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# Better airway management saves lives

Audrey De Jong and Samir Jaber

In their recent article in the *European Journal of Anaesthesiology*, Russoto *et al.*<sup>1</sup> aim to provide an update of the evidence on airway management in critically ill patients with a focus on understanding peri-intubation risks and evaluating interventions to prevent or mitigate adverse events.

This update is extremely important in order to improve airway management of critically ill patients across the world because intubation performed in critically ill patients is a very risky procedure.

From 1 October 2018 to 31 July 2019, Russoto *et al.*<sup>2</sup> performed an observational prospective study aiming to evaluate the incidence and nature of adverse peri-intubation events and to assess current practice of intubation in critically ill patients. The study was conducted in 197 sites in 29 countries across five continents, enrolling 2964 patients. They reported that 45.2% of patients experienced at least one severe complication related to intubation. The predominant event was cardiovascular instability, observed in 42.6% of all patients, followed by severe hypoxemia (9.3%) and cardiac arrest (3.1%). These results are similar to the results observed 15 years ago in the French multicentre study performed by Jaber *et al.*,<sup>3</sup> which included 253 endotracheal intubations in 220 patients. The authors reported that at least one severe complication occurred in 71 endotracheal intubations (28%). Following these alarming results, as nicely highlighted by Russoto *et al.*<sup>1</sup> in their review article, Jaber *et al.*<sup>4</sup> developed an intubation protocol designed as a practical tool to help with planning and optimising the

procedure of intubation. The Montpellier intubation protocol,<sup>4</sup> presented in Table 1, is composed of a list of items required, steps to be undertaken and points to be considered. This to be then used as an *aide-mémoire* and separated into pre-intubation, per-intubation and post-intubation episodes. The application of this protocol bundle has demonstrated its efficacy in improving safety in airway management.<sup>4</sup> In the study presented by Jaber *et al.*<sup>4</sup> in 2010, the use of the Montpellier intubation protocol in the intervention phase was associated with a significant decrease in complications compared with the control phase, either life threatening (21 vs. 34%,  $P=0.03$ ) or other (9 vs. 21%,  $P=0.01$ ), respectively.

An external validation of the Montpellier Intubation Protocol, using a modified version of the protocol, was then performed and published in 2018 by Corl *et al.*<sup>5</sup> They found that a modified Montpellier protocol was associated with a significant increase in first-pass intubation success of 16.2 (95% Confidence Interval (CI), 5.1 to 30.0), and reduction in all intubation-related complications of 12.6% (95% CI, 1.2 to 23.6). Somewhat similar to these two studies, the recent STYLETO trial performed by Jaber *et al.*<sup>6</sup> found that only 25% of patients had a severe complication, lower than the rate reported by Russoto *et al.*<sup>2</sup> The STYLETO trial<sup>6</sup> was a multicentre, randomised trial performed in 999 critically ill adults undergoing tracheal intubation. The main outcome was that the use of a stylet for tracheal intubation resulted in significantly higher successful first-attempt intubations than the use of a tracheal tube alone. Also in the same study,<sup>6</sup> the application of the Montpellier Intubation Protocol was highly recommended, which may explain the relatively low rate of complications observed in both groups (tracheal tube with stylet and tracheal tube alone), compared with the rate observed in the INTUBE study.<sup>2</sup>

It is worth noting that tracheal intubation seems the perfect situation for applying a bundle protocol for two main reasons: on the one hand, the high risk of complications *per se* and, on the other hand, the possible

**Table 1 Update of the Montpellier Intubation protocol<sup>4</sup>**

Pre-intubation
1. Two operators (i.e. four hands)
2. Fluid loading if no cardiogenic pulmonary oedema
3. Systematic early introduction of vasopressors
4. Preparation of long-term sedation
5. For pre-oxygenation, consider upright position (20° to 30° bed)
6. Pre-oxygenation during at least 3 min with noninvasive ventilation in case of hypoxic acute respiratory failure (FiO <sub>2</sub> 100%, pressure support between 5 and 10 cm H <sub>2</sub> O to obtain an expired tidal volume between 6 and 8 ml kg <sup>-1</sup> and a PEEP of 5 cmH <sub>2</sub> O), associated with apnoeic oxygenation when available and high-risk of hypoxaemia (OPTINIV method <sup>10</sup> )
Per-intubation
7. Use first videolaryngoscope for intubation procedure, if no videolaryngoscope available, consider direct Macintosh laryngoscopy with stylet <sup>6</sup>
8. Rapid sequence induction: Etomidate 0.2 to 0.3 mg kg <sup>-1</sup> or ketamine 1.5 to 3 mg kg <sup>-1</sup> or propofol 1.5 to 3 mg kg <sup>-1</sup> Succinylcholine 1 mg kg <sup>-1</sup> (without contra-indications) Rocuronium: 1.2 mg kg <sup>-1</sup> i.v. if contra-indications to succinylcholine
9. Sellick manoeuvre
10. Ventilation in case of oxygenation desaturation < 90% or if elevated risk of oxygen desaturation higher than the risk of aspiration
Postintubation
11. Capnography to check correct placement in trachea of the tube
12. Increase vasopressors especially if diastolic arterial pressure < 35 mmHg or systolic arterial pressure < 90 mmHg
13. Start early long-term sedation
14. Low airway pressure ventilation at the beginning: tidal volume 6 to 8 ml kg <sup>-1</sup> , PEEP < 5 cmH <sub>2</sub> O and respiratory rate between 10 and 20 min <sup>-1</sup> , FiO <sub>2</sub> 100%, for a plateau pressure < 30 cmH <sub>2</sub> O (protective ventilation will be started after haemodynamic stabilisation)
15. Recruitment manoeuvre: PEEP of 30 to 40 cmH <sub>2</sub> O during 20 to 30 s, FiO <sub>2</sub> 100% (if no cardiovascular collapse and in nonhypovolaemic patient)
16. Cuff pressure of the tube between 25 and 30 cmH <sub>2</sub> O without leaks

The recommendations are not mandatory, but they have to be 'considered', according to some randomised controlled trials, some observational studies and expert opinions.

prevention of these complications. As stated in the article from Russoto *et al.*,<sup>1</sup> the combination of limited physiological reserve in critically ill patients and the potential for difficult mask ventilation and/or difficult intubation<sup>7</sup> mandates careful planning and a good working knowledge of alternative tools and strategies, particularly when conventional attempts at securing the airway fail. In this setting, a few years ago, we reported the first large prospective study of a multicentre cohort of cardiac arrests occurring during ICU intubation procedures.<sup>8</sup> As expected, intubation-related cardiac arrest was not a rare event. It was recorded in 49 of 1847 intubation procedures (2.7%), was associated with a high immediate and 28-day mortality rate (28.5 and 71.4%, respectively), and was determined to be an independent risk factor for 28-day mortality; hazard ratio = 3.5 (95% CI, 2.2 to 5.6),  $P < 0.0001$ . In order to predict intubation related cardiac arrests, five independent risk factors were identified, with three potentially modifiable high-risk factors that may respond to preventive approaches; hypoxaemia prior to intubation, haemodynamic failure prior to intubation and absence of pre-oxygenation.

Emphasising prevention, Russoto *et al.*<sup>1</sup> provided a very interesting review of potential preventable risk factors

concerning intubation-related complications. To prevent severe hypoxaemia, pre-oxygenation is mandatory. Non-invasive ventilation (NIV)<sup>9</sup> for pre-oxygenation has been evaluated in critically ill patients. In a randomised controlled trial including hypoxaemic patients,<sup>9</sup> the incidence of severe hypoxaemia, that is a peripheral saturation (SpO<sub>2</sub>) in oxygen of below 80% within 30 min after intubation was 7% in the NIV group, compared with 42% in the oxygen group. In the same population of hypoxaemic patients, NIV and high-flow nasal oxygen (HFNO) can be combined<sup>10</sup> to limit the risk of hypoxia during intubation attempts. This OPTINIV study<sup>10</sup> showed an increase of the lower oxygen saturation during the intubation procedure using the OPTINIV method for pre-oxygenation, combining NIV and HFNO for apnoeic oxygenation in severe hypoxaemic patients. To prevent severe collapse, fluid loading and early introduction of vasopressors may decrease the occurrence of intubation-related haemodynamic complications,<sup>4,11</sup> even if the level of proof was low, which is also highlighted in this article by Russoto *et al.*<sup>1</sup> Large sample size, randomised controlled trials are needed to demonstrate the efficacy of fluid loading and introduction of vasopressors before the intubation procedure to reduce severe cardiovascular collapse, and to individualise patient management.

Finally, Russoto *et al.*<sup>1</sup> highlighted the importance of cognitive tools to enhance airway management safety. The use of a specific, dedicated ICU intubation algorithm<sup>12</sup> for predicted or unpredicted difficult intubations is also of major importance. The systematic use of equipment for difficult intubation, such as stylets<sup>6</sup> or videolaryngoscopes,<sup>13</sup> may help to reduce the complications related to intubation. The literature regarding this is accurately described by Russoto *et al.*<sup>1</sup> Following the COVID-19 pandemic, the use of videolaryngoscopes has gained increasing prominence when used to improve the first attempt success and also to protect caregivers against contamination by SARS-Cov-2.<sup>13,14</sup>

In conclusion, with the aim of decreasing intubation-related complications in critically ill patients, Russoto *et al.*<sup>1</sup> provide a very nice literature review. It would be of great interest if a large multicentre, clustered-randomised international study, involving 'expert and 'nonexpert' centres using an intubation bundle, were to be performed to improve the safety of the intubation procedure and save lives of critically ill patients.

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