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Essay title: Does pre-hospital lactate score predict patient outcome in trauma.

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Critically appraised topic in Paramedicine

(Lactate in trauma)

Title: Does pre-hospital lactate score predict patient outcome in trauma.

Clinical scenario:

A critical care paramedic (CCP) is called to a two-vehicle MVA, upon arrival at the scene it is found that the initial bravo crew has triaged 2 patients into red and two into green. The accident occurred 40 minutes by road from the nearest level one trauma centre. Both red triaged patients have suffered significant blood loss of uncertain quantities and have similar vital signs. Only one aeromedical retrieval team is available and is en route. As the senior clinician on scene, the CCP must decide which patient receives aeromedical transport. This CCP can measure serum lactate, which helps differentiate the injury severity of the patients.

PICO:

In pre-hospital trauma patients, does the use of a lactate score increase the accuracy of predicting patient injury severity than with current measures alone?

Relevance:

One of the many responsibilities of paramedics is the correct triaging of patients. Doing so in a way that has the least impact on hospital resources and does not impair patient care. This can only be done after a thorough patient examination to discern the severity and nature of a patient's condition. Any tools which can increase the accuracy and precision of preliminary diagnosis, thus allowing for the most efficient use of health resources should be examined. Prehospital serum

lactate is a potentially useful tool for determining injury severity in trauma, as such should be examined for potential implementation.

Search technique:

Embase and the TRIP database were both utilised for this search. The following search terms were used for both: (trauma) AND (lactate). Both searches were restricted to the last five years from the third of September 2019 which was the date the search was commenced. Initial searches were more focused on prehospital evidence however due to a paucity of evidence the search had to be widened. See figure 1 for the PRISMA flowchart.

Author, Date	Design	Population: sample cohort	Outcome	Results	Journal impact factor, and evidence rank*	Strengths (+) and limitations (-)
(Parsikia et al, 2014)	Retrospective	1,941 trauma patients over five years in a Pennsylvania level one trauma centre.	Prognostic reliability of serum lactate in the ED.	ISL measured within 35 minutes of ED arrival, is a statistically significant risk factor of in-hospital mortality (p=0.015) and OI (p=0.033), not for ICUA.	2.81 Level 3	(+) Large study size. (+) multiple study endpoints measured, in-hospital mortality, ICUA, and OI. (+) ISL measured within 35 minutes of ED admission. (-) ED study. (-) Single hospital study.
(Okello et al, 2014)	Cross-sectional retrospective analysis	502 trauma patients of Mulago Hospital, a surgical intervention capable Ugandan hospital.	Prognostic reliability of serum lactate in the ED.	ISL of ≥ 2.0 mmol/L is a discriminating prognostic device in separating severely and non-severely injured patients. This cut-off had a sensitivity of 88% and a specificity of 38%.	1.64 Level 3	(+) Cross-sectional study design. (+) ISL taken on ED admission. (+) Multiple endpoints measured. (-) ED study. (-) Small sample size. (-) Resource-limited facility. (-) Not a level one or two trauma centre. (-) Study takes place in a resource-restricted health care system.
(Pedersen et al, 2015)	Retrospective cohort	5,360 trauma patients in one year at Odense Hospital.	Prognostic reliability of serum lactate in the ED.	ISL of trauma patients is a significant predictor of seven day mortality in the ED.	1.68 Level 3	(+) ISL measured within four hours. (+) Large sample size. (-) ED study. (-) Measures seven day mortality only.

(Guyette et al, 2015)	Prospective observational	387 trauma patients selected by the North American ROC who were transported to Level one or two trauma centres.	Prognostic reliability of serum lactate in the prehospital environment.	PSL is superior at predicting the need for resuscitative care in the prehospital environment compared to other methods when patient SBP is between 70mm Hg and 100mm Hg.	3.27 Level 3	<ul style="list-style-type: none"> (+) PH study. (+) Direct comparison of BP and Lactate. (+) RC is a clear endpoint that translates to paramedic practice. (+) High impact journal. (+) Large catchment area. (+) Discerning selection of patients to best answer the CAT question. (-) small sample size.
(Brown et al, 2016)	Retrospective cohort	6,347 trauma patients transported to level one trauma centres were collected using multiple prospective prehospital databases.	Ability of PSL to predict trauma activation level, compared to current trauma activation guidelines.	PSL improves the accuracy of trauma level activation, when combined with current methods. Over triage is reduced by 7.2% while under triage was raised by 0.7%.	3.27 Level 3	<ul style="list-style-type: none"> (+) Large sample size. (+) PH study. (+) High impact journal. (+) Studies effect on trauma activation level; a crucial aspect of paramedic practice. (+) Directly compares current methods with current methods plus ISL.
(Javali et al, 2017)	Prospective observational	100 trauma patients with discerning exclusion of confounding factors such as prehospital cardiac arrest.	Prognostic reliability of serum lactate in the ED.	ISL is a useful predictor of the need for patient ICUA, and blood transfusion. ISL was also useful in predicting mortality.	0.79 Level 3	<ul style="list-style-type: none"> (+) Multiple study endpoints measured. (-) Small sample size. (-) ED study. (-) Low impact journal. (-) poorly defined inclusion of study cohort.

(Baron et al, 2018)	Retrospective chart review	10,575 trauma patients taken from electronic medical records between 2011 and 2016.	Prognostic reliability of serum lactate of mortality in the ED.	ISL is an effective tool to identify patients with a high risk of in-hospital mortality. However, ISL had poor predictive capability. Only Lactate levels above 9mmol/L were predictive of in-hospital mortality.	1.68 Level 4	(+ Large sample size. (-) ED study. (-) Chart review, does not allow for control of confounding variables.
(St. John et al, 2018)	Prospective cohort study	314 trauma patients transported by ALS over 14 months.	Reliability of PSL to predict need for RC.	PSL is predictive of need for RC in normotensive prehospital patients. PSL was no more predictive than SI.	1.72 Level 3	(+ PH study. (+) ALS paramedics. (+) RC as the main endpoint, crucial for paramedic practice. (-) restricts cohort to non-hypotensive trauma patients. (-) Small sample size.

Abbreviations: ALS = Advanced life support; BP = Blood pressure; CAT = Critically appraised topic; ED = Emergency department; ICUA = Intensive care unit admission; ISL = Initial serum lactate; OI = Operative intervention; PH = Prehospital; PSL = Prehospital serum lactate; RC = Resuscitative care; SBP = Systolic blood pressure.

* See figure 1

Comments:

Most studies found, examined ISL in the ED and focused on mortality as the main outcome. In these studies, ISL was associated with mortality, ICUA, and OI however a predictive capability was unable to be established. In the studies examining prehospital cases, the PSL was found useful in distinguishing the need for RC and trauma activation level, two important components of paramedic practice. Two separate articles found PSL to be predictive of patient injury severity in trauma patients with blood pressures between 70 and 100mm Hg.

Consider:

Based on the examined literature there is not enough high-quality evidence to devise a prehospital clinical guideline regarding PSL. There is some evidence supporting the use of serum lactate in the prehospital environment. More research is required before the full capability and use of PSL is understood and can be implemented into regular practice. The information synthesised is still useful for paramedic practice.

Clinical bottom line:

More research is required to determine if paramedics can utilise PSL to predict patient injury severity. There is enough evidence to continue research into the use of PSL, particularly in the normotensive trauma patient cohort. The exact predictive capability of PSL is unknown and should be treated with caution.

Appendix

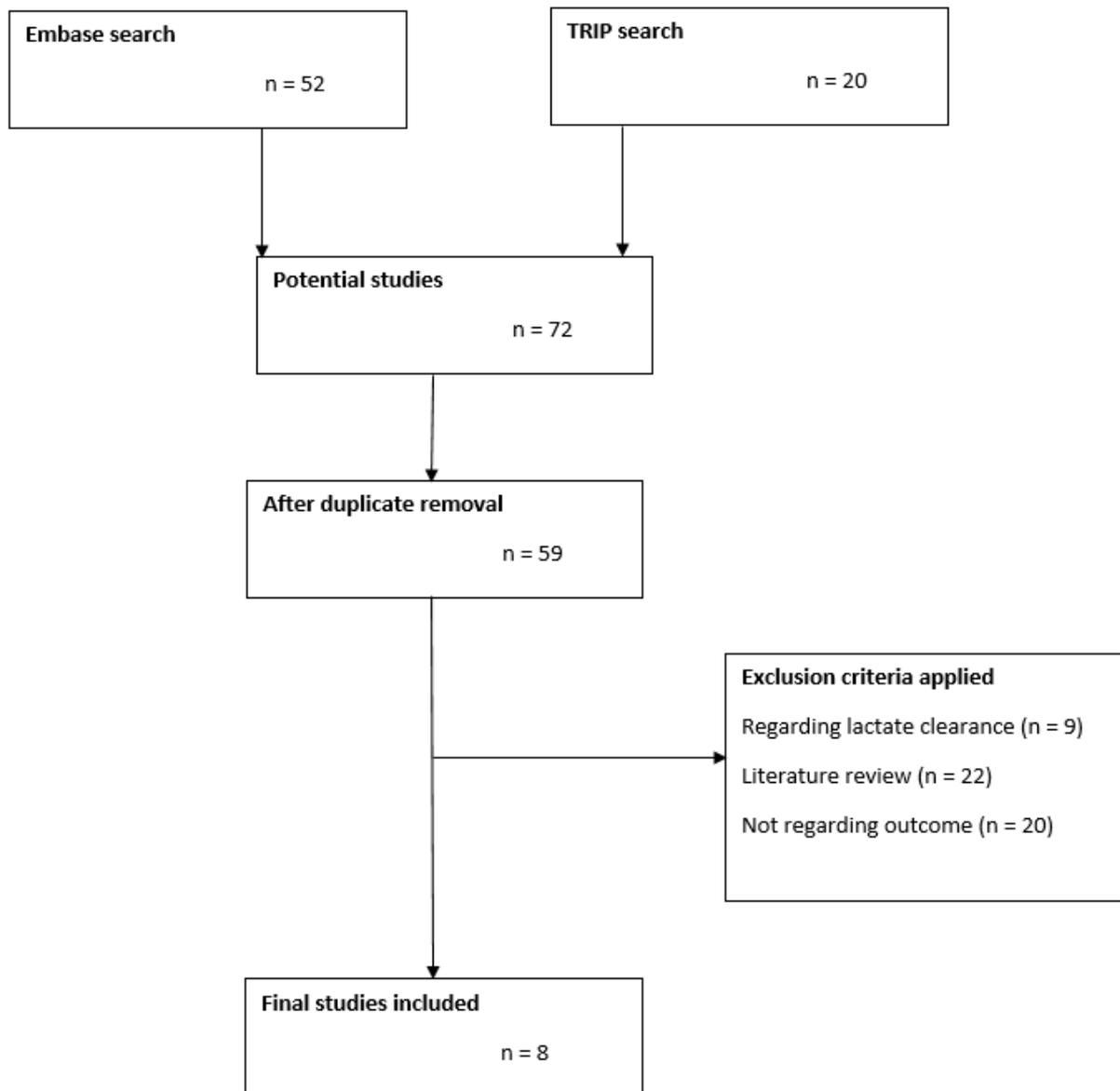


Figure 1. PRISMA exclusion flowchart

Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence

Question	Step 1 (Level 1*)	Step 2 (Level 2*)	Step 3 (Level 3*)	Step 4 (Level 4*)	Step 5 (Level 5)
How common is the problem?	Local and current random sample surveys (or censuses)	Systematic review of surveys that allow matching to local circumstances**	Local non-random sample**	Case-series**	n/a
Is this diagnostic or monitoring test accurate? (Diagnosis)	Systematic review of cross sectional studies with consistently applied reference standard and blinding	Individual cross sectional studies with consistently applied reference standard and blinding	Non-consecutive studies, or studies without consistently applied reference standards**	Case-control studies, or "poor or non-independent reference standard**"	Mechanism-based reasoning
What will happen if we do not add a therapy? (Prognosis)	Systematic review of inception cohort studies	Inception cohort studies	Cohort study or control arm of randomized trial*	Case-series or case-control studies, or poor quality prognostic cohort study**	n/a
Does this intervention help? (Treatment Benefits)	Systematic review of randomized trials or <i>n</i> -of-1 trials	Randomized trial or observational study with dramatic effect	Non-randomized controlled cohort/follow-up study**	Case-series, case-control studies, or historically controlled studies**	Mechanism-based reasoning
What are the COMMON harms? (Treatment Harms)	Systematic review of randomized trials, systematic review of nested case-control studies, <i>n</i> -of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Non-randomized controlled cohort/follow-up study (post-marketing surveillance) provided there are sufficient numbers to rule out a common harm. (For long-term harms the duration of follow-up must be sufficient.)**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning
What are the RARE harms? (Treatment Harms)	Systematic review of randomized trials or <i>n</i> -of-1 trial	Randomized trial or (exceptionally) observational study with dramatic effect			
Is this (early detection) test worthwhile? (Screening)	Systematic review of randomized trials	Randomized trial	Non-randomized controlled cohort/follow-up study**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning

* Level may be graded down on the basis of study quality, imprecision, indirectness (study PICO does not match questions PICO), because of inconsistency between studies, or because the absolute effect size is very small; Level may be graded up if there is a large or very large effect size.

** As always, a systematic review is generally better than an individual study.

Figure 2. Oxford centre for evidence-based medicine levels of evidence

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