Serum Lactate

Applicable for Trauma Triage?

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No significant conflicts of interest or financial relationships to disclose

What if there was something:

- Identifies cellular hypoperfusion well before changes in vital signs
- Potential to reduce morbidity & mortality
- Guides early intervention and destination decision
- Easily obtained in the field
- Does NOT increase scene time
- Is inexpensive

Would You Use It?
**Shock**

- Normal Cellular Metabolism
- Hypoxia & Cellular Ischemia
- Ion Shift
- Cell Disruption Begins
- Intracellular Disruption Occurs
- Mitochondrial Swelling
- Cellular Swelling

**Classic Shock Pattern**

- **Early shock**
  - 15–25% blood volume
  - Tachycardia
  - Pallor
  - Narrowed pulse pressure
  - Thirst
  - Weakness
  - Delayed capillary refill

- **Late shock**
  - 30–45% blood volume
  - Hypotension
    - First sign of "late shock"
  - Weak or no peripheral pulse
  - Prolonged capillary refill

**Serum Lactate Levels**

- Normal serum lactate level is between 0.5 – 1.0 mmol/L

- Hyperlactatemia – mild to moderate persistent increase in blood lactate concentration (2.0 – 4.0 mmol/L) without metabolic acidosis

- Lactic acidosis – persistently increased blood lactate levels (usually >4.0 – 5.0 mmol/L) in association with metabolic acidosis.

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Serum lactate (BL, pLa) is a predictor of compromised perfusion and is associated with hypovolemic shock. (Guyette, 2009)

Limited number of studies specific to Out-of-hospital environment utilization

Value of BL in out-of-hospital environment?
- Sensitivity measures the probability of ‘something’ being tested positive
  - Number of true positives (correctly identified) / Number of true positives + Number of false negatives (incorrectly rejected)
- Specificity measures the probability of something being tested negative
  - Number of true negatives (correctly rejected) / Number of true negatives + Number of false positives (incorrectly identified)

Questions to Explore:
- Potential utility in early identification of patients with significant injury?
- What value is indicative of an acute or evolving poor physiologic condition?

Prospective Observational; In-hospital mortality; 124/135 patients enrolled; Scene arrival to ED 27 minutes (+/- 10); 92 survivors/ 32 deaths
- Lactate drawn T1, T2 and ED
- Change in lactate level and the GCS were independently associated with in-hospital mortality; prognostic value was independent of vital signs
- A 3.5 mmol/L or more resulted in mortality rate 41% T1 and 47% T2
- NPV 99% with low lactate level; more sensitive marker
- Clinical relevance
  - Triage tool in out-of-hospital (OIH) setting
  - Optimization of oxygen delivery
  - Limitations – data 10 years old; patients utilized presented with abnormal vital signs; unable to generalize across OIH; inclusion criteria utilized hypotension compensatory mechanisms; small sample

Outcome
- Pre-hospital blood lactate predicts in-hospital mortality
- Prognostic value over and above common vital signs
- Lactate more sensitive in identifying at-risk population than BP or HR

Retrospective Observational: PRBC transfusion or in-hospital mortality; 2,413/787/ 31,032; nine year enrollment period
- Systolic BP between 90 – 110 mmHg
- BL level categorized (≤ 2.5, > 2.5 to 5.0, > 5.0 to 7.5, or > 7.5)
- Number of PRBC received in first 24 hours
- Two -fold increase in risk for PRBC and mortality doubled when BL increased into the > 2.5 to 5.0 range (p < 0.0001)
- Clinical relevance
  - Superior in mortality prediction than base deficit at initial and 24 hour
- Not affected by acute drug or alcohol intoxication
- Limitations – Retrospective based on SBP from registry; Unable to extrapolate to PH setting; Study looked at SBP range for 90-110 (how about with permissive hypotension?)

Outcome
- Increase in BL identified significant risk of need for transfusion and mortality
- No absolute abnormal value of BL was determined

- Retrospective Observational: Determine pLA identifies morbidity/ mortality independent of vital signs: In-hospital mortality, surgery & MODS;
  1,168/2,190 patients
  - Median pLA 2.4 mmol/L
  - Median pLA 3.8 mmol/L, mortality (5.7%): 3.4 mmol/L surgery (7.4%); 3.8 mmol/L MODS (5.7%); 2.9 mmol/L survived to discharge
  - Sensitivity issue - identified 8% at risk individuals with normal pLA
  - Clinical Relevance
    - Use provides additional prognostic information of in-hospital morbidity and mortality independent of clinical shock, respiratory distress and altered sensorium
    - Did not address minimum predictive value, venous vs. capillary sample or titration of prehospital therapy
  - Limitations - population primarily blunt trauma, higher acuity, not generalizable to trauma population
- Outcomes
  - pLA considered ADJUNCT to increase injury detection (sensitivity) in and NOT utilized as a test to rule out injury (specificity)
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- Additional Studies
    - Elderly patients, blunt injury, SBP 90mmHg, In-hospital mortality 2.8 mmol/L ± 1.8 mmol/L vs. 2.0 mmol/L ± 1.0 mmol/L, p = 0.001
    - Mortality 15% 0–2.4; 23.4% 2.5–4.0 and 39.6% > 4.0 mmol/L
    - Retrospective chart review of 216 patients; LOS or mortality utilized; criteria serum lactate obtained in PH setting
    - Categorized shock/ non-shock groups by clinical presentation; BL 0–4.0 and > 4.0 mmol/L
    - Mortality for non-shock BL 0–4.0 mmol/L 1.2% vs. Shock BL > 4.0 26/7%
- Serum lactate and Sepsis
  - Not included for this presentation
- LACTATE PRO 2 Portable Blood Lactate Analyzer
  - A blood lactate test meter, the "Lactate Pro 2" requires a 0.3µl blood sample and provides measurement in 15 sec.
  - US FDA Approved - Waived Status under the Clinical Laboratory Improvement Amendments. Device employs methodologies that are so simple and accurate as to render the likelihood of erroneous results negligible.
So What’s the Message?

- Serum lactate is a better predictor of injury/in-hospital mortality than vital signs
- Does **NOT** replace clinical evaluation
- Threshold defining acuity unknown
- Ability to generalize to trauma population unknown

To Use or Not To Use

- Technology is improving
- Research is ongoing
- Not a standard in industry
- MAY assist with early identification of shock in patients with SBP ≥ 90 mmHg and absence of traditional clinical shock patterns