Short Communication

Manual vs. mechanical ventilation in patients with advanced airway during CPR

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Early chest compressions and rapid defibrillation are important components of cardiopulmonary resuscitation (CPR). American heart association (AHA) recommends two breaths to be delivered for every 30 compressions for an adult cardiac arrest victim. Patient with an advanced airway like endotracheal tube (ETT) should be given one breath every 6 s without interruptions in chest compression (10 breaths per minute). All of the modern mechanical ventilators have option to generate spontaneous breaths by the patient if the patient has spontaneous respiratory efforts. During CPR, the mechanical ventilator is fallaciously sensing the chest compressions as patient’s spontaneous trigger and thereby it delivers higher respiratory rates. Avoiding excessive ventilation is one of the components of high quality CPR as excessive ventilation decreases venous return thereby decreasing the cardiac output and also it affects intra-thoracic pressure thereby adversely affects intra-arterial pressure. As modern ventilators have trigger for spontaneous breaths and they will be erroneously triggered by chest compressions, it would be prudent to use volume marked resuscitation bags or manual breathing devices (manual self-inflating resuscitation bag, Bain’s circuit) for delivering breaths which can be synchronised with compression phase of CPR at RR of 10 breaths per min with advanced airway in place. If any patient who is on mechanical ventilation develops cardiac arrest, patient should be disconnected from the mechanical ventilator and should be ventilated manually. Manual ventilation with aforementioned breathing devices should be used in a patient without and with advanced airway devices during CPR.

1. Manuscript

Early chest compressions and rapid defibrillation are important components of cardiopulmonary resuscitation (CPR). Global resuscitation bodies recommend two breaths to be delivered for every 30 compressions for an adult cardiac arrest victim. Patient with an advanced airway like endotracheal tube (ETT) should be given one breath every 6 s without interruption in chest compression (10 breaths per minute). Auferheide et al had found that hyperventilation (respiratory rate 12 vs. 30) reduced coronary perfusion pressure during CPR in animals. When mechanically ventilated patient develops cardiac arrest, there is widespread practice of increasing the fraction of inspired oxygen (FiO2) concentration to 100% and set respiratory rate (RR) at 10. min⁻¹ (as per guideline by global resuscitation bodies). All of the modern mechanical ventilators have provision to sense the spontaneous respiratory efforts of the patient. The ventilator senses the patient's spontaneous respiratory efforts either by flow or pressure trigger variable. Upon reaching the set trigger by the patient because of the spontaneous respiratory effort, ventilator will assist the patient’s spontaneous respiratory efforts. During CPR, the mechanical ventilator is fallaciously sensing the chest compressions as patient’s spontaneous breath trigger and thereby it delivers higher respiratory rates. Avoiding excessive ventilation is one of the components of high quality CPR as excessive ventilation decreases venous return thereby decreasing the cardiac output and also it affects intrathoracic pressure thereby adversely affects intra-arterial pressure. Ventilation and oxygenation becomes ineffective because of...
repetitive erroneous triggering of ventilator by chest compressions. The patient might be harmed because of this high RR during CPR due to decreased cardiac output which is against the recommendation for RR as 10 min\(^{-1}\) when patient has advanced airway in place. Ahn et al had compared the effectiveness of ventilation with manual self-inflating resuscitator and mechanical ventilator in manikin while performing CPR.\(^4\) Authors kept tidal volume (\(V_T\)) of 600 ml, inspiratory time of 1.2 s, RR of 10 min\(^{-1}\) and trigger was increased to maximum to avoid inadvertent delivery of additional breaths thereby delivered RR can be as set RR. Volume marked resuscitation bag was used in this study. The mean delivered \(V_T\) with resuscitation bag was 591.50 ml [with peak airway pressure (\(P_{aw}\)) of 53.20 cmH2O] and it was 529.50 ml [\(P_{aw}\) of 46.30 cmH2O] with mechanical ventilator. Delivered RR was not monitored by authors. This study had revealed that the appropriate delivery of \(V_T\) by resuscitation bag itself. The clinical endpoint for ventilation during CPR is visible chest rise which can be achieved manually with manual self-inflating resuscitation bag or by Bain's circuit. Weiss et al had compared the automatic transport ventilator (ATV) vs bag valve for ventilation in 21 patients requiring CPR.\(^5\) Though authors concluded that the emergency medicine technicians could perform other tasks when ATV was used, the delivered RR was higher in ATV group when compared with bag valve group.

Hence, there should be emphasis on taking the ventilation manually either by manual self-inflatable resuscitator (Ambu bag) or with breathing circuits (Bain's Circuit) when mechnically ventilated patient develops cardiac arrest instead of continuing with mechanical ventilator.

**Author’s contributions**

Muthapillai Senthilnathan: Term, Conceptualization, Methodology, Investigation, Resources, Data Curation, Writing-Original draft, Writing-Review & Editing; Ramya Ravi: Investigation, Resources, Data Curation, Writing-Original draft, Writing-Review & Editing; Srinivasan Suganya: Investigation, Resources, Writing-Original draft, Writing-Review & Editing; Ranjith Kumar Sivakumar: Writing-Original draft, Writing-Review & Editing.

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