JOURNAL MEETING

1. **Massive transfusion in traumatic shock**
   The Journal of Emergency Medicine, Vol. 44, No. 4, pp. 829–838, 2013
2. **Patients With Rib Fractures Do Not Develop Delayed Pneumonia: A Prospective, Multicenter Cohort Study of Minor Thoracic Injury**
   Annals of Emergency Medicine, 2012;60:726-731

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Supervisor : VS.
Presenter : Int.

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Tramatic shock

- Hemorrhage after trauma is common cause of death
  - 5 -6 million people/yr die globally from trauma
  - leading cause of death of Americans < 35 y/o
- Primary goals of traumatic shock
  - Restoration of oxygen delivery to end organs
  - Maintenance of circulatory volume
  - Prevention of ongoing bleeding
    - source control
    - correction of coagulopathy

Massive transfusion of blood products !!

Massive transfusion

- "Massive" transfusion :
  - transfusion of at least 10 U of PRBCs in 24 h
  - occurs in 1–3% of civilian traumas
- Overall injury severity--mortality rates are as high as 50–70%

Complications of massive transfusion

- Coagulopathy
- Hypothermia
- Acidosis
- Electrolyte abnormalities
- Infection
- Immunomodulatory phenomena

Propose of this article

- Complications through the use of massive transfusion protocols
  - Pathogenesis
  - Implications
  - Prevention
  - Treatment
- Optimal ratio of blood products transfused in large volume resuscitation and prevention of secondary coagulopathy

Disadvantage of resuscitation with crystalloids

- Resuscitation with 0.9% N/S
  - Dilutional anemia and coagulopathy
  - Activates inflammatory cascades
    - cellular swelling, acidosis, metabolic dysfunction, and apoptosis→interstitial edema and organ dysfunction
- American College of Surgeons
  - Avoid large-volume (>1.5L)resuscitation with crystalloids
  - Favor early transfusion of blood products

DISCUSSION

Outline

- Prevention of Coagulopathy
- Electrolyte Derangement
- Infection and Immunomodulation
- Pharmacologic Therapy
- Massive Transfusion Protocols

Prevention of Coagulopathy
Electrolyte Derangement
Infection and Immuno modulation
Pharmacologic Therapy
Massive Transfusion Protocols

- Coagulopathy after massive transfusion is multifactorial
  - Tissue hypoperfusion→ increases endothelial thrombomodulin expression→ activation anticoagulant Protein C
  - Local tissue factor → hyperfibrinolysis and DIC
- Intrinsic coagulopathy is worsened by a secondary coagulopathy caused by massive transfusion
  - Consumption of different transfusion products
  - Hypothermia(↓ 1 ◦C: ↓ 10% clotting factor activity)
  - Acidosis
    - **pH7.0:7.4 = ↓ 50-90%cotting factor activity**

Prevention of Coagulopathy
Electrolyte Derangement
Infection and Immuno modulation
Pharmacologic Therapy
Massive Transfusion Protocols

- Maintain normothermia
  - Warmed fluid or warming of the patient
- Prevent the worsening acidosis
- Avoid excessive infusion of crystalloids
- High ratio of FFP to PRBC
  - between 1:1 -1:2 units
- Dilutional hypofibrinogenemia
  - Coagulopathy worsens when serum fibrinogen levels <100 mg/dL → pooled cryoprecipitate
- Monitor of coagulopathy
- Early FFP transfusion
  - Complication: ARDS--12 times higher(>6U)
  - Give FFP when over 10U of pRBC in first 24 h

Prevention of Coagulopathy
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- Hypocalcemia
  - 3 g of citrate as anticoagulant
    - binds ionized calcium
    - May worsen by dilution
  - Coagulopathy and impaired cardiovascular function (Ca <0.8- 0.9 mmol/L)
  - Empirically prevention of this study
    - 2 g of IV calcium gluconate for every 2–4 U of PRBCs
- Hyperkalemia
  - Extracellular K+ increases 5 to10 fold
  - Renal insufficiency: May cause arrhythmias during rapid transfusion

Prevention of Coagulopathy
Electrolyte Derangement
Infection and Immuno modulation
Pharmacologic Therapy
Massive Transfusion Protocols

- Risk of transmission of blood-borne viral and parasitic infections
  - more common in the developing world
  - HIV, HBV,HCV, CMV , parvovirus B19, dengue, malaria, filariasis
- Risks are directly proportional to the volume of blood products infused

Prevention of Coagulopathy
Electrolyte Derangement
Infection and Immuno modulation
Pharmacologic Therapy
Massive Transfusion Protocols

- Immunomodulatory
  - Systemic inflammation and immunosuppression
  - Donor leukocytes ,soluble inflammatory mediators and proinflammatory lipid debris
- Non-hemolytic transfusion reactions
  - Activation of donor leukocytes and accumulation of IL-1 in stored PRBCs
- TRALI
  - 1 /5000 of PRBCs transfused
  - mortality rate: 5–8%
- Dose related risk

Prevention of Coagulopathy
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Massive Transfusion Protocols

- Tranexamic acid
  - Lysine analogues --inhibit fibrinolysis
  - significantly decrease mortality when administered within 3 h of injury
  - Advantage
    - Inexpensive, cost-effective
- Prothrombin complex concentrates
  - reversal of warfarin-mediated anticoagulation and concentrated levels of vitamin K-dependent clotting factors
  - Advantage
    - easily stored
    - rapidly administered
    - Not blood type specific

Prevention of Coagulopathy
Electrolyte Derangement
Infection and Immuno modulation
Pharmacologic Therapy
Massive Transfusion Protocols

- MTPs : reduce organ failure, blood component use, cost, and mortality
- Encouraging the early and aggressive use of FFP , platelet and pRBC transfusion
  - Ratio of pRBC, FFP and PLT
    - Most commonly ratio is 1:1:1.
  - Transfusion of >10 U of PRBCs or > 40% blood volume loss
- Unknown of optimal resuscitation end points
  - In patients without TBI
    - recommend SBP of 90 mm Hg and targeting Hb of 7–9 mg/dL

Who Will Require Massive Transfusion after Trauma?

- Prediction tools

Table 1. Clinical Prediction Tools to Predict Patients Who Will Require Massive Transfusion after Trauma

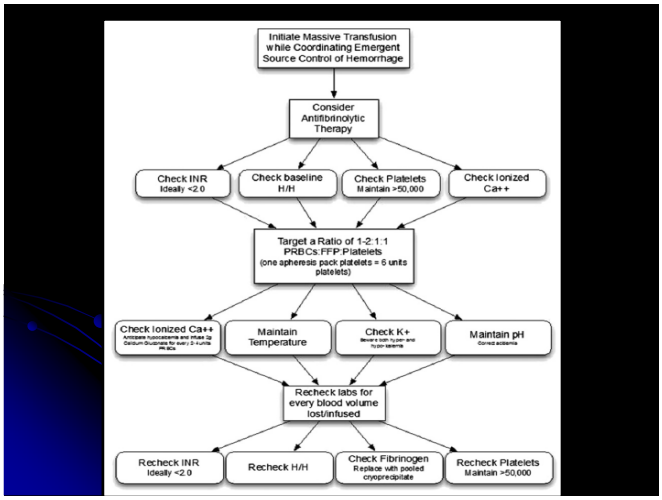
Characteristic	ABC Score (109)	TASH Score (107)	McLaughlin Score (106)
Blood pressure	SBP ≤ 90 mm Hg	SBP (categorical)	SBP < 110 mm Hg
Heart rate	HR ≥ 120 beats/min	HR > 120 beats/min	HR > 105 beats/min
FAST examination	Positive FAST examination	Positive FAST examination	–
Mechanism	Penetrating mechanism	Complex long bone or pelvic fracture	–
Demographics	–	Male gender	–
Laboratory tests	–	Hemoglobin (categorical)	Hematocrit < 32%
		Base excess (categorical)	pH < 7.25

ABC = assessment of blood consumption; TASH = trauma-associated severe hemorrhage; SBP = systolic blood pressure; HR = heart rate; FAST = focused assessment with sonography for trauma.

Conclusion

Conclusion

- Acute trauma leads to coagulopathy may be worsened by dilution of clotting factors, hypothermia, and acidosis.
- Blood products are immunomodulatory
  - induce multi-system organ dysfunction.
- The use of an MTP may reduce the morbidity and mortality
- Most commonly ratio of pRBC/FFP/PLT= 1:1:1
- The protocols should monitor
  - correct hypothermia, hypofibrinogenemia, electrolyte disturbances



Monitor

- Correct hypothermia
- Hypofibrinogenemia
- Electrolyte disturbances
  - Hypocalcemia
  - Hyperkalemia

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Introduction

- Thoracic trauma frequency
  - 12 people per million / day, 796,000 ED visits /yr.
- Minor thoracic injury patients are rapidly discharged from ER without appropriate follow.
- Delayed pneumonia is one of several morbidities related to chest trauma
  - Most minor thoracic injury studies are retrospective and based on data from admitted patients

Goals of This Investigation

- Quantify the incidence of delayed pneumonia in patients receiving a diagnosis of minor thoracic injury but discharged and treated as outpatients.
- Identify the risk factors in patients most susceptible to developing delayed pneumonia.

MATERIALS AND METHODS

- Study design
  - prospective, multicenter cohort study
  - From Nov. 2006 to Nov. 2010
  - 4 teaching hospital EDs in Canada
- Selection of participants
  - aged 16 years and older
  - C.C: minor thoracic injury
  - directly discharged without admission
- Follow up to assess outcome
  - weeks 1 and 2: CXR AP/Lat
  - week 4 and 12 : telephone interview

RESULTS

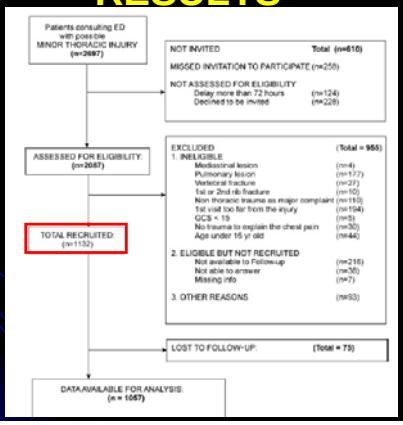

Table 1. Characteristics of 1,132 enrolled patients (included and lost).

Characteristics	Included, N=1,057 (%)	Lost, N=75 (%)
Age, mean (SD), y	53 (17)	44 (18)
>65	273 (26)	10 (13)
>75	113 (11)	6 (8)
>85	19 (2)	2 (3)
Sex (men)	666 (63)	46 (6)
Mechanism of injury		
Fall from own height	370 (35)	27 (36)
Fall greater than own height	241 (23)	10 (13)
Motor vehicle crashes	262 (25)	18 (24)
Pedestrian vs auto	11 (1)	1 (1)
Bicyclist vs auto	9 (1)	1 (1)
Direct hit	105 (10)	15 (20)
Other	58 (5)	3 (4)
Preexisting comorbidity		
Presence of at least 1 preexisting comorbidity	264 (25)	12 (16)
COPD	36 (3)	0
Asthma	87 (8)	6 (8)
Airway disease Asthma or COPD	110 (10)	6 (8)
Osteoporosis	81 (8)	2 (3)
Diabetes	110 (10)	4 (5)
Smoking status		
Current smoker	271 (31)	23 (66)
Former smoker	233 (25)	3 (9)
Nonsmoker	387 (44)	9 (26)
Alcohol intoxication	72 (7)	5 (7)
Preinjury medication		
Acetylsalicylic acid	179 (17)	8 (11)
Clopidogrel	15 (1)	0

Main result

- 2-week clinical follow-up, only 6 patients (0.6%) developed delayed pneumonia.
- 4 and 12 weeks: no other delayed pneumonia

Table 2. Clinical and demographic characteristics of patients with pneumonia (n=6).*

Age	Sex	Rib Fractures	COPD	Asthma	Osteoporosis	Diabetes	Smoking	Alcohol	Time to Pneumonia
69	Male	0	Yes	Yes	No	No	Ex-smoker	No	Day 14
49	Male	2	No	No	No	No	Ex-smoker	Yes	Day 14
60	Male	4	No	No	No	No	Yes	No	Day 2
43	Male	1	No	No	No	No	Yes	No	Day 14
71	Female	0	No	No	No	No	No	No	Day 7
55	Female	3	No	Yes	Yes	No	Yes	Yes	Day 2

- Risk of pneumonia for patients with preexistent pulmonary disease : 8.61

LIMITATIONS

- Small number of patients
- Selection bias
  - hospitalized patients were excluded
  - majority of physicians who care for minor thoracic injury patients in outpatient settings
- Self-reporting of the history
- Diagnostic bias
  - including any form of “pulmonary infection” treated after 2 weeks→ overestimate of true pneumonia
  - Physician dependence on imaging for rib fracture diagnosis

DISCUSSION

- Very low risk of subjects developing delayed pneumonia, less than 1%.
- Risk factors associated with post–minor thoracic injury delayed pneumonia:
  - radiograph-confirmed rib fractures and preexistent pulmonary disease.
  - combined relative risk of 8.6%
- Age as a risk factor of pneumonia, but should not be extrapolated to all patients with minor thoracic injury

Thanks for your attention !!!