Serum Lactate

Applicable for Trauma Triage?
S. Robert Seitz, M.Ed., RN, NREMT-P
University of Pittsburgh
School of Health and Rehabilitation Sciences
Center for Emergency Medicine of Western Pennsylvania

Member, ITLS Editorial Board

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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 Destruction Begins
- Intracellular Disruption Occurs
- Mitochondrial Swelling
- Cellular Swelling

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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.


Pre-hospital Serum Lactate

• Serum lactate (BL, pLA) is a predictive 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 88% with low lactate level; more sensitive marker
  - Clinical relevance
    - Triage tool in out-of-hospital (OOH) setting
    - Optimization of oxygen delivery
  - Limitations – data 10 years old; patients utilized presented with abnormal vital signs; unable to generalize across OOH; 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%); 2.3 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)
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
  – Greater than 25% were identified to be in occult shock, as evidenced by an elevated BL, even though SBP was 90 mmHg

  – 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