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2014-04-25
http://hdl.handle.net10539/14598

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The effect of two passive head down diaphragm stretching manoeuvres on diaphragm length in healthy adult individuals

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The diaphragm is the primary muscle of inspiration and provides life sustaining oxygen to the body. Diaphragm contraction results in pressure changes within the thorax thereby assisting in airflow into the lungs and increasing lung volumes. During this inhalation process the diaphragm moves from a dome-shaped relaxed position into a flattened shortened position. Stretching of skeletal muscles is a physiotherapy treatment modality commonly used in clinical practice. Head down tilt positions are commonly used in cardiopulmonary physiotherapy to utilise gravity to facilitate sputum drainage from different lung segments. A head down tilt position could potentially have an influence on diaphragm length if applied for a sustained period of time due to likely abdominal content displacement from a caudal to cranial position resulting in a stretch on the diaphragm. The objective was to determine if diaphragm length could be influenced by providing a stretch using the abdominal contents. Moreover, to see if this hypothesized change in length would influence the diaphragm's function.

Method:

A quasi-experimental study was conducted in 2012 with undergraduate physiotherapy students as study participants. Seventy five study participants were assessed for baseline outcome measures at rest. They then underwent four head down tilt position changes after which each measurement was re-recorded. Diaphragm length change was assessed with M-Mode ultrasound and

Diaphragm function recorded in terms of the expiratory flow generated and the thoracic expansion measured. Dyspnoea was recorded for a subjective view of tolerance of the position and vital signs were monitored throughout for the volunteers' safety. Data was analysed by using ANOVA, a Kruskal Wallis test as well as a student's t-test.

Results:

All 75 participants completed the entire study and none were withdrawn as a result of negative side effects. The results showed that the diaphragm could be stretched by using the abdominal contents in a head down tilt position ($p=0.00$). The mean and standard deviation for the greatest change from rest was 38.78mm (±11.51) on the left and 39.38mm (±11.92) on the right. There were no detrimental effects to the participants' cardiovascular or pulmonary stability. Thoracic expansion and peak flow showed an insignificant change throughout the changes in position. Thoracic expansion had a mean change of 2.48cm (±0.86) with a p value of 0.54. Peak expiratory flow rate had a change of 428.94L/min (±95.01) with a p value of 0.98. These values were less than the normal expected values for the participants.

Conclusion:

A change in diaphragm length is possible by applying a stretch to the muscle in a head down tilt position. No adverse effects occurred in healthy adult individuals during the different head-down tilt positions. Respiratory function did not show a significant improvement due to the change in diaphragm length as measured by peak expiratory flow rate and thoracic expansion.