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Pablo Alvarez Maldonado
Ulises Cerón Díaz
Alfredo Sierra Unzueta

SmartCare™ closed-loop system and the altitude problem

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Relating to "Automating the weaning process with advanced closed-loop systems" by Dr. Burns et al. [1], we agree that clinical investigations are required to asses these systems in various patient populations; but with SmartCare™ there's one additional concern to worry about.

Computer-driven Protocolized Weaning from Mechanical Ventilation (SmartCare™, Dräger, Lübeck, Germany), a strategy designed for shortening the weaning period, now-a-days is used around the world in several intensive care units and it's been recently introduced in México. The protocol was found to be efficient in a multicenter randomized trial by Lellouche et al. [2]; however, it was made on cities that not exceed 100 m above the sea level (m.s.l.), and the so-called "comfort zone" may differ strongly in its ideal limits at levels considered of "low", "medium" or "high" altitude (2,000, 3,000 and 4,000 m.s.l.) [3], so it's the case of Mexico City (2,300 m.s.l.)

In normal highland subjects, the induced hypobaric-hypoxia produces chronic hyperventilation that lowers plasma bicarbonate concentration, early on primarily by inhibiting the urinary net acid excretion. For each decrease of 1 mmHg in $PaCO_2$, the plasma bicarbonate decrease by 0.41 mmol/L and hydrogen ion concentration decrease by about 0.4 nmol/L [4], until the lost of bicarbonate reach an equilibrium that allows a normal pH. Significant hypocapnia could be seen at 2,000 m.s.l. [5].

Arterial blood samples in highland subjects of all ages allowed the modification of the Siggaar-Andersen Chart for different levels of altitude [3]. For Mexico City the expected $PaCO_2$ is on the range of 32–34 mmHg. Starting at this point, an adequate renal compensation in a normal subject will bring the serum bicarbonate to 19–22 mmol/L. If we put this subject under the computer-driven weaning protocol which tolerates a $PetCO_2$ of 55 mmHg, or its equivalent $PaCO_2$ of 59 mmHg, it will allow pH values of about 7.15 before alerting the physician with the *"Insufficient Ventilation"* alarm (if the patient keeps its respiratory frequency between 15 and 30 per minute). The *"Tachypnea", "Persistent Tachypnea"* or *"Severe Tachypnea"* alarms will alert if the response to hypercapnic stimuli is present with a rise in respiratory frequency above 30 per minute.

Anyone of these hypothetic scenarios would imply risk, with a delayed software response on raising the pressure support level, a delay on the alert that calls to check the patient's clinical condition or allowing levels of respiratory acidosis that could reverberate in other systems. The computer-driven protocol seems not too safe in highlanders, and the altitude level considered "critic" will depend on the change on acid-base balance it causes. That's why the "comfort zone" limits should be adjusted according to the altitude-expected $PaCO_2$ levels.

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P. Alvarez Maldonado · U. Cerón Díaz · A. Sierra Unzueta
Department of Intensive Care,
Hospital Español de México,
México D.F., Mexico

P. Alvarez Maldonado (✉) · U. Cerón Díaz · A. Sierra Unzueta
Ejercito Nacional 613,
Col. Granada, Delegación Miguel Hidalgo,
11520 México D.F., Mexico
e-mail: pamyacs@yahoo.com
Tel.: +52-55-52559600
Fax: +52-55-52559725