



HYPERLACTATAEMIA EXPLAINED ..

... AND IT'S NOT LACTIC ACID!

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UNDERSTANDING LACTATE (I)

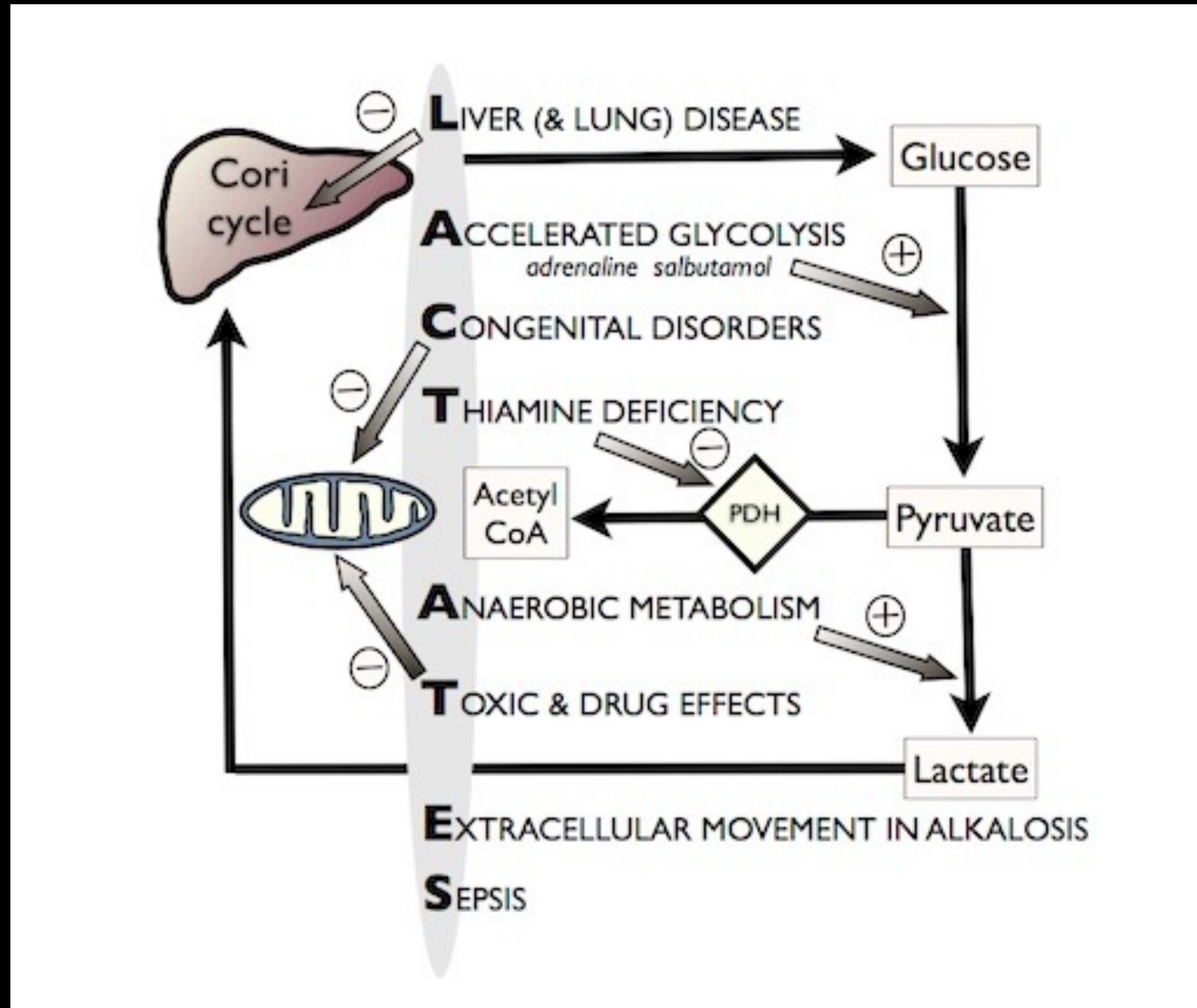
- blood lactate rises due to multiple causes
 - tissue hypoperfusion
 - accelerated aerobic glycolysis (n.b. epinephrine Rx) ...
 - mitochondrial inhibition
 - liver dysfunction
 - drugs
- lactate itself is a good guy (fuel source)
- released from muscle to feed brain, heart, liver ..



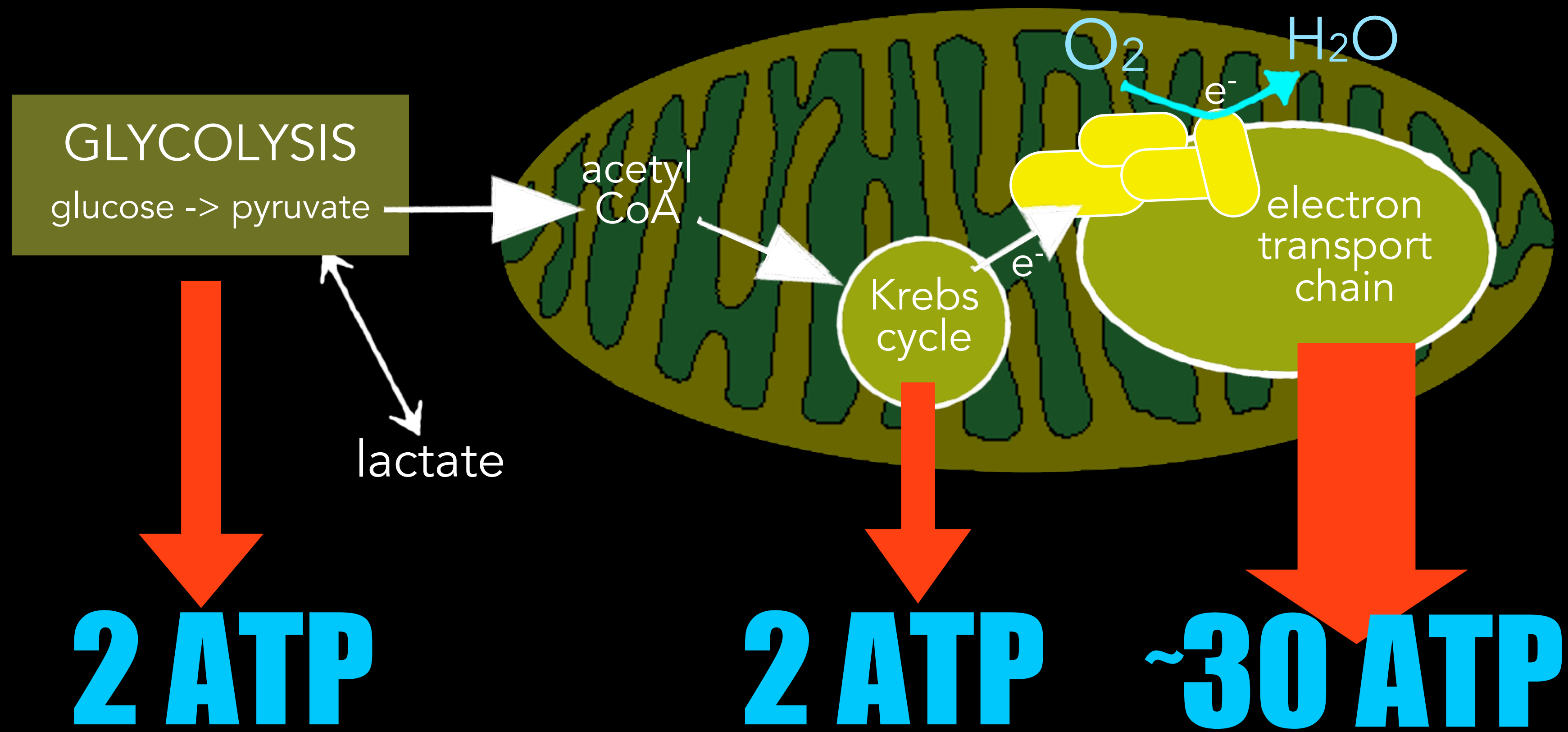
UNDERSTANDING LACTATE (II)

- blood [lactate] reflects the degree of whole body stress
- the more stressed the patient, the worse the outcome
- blood lactate = balance of total body production vs utilization..
- production/release >> utilisation before hyperlactataemia appears
... i.e it's often not an early marker

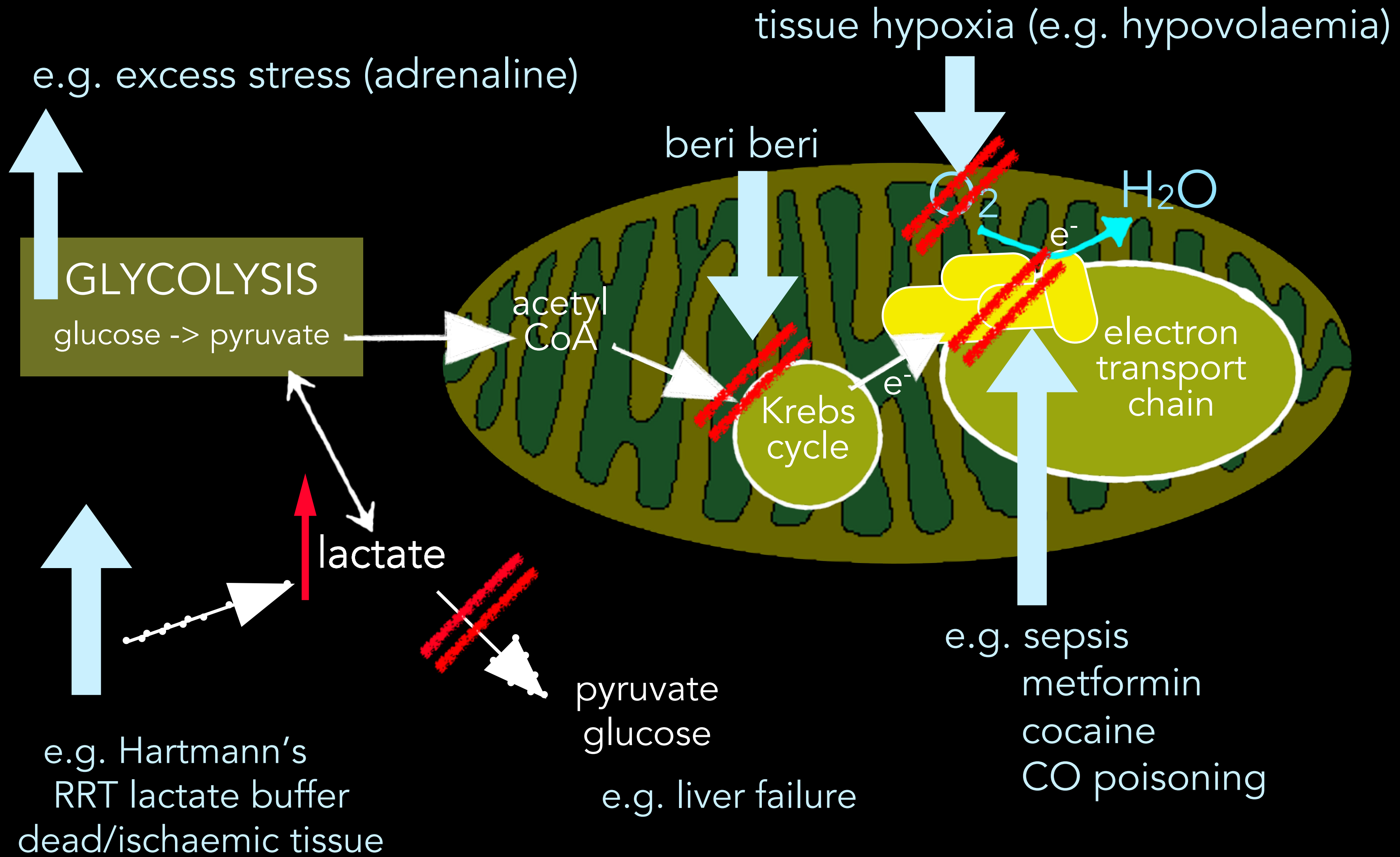
"LACTATES" - A USEFUL ACRONYM!



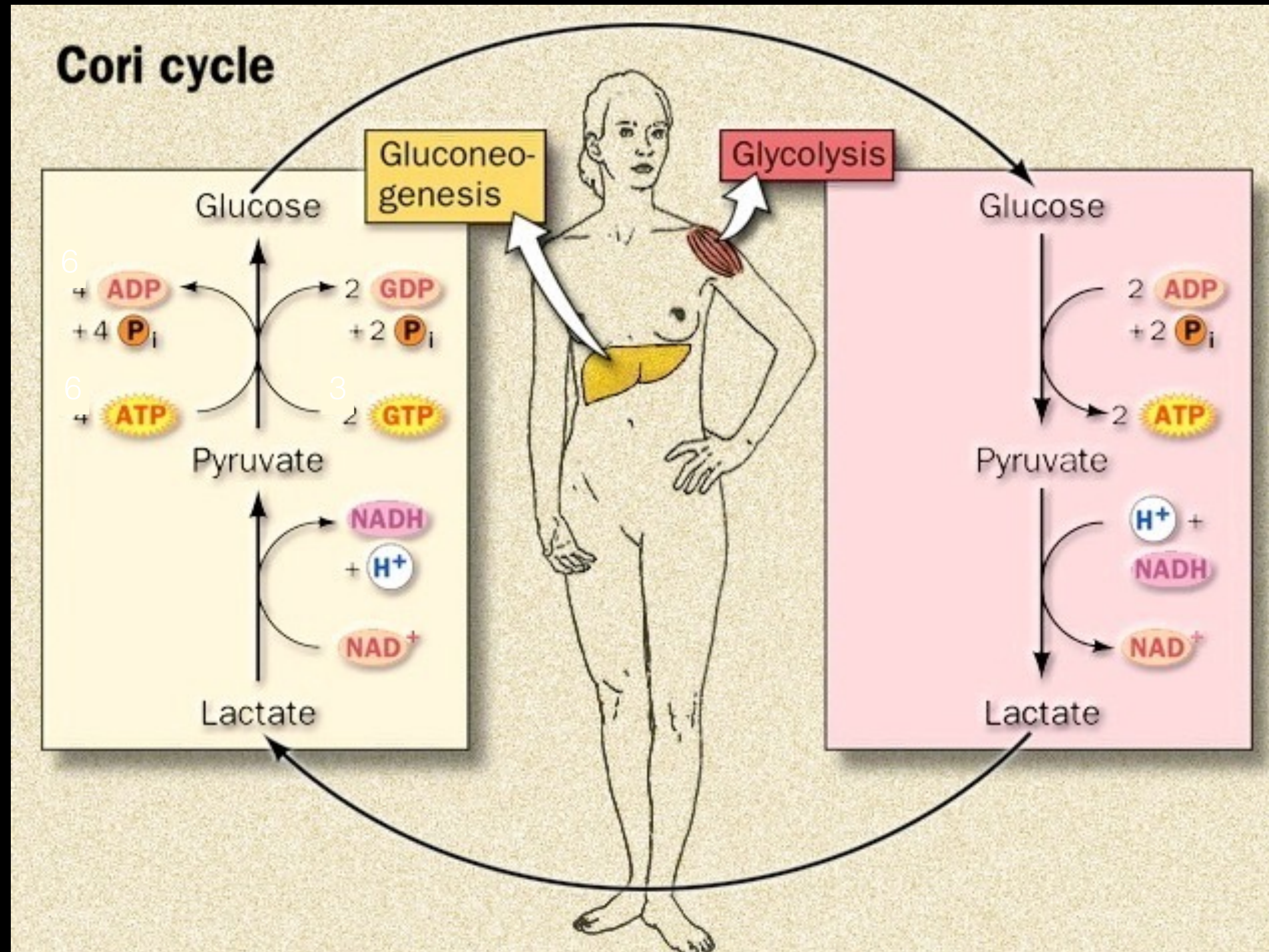
WHERE DOES LACTATE COME FROM?



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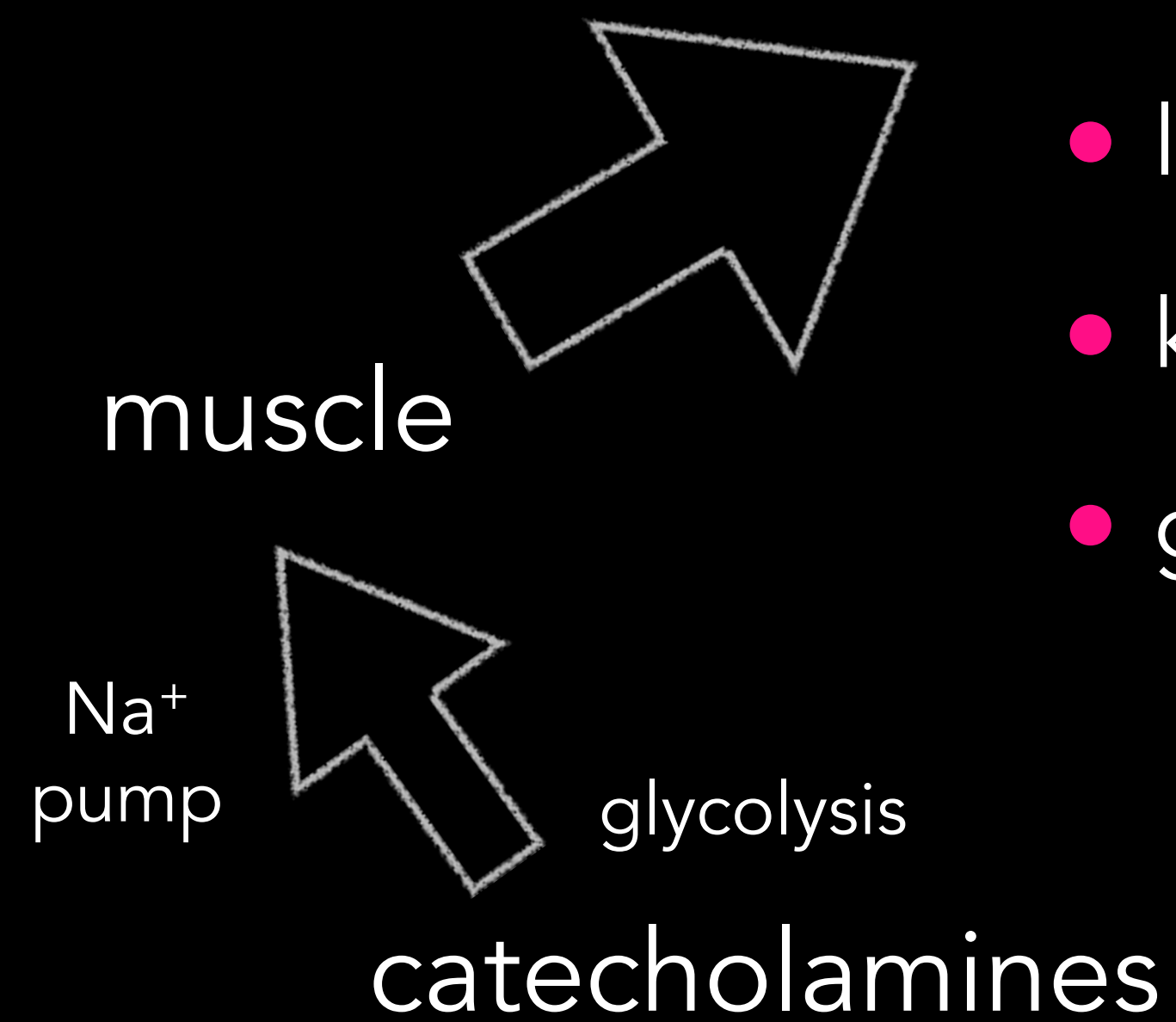


CORI CYCLE (BETWEEN MUSCLE AND LIVER)

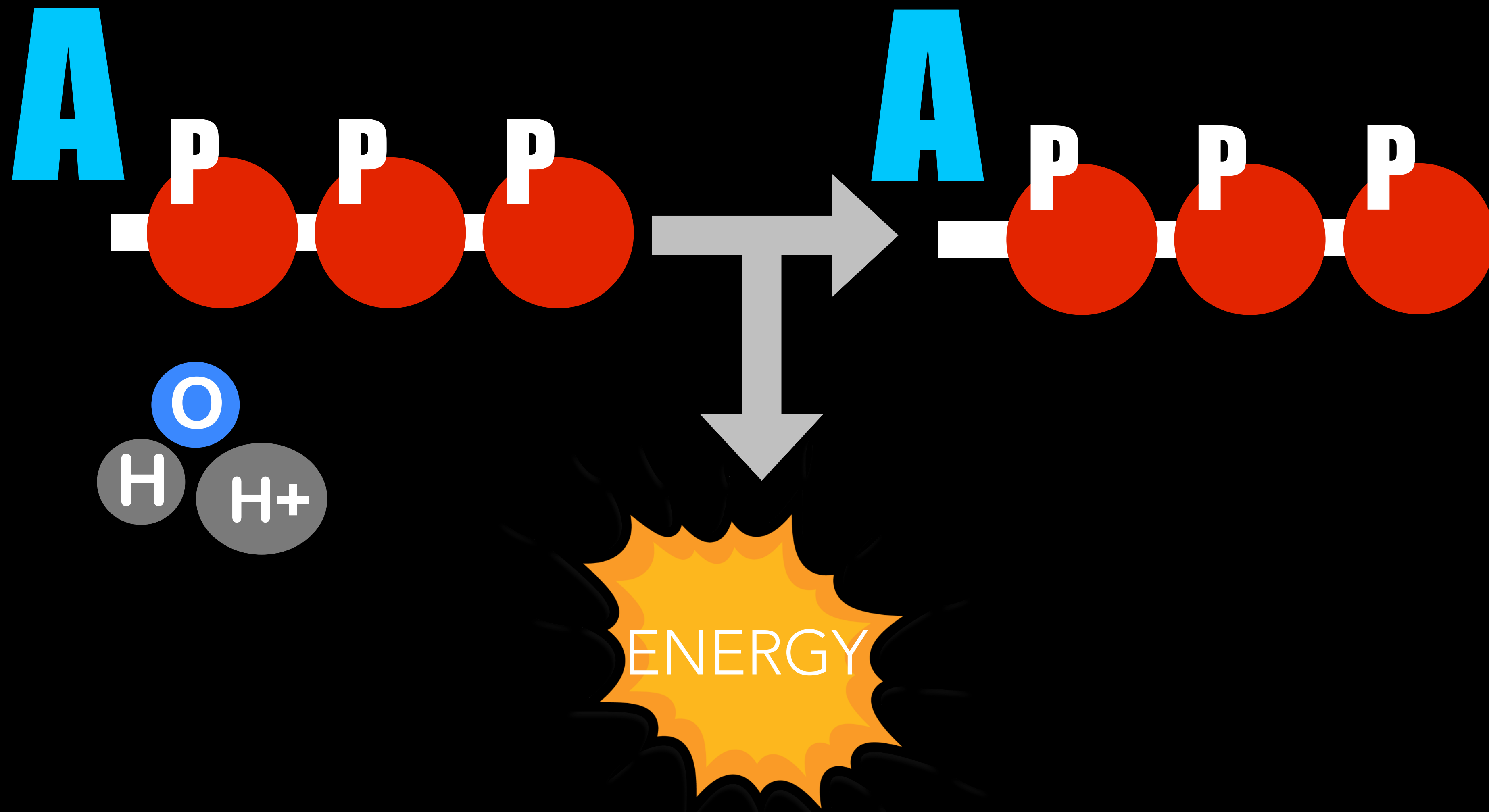


LACTATE - A FUEL SOURCE FOR ...

- heart
- brain
- liver
- kidney
- gut ..

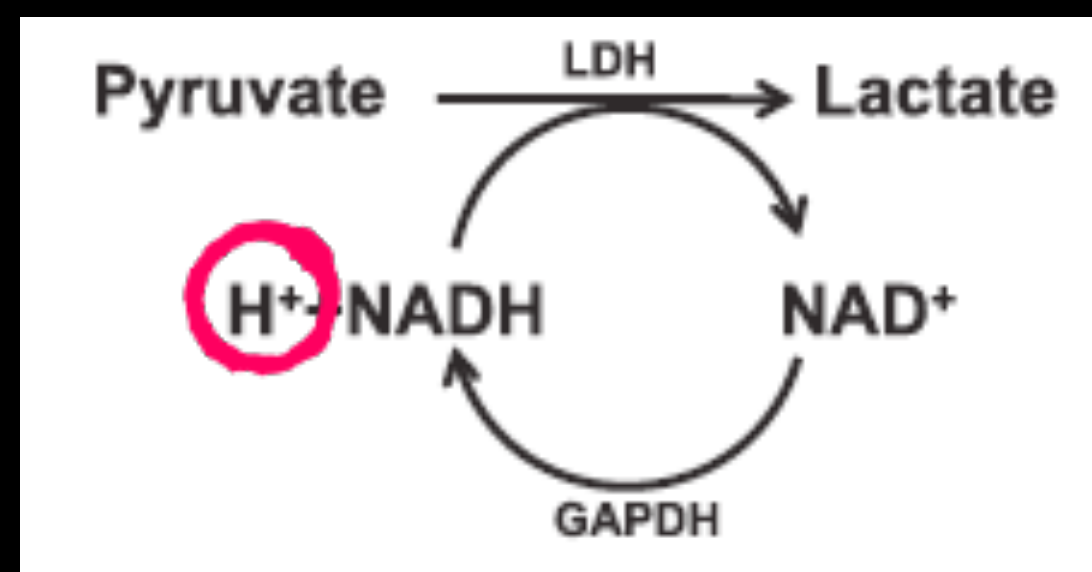


WHERE DOES THE ACID COME FROM?



THE LACTIC ACID CONSTRUCT

- long-standing belief that lactate production releases protons and causes acidosis ('lactic acidosis') is FALSE!!!
- main source of H^+ ions is from ATP hydrolysis
 - ... coupled with some H^+ ions released from glycolysis
- .. indeed, lactate production from pyruvate consumes protons!

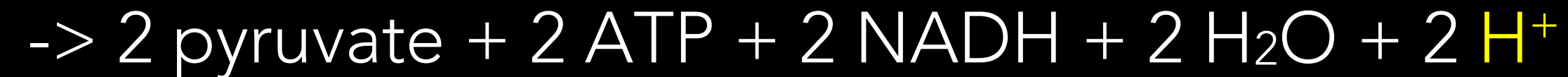


HOW ARE H⁺ IONS PRODUCED .. AND CONSUMED?

ATP HYDROLYSIS



GLYCOLYSIS



GLYCOLYSIS + LACTATE DEHYDROGENASE REACTION



CREATINE KINASE REACTION



LACTATE AS A PROGNOSTICATOR

...CIRCULATION DEPENDENT

...TIME-DEPENDENT

...LOCATION-DEPENDENT

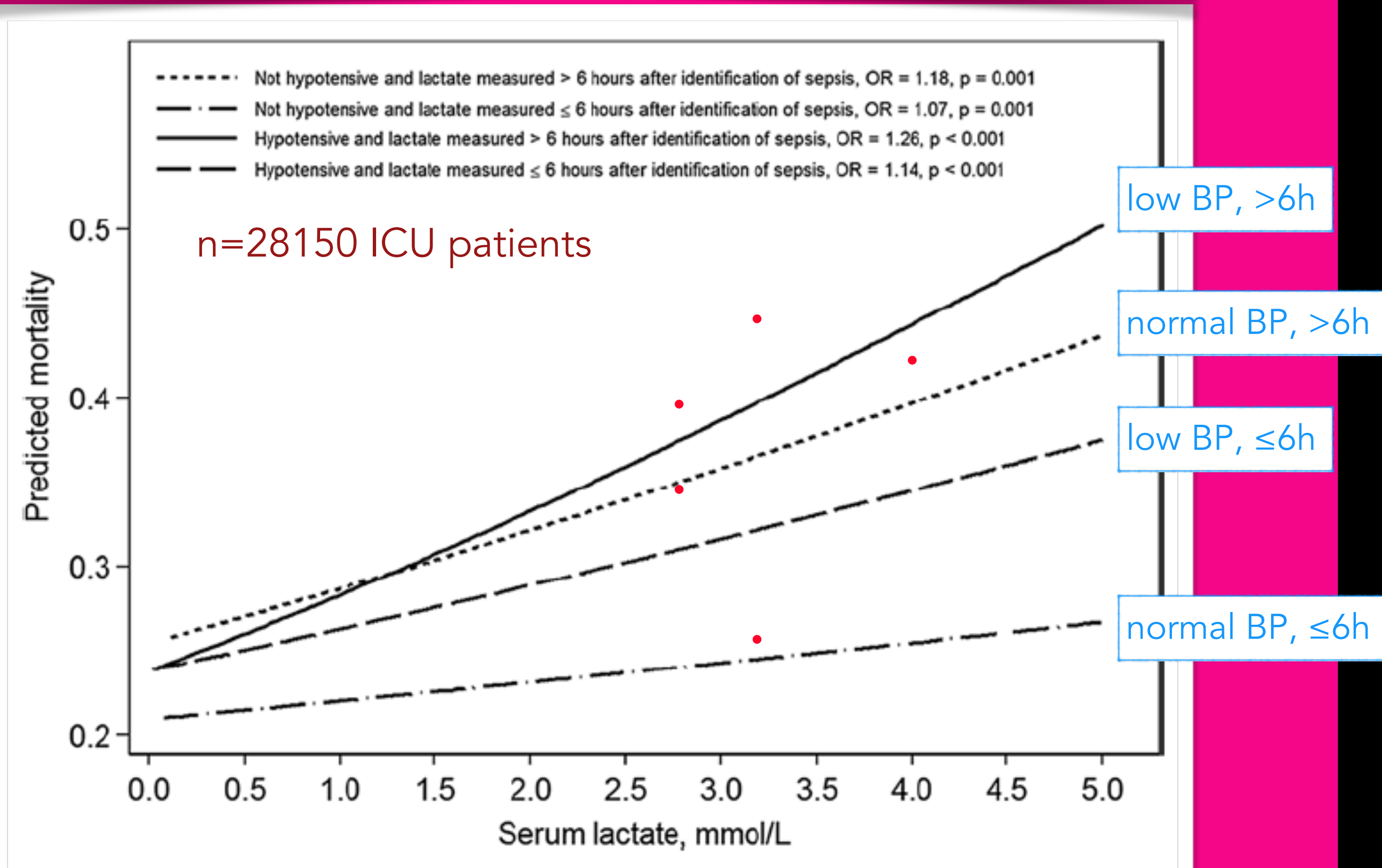


UNDERSTANDING LACTATE (III)

- a high lactate, or poor clearance after early resuscitation, prognosticates for poor outcome ..
- a rapidly normalizing lactate with Rx is generally reassuring
- however, a normal baseline level, nor rapid lactate clearance with Rx, does NOT mean patient is 'safe'
- ICU lactate \neq ED lactate (illness severity, prognostication)

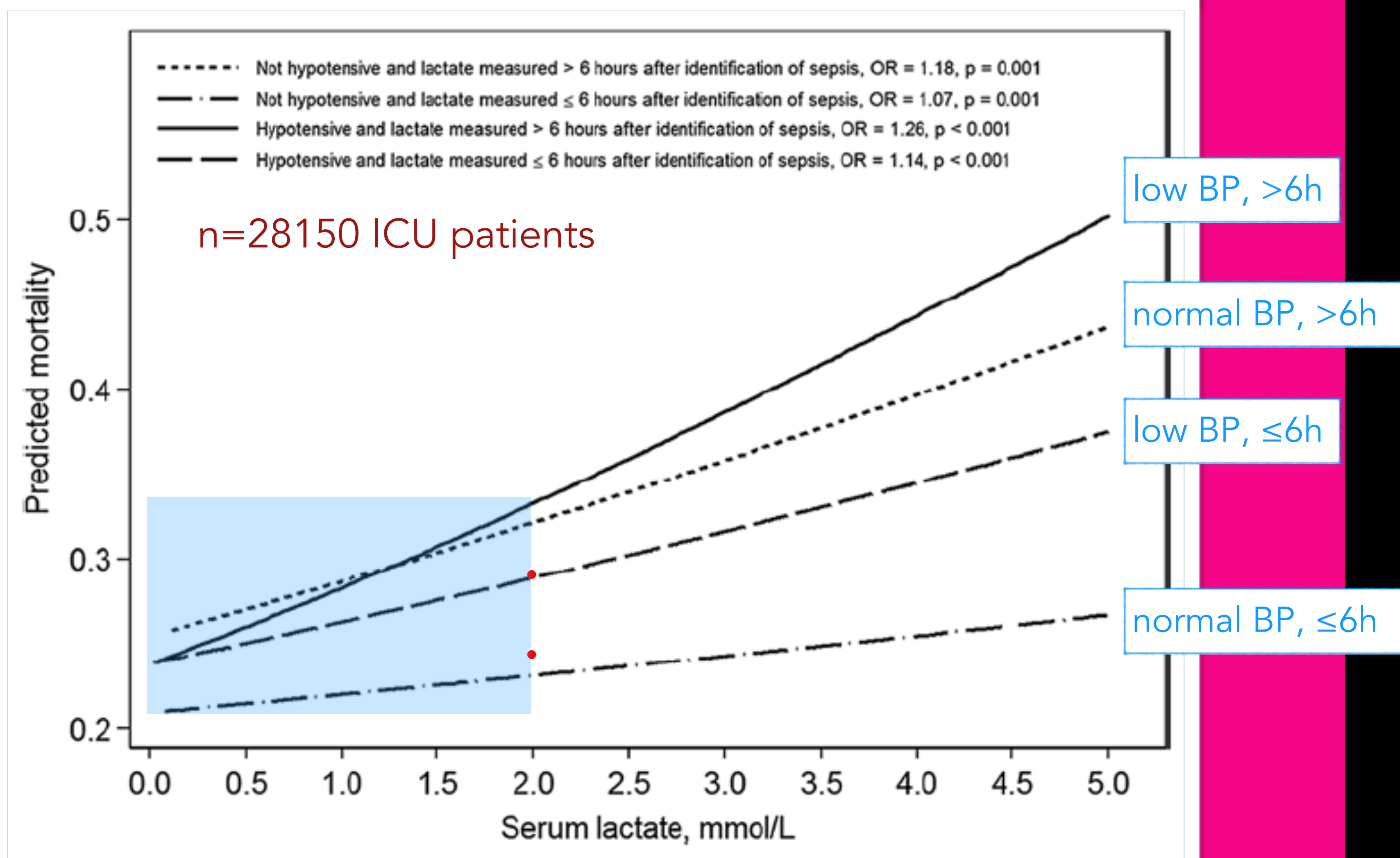
Lactate Measurements in Sepsis-Induced Tissue Hypoperfusion: Results From the Surviving Sepsis Campaign Database

Brian Casserly, MD^{1,3,4}; Gary S. Phillips, MAS⁵; Christa Schorr, RN, MSN⁶; R. Phillip Dellinger, MD⁶; Sean R. Townsend, MD⁷; Tiffany M. Osborn, MD, MPH⁸; Konrad Reinhart, MD⁹; Narendran Selvakumar, MD⁴; Mitchell M. Levy, MD^{2,3}



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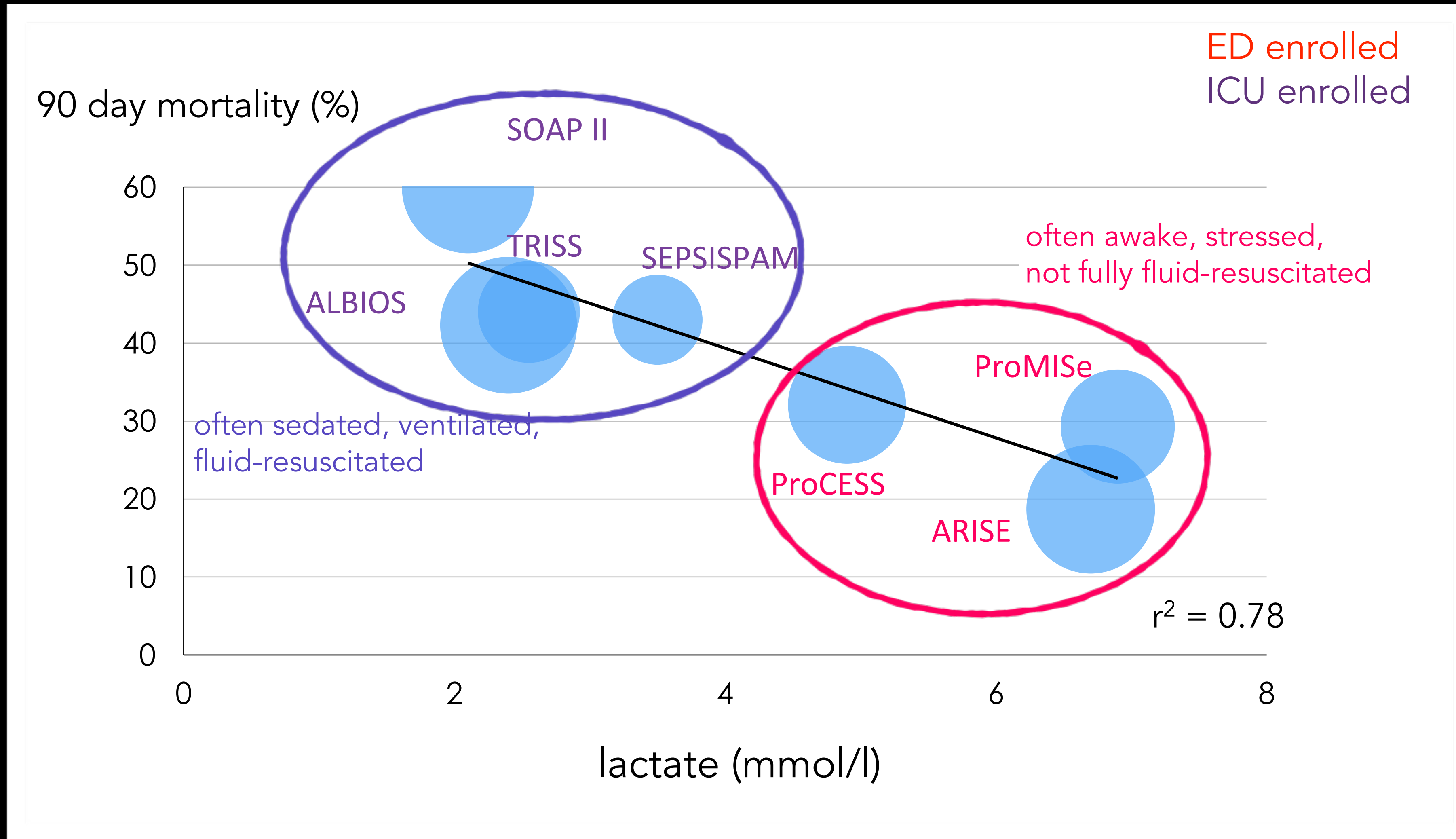


SURVIVING SEPSIS CAMPAIGN DATABASE

- 28,150 infected patients with ≥ 2 SIRS criteria + ≥ 1 organ dysfunction after fluid resuscitation
- Hospital mortality
 - 42.3% in patients having both hypotension + hyperlactataemia
 - 25.7% with hyperlactataemia (lactate ≥ 2) alone
 - 30.1% with fluid-resistant hypotension alone
 - 25% with organ dysfunction but lactate ≤ 2 and MAP ≥ 65

.. SO A NORMAL LACTATE IS STILL ASSOCIATED WITH A HIGH RISK OF DYING!

EMERGENCY DEPARTMENT LACTATE ISN'T AN ICU LACTATE



LACTATE AS A MANAGEMENT TOOL

- no good evidence yet that lactate-guided Rx is better

Lactate Clearance vs Central Venous Oxygen Saturation as Goals of Early Sepsis Therapy

A Randomized Clinical Trial

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Heather A. Claremont, BFA

Jeffrey A. Kline, MD

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Research Network (EMShockNet)
Investigators

Interventions We randomly assigned patients to 1 of 2 resuscitation protocols. The ScvO₂ group was resuscitated to normalize central venous pressure, mean arterial pressure, and ScvO₂ of at least 70%; and the lactate clearance group was resuscitated to normalize central venous pressure, mean arterial pressure, and lactate clearance of at least 10%.

There were no differences in treatments administered during the initial 72 hours of hospitalization. Thirty-four patients (23%) in the ScvO₂ group died while in the hospital (95% confidence interval [CI], 17%-30%) compared with 25 (17%; 95% CI, 11%-24%) in the lactate clearance group.

Conclusion Among patients with septic shock who were treated to normalize central venous and mean arterial pressure, additional management to normalize lactate clearance compared with management to normalize ScvO₂ did not result in significantly different in-hospital mortality.

JAMA. 2010;303(8):739-746

SUMMARY

- blood lactate rises with sepsis due to multiple causes
 - mitochondrial inhibition, liver dysfunction, drugs, accelerated aerobic glycolysis (n.b. epinephrine Rx) ... and not just tissue hypoperfusion
- the more stressed the patient, the higher the lactate
- .. the more stressed the patient, the worse the outcome
- ICU lactate \neq ED lactate (illness severity, prognostication)
- in general, a rapidly normalizing lactate is reassuring
- however, a normal baseline lactate level, nor a rapid lactate clearance with Rx, does NOT mean patient is 'safe'
- no strong evidence yet that lactate-guided Rx is better

THANK YOU FOR LISTENING!

