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What Can We Do to Prevent Tracheal Intubation–Associated Cardiac Arrest?*

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Tracheal intubation (TI) is often required in critically ill children, and it can lead to short-term and long-term complications (1, 2). The frequency of TI-related complications is low in stable patients, but it increases significantly in critically ill children (3). Some of the factors associated with a greater risk of complications are the number of intubation attempts (3, 4), weight under 10 kg (4), and the history of difficult airway (3, 4).

The frequency of cardiac arrest (CA) after TI varies from 0.4% to 3% in adults and children (3–9), but it increases to 6.2% in the cases of difficult intubation (10).

Researchers of the National Emergency Airway Registry for Children have developed a prospective registry of TI in the PICU setting. Several studies have been published from this database, analyzing the frequency of difficult intubations (10), success of TI according to the training level of the provider (9), complications (3, 4, 8), and its variation between different PICUs (11). The article by Shiima et al (12) published in this issue of *Critical Care Medicine* is a retrospective analysis considering the relationship between TI and CA.

The importance of this study lies in the fact that it is the first to analyze the factors associated with CA after TI in children and because it proposes some measures to prevent it. The results derived from this study coincide with those previously published, reporting a relatively low frequency of CA (1.7%), but with high immediate mortality rates (18%) (12). Nevertheless, only hemodynamic alterations and hypoxemia prior to TI resulted as risk factors for CA in the multivariate analysis.

The use of neuromuscular blockade was associated with a lower risk of CA. Authors suggest that this was due to the fact that the use of neuromuscular blockade was more common in patients without hemodynamic instability or history of difficult airway (12). However, it is important to have in mind that the use of neuromuscular blockade facilitates intubation and could reduce the frequency of complications.

Nevertheless, this study has some important limitations. There is no information about the etiology of CA, the period between TI and CA, the rhythm before and during CA, the resuscitation, the survival and the neurologic outcomes. These data are essential to characterize the importance and repercussion of CA.

So, what practical implications do the results of this study have for intensive care pediatricians? Should we change our actual intubation clinical practice?

The results from this study remark the importance of hemodynamic and respiratory stabilization prior to TI. This may not be possible in the emergency TI, but they should be optimized in those cases of progressive respiratory, hemodynamic or neurologic failure.

Studies in adults report that the use of noninvasive ventilation (NIV) (13) and high-flow oxygen therapy (14) decrease the risk of hypoxemia during TI, and they highlight the importance of achieving an adequate oxygenation prior to intubation. In our clinical practice, most of the patients in the PICU requiring TI for progressive respiratory insufficiency are already receiving NIV, and it is maintained for preoxygenation, ventilation and, depending on the interface, even during the process of TI.

The same applies to the administration of inotropes and volume expansion. Most of the hemodynamically unstable patients, unless they require emergency TI upon PICU

*See also p. 1675.

Key Words: airway; cardiac arrest; children; critically ill children; intubation; resuscitation

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admission, are already receiving this treatment, and TI is required due to a deterioration in the hemodynamic status.

Unfortunately, this study does not offer data about the number of patients receiving high-flow oxygen therapy, NIV, or inotropes prior to intubation. Thus, we cannot establish whether these measures may contribute to decrease TI-associated CA.

Video laryngoscopy and fibrobronchoscopy can facilitate intubation in cases of difficult airway. Nevertheless, the experience in pediatric patients is scarce, and most pediatric intensivists do not have the appropriate training in this technique. This may be the reason why a meta-analysis found that although video laryngoscopes improved glottis visualization in comparison with direct laryngoscopes, this was at the expense of prolonged time to intubation and increased failures (15).

Another important topic in this article is the relationship between the level of training and experience of the provider and TI complications. Some studies show that TI carried out by resident physicians are associated with an increased risk of complications (3, 9). Nevertheless, other studies in adults (6) and children (8) do not support these findings. Expertise of the intubating provider was not associated with CA in this study. However, there is a major confounding factor, as stated by the authors, since high-risk TI were carried out by the most experienced providers (12).

This fact has a number of relevant clinical implications. The number of opportunities to intubate during pediatric residency is low and the percentage of TI failure is high among resident physicians (8). It is important that residents receive appropriate and continuous training in TI with mannequins, but the final best training is always with patients. Thus, in order to ensure patient safety, it is essential to define those patients at low risk of complications so that residents can carry out at least one attempt of TI.

In conclusion, how can we decrease the frequency of TI-associated complications and CA in critically ill children? This objective could be achieved by means of a multimodal approach including systematic detection and prompt management of risk factors and with appropriate and continuous training, not only in the TI technique itself but also as a team with a coordinated action protocol.

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