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SCIENTIFIC LETTER

Double and multiple cycling in mechanical ventilation: Complex events with varying clinical effects

Doble y múltiples ciclados en ventilación mecánica: eventos complejos con diferentes significado clínico

Dear Editor,

In order to effectively unload inspiratory muscles and provide a safe ventilation (enhancing gas exchange and protect the lungs), the ventilator should be in synchrony with patient's respiratory rhythm. The complexity of such interplay leads to several concerning issues that clinicians should be aware and able to recognize.[1] Double-cycling, probably the second most common patient-ventilator dyssynchrony, consists of a sustained inspiratory effort that persists beyond the ventilator's inspiratory time increasing tidal volume in pressure assist-control mode and both tidal volume and airway pressure in volume assist-control mode. Double-cycling can cause prolonged diaphragm contraction with potential muscle dysfunction; breath-stacking, because of all or part of the tidal volume from the first breath is added to the second; and eventually ventilator-induced lung injury.[2,3] Nevertheless, under the same phenomenon witnessed in the ventilator screen, different pathophysiological mechanism hides which should be differentiated by clinicians. Here we report different

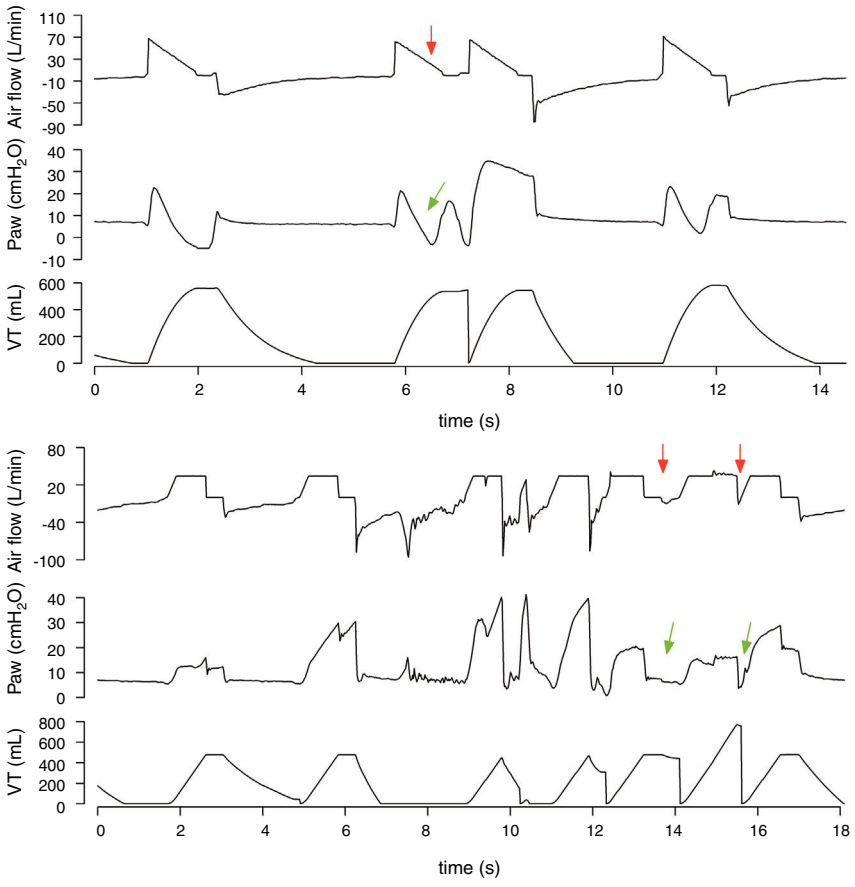

Figure 1 Flow dyssynchrony in volume-assist control ventilation with decelerating (a) and constant flow (b). Delivered flow is insufficient to meet the patient's demand, resulting in a strong inspiratory effort, reflected as a drop in airway pressure (Paw) (green arrows), lasting longer than ventilator inspiratory time, that triggers second and third mechanical inspirations (red arrows).

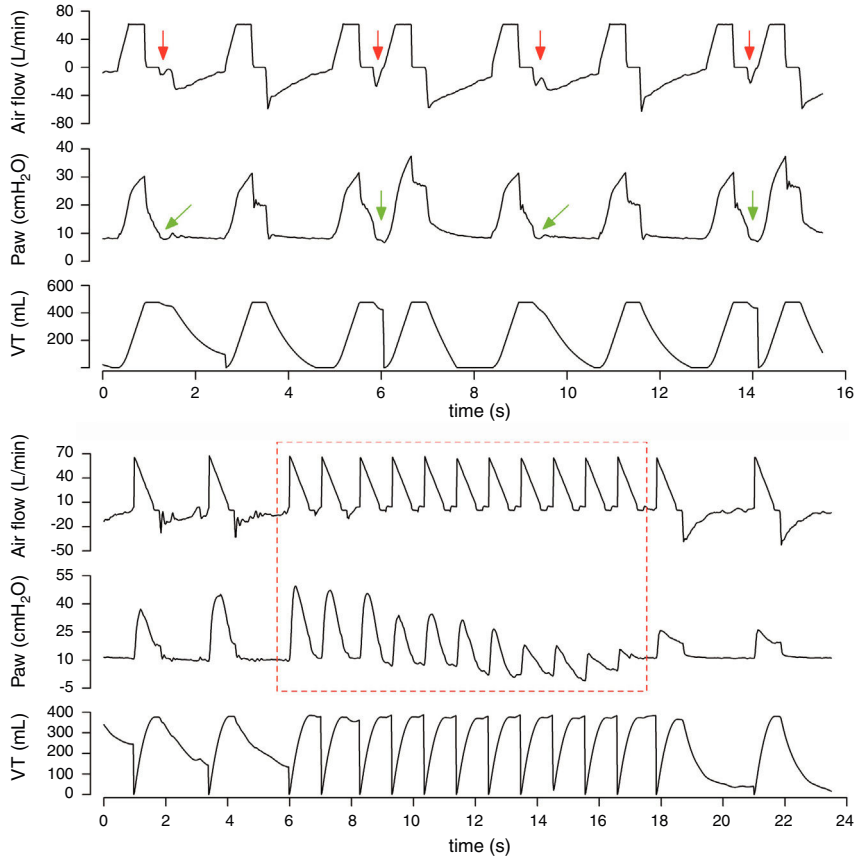

Figure 2 (a) Reverse-triggering in volume-assist control ventilation. In the first breath, mechanical insufflation is time-triggered; at the end of mechanical inspiration, reverse-triggering is seen as a negative deflection in airway pressure (Paw) (green arrows) and an increase in expiratory flow (red arrows). The third time-triggered breath is followed by a fourth, induced by reverse-triggering before complete exhalation, resulting in breath-stacking; this pattern repeats in following cycles. (b) Multiple cycling in volume-assist control ventilation with decelerating flow: the sudden cluster of mechanical insufflations without associated expiratory flow and automatic change from time-triggering to flow-triggering with progressive decrease in airway pressure (Paw) (dotted-line square) are due to massive air leakage caused by endotracheal tube displacement from the main airway; after spontaneous tube repositioning, Paw and expiratory flow recover, resulting in a change back from flow-triggering to time-triggering. This situation carries a high risk of unplanned extubation, which here occurred shortly afterward.

scenarios in where double-cycling occurs with meaningful differences.

High respiratory drive generates strong inspiratory efforts resulting in flow dyssynchrony, in where the flow delivered is insufficient to meet patient's demand, consequently, two or three mechanical inflations are delivered within a single neural inspiration (Fig. 1a and b). Vigorous inspiratory efforts could cause load-induced injury when the diaphragm muscle is sensitized to mechanical stress by systemic inflammation.[4] Moreover, eccentric (lengthening) contractions during expiration or during patient-ventilator dyssynchrony may be particularly injurious.[5,6] The resulting breath-stacking generates high transpulmonary and transvascular pressure gradients, as well as elevated local stress and uneven distribution of pressure in dependent zones of the lung.[7]

Breath-stacking also occurs in reverse-triggering, an entrainment phenomenon recently described referring to an abnormal relationship between the ventilator and the patient where the external stimulus, in this case, mechanical insufflation by the ventilator, elicits a reflexive neural response that initiates a diaphragmatic exertion. Ratios of 1:1, 2:1, 3:1 and also 1:2 of mechanical to reverse-triggered breath have been described. Breath-stacking could develop when the diaphragmatic contraction (neural time) exceed the mechanical insufflation time and drives an ineffective effort that, if strong and long enough, generates a second mechanical breath (Fig. 2a), thus delivering large tidal volumes with consequent high stress and strain upon the lungs.[2,8,9]

By contrast, in flow-triggered modes, repeated double or multiple cycling without expiration or breath-stacking in very short periods accompanied by a progressive decrease in airway pressure (Fig. 2b) strongly suggests partial dislocation of the endotracheal tube and high risk of unplanned extubation.

Waveforms presented were acquired with Better Care™ and plotted with R3.3.1.

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Seroprevalencia de anticuerpos frente a virus linfotrópicos humanos (HTLV I y II) en donantes de órganos

Human T lymphotropic virus (HTLV I and II) antibodies seroprevalence among organ donors

Sr. Editor:

Los virus linfotrópicos-T, tipo I (HTLV-I) y tipo II (HTLV-II) fueron los primeros retrovirus identificados en los seres humanos. El virus HTLV-I es el agente causal de la paraparesia espástica tropical o mielopatía asociada al HTLV-I (enfermedad neurológica degenerativa), de la leucemia de células T del adulto y otras enfermedades como la leucemia linfoide crónica de células B, uveítis, artritis y dermatitis[1,2], mientras que el HTLV-II no ha sido vinculado claramente a ninguna enfermedad, aunque tradicionalmente el análisis microbiológico de despistaje incluye siempre el HTLV I/II. La mayoría de los pacientes seropositivos para HTLV-I no desarrollan sintomatología clínica, pero una carga viral elevada o la depresión inmunitaria por coinfección con VIH o tratamiento con fármacos inmunosupresores, favorecen el desarrollo de la enfermedad. Estos virus son endémicos en determinadas zonas geográficas como Japón, África subsahariana, el Caribe, América central y del sur, donde se calcula que entre el 6%-37% de los adultos sanos de 40 años son seropositivos. La transmisión se realiza por contacto sexual, vía parenteral y también de madre a hijo, a través de la lactancia materna. Para considerar que un área geográfica es endémica, algunos autores proponen que la prevalencia de HTLV-I en algunas poblaciones debe ser entre 1-5%[3].

La transmisión de HTLV-I por transfusiones sanguíneas se ha documentado en múltiples estudios, por lo que el despistaje de anticuerpos contra los virus HTLV I/II es obligatorio en los bancos de sangre de muchos países[4]. En España y otros países, en la actualidad solamente se realiza la detección de anticuerpos frente al HTLV-I en aquellos donantes de sangre y de órganos que presentan factores de riesgo[5]. La trasmisión del HTLV por trasplante de órganos sólidos procedentes de donantes infectados ha sido ampliamente documentada[6,7]. En el año 2003 se describieron los 3 primeros casos en España de trasmisión HTLV-I por el trasplante de un hígado y 2 riñones procedentes del mismo donante infectado[8–11], presentando todos los receptores una paraparesia espástica tropical que les condicionó paraplejia o muy alta discapacidad.

Considerando la gran trascendencia de la trasmisión de esta infección a través del trasplante de órganos sólidos, nos planteamos estudiar la prevalencia de anticuerpos para los virus linfotrópicos HTLV I/II, en potenciales donantes de órganos en Asturias. Para ello, analizamos todas las muertes encefálicas ingresadas en la unidad de cuidados intensivos desde el año 2014 al 2018, ambos inclusive. Se recogieron datos epidemiológicos y resultados de la serología para los virus HTLV I/II en los potenciales donantes de órganos,