Measurements of respiratory muscle function as diagnostic criteria for diaphragmatic paralysis

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BACKGROUND

Diaphragmatic dysfunction is an underdiagnosed cause of dyspnea. Patients with unilateral diaphragmatic paralysis can be asymptomatic or present with dyspnea on exertion, which is often an incidental finding. Measurements of respiratory muscle function can aid in establishing a diagnosis and quantifying diaphragmatic dysfunction.[1,2]

OVERVIEW

A 52-year-old female patient in the late postoperative period of mitral valve replacement was referred for assessment of respiratory muscle function because of exertional dyspnea (Medical Research Council scale score = 2) and elevated right hemidiaphragm on chest X-ray.

Pulmonary function tests showed moderately reduced FEV_1 (46% predicted) and FVC (51% predicted), with normal FEV_1/FVC (88%) and reduced TLC (72% predicted). Respiratory muscle strength measurements confirmed inspiratory weakness, with low values for MIP (67% predicted), transdiaphragmatic pressure during a sniff maneuver (30% predicted), and twitch transdiaphragmatic pressure during bilateral magnetic phrenic nerve stimulation (40% predicted). Additionally, the gastric pressure (Pga) during the sniff maneuver was negative, positive values being expected during inhalation. This resulted in extremely low transdiaphragmatic pressure, reflecting diaphragmatic weakness.

Diaphragmatic ultrasound showed reduced mobility and thickness of the right hemidiaphragm during deep breathing, as well as paradoxical motion during sniffing (Figure 1A). This was probably related to the negative Pga during sniffing, with the diaphragm being sucked up into the chest, thus impairing diaphragm mechanics and respiratory pressure generation.[3]

Diaphragmatic function was also assessed by electrical impedance tomography, which showed diminished ventilation distribution in the lung corresponding to the paralyzed hemidiaphragm (approximately 29%; Figure 1B).

Cardiopulmonary exercise testing evidenced the role of diaphragmatic weakness in exercise limitation, with diaphragmatic dysfunction being evidenced by a decrease in Pga as the work rate increased. Diaphragmatic dysfunction was related to an increased RR and dyspnea for a given work rate in comparison with a healthy control (Figure 2). Studies have described patients with unilateral diaphragmatic paralysis and reduced diaphragmatic strength related to low Pga.[4,5]

CLINICAL MESSAGE

Diaphragmatic paralysis, as in the case reported here, should be considered as a cause of dyspnea. Assessment of respiratory muscle function and cardiopulmonary exercise testing can aid in establishing a diagnosis.

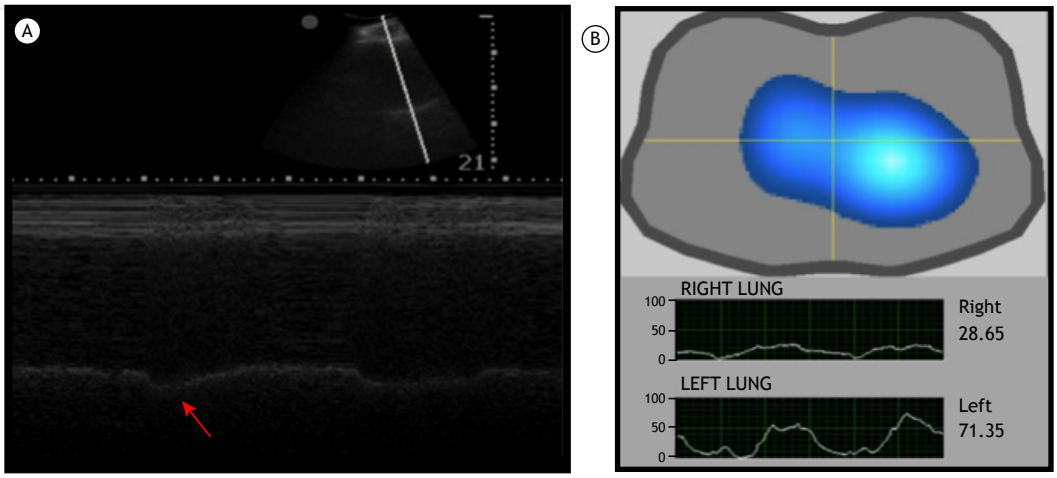

Figure 1. In A, paralyzed hemidiaphragm showing paradoxical motion during a sniff maneuver (red arrow). In B, electrical impedance tomography showing diminished ventilation distribution in the lung corresponding to the paralyzed hemidiaphragm.

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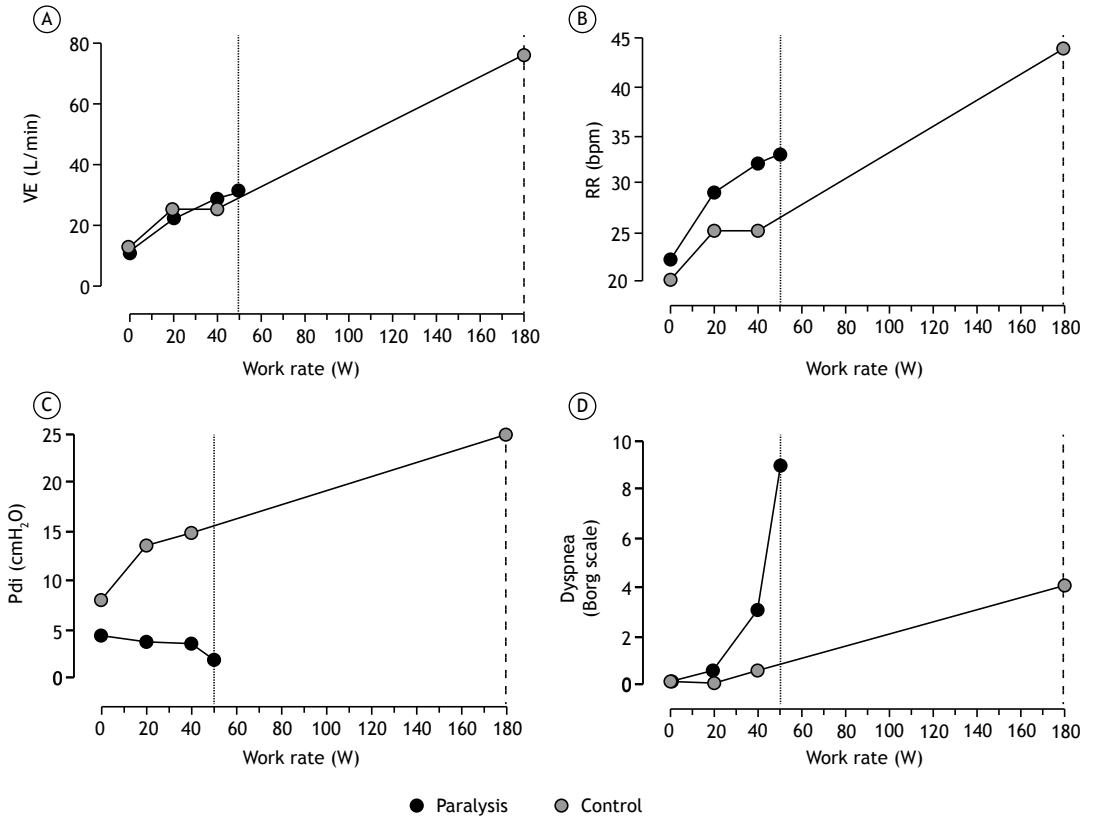

Figure 2. Cardiopulmonary exercise testing showing A) V_E, B) RR, C) transdiaphragmatic pressure (Pdi), and D) Borg dyspnea scale scores for a given work rate in comparison with a healthy control. The dotted lines represent peak exercise.

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