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Editorial

"Respiratory Pattern" or Where the Capitan Rules a Sailor has no Sway?☆

«Respiratory pattern» o donde hay patrón. . .¿no manda marinero?

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It is not uncommon for English words to enter into use in Spanish in a very liberal manner. Such is the case with the word "pattern" which, in the context of breathing, is usually translated as "breathing pattern". Although in English, the term "pattern" means specifically "a particular way in which something is done", this is not the case with the equivalent word in Spanish, "patrón", which has several meanings that might not be applicable to breathing, including "captain of a ship", although the meaning "pattern" is most commonly used in medical language. Either way, the concept of "breathing pattern" applies to how breathing takes on its habitual form, in terms of both intensity and time.

Air is moved from the atmosphere into the lungs and vice versa. In standard charts, we usually see time on the *x*-axis and various physical elements such as pressure, volume or flow on the y-axis. One of the most common ways of representing the formula that lets us calculate respiration per minute is to multiply the volume moved in every breath (circulating or tidal volume) by the respiratory rate: (VE=TV×RR).[1]

A simple alternative that became popular in respiratory physiology textbooks some years ago[2] was to express this equation in other, equivalent, terms: (VE=VT/Ti×Ti/Ttot). In this equation, frequency is given as the inverse of the total time of each respiratory cycle (1/Ttot). The latter is in fact, the sum of inspiratory time (Ti), the expiratory time (Te), and the very brief intermediate periods of apnea (Ttot=Ti+Te+x). The VT/Ti ratio reflects the speed at which air enters the lungs. In this way, ventilation can be expressed as the product of the "driving" and "timing" neural mechanisms.[1,2] This is a brave and daring formula to define what we call the "breathing pattern".

The volume of air thus mobilized would then be the product of 2 elements, one mechanical and the other timing or pace-making. The former reflects the conduction of the stimulus by the phrenic nerve, from emission of the neural impulse by the respiratory centers (pre-Bötzinger complex)[3] to the modulation effected by the rest of the central nervous structures, in response to multiple inputs, and its translation to muscle contractions leading to changes in intrathoracic pressure and the entry of air into the lungs. The second element would indicate, like a tuning fork, the time spent in inspiring and expiring air. This is a simple and elegant mathematical formula to express the pattern or model of our breathing.

By connecting a simple pneumotachometer to the respiratory system, we can obtain these flows (converted to volume) and time signals, and draw a graphic and numerical representation of our breathing. When the elementary principle has been determined, it is easy to apply it to any medical condition of interest and record changes caused by the disease or by the therapeutic action. Furthermore, adding the tidal volume/maximum volume respiratory pressure ratio is added to the Ti/Ttot ratio, the pressure-time index is obtained that can be used to predict the imminence of respiratory muscle fatigue [(P/Pmax)*(Ti/Ttot)].[4]

It is important to assess the orders issued by the respiratory nervous centers (which are, in fact, specialized neuronal groups with little anatomical differentiation) at a site as close as possible to where they were issued, avoiding the influence of the entire respiratory system. To this end, Whitelaw et al.[5] designed a method that consisted of measuring oral pressure generated by the muscles in the first 100 ms after beginning inspiration. This determination, which provides information on the orders issued centrally before they are modulated by outside influences, was called P0.1.

In any case, it must be remembered that the neural impulses, translated into mechanical changes and the dynamics of air in movement, should be harmonized with the combined mechanical situation of the pulmonary system and the rib cage. The final outcome is a balance between the orders that are issued and executed, manifesting in the form of gas exchange. Returning to the simile of the ship, the captain may issue the best orders, but if the sailor does not follow them, or if the boat is not in good working order, navigation is not effective.

Putting all these determinations (VT/Ti, Ti/Ttot, P0.1, etc.) into practice lets us bring physiology into the clinic and observe the breathing patterns associated with different conditions and situations (e.g., obesity-hypoventilation syndrome, sleep-disordered breathing, noninvasive ventilation, etc.), and to assess the patient's

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progress and prognosis.[6,7] Despite advances in magnetic stimulation, evoked potentials, and various imaging techniques, the study of the breathing pattern continues to be a great ally in assessing patients.

However, paradoxically, it seems that research in this field has slowed down in recent years. A decade ago, an editorial in ARCHIVOS DE BRONCONEUMOLOGIA drew attention to the need to cultivate our relationship with this simple, elegant and classic way of measuring breathing,[8] while very recently, Fernández Álvarez et al.[9] published an article in which the study of ventilatory patterns was found useful for confirming the effectiveness of non-invasive ventilation in patients with obesity-hypoventilation syndrome, when improvements in respiratory center activity in patients with this disease were assessed.

As we suggest in the title of this editorial, the orders of the captain (the respiratory centers) are fundamental to the correct running of the boat, but the instructions must be passed on by the bosuns (the modulatory centers and the nerves), and properly implemented by all the crew (mechanical adjustments of the rib cage, airways and conduction systems) so that the right course is followed and the ship always reaches a safe port (good gas exchange with no symptoms).

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