Massive Transfusion in Pediatric Trauma: Analysis of the National Trauma Databank

Michelle Shroyer, MPH, Russell Griffin, PhD,
Vincent Mortellaro, MD, and **Rob Russell MD, MPH**

Children's of Alabama

UAB MEDICINE
PEDIATRIC SURGERY

Introduction

- Hemorrhage is the most common cause of death in the first hours after severe trauma
- 20-40% of adult trauma deaths in the first 24 hours are due to exsanguination and subsequent coagulopathy
- Massive Transfusion has been incorporated as a part of “Damage Control Resuscitation” in adult trauma
- In the recent PROPPR trial, 4.7% of civilian adult trauma patients were deemed to need massive transfusion; 30-day mortality was ~ 25%

Introduction

Clearly defining pediatric massive transfusion: Cutting through the fog and friction with combat data

Lucas P. Neff, MD, Jeremy W. Cannon, MD, Jonathan J. Morrison, MRCS, Mary J. Edwards, MD, Philip C. Spinella, MD, *and* Matthew A. Borgman, MD, *San Antonio, Texas*

AAST, 2014

- Objective: to define massive transfusion in children based on 12 years of combat data
- >3,500 patients (< 18 years) to define an inflection point based on sensitivity and specificity curves for mortality
  - **40 ml/kg of any blood product = Massive Transfusion**
- 30% of population was transfused, 12% massively transfused, 15% mortality in massively transfused

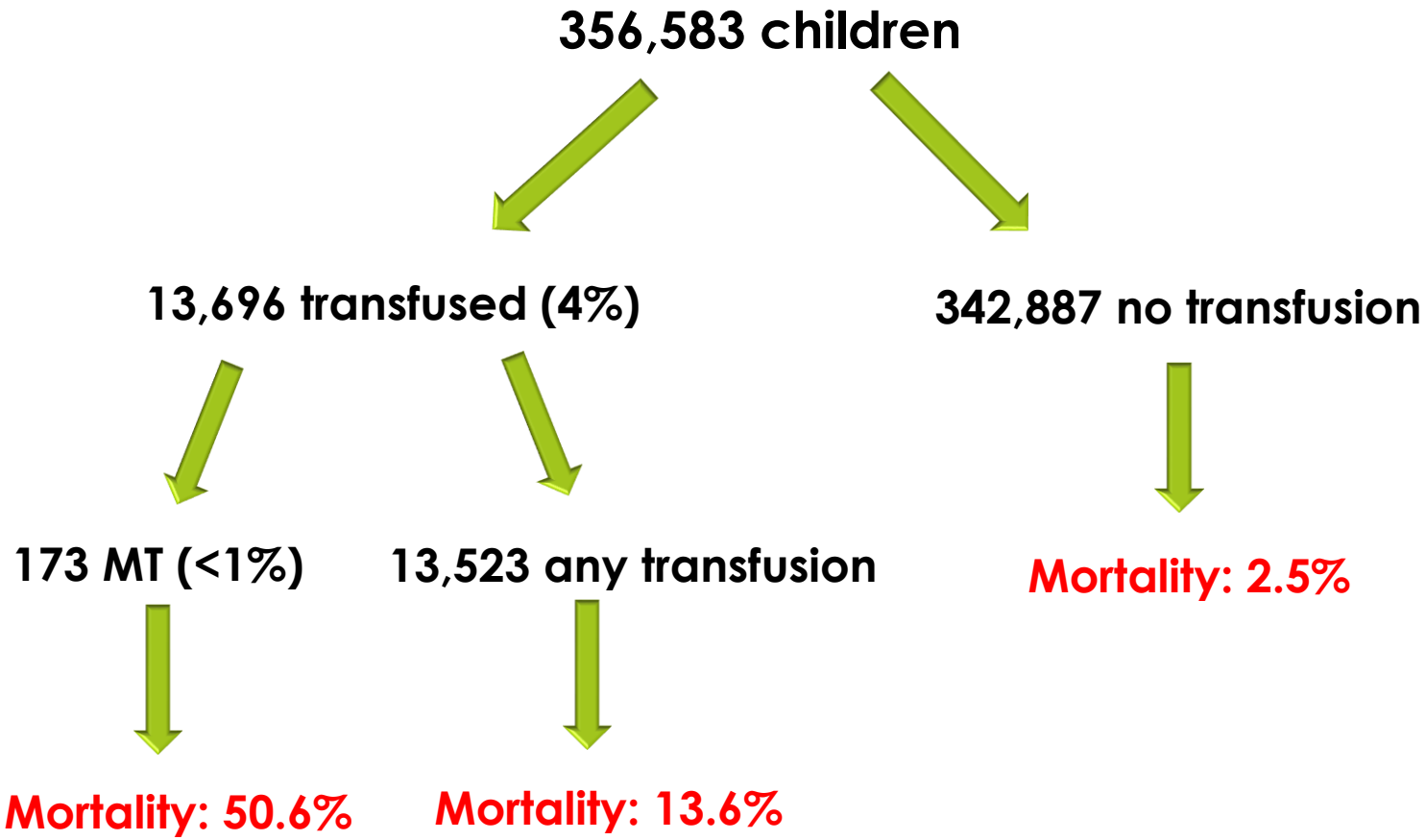
Purpose

- **Epidemiologic Study of Massive Transfusion in Pediatric Trauma**
  - Identify the incidence of massive transfusion in a large civilian pediatric trauma population
  - Compare the group of children who received massive transfusion vs. any transfusion
  - Identify factors that may be predictive of massive transfusion in the pediatric trauma population

Methods

- National Trauma Databank (2010-2012)
  - Registry of US trauma patients maintained by the American College of Surgeons
  - Included pediatric trauma patients defined as ≤ 14 years of age
- Exposure group: **Massive Transfusion group**
  - > 40 ml/kg of any blood product in first 24 hours
- Comparison group: **Transfusion group**
  - any transfusion within the first 24 hours
- Outcome: ICU/Hospital Length of Stay & Mortality
- Univariate and Multivariate analysis performed

Results


356,583 children
13,696 transfused (4%)
342,887 no transfusion
173 MT (<1%)
13,523 any transfusion
Mortality: 2.5%
Mortality: 50.6%
Mortality: 13.6%

Results: Univariate Analysis

	Any Transfusion (n=13696)		Massive Transfusion (n=170)		
	Median	[IQR]	Median	[IQR]	p value
Age	5	[0 to 11]	10	[4 to 13]	<0.001*
Temperature	36.4	[36 to 36.9]	36.2	[35.7 to 36.6]	<0.001*
Pulse	86	[72 to 108]	100	[74 to 127.5]	<0.001*
Systolic BP	138	[114 to 161]	110	[82 to 136]	<0.001*
GCS	15	[12 to 15]	5	[3 to 15]	<0.001*
ISS	9	[9 to 17]	26	[10.5 to 41]	<0.001*

Multivariate Analysis: Predictors of Massive Transfusion

Variables		Odds Ratios	95% CI	p value
Age				
	<5	ref	-	-
	5 to 12	**2.37**	**1.18-4.79**	**0.016***
	≥12	**4.55**	**2.20-9.39**	**<0.001***
Temperature				
	<35	**2.48**	**1.12-5.49**	**0.025***
	35-36.5	1.89	0.93-3.84	0.078
	36.5-38	ref	-	-
GCS				
	<8	**2.82**	**1.29-6.17**	**0.009***
	8 to 12	2.79	0.85-9.20	0.091
	12 to 15	ref	**-**	-
ISS	**≥25**	**2.01**	**1.06-3.79**	**0.03***
	<25	ref		

Outcomes

	Massive Transfusion	Any Transfusion	No Transfusion	p value
ICU Length of Stay (days)	3 [1, 9]*	4 [2, 8]*	2 [1 ,3]*	**<0.001**
Hospital Length of Stay (days)	5 [1, 12]*	6 [4, 10]*	2 [1, 3]*	**<0.001**
Mortality (%)	50.6	13.6	2.1	**<0.001**

*Values are Median (IQR)

Limitations

- National Trauma Databank
  - Not a true population-based dataset
  - Skewed toward large trauma centers
  - Information on blood product ratios difficult to discern
- Specificity
  - Diagnosis—ICD-9 codes
    - Multiple diagnoses for each patient
  - No identification for actual cause of mortality

Conclusions

- Massive transfusion in pediatric trauma population is less common than in adult trauma
- Massive transfusion in children is associated with a high mortality
- Children at risk for Massive Transfusion
  - GCS< 8
  - Older age (>5 years)
  - Hypothermic at presentation
  - ISS ≥ 25

Future Directions

- Consider a prospective registry for those pediatric trauma patients undergoing massive transfusion
  - Control over collected data and quality of data
  - Determine pediatric specific injury patterns that may influence massive transfusion
  - More detailed data about products and ratios

Massive Transfusion in Pediatric Trauma: Analysis of the National Trauma Databank

Michelle Shroyer, MPH, Russell Griffin, PhD, Vincent Mortellaro, MD, and Rob Russell MD, MPH

Children's of Alabama

UAB MEDICINE
PEDIATRIC SURGERY

AIS Codes in Massive Transfusion Group

1: **Head**	266
	22.5%
2: Face	140
	11.8%
3:Neck	8
	.7%
4: **Thorax**	220
	18.6%
5: **Abdomen**	196
	16.6%
6: Spine	51
	4.3%
7: Upper Extremity	88
	7.4%
8: **Lower Extremity**	181
	15.3%

Diagnosis	n (%)
Internal injury of thorax, abdomen or pelvis	279 (23.7)
Fracture of skull, neck, or trunk	277 (23.6)
Superficial injury or contusion	129 (11.0)
Fracture of upper or lower limb	113 (9.6)
Intracranial injury	105 (8.9)
Open wound of head, neck or trunk	87 (7.4)
Other	60 (5.1)
Injury to blood vessels	58 (4.9)
Open wound of upper or lower limb	37 (3.1)
Traumatic complication	16 (1.4)
Injury to nerves or spinal cord	8 (0.7)
Total Diagnoses	1176
Mean number of diagnoses per patient	7