

Impact of Shock, Coagulopathy and Initial Vital Signs on the Incidence of Massive Transfusion in Combat Casualties

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Background

- Initial management of trauma patients:
 - Exsanguination¹
 - Acute Traumatic Coagulopathy (ATC)²
 - Resuscitation and bloody vicious cycle³
- Defined massive transfusion (10U/24 hrs)
- Damage control resuscitation evolved

¹MacLeod et al. *Am J Surg.* 2007

²Brohi et al. *J. Trauma.* 2003

³Cosgriff et al. *J. Trauma.* 1997

As a result. . .

- Damage control resuscitation⁴
 - Stat correction of hemorrhage⁵
 - Permissive hypotension
 - Early use of blood/blood products in predefined ratios (MT protocols)
- Ratios of FFP:PRBC (>1:1.5) in MT decrease:⁶⁻⁹
 - Mortality
 - Blood/blood/product usage

⁴Holcomb JB. *J. Trauma.* 2007.

⁵Rotondo et al. *J. Trauma.* 1993

⁶Borgman et al. *J. Trauma.* 2007.

⁷Gunter et al. *J. Trauma.* 2007.

⁸Gonzalez et al. *J. Trauma.* 2006.

⁹Sperry et al. *J. Trauma.* 2008.

Ongoing challenge

No one laboratory test or physiologic variable has been shown to predict need for MT.

Goals

- #1. Determine impact of shock ($BD > 6$) and coagulopathy ($INR \geq 1.5$) on incidence of MT in combat wounded.
- #2. Develop a model to predict need for MT based on clinical and laboratory variables available shortly after admission.

Methods

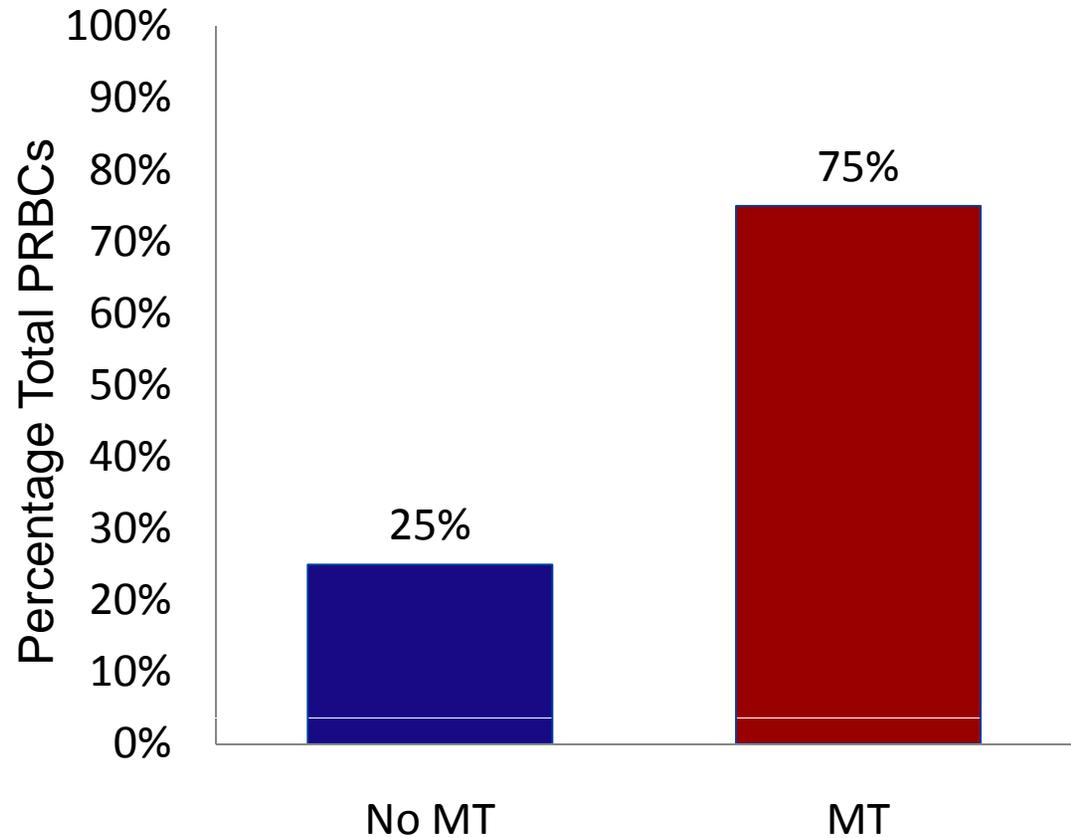
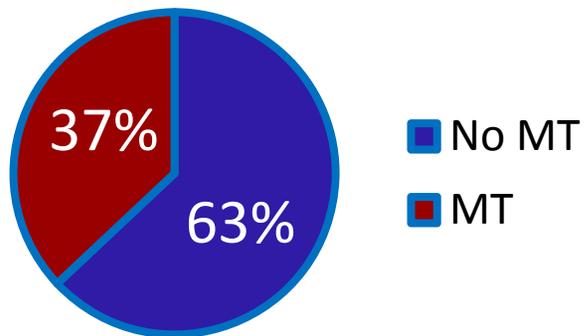
- Data analyzed. . .
 - Retrospective analysis of Joint Theater Trauma Registry for wounded U.S. military personnel
 - Included all patients who received at least one unit of blood
 - Patients with complete data set were included (N=1124)
- Laboratory values drawn at patient arrival.
- Physiologic variables were initial vital signs.

Demographic characteristics

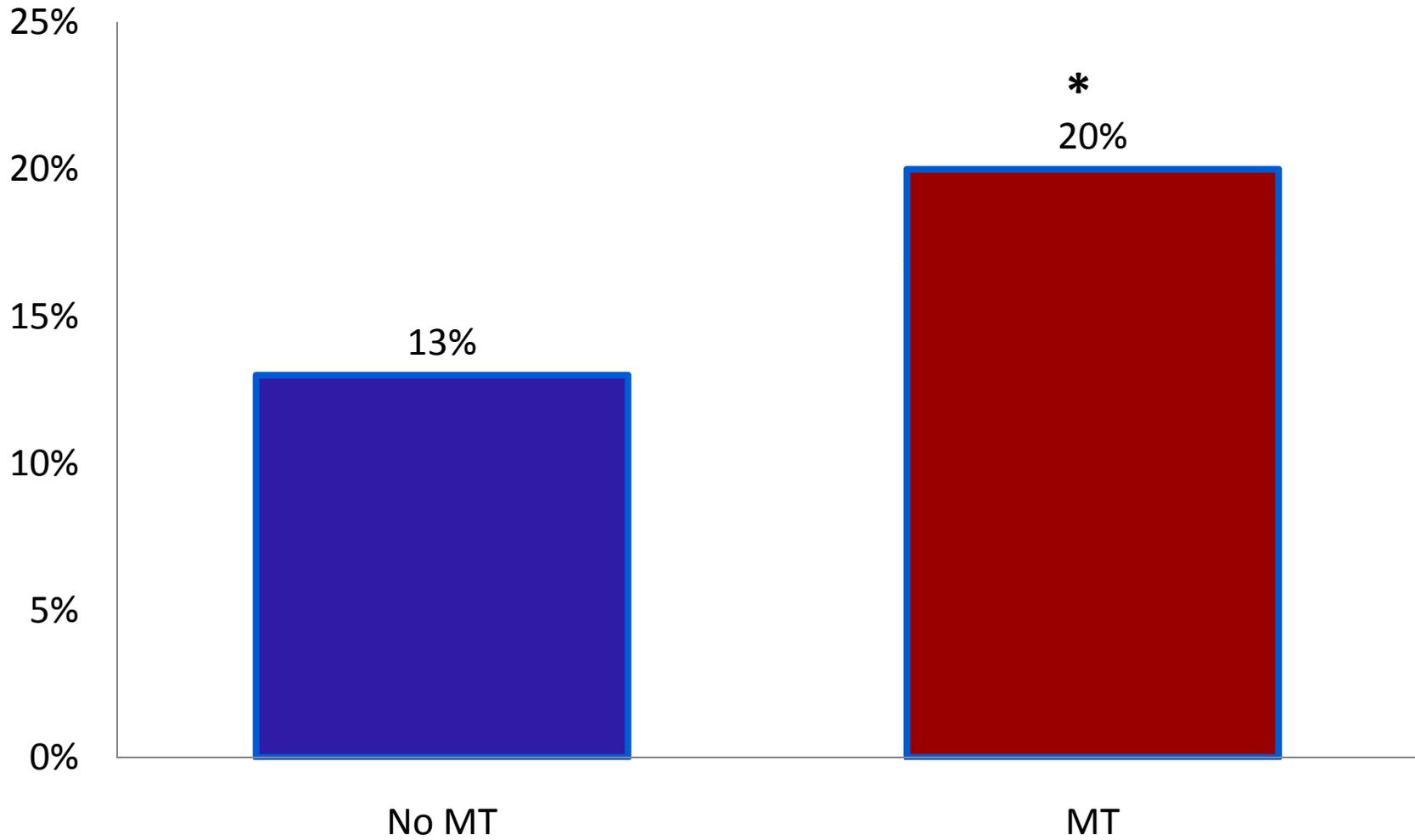
Variable	No MT		MT		P-value
	Median	Q1-Q3	Median	Q1-Q3	
Age	24	(21-29)	24	(21-28)	0.967
Temp	98	(97.3-99.1)	98	(97-99.15)	0.434
SBP	121	(103-138.5)	108	(82-129.5)	<0.0001
HR	98	(80-119)	117	(94-135.5)	<0.0001
HGB	12.5	(10.9-13.9)	11.4	(9.6-13.1)	<0.0001
BD	-3	(-6- -1)	-7	(-120- -3)	<0.0001
INR	1.25	(1.1-1.5)	1.4	(1.2-1.8)	<0.0001
PRBCs	4	(2-6)	16	(12-24)	<0.0001
ISS	17	(10-26)	22	(16-29)	<0.0001

Blood Product Distribution

Patients requiring
MT

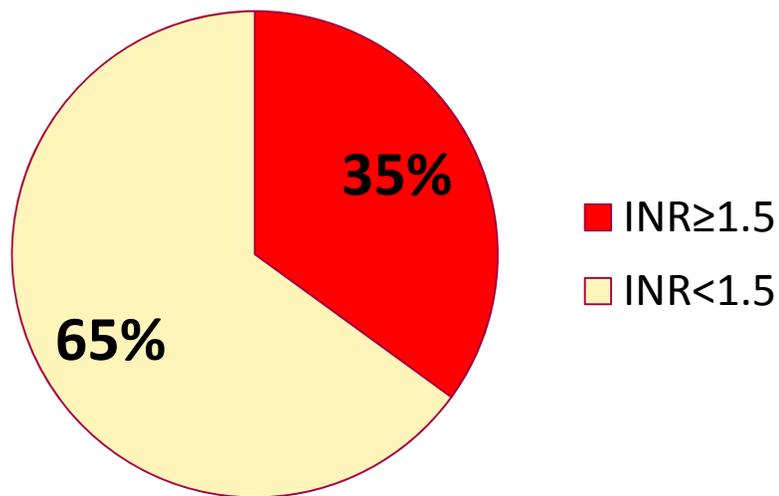


Mortality and MT

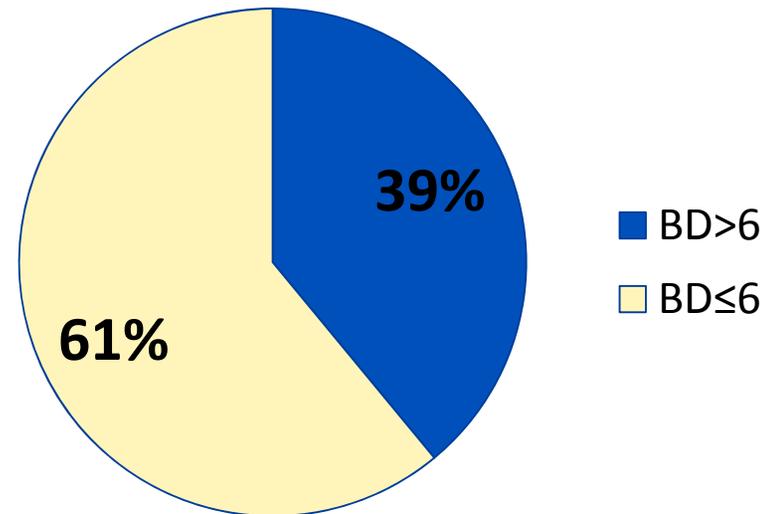


Shock and Coagulopathy at Presentation

Coagulopathy



Shock



Shock and Coagulopathy As Predictors of MT

	Base deficit ≤ 6	Base deficit >6	INR <1.5	INR ≥ 1.5
Massive transfusion	26%	54%	32%	51%
Sensitivity		57%		46%
Specificity		72%		72%
PPV		54%		51%
NPV		74%		68%

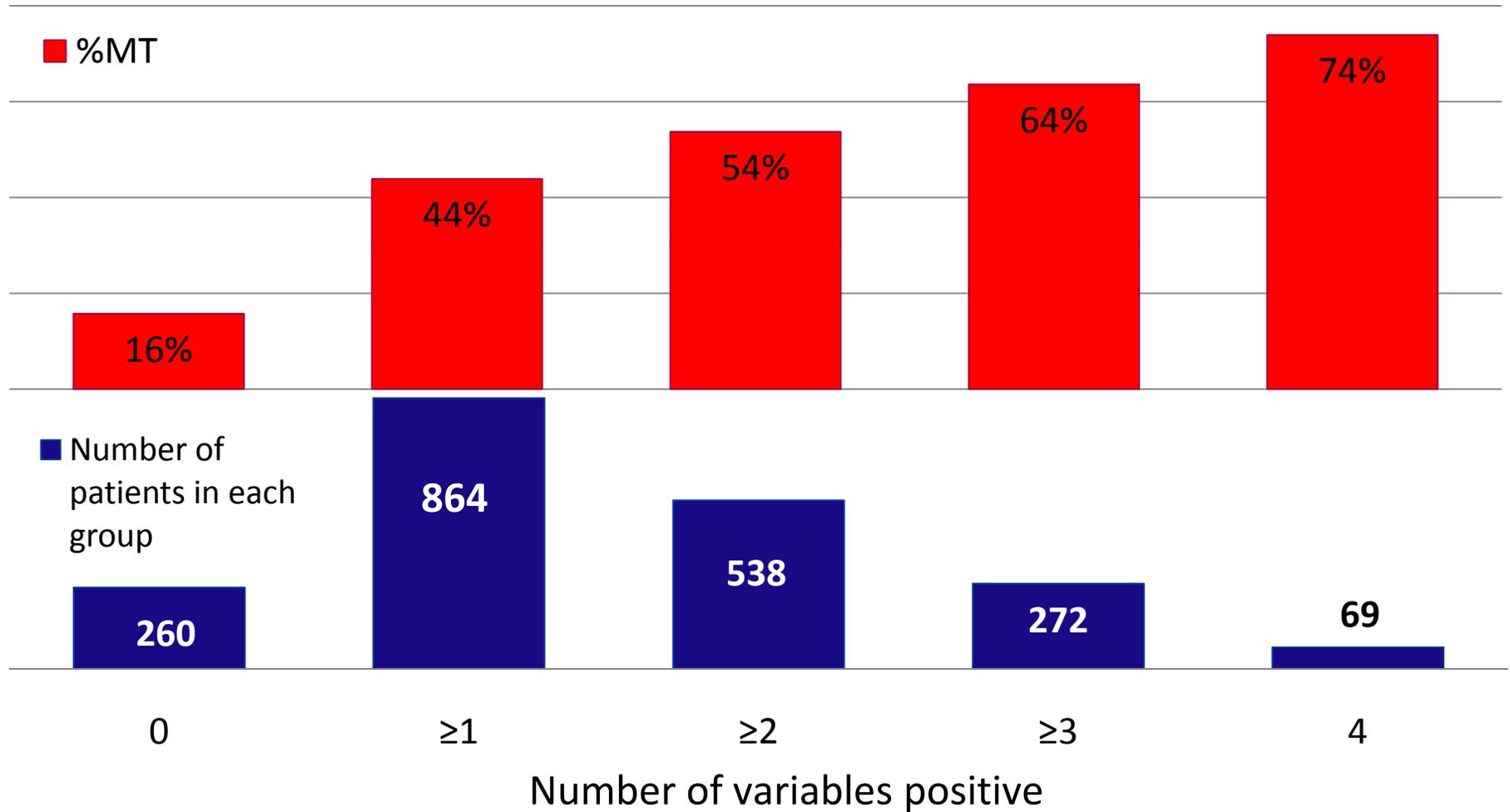
Variables indicative of MT need^{10,11}

Selected variables contributing to equation							
	B	S.E.	Weight in equation	P-value	OR	95.0% CI	
						Lower	Upper
BD > 6	1.063	0.146	52.804	<0.0001	2.896	2.174	3.858
HR >110	0.954	0.135	50.291	<0.0001	2.597	1.995	3.381
SBP <110	0.477	0.137	12.141	<0.0001	1.611	1.232	2.107
HGB ≤11	0.290	0.144	4.045	0.04	1.336	1.007	1.772
Constant	-1.634	0.122	180.592	<0.0001	0.195		

¹⁰McLaughlin et al. *J.Trauma.* 2007.

¹¹Eastridge et al. *J.Trauma.* 2007.

Clinical Variables As Predictors for MT



Predictive value of formula

Clinical Formula with Physiologic and Laboratory Values

	Number of Variables Positive			
	One	Two	Three	Four
Sensitivity	90%	69%	41%	12%
Specificity	31%	65%	86%	97%
PPV	44%	54%	64%	74%
NPV	84%	78%	71%	65%

Predicted MT, Administered MT, and Mortality Rates using TWO or more clinical Variables

% Mortality			
Observed			
	Did not receive MT(-)	Received MT(+)	<i>Chi Sq P-value</i>
No predicted MT(-)	6% (N=469)	14% (N=140)	0.0029
Predicted MT(+)	25% (N=235)	23% (N=280)	0.6277
<i>Chi Sq P-value</i>	<0.0001	0.0384	

Summary

- Existence of shock ($BD > 6$) and coagulopathy ($INR > 1.5$) when used alone are poor predictors of MT.
- Independent predictors of MT: $Hgb \leq 11$, $BD \geq 6$, $HR > 110$, $SBP < 110$.
- Using two clinical variables, sensitivity for MT need approaches 69%.
- Mortality higher in the group who we predicted needed a MT but did not receive it when compared with other groups.

The possibility for improvement in our ability to predict MT needs still exists.