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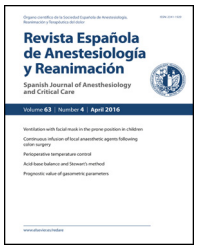

REVIEW

Recruitment manoeuvres in anaesthesia: How many more excuses are there not to use them?☆

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Abstract Pulmonary recruitment manoeuvres (RM) are intended to reopen collapsed lung areas. RMs are present in nature as a physiological mechanism to get a newborn to open their lungs for the first time at birth, and we also use them, in our usual anaesthesiological clinical practice, after induction or during general anaesthesia when a patient is desaturated. However, there is much confusion in clinical practice regarding their safety, the best way to perform them, when to do them, in which patients they are indicated, and in those where they are totally contraindicated. There are important differences between RM in the patient with adult respiratory distress syndrome, and in a healthy patient during general anaesthesia. Our intention is to review, from a clinical and practical point of view, the use of RM, specifically in anaesthesia.

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Maniobras de reclutamiento en anestesia: ¿qué más excusas para no usarlas?

Resumen Las maniobras de reclutamiento (MR) pulmonar tienen como finalidad reabrir las áreas de pulmón colapsadas. Las MR están presentes en la naturaleza como un mecanismo fisiológico para conseguir que un neonato abra sus pulmones por primera vez al nacer, y también las usamos, en la práctica clínica anestesiológica habitual, en la inducción o durante la anestesia general al desaturar un paciente. Sin embargo, existe en la práctica clínica mucha confusión en cuanto a su seguridad, el mejor modo de realizarlas, cuándo llevarlas a cabo, en qué pacientes están indicadas y en quiénes están totalmente contraindicadas. Existen importantes diferencias entre la MR en el paciente con síndrome de distrés respiratorio del adulto y en paciente sano durante una anestesia general. Se pretende, desde un punto de vista clínico y práctico, revisar el empleo de la MR, específicamente en anestesia.

Introduction

For many years, clinicians refused to recognise that general anaesthesia could cause significant atelectasis. However, lung CT scans, and more recently electrical impedance tomography and pulmonary ultrasound, have clearly shown the presence of atelectasis after general anaesthesia induction, which is estimated to occur, to a greater or lesser extent, in up to 90% of anaesthetised patients.[1–7] The percentage of atelectasis is usually small, less than 3% or 4%, but in populations that are particularly sensitive to collapse, such as neonates, children under 3 years, obese patients, pregnant women in the last trimester, patients with acute respiratory distress syndrome (ARDS), etc., this percentage can be higher than 25% of the total lung mass when the patient is under mechanical ventilation.[3–11]

Once the existence of anaesthesia-induced atelectasis was confirmed, some experts began to question whether recruitment manoeuvres (RM) can cause barotrauma and pneumothorax. Our research over the past 4 years have shown, even in neonatal models, the safety of RMs in healthy lungs ventilated in pressure control mode using a constant driving pressure and stepwise increments in PEEP.[12–15] In our studies in transpulmonary pressure we have shown that overdistension and maximum opening occur at 30 cmH_2O. However, at a constant driving pressure, pneumothorax does not occur until transpulmonary pressure reaches 60 cmH_2O.[12–19] In studies in alveolar pressure, pneumothorax has never occurred at pressures below 75–90 cmH_2O.[12–19] The only study carried out so far in human cadavers with healthy lungs described alveolar rupture occurring at pressures similar to those observed in our experimental studies.[15]

Today, we know that children do not need more than 30 cmH_2O of pressure, and that adults only need 40 cmH_2O for full recruitment during anaesthesia. This leaves a considerable safety margin (30–40 cmH_2O) between the opening pressure and the threshold pneumothorax pressure, provided that these maximum ventilator pressures are not exceeded, and RMs are performed in progressive steps in pressure control mode.[12–19] Our experimental findings have been confirmed in real world practice: several clinical studies comparing the incidence of pneumothorax among ARDS patients with and without RMs found no difference between groups.[20] In fact, we are unaware of any study published to date that has shown a higher incidence of pneumothorax in patients with RMs.[16–20]

The effect on RMs on haemodynamics has been investigated in many experimental and clinical studies.[16–20] We now know that cardiac output always decreases for a few seconds or a few minutes (the duration of the peak pressure phase) at the start of the manoeuvre, and then normalises within a few minutes of reducing opening pressure. This is because preload is reduced while right ventricular afterload is increased during the pressurisation phase, which affects the filling pressure of the left ventricle. However, if the entire collapsed area is reopened, cardiac output usually improves over pre-RM levels within 15–20 min. This is because reversing the hypoxic pulmonary vasoconstriction caused by atelectasis reduces pulmonary vascular resistance.[18–25]

With regard to the impact of RMs on patient morbidity and mortality, the most comprehensive meta-analysis to date on RMs in anaesthesia,[26] which included 439 studies in RMs, concluded that all studies have so far shown that RMs improve intraoperative oxygenation, reduce the need for high FiO_2, correct intraoperative hypoxaemia, and reduce postoperative pulmonary complications. The authors conclude that RMs followed by PEEP to prevent a new collapse should always be instituted after anaesthetic induction, except when contraindicated.[26]