

Shock Index as a Predictor of Mortality Among Severely Injured Hemorrhagic Shock Patients

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Introduction: Hemorrhagic Shock & Shock Index

No commonly accepted...

- Specific resuscitation regimen
- Resuscitation endpoints

Shock Index (SI) = HR / SBP

- Ratio that adjusts to individual pts.
- May predict uncompensated shock
- Vital signs available, simple equation

Objective: Study Questions

- Is SI ≥ 1 predictive of 28-day or 48-hour mortality at...

- EMS arrival
- ED arrival
- ED disposition?

Methods: Secondary Analysis

- Results dependent upon methodology
- Four methods of exclusion for GCS = 3
 - Include all pts. regardless of GCS
 - Exclude if any GCS = 3 from EMS, ED, Dispo.
 - Exclude from respective GCS = 3 phase
 - Exclude from respective GCS = 3 phase, carry forward ED Arrival GCS \Rightarrow ED Dispo.

Results: SI ≥ 1 Over Time

	EMS n = 176	ED arr. n = 197	ED dispo. n = 192
% pts. SI ≥ 1	139 (79%)	118 (60%)	99 (52%)
Continued ≥ 1	---	80 (58%)	68 (58%)
New ≥ 1	---	38 (32%)	11 (11%)
SI ≥ 1 EMS, not ED arr.	---	---	20 (20%)

Results: ED Dispo. SI ≥ 1 Mortality Rate

Method	Dispo. SI ≥ 1 : 48-hr. Mort.	Dispo. SI ≥ 1 : 28-day Mort.
Incl. all	69% vs. 43% RR = 1.6x, OR = 3.0	67% vs. 44% RR = 1.5x, OR = 2.6
Excl. ever GCS = 3	74% vs. 39% RR = 1.9x, OR = 4.3	69% vs. 40% RR = 1.8x, OR = 3.4
Excl. when GCS = 3	43% vs. 20% RR = 2.2x, OR = 3.0	43% vs. 26% RR = 1.7x, OR = 2.6
Fwd ED arr., Excl. GCS = 3	74% vs. 38% RR = 1.9x, OR = 4.5	68% vs. 39% RR = 1.7x, OR = 3.2

Significance: Shock Index- Potential Use

- Physiologically relative to pt.
 - HTN
 - Pregnant
 - Pediatric and geriatric
- When considering ED disposition to ICU or OR, calculation may be appropriate
- May prove useful in other settings
 - EMS
 - Military

Introduction: Shock Index- Potential Use SI Detects Compensated Shock

- | | |
|----------------------------------------------|---------------------------------------------------------------------|
| Uncompensated | Compensated |
| • Continued bleeding | • Bleeding stopped |
| • End-organ hypoperfusion (brain, heart, GI) | • End-organ perfusion |
| • Fluids necessary | • Fluids can be lethal! (hemorrhage, emboli, DIC, SIRS, ARDS, MSOF) |

Is there a clinical guideline to determine resuscitation endpoint?

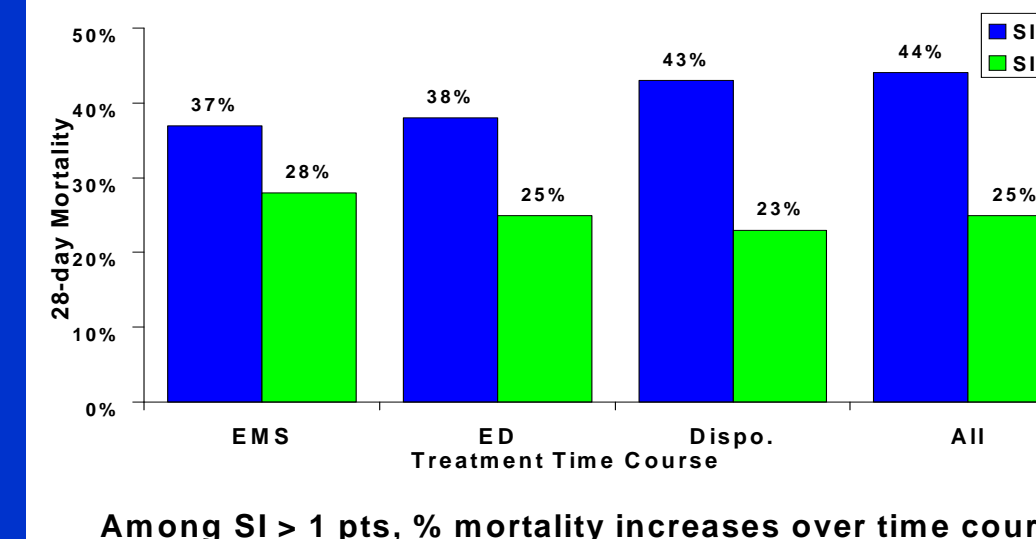
Methods: US & EU DCLHb Trials

- DCLHb: human hemoglobin solution
- Randomized, saline-controlled, single-blinded
- Trauma Centers: 18 US & 32 EU sites
- Standard Rx, with DCLHb add-on in ED
 - Fluid limited to 1L before NS / DCLHb in EU trial
 - DCLHb infused prehospital in EU trial
- Patients: severe traumatic hemorrhagic shock
 - Estimated to be most severely injured 2 - 4%
 - 119 EU, 98 US

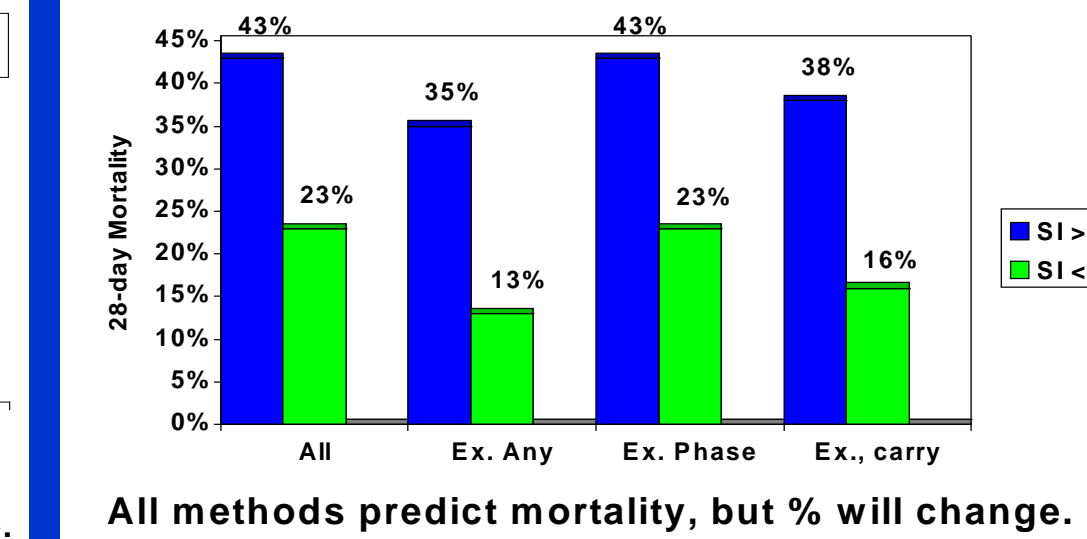
Methods: Statistical

- Data tabulated at each study site
- Compiled centrally and tabulated
- Database converted to MS Excel 2000®
 - Variables re-encoded
 - SI calculated
- SPSS version 10® & Epi Info for calculations
 - χ^2 (two-tailed) = 0.05
 - Descriptive statistics
 - Comparison of means: Student's t-test

Results: 28-day Mortality & SI vs. Time



Results: ED Dispo. SI ≥ 1 vs. Method



Significance: SI-Time Course & Limitations

- Fluid resuscitation endpoint: SBP > HR
- Potential decision guideline: ED \Rightarrow OR
- Future hemorrhagic shock trials
- Limitations
 - Elapsed time course differs
 - Severely injured pts.
 - Treatment varied by setting
 - Effects of DCLHb confounding

Introduction: Prior SI Research

- SI may predict need for immediate treatment, ICU admit
- Vitals alone may be as valid²
- Prior optimal values cumbersome²
- Exclusion of pts. GCS ≤ 8 ²
- Conclusion: SI is controversial and not routinely used clinically in US

Methods: Secondary Analysis

- Assessments
 - RTS & GCS assessed by EMS & in ED
 - GCS carried forward after admin. of sedatives and/ or paralytics
- Excluded pts.: missing data
- Missing SBP assumed to be 60 mmHg
- Missing vital sign used from next phase if within 15 minutes

Results: SI Values Over Time

	EMS	ED arr.	ED dispo.
Mean \pm SD	1.4 \pm .5	1.2 \pm .5	1.1 \pm .5
Range SI	0.4 - 3.0	0.2 - 4.1	0.1 - 3.1 HR: 20-151 SBP: 22-198
Δ SI		-0.24 \pm .68	-0.07 \pm .57

Δ SI EMS \Rightarrow ED dispo. = -0.27 \pm .65

Results: SI ≥ 1 & Mortality

- SI ≥ 1 predicts mortality only at ED dispo.
- 48-hour mortality
 - RR = 1.6x higher
 - 69% vs. 43%, OR = 3.0, 95% CI 1.5 - 6.0, p = .001
- 28-day mortality
 - RR = 1.5x higher
 - 67% vs. 44%, OR = 2.6, 95% CI 1.3 - 5.2, p = .004

Significance: Shock Index & Mortality

- Fewer pts. with SI ≥ 1 per setting
- Change in SI not predictive
- ED disposition SI is only time-point predictive of mortality
- ED disposition SI predictive of mortality regardless of GCS

Recommendations: ED Treatment & Hemorrhagic Shock Clinical Trials

- Continue to utilize GCS & RTS
- Monitor SI
- SBP > pulse could be the endpoint
 - Consider slowing IV resuscitation fluid bolus, blood once SBP > pulse
 - Send pt. \Rightarrow OR, IV fluid to maintain SBP > pulse

¹ Rady MY, Smithline HA, Blake H, et al. *Ann. Emerg. Med.* 24(4):685-90, 1994 Oct.
² King RW, Plewa MC, Buderer NM, et al. *Acad. Emerg. Med.* 3(11):1041-5, 1996 Nov.

