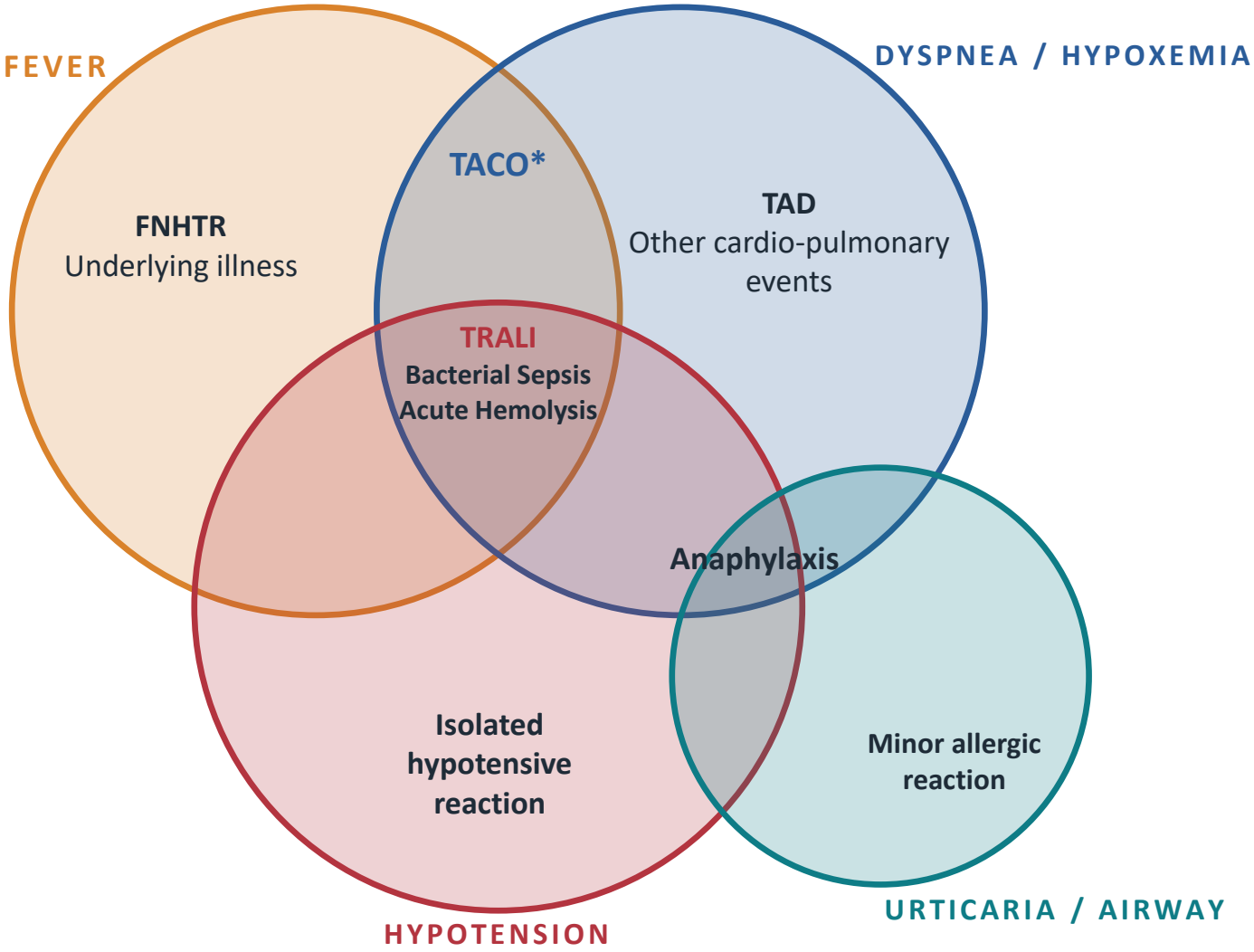
STEP 4

Document

Source: Bloody Easy 5.1.

Start with sign(s) and symptom(s)
Don’t Stop at One Symptom: They Overlap!

Use the leading symptom to open the differential; use the whole picture to close it.



Sources: Bloody Easy 5.1; Canadian Blood Services Clinical Guide, Ch. 10; Parmar et al., Vox Sang 2017. Schematic: overlaps are typical, not exhaustive.

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Case 1: A New Fever

74-year-old man

Myelodysplastic syndrome, transfusion-dependent

BEFORE TRANSFUSION

- Temperature 36.9 °C
- BP 132/78, HR 80
- No signs of infection

TREATMENT

Red cell transfusion is started.

75 MIN INTO THE RBC Transfusion

Chills. BP and SpO_2 unchanged.

38.4 °C

up from 36.9 °C

ACTION

Transfusion stopped. Clerical check correct, DAT negative.

Fictional teaching composite based on NHSN/AABB hemovigilance criteria.

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Approach to Fever During / Post-Transfusion

FEVER (and/or shaking chills or rigors): rise > 1°C AND temperature > 38°C, during or up to 4 hours after transfusion

STEP 1 **Stop the Transfusion** → STEP 2 **CHECK Patient.** → STEP 3 **CHECK Product** → STEP 4 **Document**

Fever differential

Febrile Nonhemolytic Transfusion Reaction (FNHTR)
Most common.

Acute hemolytic
ABO or clerical error.

Bacterial contamination
Highest risk with platelets.

How to tell them apart:
Blood group error or serious symptoms?

Temperature ≥ 39°C · hypotension / shock · shaking chills / rigors · dyspnea · back / chest pain
hemoglobinuria / oliguria · bleeding from IV sites · nausea / vomiting

↓ **NO**

Likely FNHTR

Give acetaminophen 325-650 mg

continue cautiously under observation.

Stop if any serious symptom develops; then do not restart.

↓ **YES**

DO NOT RESTART

Suspect hemolytic reaction or bacterial contamination:

recheck ABO group; return unit and tubing for culture and Gram stain; blood cultures from a different site; first post-transfusion urine; antibiotics if sepsis suspected.

Sources: Bloody Easy 5.1, Fever algorithm (ORBCoN, 2023); Canadian Blood Services Clinical Guide to Transfusion, Chapter 10.

Case 1

FNHTR

Febrile Non-Hemolytic Transfusion Reaction

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Case 2: An Itchy Rash



45-year-old woman

Acute myeloid leukemia, on induction chemotherapy

BEFORE TRANSFUSION

- Platelets 8 × 10^9/L
- Vital signs normal
- No rash

TREATMENT

Platelet transfusion is started.

20 MIN INTO THE UNIT

Itchy rash on arms and chest. No wheeze or swelling.

124/76

BP, unchanged

ACTION

Transfusion paused; antihistamine given.

Fictional teaching composite based on NHSN/AABB hemovigilance criteria.

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Approach to Urticaria and Allergic Reactions

Urticaria ddx

Minor allergic

Anaphylaxis

STEP 1 Stop the Transfusion

STEP 2 CHECK Patient.

STEP 3 CHECK Product

STEP 4 Document

How to tell them apart: Accompanying symptoms

Hypotension · dyspnea / cough · tachycardia · generalized flushing · nausea / vomiting · widespread rash > ⅔ of the body

Consider restarting only after assessment supports a mild isolated reaction, symptoms have resolved.

NO

Consistent with a minor allergic reaction

Give diphenhydramine 25-50 mg IV/PO and continue the transfusion cautiously. **Stop if any serious symptom develops; then do not restart.**

YES

DO NOT RESTART

ACTIVATE THE EMERGENCY RESPONSE and give intramuscular epinephrine promptly according to the local anaphylaxis protocol..

Sources: Bloody Easy 5.1, Urticaria and other allergic reactions/anaphylaxis algorithm (ORBCoN, 2023); Canadian Blood Services Clinical Guide to Transfusion, Chapter 10.

Case 2

Minor allergic Reaction

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Case 3: A Sudden Drop in Blood Pressure

68-year-old man

Day 1 after hip replacement

BEFORE TRANSFUSION

- Takes ramipril (ACE inhibitor)
- BP 134/80, Hb 72 g/L
- No active bleeding

TREATMENT

Red cell transfusion is started.

10 MIN INTO THE UNIT

Flushing. No fever, rash or dyspnea.

76/42

BP (mmHg)

ACTION

Transfusion stopped. BP recovers within 15 minutes.

Fictional teaching composite based on NHSN/AABB hemovigilance criteria.

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Approach to Hypotension During Transfusion

HYPOTENSION- ADULT: systolic drop ≥ 30 mmHg from baseline **AND** absolute systolic ≤ 80 mmHg, during or within 1 hour of completing transfusion

STEP 1 **Stop the Transfusion** → STEP 2 **CHECK Patient.** → STEP 3 **CHECK Product** → STEP 4 **Document**

Differential	Acute hemolytic	Bacterial sepsis	Severe FNHTR	Bradykinin-mediated hypotension	TRALI	Anaphylaxis

Is the hypotension related to the transfusion?

NO ↓

Unrelated to transfusion: possibly resume the transfusion after reassessing.

YES ↓

Do not restart the transfusion. Follow the algorithm for the suspected reaction.

Bradykinin-mediated hypotension: 3.2 per 100,000 units; mostly with platelets; over half on ACE inhibitors. Routine vitals check at 15 minutes after restarting transfusion.

Source: Bloody Easy 5.1, Hypotension algorithm and bradykinin-mediated hypotension (ORBCoN, 2023).

Case 3:

Bradykinin-Mediated Hypotensive Transfusion reaction

Case 4 presentation:

Case 4: Sudden Hypoxemia During RBC Transfusion



82-year-old woman

Admitted with gastrointestinal bleeding

MEDICAL HISTORY

- Heart failure with preserved ejection fraction
- Chronic kidney disease
- Hypertension
- Body weight 49 kg

STATUS

Bleeding has stopped. Hemodynamically stable. Hemoglobin 64 g/L.

ORDER

Two RBC units are ordered.

75 MINUTES INTO THE SECOND RBC UNIT

Sudden dyspnea and desaturation

82%

SpO_2 on room air

ACTION

The transfusion is stopped.

Fictional teaching composite based on current TACO criteria.

Approach to Dyspnea/Hypoxemia During Transfusion

DYSPNEA: new or worsening respiratory distress during or after transfusion

STEP 1 **Stop the Transfusion** → STEP 2 **CHECK Patient.** → STEP 3 **CHECK Product** → STEP 4 **Document**

Differential

TACO	TRALI	Anaphylaxis	TAD*
During or up to 12 h	*During or within 6 h*	*Usually within minutes*	*Within 24 h*

Provide oxygen and supportive care, administer diuretics when clinically indicated, and consider BNP testing.

NEXT

Order a STAT chest X-ray

TRALI suspected: notify the transfusion service immediately for donor and recipient testing

***TAD (transfusion-associated dyspnea):** respiratory distress within 24 h of transfusion that does not meet criteria for TACO, TRALI or an allergic reaction. It must be the most prominent clinical feature and not explained by the underlying condition or another known cause.

Source: Bloody Easy 5.1, Dyspnea management algorithm (ORBCoN, 2023); Canadian Blood Services Clinical Guide to Transfusion, Chapter 10.

Case 4:



1. What is your leading diagnosis?
2. What are two reasonable alternatives?
3. What single piece of information would most change your mind?

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Case 4: Bedside Clues

Parameter	Before transfusion	At the reaction
Blood pressure	132/68 mmHg	**178/92 mmHg**
Heart rate	78/min	**112/min**
Respiratory rate	18/min	**34/min**
O_2 saturation (RA)	96%	**82%**
Temperature	—	**37.4°C**

EXAMINATION

Present

- Bilateral crackles
- Elevated jugular venous pressure
- New peripheral edema

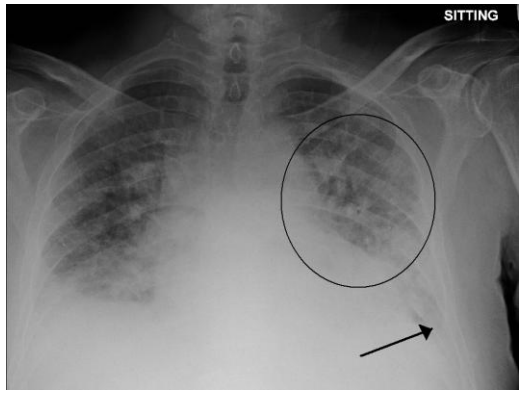
Absent

- Urticaria
- Wheeze
- Stridor
- Back pain

Fictional teaching composite based on current TACO criteria.

Case 4: Evidence Accumulates

Chest radiograph shows new bilateral interstitial and alveolar pulmonary edema, small bilateral pleural effusions, and an enlarged cardiac silhouette.



- Post-transfusion reaction NT-proBNP is more than 1.5 times the pretransfusion value
- Intravenous furosemide produces brisk diuresis with rapid improvement

Fictional teaching composite based on current TACO criteria.

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Case Summary

82-year-old woman with HFpEF and chronic kidney disease

- 75 minutes into the second RBC unit.-→Acute

- Sudden dyspnea; SpO_2 82% on room air.

- No urticaria, wheeze, stridor, or back pain.

- BP 178/92 mmHg; HR 112/min; RR 34/min. Bilateral crackles, elevated JVP, and peripheral edema.

- Bilateral pulmonary edema, small pleural effusions, -proBNP >1.5× baseline.

- Brisk diuresis and rapid improvement in breathing and oxygenation after IV furosemide.

MOST CONSISTENT DIAGNOSIS

TACO

Transfusion-associated circulatory overload

Fictional teaching composite. Summary of the supplied Case 1 slides.

TACO: Current International Surveillance Definition

Timing: during or **up to 12 hours** after transfusion.

REQUIRED: AT LEAST ONE OF

A **Acute or worsening respiratory compromise**

B **Acute or worsening pulmonary edema based on**

- **Clinical Examination and/or**
- **imaging, and/or**
- **other noninvasive cardiac assessment (echocardiogram)**

PLUS SUPPORTING CRITERIA · *at least 3 criteria in total from A to E*

C New cardiovascular changes not explained by the underlying condition, such as tachycardia, hypertension, raised JVP, cardiomegaly, or peripheral edema

D Evidence of fluid overload, positive balance, weight change, or improvement with diuresis

E Supportive biomarker findings: posttransfusion BNP or NT-proBNP above the age-specific reference range AND greater than 1.5 times the pretransfusion value.

These are surveillance criteria. They do not replace immediate clinical treatment.

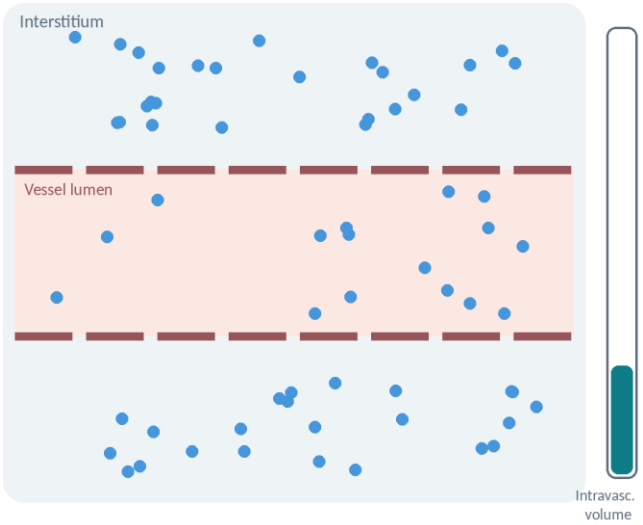
Sources: ISBT-IHN-AABB TACO definition, 2018; Wiersum-Osselton et al., Lancet Haematology 2019.

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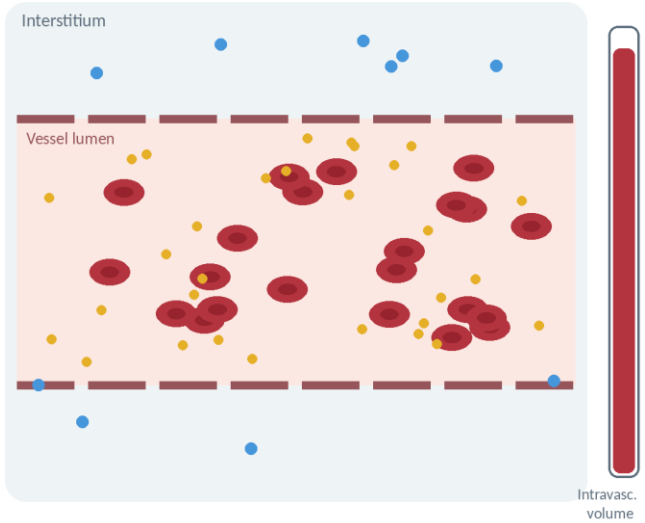
300 mL of Saline # 300 mL of Blood

1 Crystalloid redistributes



#

2 Blood components are retained



3 At-risk patients:

- Age over 70, or infants
- Heart failure or LV dysfunction (including prior MI)
- Renal impairment
- Positive fluid balance or existing fluid overload
- Severe euvolemic anemia (Hb < 50 g/L)

1 **Crystalloid:** Isotonic crystalloid redistributes through the extracellular space

Result: When pressure-driven pulmonary capillary filtration exceeds lymphatic drainage, fluid accumulates in the interstitium and eventually the alveoli.

2 **Blood components:** Red cells normally remain within the circulation.
Plasma proteins are relatively retained but undergo transvascular exchange and lymphatic return.

Sources: Woodcock & Woodcock, Br J Anaesth 2012; Hahn, Anesthesiology 2010; CBS RBC product information; Semple et al., Blood 2019; AABB Bulletin #15-02 (2026). Panel 3 is schematic.

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Who Can Leave the Hall?



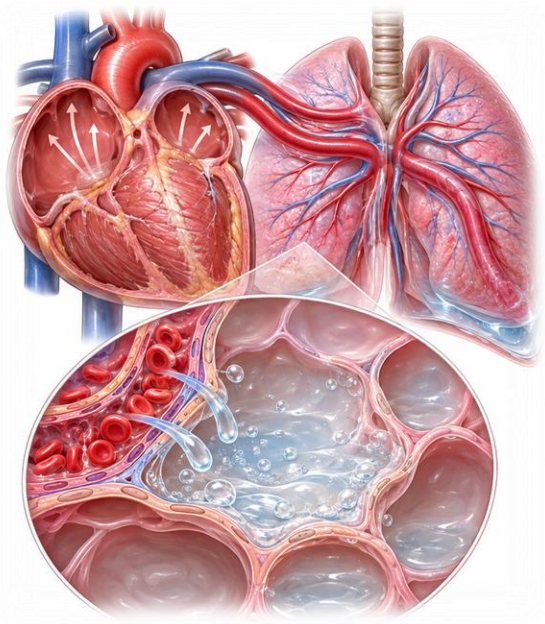
Crystalloid
Small guests slip out the little doors



Red cells and plasma proteins
Big guests are too large for the doors

From Volume Overload to Hypoxemia: What Happens in TACO

1. **Retained volume:** circulating volume rises.
2. **Raised filling pressures**
3. **Raised pulmonary capillary pressure**
4. **Interstitial, then alveolar edema**
5. **Hypoxemia**





Sources: Semple et al., Blood 2019; AABB Association Bulletin #15-02, revised 2026; ISBT-IHN-AABB TACO definition, 2018. Illustrations are a teaching analogy.

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Preventing TACO: When Transfusion Is Necessary

1

Assess risk and baseline

Review **cardiac** and **renal** history, fluid balance, and baseline respiratory status.

2

One RBC unit, then reassess

In stable, nonbleeding adults, reassess before another unit.

3

Individualize volume and rate

Use a slower rate in at-risk patients; avoid unnecessary IV fluids; consider split units.

4

Preventive diuresis selectively

Consider in selected high-risk patients; not routine for everyone.

5

Allow time for monitoring

Schedule nonurgent outpatients early enough for slow infusion, reassessment, and observation.

Necessary transfusion still requires a safe dose, rate, and monitoring plan.

Sources: AABB Association Bulletin #15-02, updated March 2026; CBS Clinical Guide, Chapter 10. Scheduling: suggested local workflow.

- TACO: Underrecognized, Yet a Leading Cause of Transfusion-associated fatality

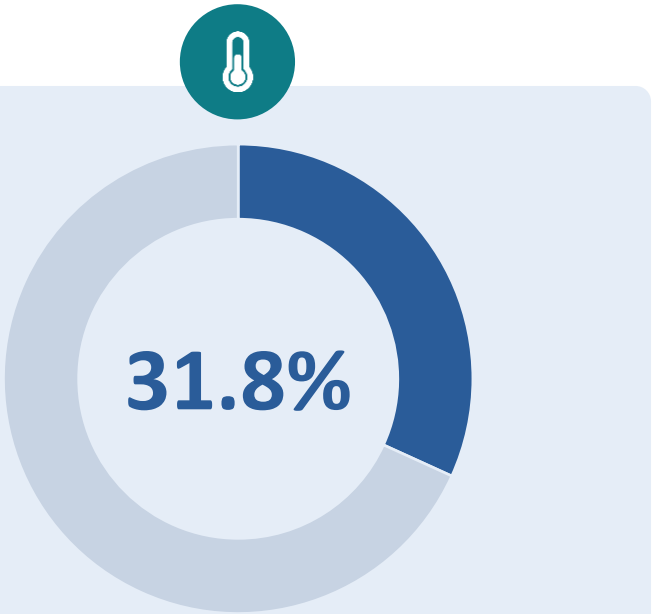
Benefits Across the Care Team



	Patient	Clinical team	Transfusion medicine
If not suspected	• Progressive hypoxemia • Escalating oxygen requirement • Risk of ICU admission	• Repeated overnight escalations • Ongoing clinical deterioration • Uncertainty about further transfusion	• Incomplete documentation (no X-ray, no diuretic) • Repeated follow-up calls • Uncertain classification

Early recognition improves patient outcomes, reduces avoidable escalation, and supports accurate classification.

Important Pitfall: Fever Does Not Exclude TACO



New reaction-associated fever occurred in 31.8% of 107 suspected TACO cases in one retrospective cohort.

Source: Parmar et al. Vox Sanguinis. 2017;112:70-78; Bloody Easy 5.1.

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Case 5 presentation:

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Case 2: The Same First Symptom



60-year-old woman

known congenital factor V deficiency presents with significant gastrointestinal bleeding. Plasma is prescribed for factor replacement because no specific factor V concentrate is available.

BEFORE TRANSFUSION

- No history of heart failure or renal failure
- No pneumonia, sepsis, trauma, or aspiration
- Oxygen saturation 97% on room air
- Respiratory status **stable** during the preceding 12 hours

TREATMENT

Plasma transfusion is started.

40 MINUTES INTO THE SECOND PLASMA UNIT

Severe dyspnea and desaturation

80%

SpO_2 on room air

ACTION

The transfusion is stopped.

Fictional teaching composite based on current TRALI criteria.

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Case 5: More Information

Parameter	Before transfusion	At the reaction
Blood pressure	126/72 mmHg	**88/54 mmHg**
Heart rate	82/min	**118/min**
Respiratory rate	17/min	**36/min**
Temperature	36.9°C	**38.1°C**
O_2 saturation (RA)	97%	**80%**

EXAMINATION

Present

- Diffuse crackles

Absent

- Elevated JVP
- Peripheral edema
- S3
- Urticaria
- Wheeze
- Stridor

Fictional teaching composite based on current TRALI criteria.

Case 5

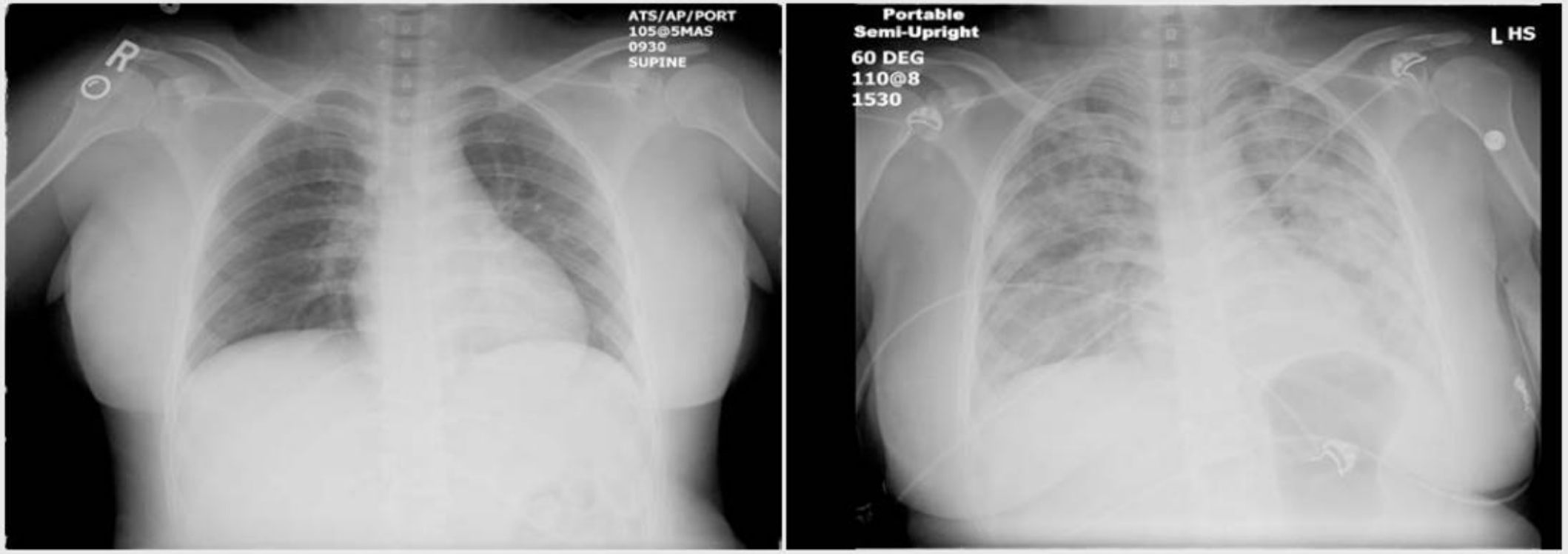


Fig 1: Pre and Post transfusion X-rays of our patient with TRALI. Bilateral Lung infiltrate with pulmonary edema is an essential criteria for the clinical diagnosis of TRALI.

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Case Findings

CXR

Imaging

- New diffuse bilateral pulmonary opacities
- Normal cardiac silhouette
- No significant pleural effusions

ECHO

Cardiac assessment

- Preserved cardiac function
- No evidence that left atrial hypertension is the principal cause

BNP

Biomarker

- NT-proBNP has not increased substantially from baseline

+

Additional supporting findings

- Recipient and component cultures subsequently remain negative
- No convincing evidence that elevated cardiac filling pressures are the principal cause of the edema
- Oxygen and respiratory support provided; hypotension managed appropriately

MOST CONSISTENT DIAGNOSIS

TRALI

Type I

Transfusion-related acute lung injury

Fictional teaching composite based on current TRALI criteria.

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TRALI: 2019 Consensus Definition

COMMON FEATURES OF TYPE I AND TYPE II

All four must be present

1 TIMING

Acute onset during or within 6 hours after transfusion

2 HYPOXEMIA

PaO_2/FiO_2 ≤300 or oxygen saturation <90% on room air

3 IMAGING

Bilateral pulmonary edema on chest imaging

4 CARDIAC PRESSURE

Left atrial hypertension absent, or not the principal cause

KEY DIFFERENCES BETWEEN TYPE I AND TYPE II

TYPE I

- **No ARDS risk factor**
- No temporal relationship to another ARDS risk factor

TYPE II: ADDITIONAL CRITERIA

- **ARDS risk factor present, or pre-existing mild ARDS**
- Respiratory status stable during the preceding 12 hours
- The worsening respiratory condition is caused by the transfusion.

i Donor antibody detection is not required for the clinical diagnosis.

Source: Vlaar et al. A consensus redefinition of TRALI. Transfusion. 2019;59:2465–2476.

TRALI

Transfusion-Related Acute Lung Injury

Permeability pulmonary edema

Donor antibodies and/or biologic response mediators

↓

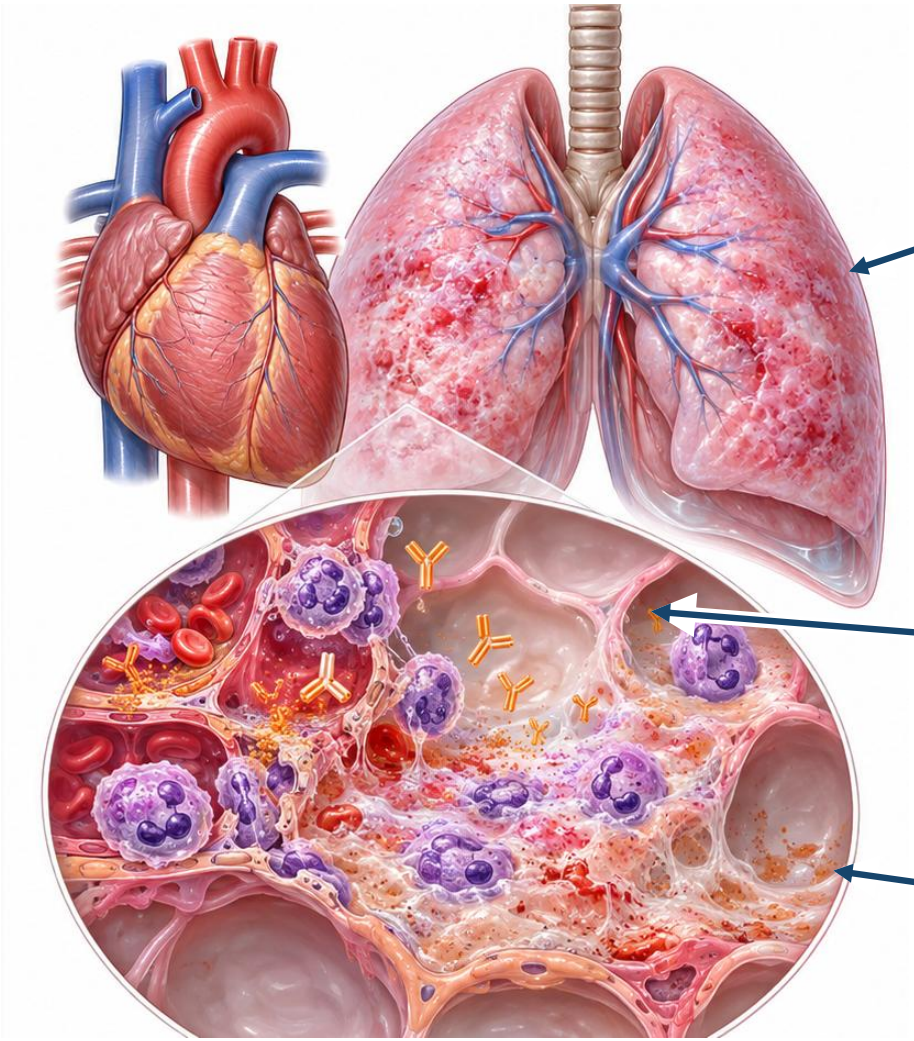
Neutrophil activation and endothelial injury

↓

Increased capillary permeability

↓

Protein-rich fluid in alveoli



Noncardiogenic pulmonary edema

Endothelial injury and capillary leak

Protein-rich edema (high protein)

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TRALI: Treatment, Prognosis, and Prevention

Treatment

- Stop the transfusion and provide oxygen and respiratory support.
- Use noninvasive ventilation or intubation with lung-protective ventilation when required.
- Manage hypotension carefully.
- Diuretics are not routine treatment for isolated TRALI. Use them only when clinically significant circulatory overload also exists.
- No specific pharmacologic therapy has proven benefit; corticosteroids are not routinely supported.

PROGNOSIS

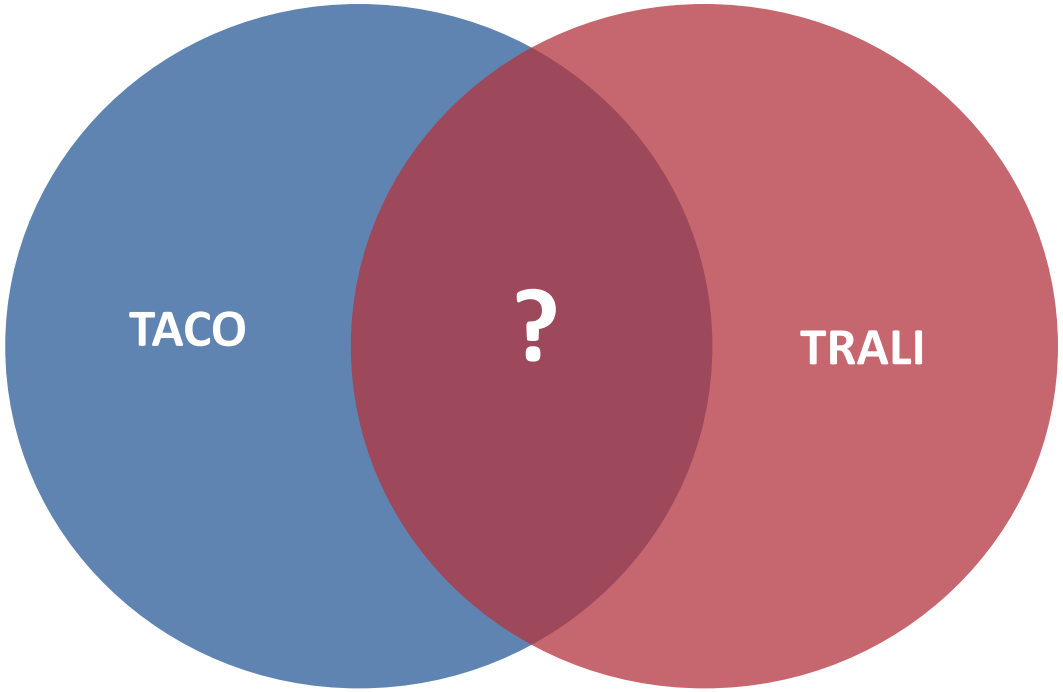
Many patients improve over several days, but severe cases may require ICU admission and mechanical ventilation. Outcome varies with severity and comorbidity.

PREVENTION AND REPORTING

- Notify the transfusion service promptly. The blood supplier coordinates investigation of implicated donors for leukocyte antibodies and recipient testing for corresponding antigens when indicated.
- Donor and recipient HLA/HNA testing is coordinated through the blood supplier.
- Donor mitigation and plasma-reduction strategies have reduced TRALI risk.

Sources: Bloody Easy 5.1; Canadian Blood Services Professional Education; Vlaar et al., Transfusion 2019.

When TACO and TRALI Cannot Be Distinguished



TRALI/TACO CANNOT BE DISTINGUISHED

Source: Vlaar et al., Transfusion 2019; AABB Association Bulletin #15-02, revised 2026.

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Take-Home Messages: Recognize, Treat, Report

Recognize and stabilize.

Stop the transfusion, assess the patient, and provide oxygen and respiratory support.

TACO: treat suspected circulatory overload. LEADING Cause of transfusion associated mortalities

Give diuretics when clinically indicated; escalate respiratory support or ICU care as needed.

TRALI: support oxygenation and circulation.

Provide supportive respiratory care; avoid routine diuretics unless overload also exists.

Interpret the whole clinical picture.

No single finding reliably separates TACO from TRALI. Fever does not exclude TACO.

Notify early and document clearly.

Document the onset, clinical findings, transfusion details, and treatment response.

Sources: Supplied lecture, documentation and take-home slides; AABB #15-02 (2026); CBS Clinical Guide; Vlaar et al., Transfusion 2019.

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THANK YOU

