high. When associated with signs of tissue hypoperfusion, an elevated SvO₂ (or ScvO₂) does not mean that resuscitation efforts are no longer necessary. We previously reported that elevated SvO₂ values did not exclude fluid responsiveness in patients with sepsis and signs of tissue hypoperfusion (5). Similarly, Monnet and colleagues showed that blood lactate and venoarterial Pco₂ differences, but not ScvO₂, predicted an increase in VO₂ in fluid-responsive patients (6).

Hence, we do not think that the observations by Gattinoni and colleagues should influence the way in which patients with sepsis are managed. Hyperlactatemia associated with other signs of tissue hypoperfusion should encourage attempts to increase DO₂ with fluids, transfusions, and/or dobutamine administration, even in the absence of acidemia or when ScvO₂ is not reduced.

Author disclosures are available with the text of this letter at www.atjournal.org.

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References

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Reply to Nalos and Robergs and to De Backer and Vincent

From the Authors:

We thank Professors Nalos and Robergs for their supportive comments concerning our paper and our hypotheses (1), particularly with regard to the lack of a direct causal relationship between elevated lactate and acidemia in patients with sepsis. Moreover, we agree that the cause of hyperlactatemia is often multifactorial and that the use of catecholamines is certainly a well-accepted contributor. In our population, lactate and epinephrine were weakly but significantly related ($R^2=0.06; P<0.0001$). Professors De Backer and Vincent disagree with us on several points, which deserve a point-by-point reply.

1. They stated that “hyperlactatemia can be of hypoxic origin even in the absence of acidosis, and of nonhypoxic origin even when there is acidemia.” The confusion here might stem from confounding of the terms “acidosis” and “acidemia.” As soon as it is released into the blood, lactate (a strong negative ion) causes acidemia. If the measured pH does not fall, it simply means that other cofactors are operating. In our 1,741 patients with sepsis, the primary cofactor that determined acidemia was kidney function. Therefore, the relationship between acidemia and lactate has nothing to do with lactate origin.

2. They stated that “high SvO₂ values can be the result of microcirculatory alterations.” Actually, in their own cited work, they showed that microcirculation was altered in patients with sepsis compared with patients without sepsis, but venous oxygen saturation (SvO₂) values were similar.

3. They stated that elevated ScvO₂ is compatible with inadequate perfusion (due to peripheral shunt), thus implying a need for further fluid resuscitation. This argument reflects the common belief that if peripheral shunt increases, the SvO₂ will increase despite inadequate oxygen delivery. The validity of this concept may be tested by considering the periphery as comprised of two compartments: one oxygen consuming (VO₂) and perfused (Q – Qsp), and one not oxygen consuming but perfused (Qsp). Accordingly, the “peripheral shunt” fraction (Qsp/Q) may be described as:

$$\frac{Q_{sp}}{Q} = \frac{SvO_2 - SvO_2id}{SaO_2 - SvO_2id},$$

where SvO₂ and SaO₂ are the central venous and arterial oxygen saturations, respectively, and SvO₂id is the oxygen saturation of the blood exiting the VO₂ consuming/perfused compartment. Therefore:

$$SvO_2id = SaO_2 - \frac{VO_2}{Q \times (1 - \frac{Q_{sp}}{Q}) \times k},$$

where $k = Hb$ (g/L) $\times 1.39$ ml O₂/g Hb.

The ScvO₂, which derives from the sum of ScvO₂id and SaO₂ of the shunted blood, is equal to:

$$ScvO_2 = SaO_2 \times \frac{Q_{sp}}{Q} + SvO_2id \times \left(1 - \frac{Q_{sp}}{Q}\right).$$

Then, substituting SvO₂id:
ScvO₂ = SaO₂ × \left( \frac{Q_{sp}}{Q} \right) + \left( \frac{V_O₂}{Q \times k \times \left( 1 - \frac{Q_{sp}}{Q} \right)} \right)
= SaO₂ × \left( \frac{Q_{sp}}{Q} \right) × \left( 1 - \frac{Q_{sp}}{Q} \right) - V_O₂

from which, solving and simplifying for \left( 1 - \frac{Q_{sp}}{Q} \right):
= SaO₂ × \left( \frac{Q_{sp}}{Q} \right) × \left( 1 - \frac{Q_{sp}}{Q} \right) - V_O₂

Thus, relying solely on Xpert MTB/RIF improves the diagnosis of nontuberculous mycobacterial infections.

When Considering Nontuberculous Mycobacterial Infections

To the Editor:

We read with great interest the article by Lee and colleagues on the use of the Xpert MTB/RIF assay as a substitute for smear microscopy in an intermediate-burden setting (1).

Although we agree with the authors’ conclusions regarding the diagnosis of tuberculosis, it must be remembered that smear microscopy also allows the diagnosis of nontuberculous mycobacterial (NTM) diseases. The main limitation of Xpert MTB/RIF as compared with microscopy is that it allows only the diagnosis of tuberculosis, whereas microscopy also diagnoses NTM infections.

In the author’s epidemiological setting, half of the positive cultures are a result of NTM and 45% of smear-positive cases are caused by NTM. Overall, the improvement in tuberculosis diagnosis (97 cases detected by Xpert among smear negative) was approximately equal to the number of missed NTM cases (82 smear positive).

Thus, relying solely on Xpert MTB/RIF improves the diagnosis of smear-negative tuberculosis but delays the diagnosis of the most severe NTM cases (the smear-positive ones). Whether the benefit in tuberculosis diagnosis is worth the disadvantage in NTM diagnosis remains to be studied before substituting smear microscopy with Xpert.

References


