ISSN 2379-4046

EMERGENCY MEDICINE
Open Journal

Openventio PUBLISHERS

Editorial

Cardiopulmonary Resuscitation: To Intubate or Not to Intubate

Chien-Chang Lee MD, ScD[1*]; Jon Wolfshohl, MD[2]; Eric H Chou, MD[2]

[1]*Department of Emergency Medicine, National Taiwan University, Taipei 106, Taiwan*
[2]*Department of Emergency Medicine, John Peter Smith Hospital, Fort Worth, Texas, USA*

[*]***Corresponding author***
Chien-Chang Lee MD, ScD
Department of Emergency Medicine, National Taiwan University Hospital, No. 7, Chung-Shan South Road, Taipei 100, Taiwan; Tel. +886-2-23123456 ext 62831; Fax. +886-2-23223150; E-mail: cclee100@gmail.com

Article information
Received: July 27th, 2018; **Accepted:** August 20th, 2018; **Published:** August 20th, 2018

Cite this article
Lee C-C, Wolfshohl J, Chou EH. Cardiopulmonary resuscitation: To intubate or not to intubate. *Emerg Med Open J*. 2018; 4(1): e1-e3. doi: 10.17140/EMOJ-4-e005

INTRODUCTION

Cardiopulmonary resuscitation (CPR) is a "tug of war" between life and death. The most suspenseful and technically difficult task in the resuscitation process is often endotracheal intubation. However, the benefits of endotracheal intubation during CPR have been seriously challenged in recent literature.[1]

POTENTIAL HARMS OF ENDOTRACHEAL INTUBATION DURING RESUSCITATION

Establishment of an advanced airway to maintain gas exchange and oxygenation has been viewed as an essential life-saving procedure during resuscitation. Over the past few decades, clinicians have taken for granted the importance of such practice, despite lack of high-quality evidence. However, since the late 1990s, our fundamental understanding of cardiopulmonary resuscitation has changed significantly.[1] The quality of chest compressions has been found to be the most important factor leading to a successful cardiopulmonary resuscitation. Any interventions that may interrupt chest compressions during CPR, such as central venous catheter cannulation, bedside echocardiography, and cardiac rhythm check, should be minimized. Tracheal intubation during resuscitation is a dilemma. On one hand, airway patency is the key to effective ventilation, but on the other tracheal intubation during CPR is technically challenging. Observational studies have reported a nearly 15% failure rate for the first intubation attempt, and the failure rate can be as high as 50% for pediatric patients.[2,3] Failure of tracheal intubation can result in a prolonged interruption of chest compression. Even if tracheal intubation is successful, hyperventilation is a frequent complication which can lead to failure of cardiopulmonary resuscitation. It may also lead to elevated intrathoracic pressure resulting in depressed coronary perfusion pressure.[4,5] Coronary perfusion pressure is the single most important indicator for return of spontaneous circulation (ROSC). Low coronary perfusion pressure (CPP) results in low ROSC rate. Given the potential harm associated with tracheal intubation during resuscitation, a bold hypothesis was postulated: using a less invasive way of ventilation, such as bag-valve-mask ventilation or laryngeal mask ventilation, in place of tracheal intubation during CPR may reduce the interruption of chest compression and could improve the CPR success rate.[4-7]

EVIDENCE FROM OBSERVATIONAL STUDIES

In 2000, the American Heart Association (AHA) set up a large, high-quality registry collecting resuscitation data on in-hospital cardiac arrest as part of an ongoing quality improvement program. This AHA registry, now called Get With The Guidelines–Resuscitation provides an opportunity to analyze the relationship between endotracheal intubation and CPR outcomes. The research team from the Department of Emergency Medicine at Beth Israel Deaconess Medical Center in Boston, Massachusetts accessed this registry capturing 15-years of data from 668 U.S. hospitals and performed a propensity score matched analysis in both children and adults.[6,7] They found that patients undergoing endotracheal intubation during resuscitation had a significantly lower survival to hospital discharge than those without endotracheal intubation. The analysis of the adult resuscitation data showed that 71,615 of 108,079 (66.3%) cardiac arrest patients were intubated within 15 minutes of CPR initiation, of which the investigators were able to find 43,314 (60.5%) patients with a suitable control patient. In matched analysis, patients receiving endotracheal intubation during CPR had a significantly worse outcome, including lower ROSC rate

(57.8% *vs.* 59.3%, $p<0.001$), lower survival to discharge rate (16.3% *vs.* 19.4%; $p<0.001$), and worse cerebral performance category scores among those that survived (10.6% *vs.* 13.6%; $p<0.001$). The pediatric study included 2,294 children with in-hospital cardiac arrest, of which 1,555 (68%) received tracheal intubation within 15 minutes of CPR initiation. The survival to discharge rate was lower (36% *vs.* 41%; $p=0.03$) for intubated children, but the ROSC rate (68% *vs.* 68%; $p=0.96$) and proportion of patients that survived with good neurologic outcome (10.6% *vs.* 13.6%; $p<0.001$) were not significantly different between the two groups.

STUDY DESIGN FACTORS

Given these noteworthy results were from observational studies rather than a randomized trial, the possibility of a reverse causation, namely confounding by indication, has been raised.[6,7] Patients who respond to the first few rounds of CPR with adequate spontaneous ventilation may not require intubation, whereas patients who do not respond to CPR as quickly are more likely to be intubated. Therefore, it is possible that the correlation between intubation and poor outcomes is a result of reverse causation. This problem, called confounding by indication,[8] is notoriously difficult to control for even when a comprehensive set of potential confounders, such as demographics, comorbidity, diagnosis, and resuscitation medications are included in the regression model for adjustment. In order to overcome the rapidly changing patient condition and indications of intubation during resuscitation, Andersen LW adopted a novel time-dependent propensity score matching method to adjust for the time-variant confounding.[6,7,9] Operationally, the study only considered patients who underwent endotracheal intubation within 15-minutes of CPR initiation.[6,7] All patients were stratified into 15 strata by "time (minute) since resuscitation." Many factors that affecting the decision to intubate or the prognosis of resuscitation were included to build 15 propensity score models, which were then used for matching intubated to non-intubated patients in the 15 strata. The analysis virtually mimicked 15 randomized controlled trials carried at each minute after resuscitation initiation. By adopting the rigorous design and analytical approach, the study showed the potential harm of intubation during resuscitation. Results of this study actually corroborated the findings of the world's largest pre-hospital resuscitation trial in Osaka in which 64,000 patients with out-of-hospital cardiac arrest were included for analysis. The study also showed patients undergoing tracheal intubation in the pre-hospital settings had a significantly lower ROSC rate than patients not undergoing endotracheal intubation.[10]

Although it is an observational study, it has many advantages. In addition to rigorous design and analysis, the study also used a high-quality database of prospective collected data from 668 U.S. hospitals over 15 years. A randomized trial will not be available in the short-term given the sample size required to sufficiently power such a study for this analysis may beyond 1,000 patients. Therefore, the existing evidence cannot be ignored and should prompt a review of the current guidelines for endotracheal intubation in cardiopulmonary resuscitation.

CLINICAL IMPLICATIONS

There are clinical implications from these two studies.[6,7] First, unless there is a clear sign of airway obstruction, patients with presumed cardiogenic cardiac arrest should undergo five cycles of CPR before considering tracheal intubation, either using manual bag-valve-mask ventilation or laryngeal mask airway ventilation. Second, if the first endotracheal intubation attempt fails, a clinician should resume chest compressions immediately, prior to making a second intubation attempt. Laryngeal mask airway may be an alternative in these situations. Lastly, hyperventilation should be avoided if an advanced airway is successfully established.[4,5]

CONCLUSION

Tracheal intubation during resuscitation may do more harm than good to both adult and pediatric patients in cardiac arrest. Clinicians may consider bag-valve-mask or laryngeal mask airway ventilation if the initial intubation attempt fails or is expected to be technically difficult. A sufficiently powered randomized trial is needed to confirm the findings of these two studies.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. deCaen AR, Garcia Guerra G, Maconochie I. Intubation during pediatric CPR: Early, late, or not at all? *JAMA*. 2016; 316(17): 1772-1774. doi: 10.1001/jama.2016.13905

2. Goto T, Gibo K, Hagiwara Y, et al. Factors associated with first-pass success in pediatric intubation in the emergency department. *West J Emerg Med*. 2016; 17(2): 129-134. doi: 10.5811/westjem.2016.1.28685

3. Kim J, Kim K, Kim T, et al. The clinical significance of a failed initial intubation attempt during emergency department resuscitation of out-of-hospital cardiac arrest patients. *Resuscitation*. 2014; 85(5): 623-627. doi: 10.1016/j.resuscitation.2014.01.017

4. Aufderheide TP, Sigurdsson G, Pirrallo RG, et al., Hyperventilation-induced hypotension during cardiopulmonary resuscitation. *Circulation*, 2004. 109(16): p. 1960-1965. doi: 10.1161/01.CIR.0000126594.79136.61

5. Pitts S, Kellermann AL. Hyperventilation during cardiac arrest. *Lancet*. 2004. 364(9431): p. 313-315. doi: 10.1016/S0140-6736(04)16740-8

6. Andersen LW, Granfeldt A, American Heart Association's Get With the Guidelines-Resuscitation Investigators, et al. Association Between Tracheal Intubation During Adult In-HospitalCardiac Arrest and Survival. *JAMA*. 2017; 317(5): 494-506. doi: 10.1001/

jama.2016.20165

7. Andersen LW, Raymond TT, American Heart Association's Get with the Guidelines-Resuscitation Investigators, et al. Association Between Tracheal Intubation During PediatricIn-Hospital Cardiac Arrest and Survival. *JAMA*. 2016; 316(17): 1786-1797. doi: 10.1001/jama.2016.14486

8. Griesdale D, Jones PM. In asking the right questions, be cautious of confounding by indication. *Can J Anaesth*. 2018. doi: 10.1007/s12630-018-1172-5

9. Ray WA, Liu Q, Shepherd BE. Performance of time-dependent propensity scores: A pharmacoepidemiology case study. *Pharmacoepidemiol Drug Saf*. 2015; 24(1): 98-106. doi: 10.1002/pds.3727

10. Hasegawa K, Hiraide A, Chang Y, Brown DF. Association of prehospital advanced airway management with neurologic outcome and survival in patients without-of-hospital cardiac arrest. *JAMA*. 2013; 309(3): 257-266. doi: 10.1001/jama.2012.187612