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Editorial

To intubate or not intubate during paediatric cardiopulmonary resuscitation (CPR): is that the question?

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To intubate or not intubate during paediatric cardiopulmonary resuscitation (CPR): is that the question?

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Paediatric cardiac arrest, while infrequent, continues to carry a high morbidity and mortality. In Spain, the survival for in-hospital cardiac arrest is of 41%.[1] One of the most frequent causes of cardiac arrest in paediatric patients is acute respiratory failure, especially of the hypoxaemic type, so effective early ventilation and high-quality chest compressions currently constitute the basis of paediatric cardiopulmonary resuscitation. Although bag-and-valve mask ventilation continues to be the recommended technique for initial airway management and ventilation in children, the European Resuscitation Council (ERC) guidelines of 2015 consider tracheal intubation the safest and most effective approach for maintaining the airway during prolonged resuscitation. However, invasive airway management in children is not free of risk and requires experienced and well-trained rescuers. Furthermore, incorrect placement, accidental dislodgment or endotracheal tube obstruction in intubated children are frequent incidents during CPR that increase the risk of death.

It is not surprising that in out-of-hospital paediatric cardiac arrest, intubation—usually performed by staff with less training in paediatric airway management—is not associated with improved survival or neurologic outcomes in patients compared to bag-valve-mask ventilation.[2] In fact, the 2015 guidelines of the International Liaison Committee On Resuscitation Pediatric Task Force (ILCOR) and the American Heart Association (AHA) already did not recommend the intubation of paediatric patients with cardiac arrest in out-of-hospital settings with short transport times, and supported the use of bag-valve mask ventilation.

Conversely, in cases of in-hospital cardiac arrest, early intubation of paediatric patients is commonly performed by experienced rescuers to secure the airway and facilitate oxygenation, ventilation, and uninterrupted and high-quality chest compressions, thus reducing no-flow time.[3] Although intubation in expert hands is a safe procedure, its performance during resuscitation requires the interruption of chest compressions, which can compromise the quality of CPR[4] and delay the delivery of other interventions such as epinephrine or defibrillation.[5,6] In addition, intubated patients are at higher risk of hyperventilation and hyperoxia—both associated with increased patient mortality post resuscitaiton[7]–and of increased intrathoracic pressure, with the corresponding reduction of the venous return and cardiac output achievable by chest compressions.

Although it is a widespread practice, there is no evidence that early intubation of paediatric patients during CPR improves survival or neurologic outcomes in the few studies conducted in the paediatric age group.[2,8]

In a prospective observational study recently published in JAMA, Andersen *et al.*[9] analysed data from United States hospitals included in the Get With the Guidelines-Resuscitation Register to assess whether tracheal intubation of paediatric patients with in-hospital cardiac arrest improved patient outcomes. The study included 2294 patients aged less than 18 years with in-hospital cardiac arrest that required compressions for more than one minute between years 2000 and 2014. Of the patients included in the study, 1555 were intubated during CPR, with a mean time to intubation of five minutes. The authors found a decreased survival in patients that were intubated during CPR (survival of 36%) compared to patients that were not intubated (survival of 41%), with an intubation-attributable proportion of deaths of 6.2% (95% confidence interval [95 CI]: 2.8 to 9.4).[10] This is a study of high methodological quality, as noted in the article by Ruiz-Canela Cáceres *et al.*,[10] in which the authors strived to reduce the potential biases associated with cohort studies by using the propensity score calculated by means of a multivariate hazards model, analysing not only demographic factors, pre-existing conditions, and arrest characteristics or location for intubated and not intubated patients, but also time to intubation in minutes. The inclusion of the time to intubation in the propensity score allowed the authors to match patients intubated in each period with patients of similar characteristics that were not intubated at the time, emulating the set up of a randomised study, and thus producing a quasi-experimental study.[11] Also, the study controlled for the potential bias of patients intubated during CPR being more severely ill than patients not intubated during CPR.

Since it was not a randomised controlled trial, the study did not eliminate all potential sources of confounding, such as patients needing intubation due to difficulty ensuring ade-

quate ventilation with a bag-valve mask,[12] the number of intubation attempts and failures (patients in whom intubation failed were considered not intubated), or the duration of the interruption of chest compressions or their quality. Another potential source of confounding in the study was that patients that at a given moment were in the "control" or no intubation group could later require intubation and switch groups.

Although the study by Andersen *et al.* is the largest study conducted on paediatric CPR to date, it is an observational study and not a randomised clinical trial, so the conclusions reached by the authors ("tracheal intubation during [paediatric] cardiac arrest compared to no intubation was associated with decreased survival to hospital discharge"), which question our current approach to paediatric resuscitation, ought to be considered with caution. Should we intubate during paediatric CPR?

Should we adopt the CAB sequence (Circulation, Airway, Breathing), as it has been done in adult resuscitation, in place of the classic ABC (Airway, Breathing, Circulation)? To be sure, we would have to confirm current findings with a randomised clinical trial. This presents the dilemma of whether carrying out such trial would be ethical, as it would involve the random assignment of paediatric patients with cardiac arrest to the intubation or no intubation arms during resuscitation regardless of the circumstances surrounding cardiac arrest or its duration. Furthermore, a trial of this nature would pose unfeasible logistical challenges, such as requesting consent for random assignment. Thus, prospective observational studies are needed to obtain more evidence on the risks and benefits of intubation during paediatric CPR.

Perhaps the question is not whether to intubate or not, but rather when and how to intubate. If intubation is performed, it seems obvious that taking all possible measures to guarantee the quality and safety of the procedure and keeping intubation from interfering with CPR measures to the extent possible would lead to a decrease in the deaths associated with intubation.

Consequently, our recommendation is that if the staff are not experienced enough in the intubation procedure or intubation is expected to be complicated due to patient or setting characteristics or the available resources, and as long as the patient is receiving adequate ventilation and oxygenation with a bag-valve mask, it is reasonable to wait and delay intubation until it can be performed quickly and safely.

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