



Helmet continuous positive airway pressure (CPAP) and arm deep vein thrombosis (DVT) in COVID-19: a double-edged sword

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Patients with COVID-19 have an increased risk for venous thromboembolism; abnormal coagulation parameters are associated with poor prognosis and existence of disseminated intravascular coagulation is common in patients dying from COVID-19 pneumonia (1,2).

In COVID-19 patients, non-invasive ventilation is often delivered via helmet-continuous positive airway pressure (CPAP), assuming that it can be better tolerated for a prolonged support. The helmet might reduce environmental dispersion of virus into ambient air and therefore the risk for healthcare providers by applying a high efficiency particulate filter (HEPA) at the gas outlet. Application of helmet CPAP should focus on the fixation system as armpit straps under the axilla could provoke pain and pressure ulcers; moreover, the basilic vein diameter is increased due to blood flow drainage limitation provoked by armpit straps; counterweight strategies can mitigate the pressure exerted and increase its efficacy and tolerability (3). Yet, the collar fitting around the neck might similarly impact venous flow in the axillary vein territory. Airflow turbulence and noise can further promote hypercoagulability via activation of platelets (4).

Two male patients with COVID-19 were admitted for respiratory failure with tachycardia requiring oxygen therapy with helmet CPAP (10 cmH₂O). The clinical picture was typical for SARS-COV-2 infection: activation of coagulation was shown by increased D-dimer levels (86,449 and 4,133 µg/L respectively, nr 0-500) despite prophylactic enoxaparin (4,000 IU sc/day). Physical findings were unremarkable for patient 1, whereas patient 2 showed

unilateral arm swelling and pain.

Color Doppler vascular ultrasound examination revealed in patient 1 unilateral complete thrombosis of a collateral branch of the brachial vein draining the medial aspect of the forearm and in patient 2 omolateral massive thrombosis of the brachial, median and perforating veins of the arm. Lower limb evaluation was negative for DVT in both cases.

Anticoagulation with enoxaparin 100 IU/kg bid was started: patient 1 had complete recanalization, patient 2 reported reduction of arm swelling and partial thrombus resolution within the following 4 days. At discharge there was still thrombus at the junction between the brachial and axillary vein.

Both patients were discharged alive on full dose enoxaparin.

We recommend routine evaluation of the arms for DVT especially if helmet CPAP is applied, as it can sustain a mechanical trigger for local impairment of blood drainage. Yet, despite anticoagulation is routinely recommended in COVID-19 patients, the hypercoagulability is a major issue (5). Furthermore, we envision a rationale for preferring face mask interface for delivering CPAP in this scenario. Indeed, the deterioration of respiratory failure with high dead space requiring intubation might be sustained by episodes of asymptomatic pulmonary embolism triggered by non-invasive ventilation via helmet.

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