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Title: Quality of bag mask ventilation in critically ill children

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Structured Abstract (250 words max)

Purpose

To characterize the quality of Bag Mask Ventilation (BMV) delivered to critically ill children and to evaluate the association of BMV quality on the occurrence of adverse tracheal intubation associated events (TIAEs) and severe oxygen desaturation during tracheal intubation (TI).

Scope

BMV is a fundamental skill for acute care providers but is difficult to perform in critically ill children. There is a concern that low-quality BMV is common, contributing to severe oxygen desaturation and physiologic derangement in critically ill children.

Methods

We measured key components of BMV quality in critically ill children using a Respiratory Function Monitor (RFM): Expiratory Tidal Volume (T_{Ve}), Peak Inspiratory Pressure (PIP), % leak around the mask, presence of upper airway obstruction. We defined high-quality breath as all components within the target.

Results

Due to COVID-19, our data collection has been delayed.

Purpose

Our goals are to characterize the quality of BMV delivered to critically ill children and to evaluate the association of quality of BMV on the occurrence of adverse TIAE, severe oxygen desaturation, and brain oxygen desaturation during TI procedures.

Scope

Airway management with Tracheal Intubation (TI) in critically ill children is an important life-saving procedure with known high risk. We identified and reported that 20% of TI are associated with adverse TI associated events (TIAEs) and 14% with severe oxygen desaturation (defined as SpO₂<80% for children with baseline SpO₂>90%) using our National Emergency Airway Registry for Children (NEAR4KIDS), a multicenter quality improvement (QI) database of 41 pediatric ICUs. These children who suffered adverse TIAE or severe desaturation had a longer duration of mechanical ventilation and ICU stay. Implementation of a multidisciplinary checklist decreased these event rates by only 4% since 2013, remaining far from ideal. Current ongoing QI interventions have targeted the implementation of apneic oxygenation and video (with to Tw 0 Tr 0. vement (QI))Tj 0.0

tidal volume as opposed to inspiratory tidal volume which includes the leak around the mask),
PIP, % leak around the mask,

There was a substantial pause of BMV during laryngoscopy as a part of TI procedure. The median duration was 59.5 sec (IQR:44-84 sec) for the first attempt (n=30, one patient is missing this data), 68 sec (IQR:42-72 sec) for the second attempt (n=9), and 39.5 sec (IQR: 39-51 sec) for the third attempt (n=6). The brain tissue oxygen saturation data analyses are ongoing.

Discussion

In the current study, we aim H G to characterize the quality of BMV provided in critically ill children who receive GTI procedures in the ICU. Our preliminary finding V indicate that poor-quality BMV is common and may be associated with the poorer patient outcomes: adverse TIAEs and oxygen desaturation.

This finding is significant because our previous studies showed that the adverse TIAEs and oxygen desaturation events during TI procedure are also associated with a longer duration of mechanical ventilation, O R Q C U H day, and P R U C U mortality. We also recently evaluated commonly performed BMV mitigation techniques and documented various levels of success (e.g., supraglottic or adjunct airway use success rate for improving BMV: 73%, provider change: 80%).

We plan to complete a final data analysis and use this observational study data for future RO1 application. With this preliminary study result, we are informed that the quality of BMV given to critically ill children is suboptimal, and there is substantial room for improvement. Poor quality of BMV may be associated with poor patient outcomes. Future quality improvement work should target the high quality of BMV using simulation, real time feedback, and effective coaching.

Conclusion

Our preliminary analyses of the data suggested the poor quality of BMV is pervasive and may be associated with patient outcomes. The data collection was delayed due to COVID-19. The completion of full data analyses will further quantify the safety gap in the current pediatric ICU practice.

Significance

BMV is an essential, life-saving skill performed for critically ill children. Yet the BMV quality measured by a Respiratory Function Monitor revealed a high proportion of poor quality BMV breaths. These poor-quality breaths may be associated with poor patient outcomes for critically ill children.

Implications

Quality of BMV for critically ill children should be measured and intervened. Future quality improvement studies should include educational and innovative interventions to improve the quality of BMV in critically ill children.

Publications

Daly Guris RJ, Doshi A, Boyer DL, Good G, Gurnaney HG, Rosenblatt S, McGowan N, Widmeier K, Kishida M, Nadkarni V, Nishisaki A, Wolfe HA. Just-in-Time Simulation to Guide Workflow Design for Coronavirus Disease 2019 Difficult Airway Management. *Pediatr Crit Care Med*. 2020 Aug;21(8):e485-e490. PMID: 32459793; PMCID: PMC7288785.