On-line plasma lactate concentration monitoring in critically ill patients

Christian De Tymowski¹, Sabri Soussi¹, François Depret¹ and Matthieu Legrand¹,²,³*

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Blood lactate concentration (BLC) is widely used to guide resuscitation in critically ill patients [1]. Muscular microdialysis has previously been used to illustrate the importance of the Na/K pump in hyperlactatemia in septic shock patients [2], with BLC reflecting metabolic changes rather than oxygen debt [3]. Microdialysis has now also been applied to intravascular continuous monitoring [4] (Eirus TLC®, Maquet Critical Care, Solna, Sweden). Nevertheless, the potential clinical implications of on-line lactate monitoring are unclear. In this regard, we illustrate the high sensitivity of the device to detect BLC variations and the potential clinical implications of this.

An adult patient presented with a total body surface area burn of 70% after a suicide attempt by self-immolation. A triple-lumen central venous catheter (CVC) with an integrated microdialysis function was placed in the left internal jugular vein. A second CVC was placed in the right femoral vein. Figure 1 shows BLC variation during the first hours after resuscitation. On top of the general trend of BLC assessment, we propose an alternative additional use of continuous BLC monitoring, namely assessment of blood lactate clearance [5]. A short-lasting rise in BLC can be identified in the global trends (circles in Fig. 1a) corresponding to fluid challenges using Ringer lactate (RL; 500 ml, lactate 29 mmol/L, amount of lactate 14.5 mmol). Lactate clearance can be assessed using the flowing formula: 

\[ Lc (L/kg/h) = \frac{D (mmol/kg)}{AUC (mmol/L/h)} \]

where \( Lc \) is lactate clearance, \( D \) is the amount of L-lactate infused, and \( AUC \) is the area under the curve from RL infusion until BLC reaches its initial level. Two RL bolus infusions via the femoral CVC performed with a 2-h interval (Fig. 1b) allowed us to evaluate lactate clearance at 934 and 1172 ml/min, respectively [5]). The AUC was calculated by the trapezoid method, i.e., the sum of BLC means every minute, with the BLC at initiation of the RL infusion used as the reference (Fig. 1c). Lactate production was calculated to be 3518 and 3176 μmol/kg/h, respectively, as lactate production (μmol/kg/h) = blood lactate (mmol/L) × lactate clearance (mL/kg/h) [5]. Inter-measurement variability was 16 and 7%, respectively, for lactate production and clearance.

To summarize, this case illustrates that continuous monitoring could allow sensitive detection of rapid and short-lasting changes in BLC after a 500-ml RL infusion. This could be used to assess lactate clearance. Further studies are needed to validate this concept.

* Correspondence: matthieu.legrand@aphp.fr

¹ AP-HP, GH St-Louis-Lariboisière, Department of Anesthesiology and Critical Care and Burn Unit, St-Louis Hospital, Assistance Publique- Hopitaux de Paris, Paris, France
² University Paris Diderot, Paris, France
Full list of author information is available at the end of the article

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Abbreviations
AUC: Area under the curve; BLC: Blood lactate concentration; CVC: Central venous catheter; D: Amount of L-lactate infused; Lc: Lactate clearance; RL: Ringer lactate

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Availability of data and materials
Figure 1 is original and has never been published.

Authors’ contributions
CDT, SS, and ML collected and analyzed the data and drafted the manuscript. FD helped to draft the manuscript. All authors read and approved the final manuscript.

Authors’ information
Matthieu Legrand is the guarantor of the content of the manuscript, including the data and analysis.

Competing interests
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Ethics approval and consent to participate
The study was approved by our local ethics committee (comité de protection des personnes IV, St-Louis hospital; Institutional review board 00038335, protocol 2013/17NICB). Informed consent was waived by the ethics committee as this is a non-interventional study. We have removed details pertaining to age and sex from the manuscript so as not to compromise the anonymity of the patient.

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Author details
1AP-HP, GH St-Louis-Lariboisière, Department of Anesthesiology and Critical Care and Burn Unit, St-Louis Hospital, Assistance Publique- Hopitaux de Paris, Paris, France. 2University Paris Diderot, Paris, France. 3UMR INSERM 942, Institut National de la Santé et de la Recherche Médicale (INSERM), Lariboisière hospital Univ Paris Diderot, F-75475 Paris, France.

Fig. 1 Panel (a) Contiguous plasma lactate monitoring showing changes in lactate level over the first 65 h. Circles indicate Ringer lactate boluses. Panel (b) Zoom on changes induced by 2 boluses of Ringer lactate (500 ml). Panel (c) Area under the curve of plasma lactate during and after infusion of 500 Ringer lactate (Bolus A of panel b)
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