A homemade esophageal pressure manometry device in the context of limited resources for COVID-19 pandemic.

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Accepted on March 09, 2021

Description

The COVID-19 pandemic faces intensivists with the challenge of providing care for a great number of severely ill patients simultaneously, often with stretched resources. Extracorporeal Membrane Oxygenation (ECMO) must be considered for selected severe COVID-19 patients, but requires the allocation of limited, precious resources. Obesity is highly frequent among patients admitted to intensive care for severe COVID-19 [1]. Obese patients have an increase in abdominal pressure and a very stiff chest wall, with elevated baseline pleural pressure. Much of the pressure that is applied by the ventilator will be used to distend the chest wall rather than the lung [2]. The transpulmonary pressure (PL) might not be accurately reflected by plateau pressure (PPLAT) due to an increase in the relative contribution of chest wall elastance to overall respiratory system elas-tance. Thus, an elevated PPLAT may be related to an elevated transthoracic pressure, rather than an increase in PL, with accompanying lung over distension. Esophageal pressure (PES) manometry has been proposed as a surrogate for pleural pressure, al-lowing the assessment of actual PL to optimize Positive End-Expiratory Pressure (PEEP) levels, resulting in lung recruitment [3]. PEEP can be titrated to target an end-inspiratory trans pulmonary pressure (PLend-insp=PPLAT–PESend-insp) of 20 to 25 cm H_2O instead of a respiratory system PPLAT of 30 cm H_2O. Furthermore, monitoring PL allows PEEP titration to prevent negative end-expiratory trans pulmonary pressure and avoid end-expiratory alveolar collapse with the cyclic opening and closing of alveoli during tidal ventilation. This is typically achieved by targeting an end-expiratory trans pulmonary pressure (PLend-exp=PEEPTOT–PESend-exp) between 0 and 10 cm H_2O. Finally, the trans pulmonary driving pressure (ΔPL=PLend-insp-PLend-exp) can also be used to minimize lung stress, with targets between 10 and 12 cm H_2O. In selected patients, these interventions may prevent excessive lung stress due to excessive PEEP, or limit atelectrauma and improve oxygenation by safely increasing PEEP levels, thus lowering the need for rescue therapy such as ECMO [4]. One of the main obstacles to the wide adoption of PES manometer is the availability and cost as-associated with esophageal balloons. Cheaper alternatives using air-filled or liquid-filled catheters have been proposed [5]. In obese patients in particular, passive collapse of the esophagus in supine position allows for pressure measurement without the use of a balloon, as shown on computer tomography (Figure 1a). We present here a homemade PES manometer device using readily available equipment. A Levin tube (18 French), with its lower extremity cut above drainage holes, is attached to a fluid-filled pressure transducer system (Figure 1b). After cutting the lower extremity of the tube above drainage holes to allow measurement through a single hole, air is flushed from the tube using saline solution and the device is zeroed before nasogastric intubation. The introduction technique is similar to that of other PES manometer devices: after a depth of about 60 cm, placement of the balloon is confirmed by a transient increase in pressure after gentle compression of the abdomen. The tube is then withdrawn to a depth of about 40 cm, with adequate positioning assessed by the detection of cardiac artifacts (Figure 1c). Correct placement can then be assessed by applying pressure on the chest wall during an expiratory hold, by verifying that the increase in both airway pressure and PES is similar. The introduction procedure being similar to standard gastric intubation, it could be performed by trained nurses under medical supervision to optimize workflow when fast patient management requires it.

Figure 1(A). *PE nasogastric tube as seen on computed tomography;Esophagus collapse in supine position allows pressure manometry without requiring a balloon. Asterisk (*) shows both feeding tube (right-hand side) and PE tube (left-hand side).*

Figure 1(B). *Required equipment; A: Levin nasogastric tube with lower extremity cut above drainage holes. B: Linking piece between nasogastric tube upper extremity and transducer tubing. C: Disposable transducer kit. D: Flushing solution in a pressure bag.*

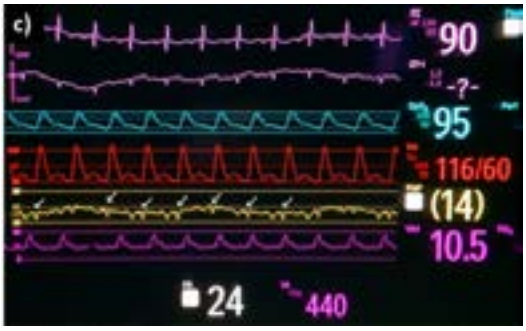

Figure 1(C). *Example of esophageal pressure manometry with presented device. Yellow curve (fifth from the top, labeled "PAP") shows PE manometry, with ventilatory oscillations and cardiac artifacts (white arrows).*

Ethical Approval and Ethical Approval Number

Not applicable.

Funding

None

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