Pathologic Signs: Diaphragm Dysfunction

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Introduction: The diaphragm is the principal muscle of respiration, essential for effective ventilation both in health and during disease. Diaphragmatic dysfunction (DD) is increasingly recognized as a determinant of clinical outcomes in critically illness and chronic respiratory diseases. Impaired diaphragmatic function has been linked to prolonged mechanical ventilation, failed weaning, impaired gas exchange, and increased mortality. Consequently, reliable, non-invasive, and repeatable methods to assess diaphragmatic function are of significant clinical importance.

Body: Ultrasound has emerged as the most practical bedside tool for assessing diaphragmatic structure and function. Key parameters include diaphragmatic thickness at end-expiration and inspiration, thickening fraction (TF), and excursion. These indices provide real-time, radiation-free measurements and can be performed repeatedly, even in unstable patients. Clinical studies demonstrate that diaphragmatic thinning during mechanical ventilation is associated with longer ICU stays and poor outcomes. Reduced TF or limited excursion predicts weaning failure and higher reintubation rates. In patients with acute exacerbations of chronic obstructive pulmonary disease (COPD), decreased diaphragmatic motion and thickening have been correlated with prolonged hospitalization, non-invasive ventilation failure, and increased mortality risk. Beyond the ICU, ultrasound-derived diaphragmatic indices show significant correlations with spirometric measures in COPD and interstitial lung disease, highlighting their utility in chronic disease monitoring. Despite these advantages, limitations remain, including operator dependency, technical difficulty in obese patients or left hemidiaphragm imaging, and variability in proposed cutoff values.

Conclusion: Diaphragm ultrasound is a non-invasive, repeatable, and clinically valuable method for assessing respiratory muscle function. Thickness, thickening fraction, and excursion provide robust prognostic information across acute and chronic respiratory diseases, particularly in predicting weaning success, ventilator duration, and survival. Standardization of measurement protocols, validation across diverse populations, and integration into clinical decision pathways remain key priorities for future research.