The potential benefit of continuous glucose and lactate monitoring

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A new technology for the continuous and simultaneous measurement of both glucose and lactate has been recently introduced into clinical use. This monitoring device (EIRUS, MAQUET) is composed of a central venous catheter with an integrated microdialysis function (1,2). This lecture will explore the theoretical clinical benefits of such novel monitoring technology.

Critically ill patients often develop (stress-induced) hyperglycemia, which, when left untreated, has been shown to be associated with increased mortality and morbidity. Several seminal studies have therefore promoted Intensive Insulin Therapy (IIT) in order to achieve Tight Glycemic Control (TGC). However, later studies failed to reproduce the same benefits of TGC. Furthermore, they have pointed out that TGC may be associated with more frequent episodes of hypoglycemia due to overzealous IIT leading to inadequate blood glucose control. In addition, exaggerated variability of glucose levels has also been shown to be associated with worse outcome. The achievement of adequate and safe glucose control has been dependent, until recently, on frequent intermittent blood sampling which are both time-consuming and costly. The newly introduced technologies for continuous glucose monitoring (3) offer a more practical and safer alternative, as a continuous measurement may prevent long periods of undetected hyper- or hypoglycemia, while enabling a safer implementation of a more pro-active glucose control approach. It is also possible that TGC with continuous glucose measurement will reduce glucose variability irrespective of the target range.

Hyperlactatemia is a useful surrogate marker representing anaerobic metabolism resulting from an imbalance between oxygen supply and demand in the tissues. During circulatory shock, inadequate oxygen delivery results in mitochondrial hypoxia. Under such hypoxic conditions, mitochondrial oxidative phosphorylation fails, and energy metabolism becomes dependent on anaerobic glycolysis. Anaerobic glycolysis sharply increases the production of cellular lactate, which diffuses into the blood during prolonged cell hypoxia. Since elevated lactate levels are
associated with poorer outcome, and their prognostic value exceeds that of blood pressure, for example, lactate is being used as an outcome marker (4). In patients with a clinical picture of severe infection, the blood lactate concentration varies in proportion to the ongoing deficit in tissue oxygenation, and the ability of the patient to reduce the blood lactate concentration indicates restoration of oxygen delivery with resuscitation. Early resuscitation targeting lactate clearance as the marker of adequacy of oxygen delivery was found to be non-inferior to ScvO2 monitoring for the outcome of in-hospital mortality. Thus lactate trends can provide vital information regarding the patient’s response to resuscitation interventions, while an increase in lactate can point to continuing deterioration. This information may not be provided in a timely manner by intermittent monitoring. Changes in lactate levels in any patient deserve attention, although increases in lactate may also be due to increased glycolysis or poor lactate clearance (e.g. due to liver dysfunction) (6). The ideal time-domain of continuous lactate measurements remains to be determined. However, our ability to continuously monitor lactate provides us with new opportunities to detect and follow low-flow states, as well as better understand lactate’s unique pathophysiological features.

References