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Title: Electromyography of the parasternal intercostal muscles in bronchial hyperresponsiveness testing

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Body: Background: Bronchial hyperresponsiveness testing (BHT) can be used to support or refute a diagnosis of asthma, but requires technically-acceptable spirometry to be performed. Parasternal intercostal muscle electromyography (EMGpara) provides a non-invasive, effort-independent method to assess load on the respiratory system. The relationship between EMGpara and spirometry in adults undergoing BHT is unknown. Methods: 16 subjects (mean (SD) age 29.5 (7.4) years) underwent methacholine challenge testing, performed in accordance with ATS guidelines. Surface EMGpara was recorded bilaterally from the 2nd intercostal space, at baseline and between consecutive methacholine doses. EMGpara was converted to root-mean-square (RMS) and mean peak RMS EMGpara per breath calculated. Results: Significant relationships were observed between methacholine concentration, EMGpara and FEV1 (all $p < 0.001$). Subjects with a positive test response ('responders', defined as change in FEV1 $\geq 20\%$, $n=8$) showed a significant median (range) change in both EMGpara (45.2 (-0.65 — 157.4)% , $p < 0.05$) and FEV1 (-33.5 (-25.2 — -58.6)% , $p < 0.01$). EMGpara did not change significantly in subjects with $< 20\%$ drop in FEV1 ('non-responders', $n=8$). The median (range) change in EMGpara at PC20 was 35.6 (2.6 — 57.6)%. Change in EMGpara was significantly correlated with change in FEV1 in the responder group ($r = -0.883$, $p = 0.015$), but not in non-responders. Conclusions: EMGpara can detect change in respiratory load during methacholine-induced bronchoconstriction. The change in EMGpara was greater than that in FEV1. EMGpara may provide an alternative outcome measure in BHT in patients unable to perform spirometry adequately.