TACO

Est-ce que cette complication transfusionnelle peut être prédite et prévenue?

Jeannie Callum, BA, MD, FRCPC, CTBS

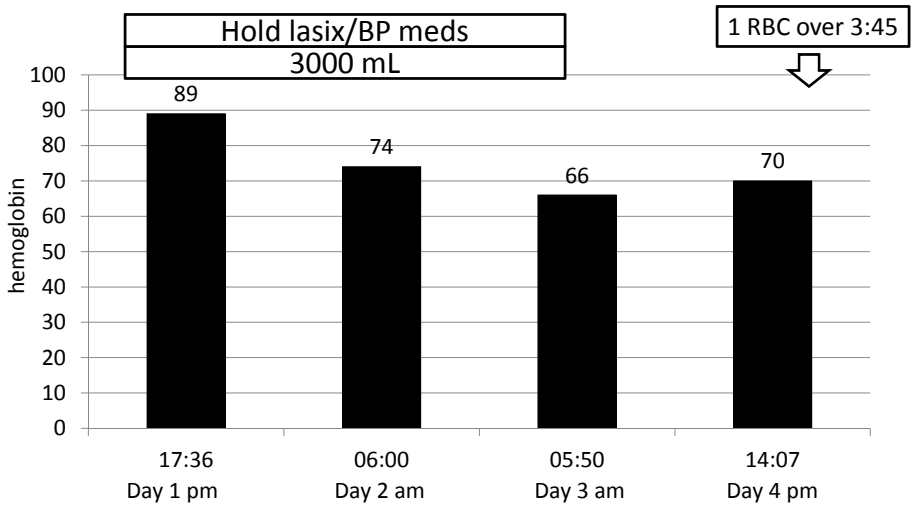
Sunnybrook
HEALTH SCIENCES CENTRE

2

Case

- **89 year old** man with a 3 year history of CLL (followed by family MD) admitted with sepsis
- Past medical history of **heart failure, coronary disease, and hypertension**
- ASA, **Lasix 60 mg**, Synthroid, Metoprolol, Ramipril
- Streptococcus parasanguinis detected in blood
- Admission exam: BP 95/59, 91% on 2 liters, cardiac exam normal, peripheral **edema**, **bibasilar crackles** on respiratory exam
- CBC: white count 657 (never treated)

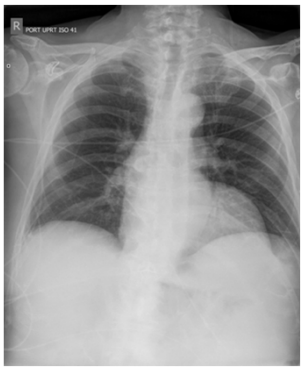
First 5 Days



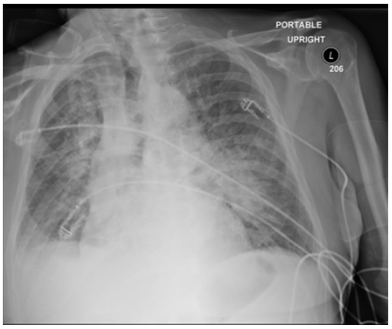
Transfusion reaction

- Transfused started at 20:10, completed at 23:45
- At 03:30 transfusion reaction identified
- Increase in heart rate (121 to 134), increase in respiration (20 to 35), increase in BP (100/60 to 127/72)
- Hypoxia (98% to 78%)
- Lungs: crackles

Chest x-ray performed



Admission



5 hours after
the end of transfusion

Management

- 100% oxygen by BiPAP
- Patient transferred to ICU
- Over the next 6 hours: 3 doses of furosemide totaling 140 mg
- Brisk diuresis followed by weaning from BiPAP
- Hemoglobin 100 g/L post 1 unit transfusion
- Complete recovery and discharged from ICU

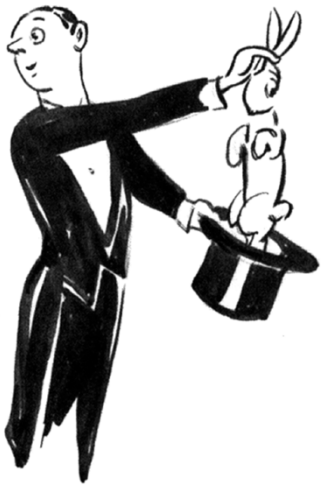
‘negative’ issues

- 3000 mL crystalloid pre-transfusion
- Diuretics held
- Anti-hypertensives held
- Physical exam at admission: failure
- No fluid assessment immediately pre-transfusion
- Elective transfusion started at 8 PM at night
- No pre-emptive diuretics
- At time of reaction 1st dose of lasix was administered orally (20 mg only)

‘positive’ issues

- Transfusion run over 3-4 hours
- Reaction reported
- Chest x-ray done
- Survived

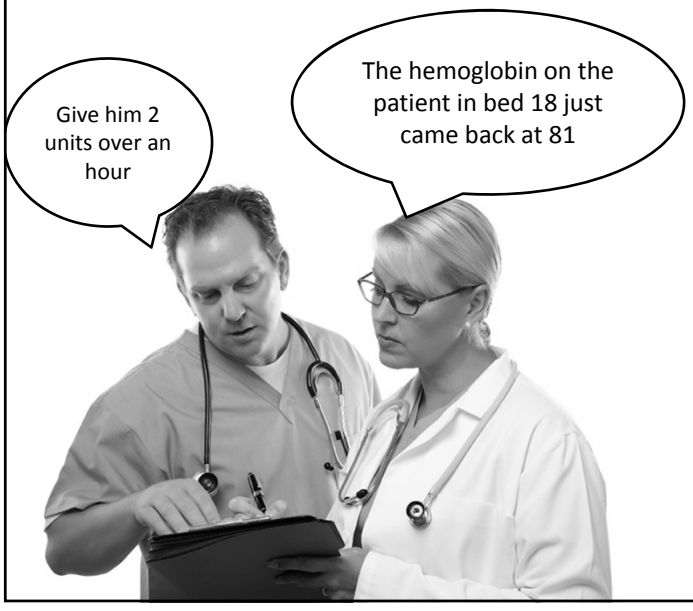
présentation magique



Options to prevent TACO

- **Promote non-transfusion options**
- No verbal orders for transfusion
- Mandatory pre-transfusion risk assessment and volume assessment
- **Hospital fluid management protocols**
- Slow the rate of transfusion
- Pre-emptive furosemide
- 1 RBC at a time
- **Platelet additive solution (not plasma)**
- Plasma volume (supernatant) reduction for RBC/Platelets
- 'Critical' nursing supervision

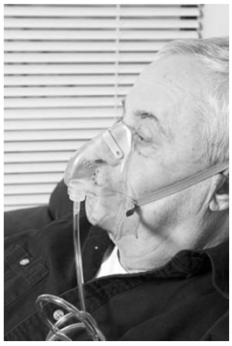
Verbal orders



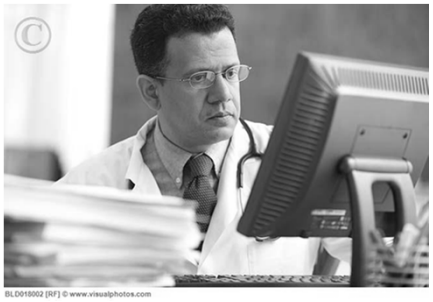
The perfect 'pre-transfusion' world

- Chart review of risks for TACO
- Assessment of fluid balance
- Assessment of current oxygen therapy
- Pre-transfusion physical exam
  - Vitals, oxygen saturation, jugular venous pressure, heart sounds, respiratory exam, edema

Verbal orders



Mandatory pre-transfusion risk assessment and volume assessment



We need new blood
Standard requiring this

Risk assessment

- Age > 70 years
  - TACO patients are older compared to patients without TACO (mean age 84 vs. 77 years)
  - Quebec hemovigilance 64% over age 70
  - TACO older than TRALI patients (73 vs. 60)
  - However, hemovigilance systems report TACO in all age groups (2.6% <18, 14% 18-59, 19% 60-69) and mean age in one report was 60 years (range 8-89)

Popovsky MA, et al. *Immunohematology.* 1996;12(2):87-89.
Robillard P, et al. *Transfusion* 2008; 48 suppl: 204A, 212A
Li G, et al. *Transfusion* 2009; 49: 13-20
Popovsky MA, et al. *Transfusion* 1985; 25: 469

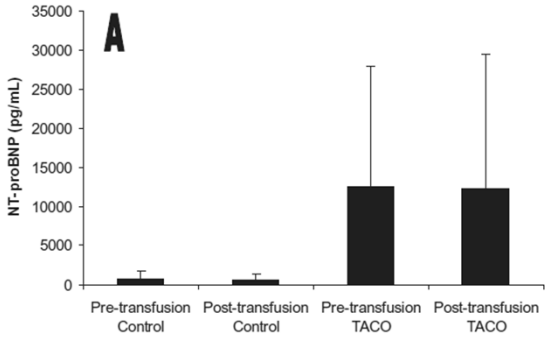
Risk assessment

- Fluid balance positive over last 24 hour
  - Review of unreported TACOs out of 382 joint replacements – mean positive fluid balance of 2480 mL, despite blood loss <500 mL
  - Fluid balance +5.9L in TACO cases vs. +2.0L in controls ($p<0.01$)

Popovsky MA, et al. *Immunohematology.* 1996;12(2):87-89.
Rana R, et al. *Transfusion* 2006; 46: 1478-83.

Risk assessment

- Fluid balance positive over last 24 hour
  - Patients who develop TACO are overloaded before transfusion as measured by NT-proBNP



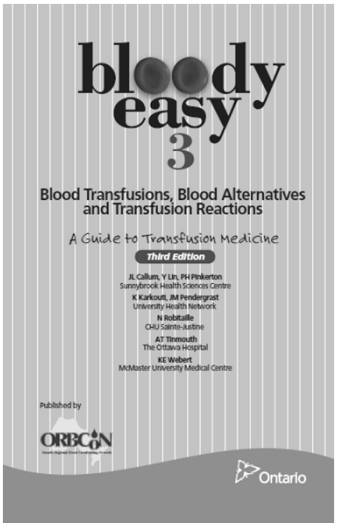
Tobian AAR, et al. Transfusion 2008; 48: 1143-50

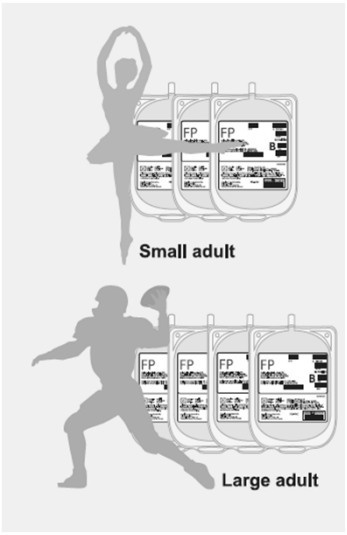
Risk assessment

- Current dosage of diuretics
- Poor LV function
  - History of CHF more common in TACO vs. TRALI (22% vs. 8%)
  - Left ventricular ejection fraction lower in TACO vs. TRALI (median ejection fraction 44% vs. 60%)
  - In multivariate analysis of risks for TACO in ICU patients, left ventricular dysfunction increases the risk 8-fold (OR 8.23; 3.4-22.0)
- Chronic renal failure
  - Renal failure more common in TACO vs. TRALI (68% vs. 41%)

Li G, et al. *Transfusion* 2009; 49: 13-20
Li G, et al. *Transfusion* 2011; 51: 338-43

Plasma is a high risk product





Prospective observational study

Li et al, Transfusion 2011; 51: 338-43

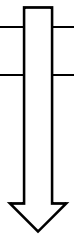
- Prospective observational study in an ICU
- 6% of 901 transfused patients develop TACO
- Compared with matched controls TACO cases had:
  - more positive fluid balance (1.4 L vs. 0.8 L)
  - larger amount of **plasma** (0.4 L vs. 0.07)
  - faster rate of transfusion (225 mL/hr vs. 168 mL/hr)
- Compared with random controls TACO cases:
  - left ventricular dysfunction increased risk of TACO 8.23x
  - **plasma** ordered for reversal of anticoagulant increased TACO risk 4.31x [Note: importance of PCC use]

21

MI patients – Watch out

Cooper HA, et al. Am J Cardiol 2011; epub ahead of print.

	Liberal 30% (n=21)	**Conserv 24% (n=24)**	**p**
In-hospital death, recurrent MI, CHF	38%	13%	0.046
In-hospital new or worsening CHF	38%	8%	0.03
In-hospital death	5%	8%	1.0



1 in 3 MI patients Transfused to 100

22

Baseline fluid assessment

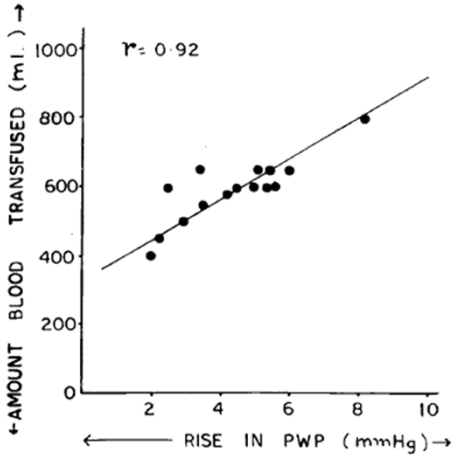
- Vitals
- Current FiO_2
- Oxygen saturation
- Jugular venous pressure
- Heart sounds
- Respiratory exam
- Edema assessment

Slow the rate of transfusion

- AABB Technical Manual = 2-4 mL/min for RBCs (faster for plasma and platelets!)
  - 120-240 mL/hr = 1 RBC over 1 or 2 hours
- Review of 47 cases of TACO – range 1-48 mL/min
- Rate of infusion faster in TACO vs. control patients (225 vs. 168 mL/hour, p=0.03)

Popovsky M. ISBT Science Series 2008; 3: 166-69
Li G, et al. Transfusion 2011; 51: 338-43

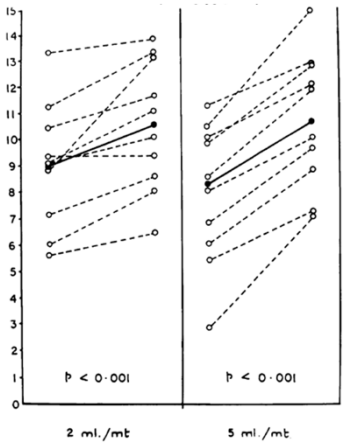
PCWP and volume infused



Gupta SP, et al. Angiology 1982; 33: 343-8

Chronic anemia – slow vs. fast

PCWP



Nand N, et al. Angiology 1985; 36: 617-21 (n=20); low risk patients

Rate control

- The importance of the infusion pump

Pre-emptive diuretics

Balegar KK et al. J Pediatric 2011; 159: 913-8.

- Very small RCT in neonates suggests furosemide is effective

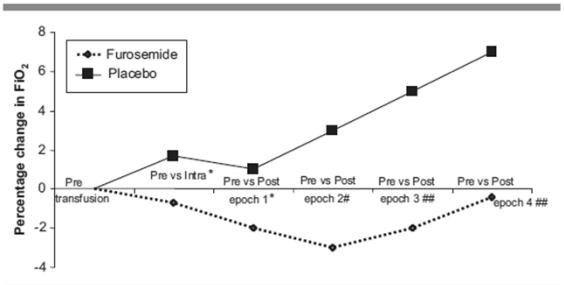
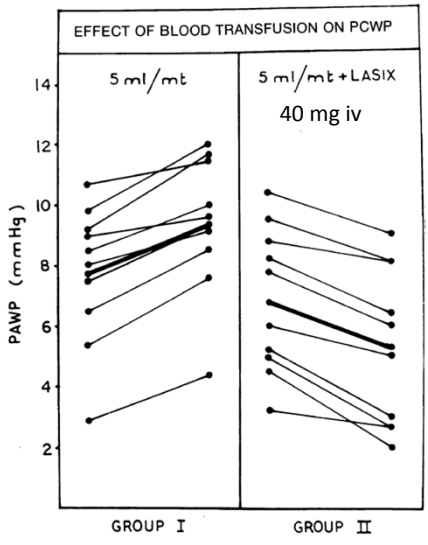


Figure 2. Graph showing percentage of change in FiO_2 during and after PRBCT as compared with the pretransfusion period in the 2 groups. *$P > .05$, #$P = .03$, ##$P = .01$, intra- and posttransfusion epochs vs pre-transfusion.

Pre-transfusion furosemide might help



Mean urine Output = 973 mL

Gupta, Angiology 1983[29]

How often do patients get prescribed furosemide?

- Who knows!
- 2 patients/324 (0.6%) treated with furosemide <u>before</u> transfusion in retrospective study at 3 hospitals (all ages)
  - Not clear if any furosemide ordered <u>after</u> transfusion
- 17/40 (43%) pediatric patients in Oakland, California

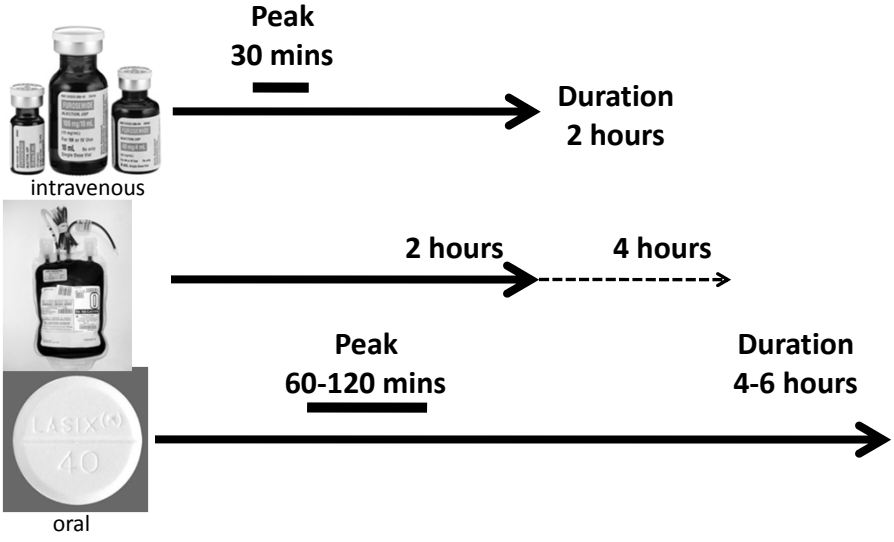
Agrawal AK, et al. Ped Blood Cancer 2012; 58: 466-8
Fry JL, et al. Transfusion 2010; 50: 1722-30

Regular daily diuretics

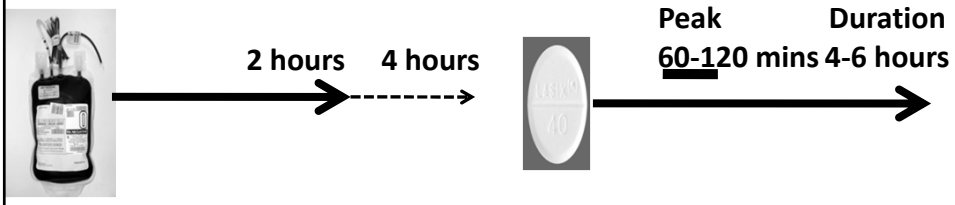
- Patients on regular daily diuretics (presumably for hypertension of heart failure) are not protected

Li G, et al. Transfusion 2011; 51: 338-43

Re-thinking how you give lasix with blood



This might be common, but incorrect



How do I time the furosemide?

At the start of the transfusion!

Intravenous = higher risk patients
Oral = lower risk patients

The origin of single unit transfusions?

Reece & Beckett. JAMA 1966; 195: 801-816
Micolonghi T. Rhode Island Med J 1966; 49: 533-6.

Single unit tranfusions (Inpatients, ≤2 units, not OR)

Ma et al. Transfusion Med 2005; 15: 307-12

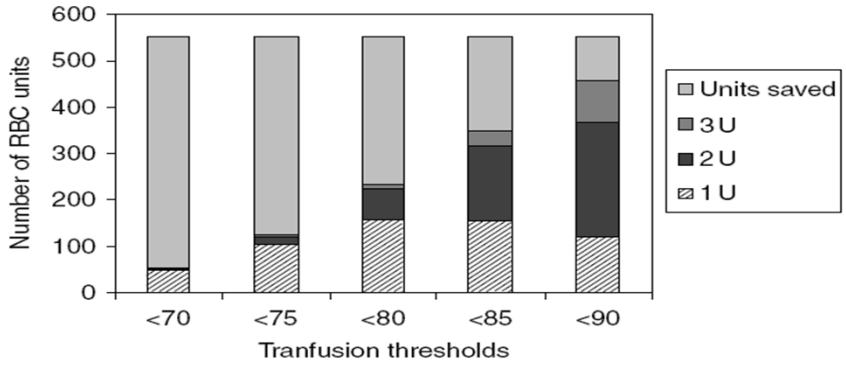
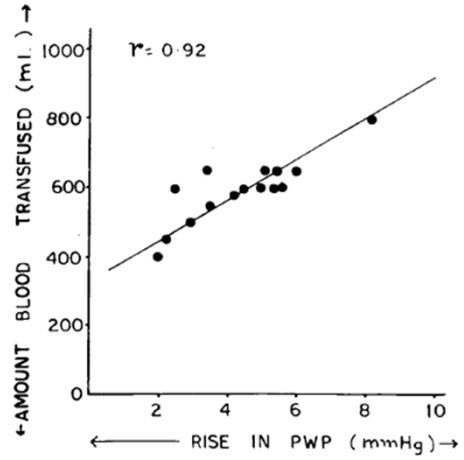


Fig. 2. Units of red blood cells (RBC) saved with adherence to a transfusion threshold and a single-unit transfusion policy.

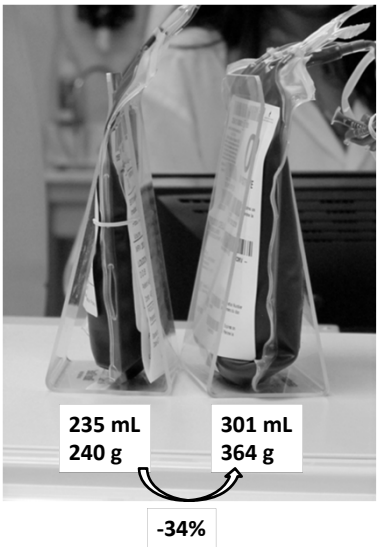
Does the transfusion of 2 units to adults (as opposed to 1 unit) reduce the risk of TACO?



Gupta SP, et al. Angiology 1982; 33: 343-8

RBC supernatant removal

- For extremely high risk patients?
- For patients already in congestive heart failure?
- For patients on the cardiology ward or coronary care unit?



Split RBC

Critical nursing supervision

- Pre-transfusion volume assessment
- Question over-zealous physicians
- Refusing verbal orders
- Critical at 15 minute check
  - BP up? O_2sat okay?
- Close monitoring of high risk patients

15 minute vitals

- At the 15 minutes, systolic blood pressure, pulse pressure and mean arterial pressure were higher in overloaded patients compared to controls

Andrzejewski C, et al. Transfusion 2008; 48 suppl: 204A

Summary – How to prevent TACO

- No verbal orders for transfusion
- Mandatory pre-transfusion risk assessment and volume assessment
  - Age>70, LV dysfunction, renal failure, positive fluid balance, current dose of diuretics, acute myocardial infarction, plasma
- Slow the rate of transfusion – at risk transfusion should be run at 1-2 mL/minute (60-120 mL/hr to complete by 4 hrs)
- Pre-emptive furosemide *before* the transfusion
- 1 unit of RBC at a time (non-bleeding)
- Plasma volume reduction or split units for RBC/Platelets for very high risk patients
- 'Critical' nursing supervision
  - Question the physician (rate and furosemide), pre-transfusion volume assessment, 15 minute vitals, use a pump, watch closely