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Clinical Image
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# Sternocleidomastoid and Diaphragm Ultrasound after 2007 Hours of Mechanical Ventilation in a Patient with COVID-19 Pneumonia

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## Clinical Image

A 55-year-old male patient was admitted to ICU due to COVID-19 pneumonia and severe ARDS. The patient was mechanically ventilated for 2007 consecutive hours. A thoracic ultrasound (Vivid I, GE Healthcare), was performed when the patient was on t-piece with low level of oxygen supplementation. Diaphragm ultrasound (2-12 MHz linear transducer) revealed a thick, hypertrophic diaphragm at end-expiration (0.30 cm), with low thickening fraction (TF=16.6%) (Figure 1a). Simultaneously, the sternocleidomastoid was evaluated by ultrasound (Figure 1b-1f), scanned in the transverse plane, using the same linear probe with large amount of echo-gel to reduce the pressure of the transducer on the skin [1]. The diameter of sternocleidomastoid at end-expiration (Figure 1e) and at end-inspiration (Figure 1f) were 0.86 cm and 1.15 cm respectively, resulting in high TF of 33.7%. These findings indicate intense sternocleidomastoid activity during inspiration and severe weakness of hypertrophic diaphragm, which is likely due to increased work of breathing and under-assist during assisted modes of support [2,3]. It follows that during mechanical ventilation, hypertrophy of the diaphragm represents a maladaptation to low assist and similar to atrophy [2], may result in severe diaphragmatic weakness necessitating the significant contribution of sternocleidomastoid to sustain spontaneous breathing. Ultrasound can be used to quantitate sternocleidomastoid and diaphragmatic activity and differentiate between atrophic and hypertrophic diaphragmatic weakness.

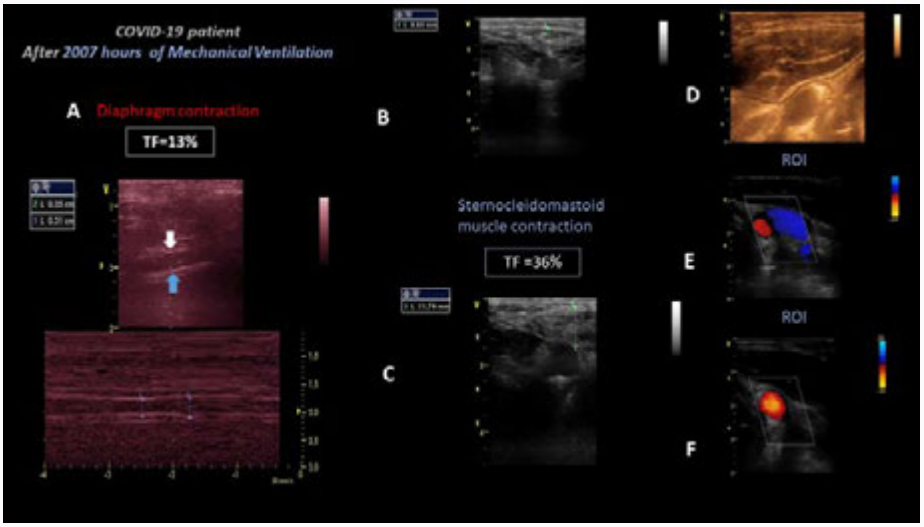


**Figure 1:** Ultrasonography of diaphragm (a) and Sternocleidomastoid Muscle (STE) (b, c, d, e and f):
a) Diaphragm ultrasound images showing the diaphragm diameter at end-expiration (TEE: 0.30 cm) and the diaphragm peak diameter during inspiration (TEI: 0.35 cm). The red and blue arrows indicate the pleural and peritoneal diaphragmatic layer respectively.
b-d Region of interest b) STE delineation. c and d) STE, Jugular Vein (JV) and Carotid Artery (CA) at end-expiration (c) and during inspiration at peak STE contraction (d). Color Doppler was used to demonstrate clearly the region of interest. Notice that during inspiration JV collapses likely due to intense STE contraction (d).
e and f: STE-diameter at end-expiration (TEE: 0.86 cm) and the STE-peak diameter during inspiration (TEI: 1.15 cm). The thickening fraction (TF, %) of diaphragm and STE were calculated using the formula TF=TEI-TEE/TEE.

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