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Title: Diaphragmatic excursion in Duchenne muscular dystrophy (DMD) studied by M-mode ultrasonography

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Body: Techniques traditionally employed to assess diaphragmatic weakness or paralysis in DMD, i.e. transdiaphragmatic pressure, EMG, fluoroscopy, plethysmography, MRI are invasive, associated with radiation or complex. The aim of this study was to determine the feasibility of diaphragmatic excursion (DE) measurements by ultrasonography (US) as an alternative. Eight DMD patients (age 15.2±4.1 yrs, BMI 20.5±5.6 kg/m^2, FVC 59.3±20%pred) and 10 healthy controls (age 25.4±4.3 yrs, BMI 22.3±2.5 kg/m^2) were studied by M-mode US transverse scanning in supine position using a convex probe (2.7-5 MHz) positioned in the right subcostal anterior area. DE was determined by a custom-designed software for image processing at end-inspiration and end-expiration during quiet breathing (QB) and at full inspiration during an Inspiratory Capacity (IC) maneuver. In DMD, DE was in average 17.2±4.7(SD) and 32.8±8.9 mm during QB and IC, respectively, whereas in controls it was 24.2±8.1 and 57.5±11.1 mm (see fig. for individual data). ANOVA analysis revealed significant differences in DE values between QB and IC in both DMD and controls ($p<0.001$) and between DMD and controls during both QB and IC ($p<0.001$). In conclusion, DE is significantly reduced in DMD patients during both spontaneous breathing and maximal inspiration. US M-mode assessment of diaphragmatic displacement is a reliable noninvasive method for functional assessment of the diaphragm.