Stratified preoperative lactate in poly-trauma patients undergoing axial and lower extremity fixation

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INTRODUCTION: In polytraumatized patients, a lactate level of <4.0 mmol/L has been established utilizing the area under the Receiver Operator Curve (ROC) optimized to identify a single threshold level. The purpose of this study is to apply the Stratum Specific Likelihood Ratio (SSLR) to further characterize optimized preoperative lactate goals in a polytraumatized patient population undergoing axial and/or lower extremity fixation.

METHODS: TriNetX, a large database of >100 million patients, was queried to identify poly-traumatized patients from US hospitals undergoing axial and/or lower extremity fixation with a documented lactate value on the day of operation. Patients were then stratified based on lactate values according to the following cutoffs: ≤ 1mmol/L, 1.1-1.5mmol/L, 1.6-2.0 mmol/L, 2.1-2.5 mmol/L, 2.6-3.0 mmol/L, 3.1-3.5 mmol/L, 3.6-4.0 mmol/L, ≥ 4.1 mmol/L. The likelihood ratio of systemic complications, critical care requirements and mortality were calculated at each stratum in comparison to the overall cohort and overlapping 95% confidence intervals were then merged.

RESULTS: A total of 18,217 US-based patients were identified that met criteria for the study. When analyzing for systemic complications, lactate cutoffs of ≤2.5 mmol/L, 2.6-3.5 mmol/L and ≥3.6 mmol/L statistically differ with likelihood ratios of 0.95 (95%CI 0.94-0.96), 1.17 (95%CI 1.11-1.23) and 1.56 (95%CI 1.47-1.66) respectively. Risk for critical care requirement can be further broken down into lactate values of ≤1 mmol/L (LR 0.85, 95%CI 0.82-0.88), 1.1-1.5 mmol/L (LR 1.03, 95% CI 0.99-1.06), 1.6-2.0 mmol/L (LR 1.21, 95%CI 1.16-1.26), 2.1-3.0 mmol/L (LR 1.34, 95%CI 1.29-1.40) and ≥3.1 mmol/L (LR 1.79, 95%CI 1.70-1.88). With respect to death, the cutoff of ≤4 mmol/L and ≥4.1 mmol/L represent the only statistically different strata with LR of 0.9 (95%CI, 0.87-0.93) and 2.81 (9%%CI, 2.36-3.34) respectively (Table 1).

DISCUSSION AND CONCLUSION: SSLR allows for more in depth stratification of continuous parameters such as lactate. In a polytraumatized patient population, risk for systemic complications and for critical care requirements appear to significantly differ at a variety of lactate thresholds, although the overall clinical difference is small. Despite heterogeneity of health care organizations, patient population and injury pattern, a lactate cutoff of 4 mmol/L continues to display significant clinical difference in terms of post-operative mortality risk.

Table 1. Stratum specific likelihood ratio's (SSLR) and 95% confidence intervals were calculated for each lactate strata with comparison to the overall population and values were recorded. Strata with overlapping 95% confidence intervals were then merged, providing the final lactate stratum on the right. Final strata are bolded. Any strata with a 95% CI including the value of 1 is noted to not differ from the baseline population.

1A. Systemic Complications – Pneumonia, acute respiratory failure, acute kidney failure, myocardial infarction, cardiac arrythmia, sepsis, infection

Lactate Stratum (mmol/L)	Likelihood Ratio	95%CI Lower Bound	95%CI Upper Bound	Lactate Stratum (mmol/L)	Likelihood Ratio	95%CI Lower Bound	95%CI Upper Bound
≤1	0.93	0.89	0.97				
1.1-1.5	0.96	0.93	1	**≤2.5**	0.95	0.94	0.96
1.6-2.0	1.01	0.97	1.06				
2.1-2.5	0.98	0.92	1.03				
2.6-3.0	1.22	1.15	1.3	**2.6-3.5**	1.17	1.11	1.23
3.1-3.5	1.23	1.13	1.33				
3.6-4.0	1.63	1.49	1.8	**≥3.6**	1.56	1.47	1.66
≥4.1	1.66	1.53	1.79				

1B. Mortality

Lactate Stratum (mmol/L)	Likelihood Ratio	95%CI Lower Bound	95%CI Upper Bound	Lactate Stratum (mmol/L)	Likelihood Ratio	95%CI Lower Bound	95%CI Upper Bound
≤1	0.74	0.61	0.90				
1.1-1.5	0.83	0.70	0.97				
1.6-2.0	0.98	0.82	1.16				
2.1-2.5	0.97	0.77	1.21	**≤4.0**	0.90	0.87	0.93
2.6-3.0	0.84	0.64	1.12				
3.1-3.5	1.14	0.84	1.54				
3.6-4.0	1.20	0.85	1.70				
≥4.1	2.81	2.36	3.34	**≥4.1**	2.81	2.36	3.34