Early coagulopathy and lethal triad in burns patients: an issue for pre-hospital care?

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The lethal triad

- The ‘lethal triad’ is a well described entity in the trauma population and is associated with significant mortality.
  Moore EE. *Am J Surg* 1996;172:405-410
- Major burn patients are exposed to similar physiological insults
- Little is known about the incidence and effect of an early coagulopathy and lethal triad in burns patients
- A lethal triad could impact on early surgical procedures, CVS stability and septic complications

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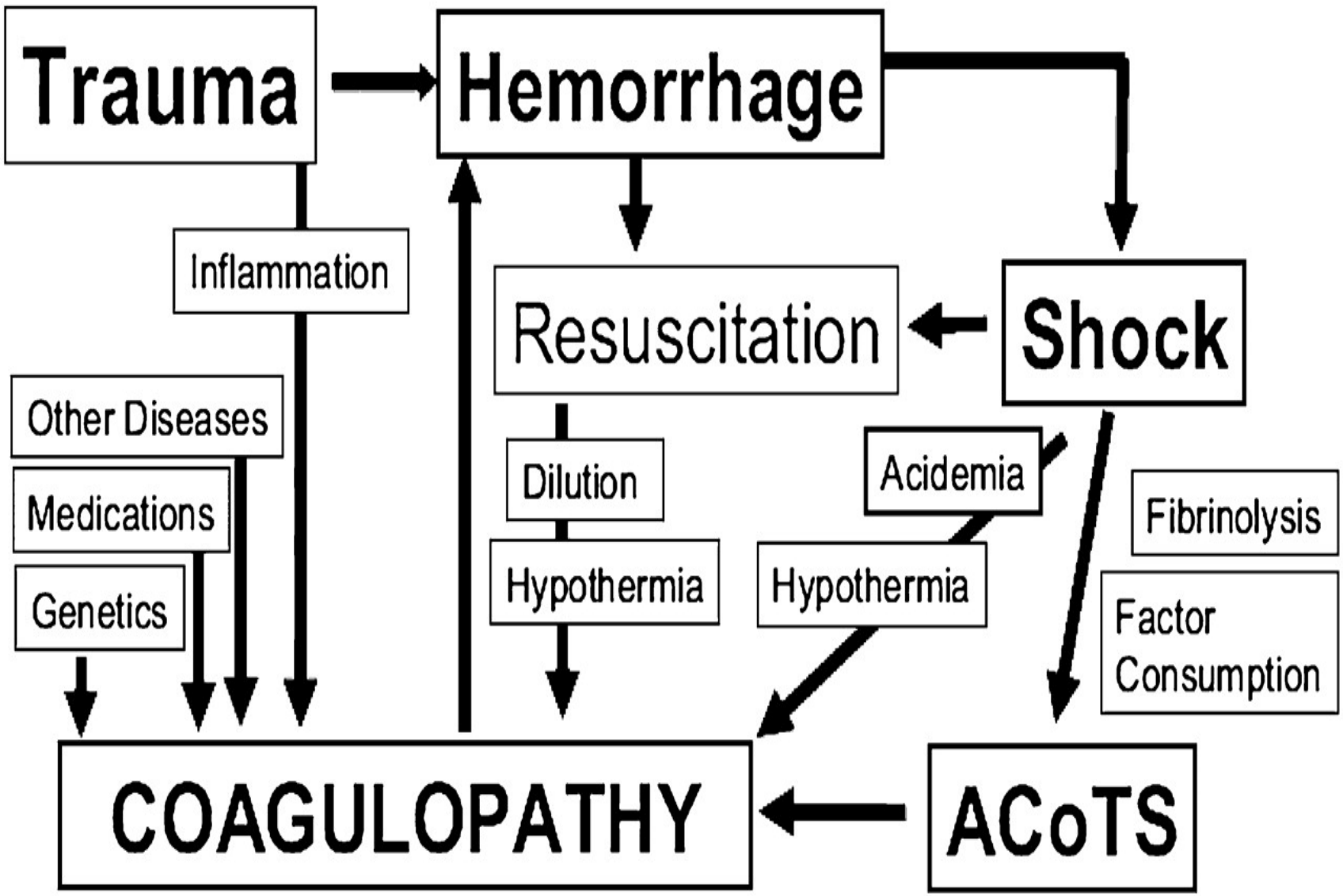

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Coagulopathy

- Acute traumatic coagulopathy (ATC) is a well described phenomenon in the trauma population associated with significant mortality Brohi K et al. *J Trauma*. 2003;54:1127-1130
- ATC is an impairment of haemostasis involving a complex dynamic interaction between endogenous anticoagulants and fibrinolysis
- ATC is driven by an endothelial injury and hypoperfusion, which results in in increased thrombomodulin expression and APC
- An early burn induced coagulopathy has yet to be demonstrated

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Hypothermia

- Significant problem!

- Factors involved
  - Large volume fluid resuscitation
  - Thermal tissue injury impairs skin's insulating ability
  - Anaesthesia impacts thermoregulation
  - Impaired endogenous heat production as a result of anaerobic metabolism
  - Reluctance to warm burn patients by medical professionals?

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Acidaemia

- Major burns are characterised by
  - Direct endothelial injury
  - Systemic hypoperfusion
  - Hypovolaemia/ haemoconcentration
  - Impaired myocardial contractility and cellular hypoperfusion.
- This decreased oxygen delivery results in a shift to anaerobic metabolism, lactate production and metabolic acidaemia
- The initial lactate is a strong predictor of mortality in burns patients. Latenser BA. *Crit Care Med*. 2009 Oct;37(10):2819-26

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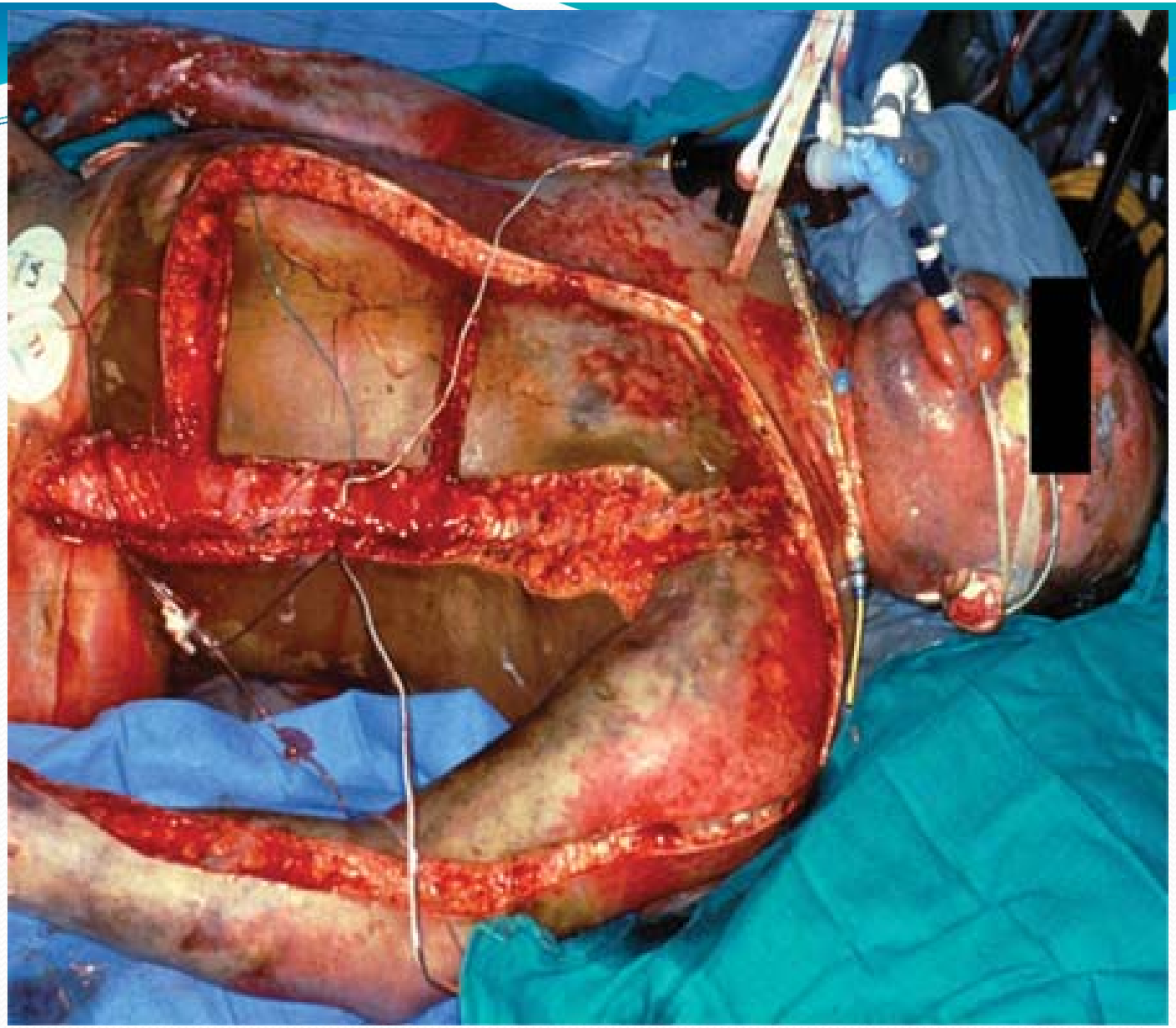

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Aim

- The primary aim of this study was to identify a clinically significant early burn induced coaguloapthy and lethal triad in thermal injuries

- We also sought any association with the validated abbreviated burn severity index (ABSI), fluid administration and mortality

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Abbreviated Burn Severity Index

Parameter	Finding	Points
Sex	Female	1
	Male	0
Age (years)	0–20	1
	21–40	2
	41–60	3
	61–80	4
	81–100	5
Inhalation injury	Yes	1
	No	0
Presence of full-thickness burn	Yes	1
	No	0
BSA burn (%)	1–10	1
	11–20	2
	21–30	3
	31–40	4
	41–50	5
	51–60	6
	61–70	7
	71–80	8
	81–90	9
	91–100	10

PROOF

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Methods

- Patients with TBSA burns ≥30% from October 2008 to December 2011 were identified from the metavision database
- A structured and anonymous metavision review was conducted
- The database was scrutinised for a predetermined list of demographics, interventions, admission observations and investigations
- Exclusion criteria were: associated major trauma, arrival at the burn centre>12 hours after burn, significant CO/Cyanide poisoning, pre-existing coagulopathy, any PRBC/FFP/PCC administration and non-thermal injuries

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Definitions

- Coagulopathy - PT≥14.7/APTT≥45 seconds
  (Local lab. reference & Davenport et al. *Crit Care Med* 2011;39(12):2652-2658)

- Hypothermia - Temperature≤35.5°C

- Acidaemia - pH≤7.25

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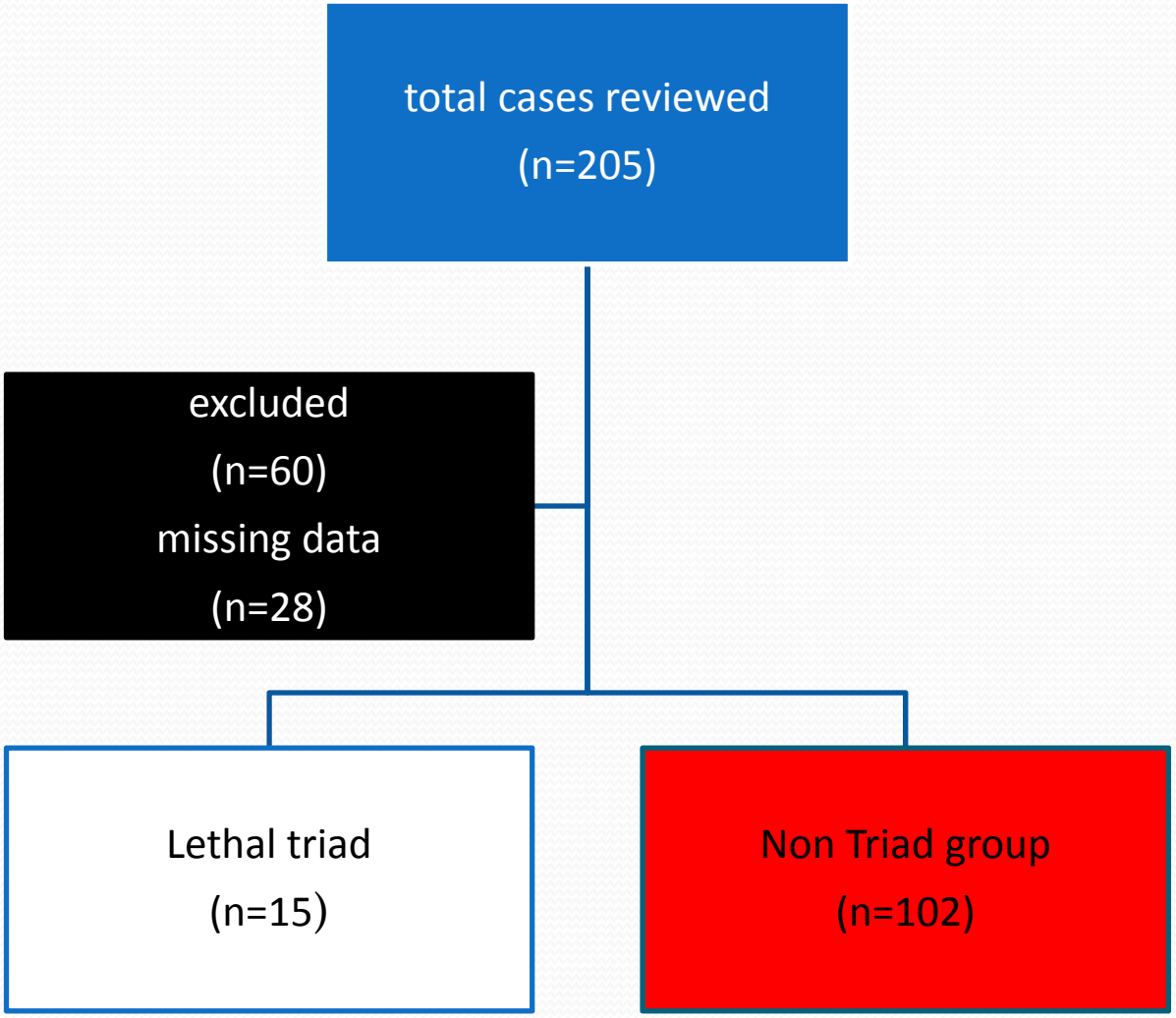
Lethal Triad



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Demographics	Lethal Triad		*P*-value
	Present (n=15)	Absent (n=102)	
Age in years, mean (SD)	46 (20.9)	33.0 (21.9)	0.033*
Sex (M/F)	10/5	65/37	1
TBSA burn, mean (SD)	59.2 (18.7)	47.9 (18.1)	0.027*
Inhalational injury present	13 (86.7%)	31 (30.4%)	<0.0001*
Abbreviated burn severity index, median (IQR)	12 (9-13)	8.5 (6-10)	0.0011*
Time from burn to arrival Burn Centre in minutes, mean (SD)	352 (107.5)	361.5 (160.8)	0.83
Fluid received prior to arrival at Burns centre. ml, mean (SD)	4783.3 (2140.1)	4167.1 (2910.6)	0.43
Fluid deficit according to Parkland formula on arrival in Burns centre. ml, mean (SD)	1903.2 (2095.6)	301.7 (2287.5)	0.012*
Mortality rate at 28 days (%)	10/15 (66.7)	12/102 (11.8)	<0.0001*

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Coagulopathy

- 39.3% of the 117 patients were coagulopathic on admission
- There was no significant correlation between the PT and volume of fluid administered (*p* - 0.095, r - 0.155)
- The 28 day mortality rate for patients with a coagulopathy of 39.1% was significantly higher than the 8.5% of those with normal coagulation (*p*-0.0001)
- The predictive value of an early coagulopathy in regards to 28 day mortality was sought using logistic regression analysis. All components of the ABSI were adjusted for
- An earlier coagulopathy was an independent predictor of 28 day mortality, OR 3.42 (1.11-10.56)

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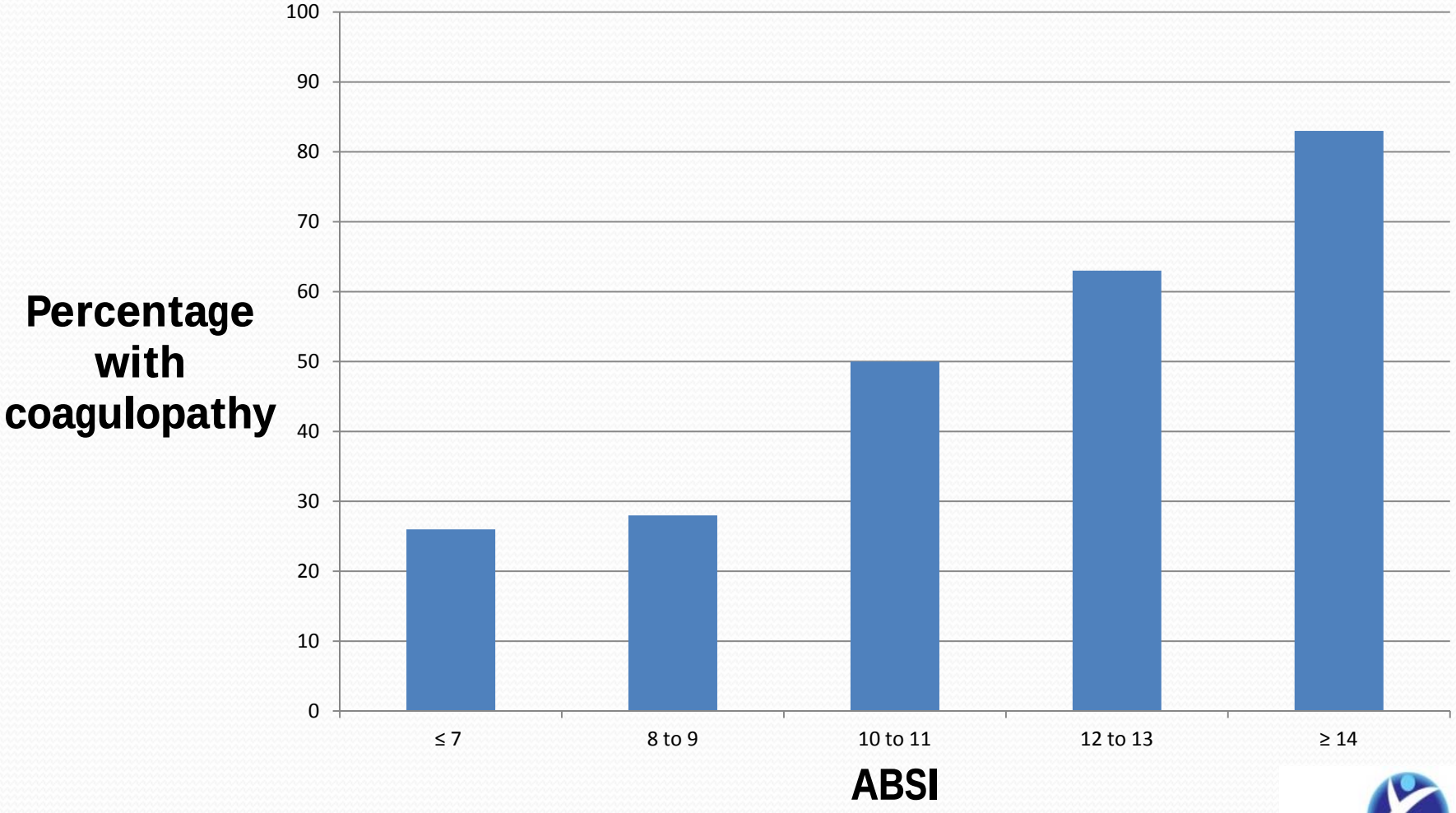
Incidence of coagulopathy with ABSI

Pearson product moment correlation coefficient *r* - 0.292 and *p* - 0.0013



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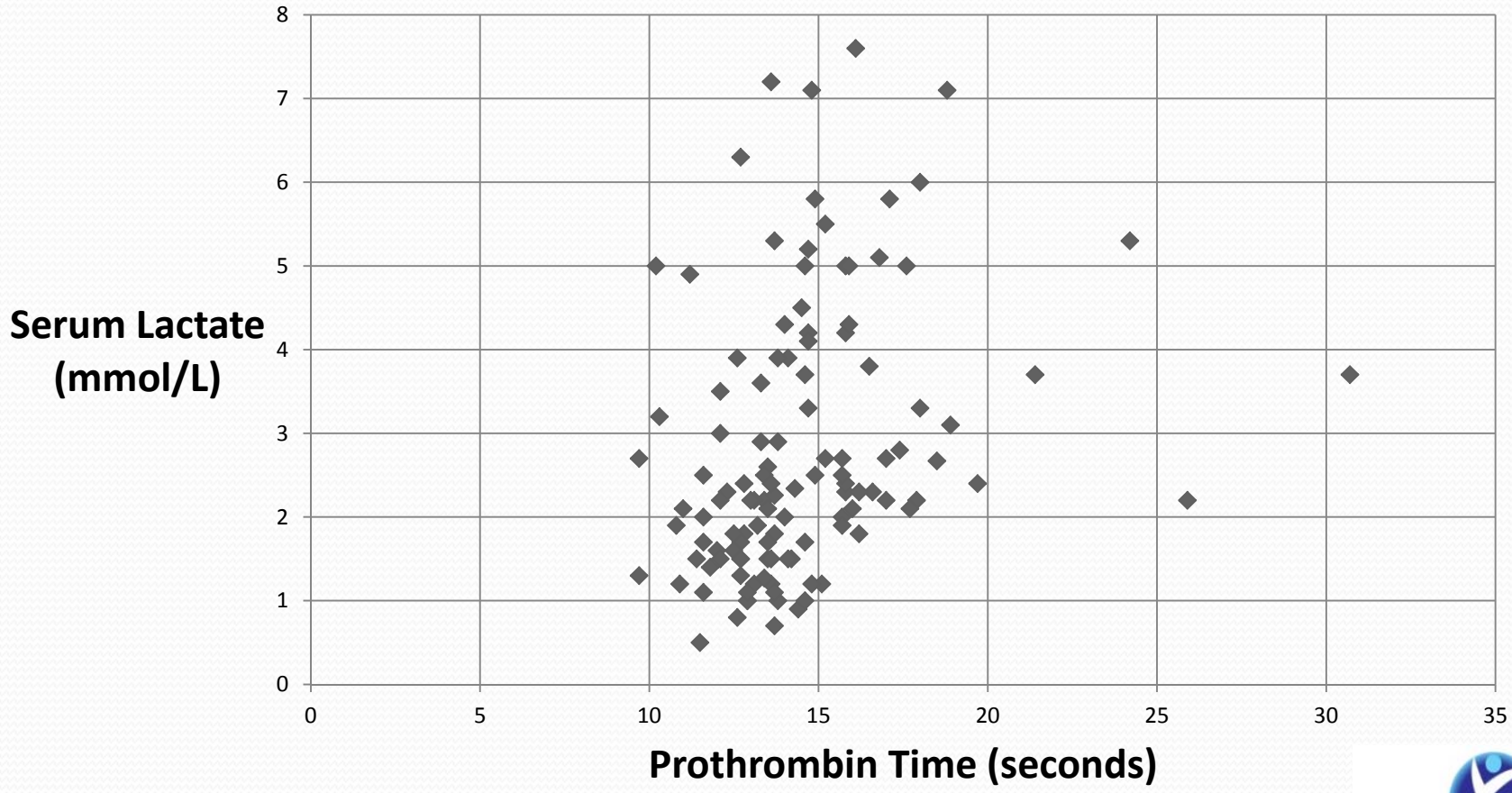
PT vs serum lactate

Pearson product moment correlation coefficient, *r* - 0.292 and *p* - 0.001



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Summary

- In patients with major thermal injuries there is a clinically significant early burn induced coagulopathy
- This coagulopathy correlates to serum lactate and ABSI but is unrelated to fluid administration
- An earlier coagulopathy was an independent predictor of 28 day mortality
- A subgroup of major burns patients exhibit the lethal triad which is associated with an increased mortality

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Conclusion

- In the pre-hospital management of major burns it is vital to accurately assess the burn area and resuscitate appropriately to limit tissue hypoperfusion
- An acute burn induced coagulopathy has significant bleeding implications for any surgical procedures
- Ensure temperature conservation
  - Highest possible ambient temperature
  - Use of Clingfilm, space blankets and layering techniques
  - Use of active warming methods such as heat pads and the En-Flow fluid warmer

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Questions?