Mechanical Insufflation-Exsufflation: More Than Just Cough Assist

In this issue of RESPIRATORY CARE, Cesareo and colleagues[1] report findings from a carefully performed scientific study looking at the effects of mechanical insufflation-exsufflation (MI-E) on the physiologic function of the respiratory system in subjects with respiratory muscle weakness due to Duchenne muscular dystrophy (DMD). In their experiment, MI-E was not used for the purpose of removing secretions from the airways, which is the accepted clinical indication for the device, but rather to measure the physiologic effects of cycling on the lung and chest wall through volumes above and below those normally seen during tidal or even maximal voluntary ventilation maneuvers in patients with neuromuscular weakness due to DMD. There are significant data which indicate that MI-E is effective in patients with neuromuscular weakness who need assistance in clearing secretions due to ineffective cough.[2] However, the physiologic effects on the respiratory system of the application of MI-E as a routine application and not for secretion removal has not been well studied, particularly in the non-pediatric population. This study reports the physiologic effects on breathing frequency, tidal volume, and other parameters measured by both standard spirometry and optoelectronic plethysmography.

The major finding of the study by Cesareo et al.[1] was that subject breathing frequency and rapid shallow breathing index decreased after 5 cycles of application of MI-E. This is important because a decrease in rapid shallow breathing index has been associated with an improved balance of respiratory capacity and ventilation demand in other patient populations.[3] The MI-E settings used in this study were exactly the same as the subjects' home settings, which is important because previous studies applied MI-E settings adjusted by the research laboratory and thus may not reflect real life situations.[4] The measurements were taken shortly after the application of MI-E, so we do not know whether this is a durable effect. In addition, we do not know the physiologic mechanism. MI-E moves air into and out of the alveolar space, so the applied therapy may have functioned to hyperventilate the subjects briefly, thus resulting in a decrease in ventilatory drive and frequency or perhaps causing relative inhibition of the Hering-Breuer reflex, as suggested by the authors. However, it may also have been that MI-E application caused an effect on the mechanical respiratory system, such as opening collapsed alveoli and thus improving lung compliance or perhaps even positive effects on chest wall compliance, which is known to be decreased in DMD. Other studies of lung-volume recruitment maneuvers have shown improvements in respiratory system compliance.[5,6] Published lung-volume recruitment studies have focused on the insufflation portion of the breath and usually involve higher inflation pressures with a prolonged breath-hold at maximal inspiratory capacity. The authors of this study did not think that there was a "recruitment" effect in their trial as the vital capacities of their subjects did not change after application of MI-E. However, measuring the effects on compliance due to recruitment of the lung and particularly the chest wall requires more invasive measurements that not performed in this study. The MI-E device can be set to perform lung-volume recruitment maneuvers as well the full cough cycle, and in the future it could well be worth comparing the two maneuvers with measurements of compliance of the respiratory system or its components.

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This study supports the very important and growing notion that respiratory support for patients with neuromuscular weakness is much more than just a focus on the noninvasive ventilator and actually requires a holistic approach to ventilation, cough function, and maintenance of the mechanical properties of the lung and chest wall in a way that is as close to normal as possible.

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