

The Importance of Lactate

As an intern, I'm often asked to order a lactate level on my critically ill patients. But what does a lactate level actually tell us? To answer this question, it first must be understood where lactate comes from. Lactate is the product of **anaerobic respiration in cells**, so the obvious answer is that it is produced by cells when they are not receiving enough oxygen. Are there other sources of lactate? Lactic acidosis is broken down into type A and type B. Type A is the obvious type where evidence of **systemic hypoperfusion or decreased oxygenation of the blood** is present. Type B is the less obvious type, as well as the less common type. In type B lactic acidosis, evidence of systemic hypoperfusion is not present. The mechanisms may include **toxin-induced dysfunction of cellular metabolism, as well as areas of regional ischemia**. Causes of type B lactic acidosis can include **diabetes mellitus, malignancy, alcoholism, errors of inborn metabolism, mitochondrial dysfunction, drugs/toxins (biguanides, alcohols, iron, isoniazid, zidovudine, and salicylates), and D-lactic acidosis in patients with short gut syndrome**. It is also important to note that lactate is cleared from the blood mostly by the liver with the kidneys also helping to a lesser degree. **Any dysfunction of a patient's liver or kidneys could potentially elevate their lactate level.**

So of course a septic patient with hypotension and hypoxia is going to have an elevated lactate level; what is the big deal? Why even check a lactate level? As Dr. Mikkelsen, et. al at the University of Pennsylvania have shown us in their paper entitled "Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock," a patient's initial lactate level can help us predict the patient's **odds of surviving their illness**. Their research was performed at a single tertiary care center spanning from 2005 to 2007. They included 830 adults who were admitted to the hospital with severe sepsis. The primary outcome was 28-day mortality. Patients' initial lactate levels were stratified as low (<2 mmol/L), intermediate (2-3.9 mmol/L), or high (>4 mmol/L). Patients were further characterized as being in shock vs. non-shock. Their results show that in the non-shock patients, mortality of the low, intermediate, and high levels were 14%, 52%, and 50%, respectively. In the shock patients, the mortality was 6%, 22%, and 46%, respectively. It stands to reason that an initial serum lactate level can be an important tool in a physician's arsenal to help make clinical decisions when a critically ill patient presents to the ED.

The single initial measurement of lactate is likely to be the most important use to the emergency physician; however, serial lactate measurements have been shown to be important when assessing the admitted patient. In a recent article entitled "Lactate Clearance Is a Useful Biomarker for the Prediction of All-Cause Mortality in Critically Ill Patients: A Systematic Review and Meta-Analysis" published in *Critical Care Medicine*, Zhang and Xu showed that serial measurements of lactate could also potentially be used to **predict mortality in a patient**. Their meta-analysis included 15 studies that investigated the prognostic value of the clearance of lactate. Although there was no uniformity in how the studies defined the time frame for lactate clearance or the magnitude of the clearance, all studies showed that the higher the clearance of lactate, the lower the risk of death. This was presented with the caveat that the lactate clearance was a better predictor of mortality in non-septic patients. Persistently elevated lactate levels are a way to determine poor outcomes, and lactate clearance provides a way to risk stratify ill patients (**nobody knows how much lactate clearance is enough**).

When it comes to the critically ill patient, a serum lactate level has several uses. The initial level and the clearance of lactate can both be used as **prognostic indicators** for patients. If a patient will be spending several hours in the ED, think about trending their lactate level in order to **risk-stratify** the patient. Finally, it is important to keep in mind the **potential sources of lactate** and that just because a patient's serum level is elevated does not mean they are hypoperfusing their tissues.

References // Further Reading:

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- Mikkelsen MD, Mark, et. al. "Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock." *Critical Care Medicine*. Vol. 37. No. 5. Pg 1670-1677.
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