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Lung Protective Ventilation During General Anesthesia: A Staff Education Project

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Executive Summary

Introduction of Problem

Lung protective ventilation has shown to be an effective strategy of ventilation in critical care patients and perioperative patients. However, anesthesia providers often still utilize traditional modes of ventilation during general anesthesia. To improve the knowledge and utilization of lung protective ventilation during general anesthesia a clinical practice tool was needed.

Literature Review

An exhaustive literature review yielded ten relevant articles. These studies discussed the physiological effects of mechanical ventilation, and they discussed the components and benefits of lung protective ventilation related to the consequences of mechanical ventilation.

Positive end-expiratory pressure (PEEP). PEEP may help open and keep open the regions of the lungs that collapse following induction of anesthesia (Neto et al., 2015). It may also help maintain the alveoli open during the entire breathing cycle, preventing the cyclic opening and closing with each breath (Neto et al., 2015). The use of PEEP could increase functional reserve, and by keeping end-expiratory volume constant, it could decrease tissue stress and capillary filtration (Serpa Net, Filho, Rocha, & Schultz 2014).

Low tidal volume. Ventilator settings are one of the strongest predictors of the development of postoperative Acute Respiratory Distress Syndrome (ARDS) (Serpa Neto et al., 2014). The ARDS network reports that low tidal volume (6mL/kg of predicted body weight (PBW)) ventilation is associated with decreased mortality and increased ventilator-free days when compared to large tidal volume (12mL/kg of PBW) ventilation (Kimura et al., 2016). An increase as small as 1mL/kg PBW correlates with a 23% increase in ICU mortality risk (Kimura et al., 2016). The use of large tidal volumes in patients without ARDS is the main risk factor associated with developing lung injury (Kimura et al., 2016).

Recruitment maneuvers. Recruitment maneuvers are defined as the application of temporary high airway pressure to reinflate collapsed lung units (Kimura et al., 2016). Recruitment maneuvers, when combined with adequate PEEP, have the ability to open and keep open previously collapsed lung regions (Coppola et al., 2014).

Low pressure ventilation. After reviewing data on 53454 patients, Ladha et al. (2015) concluded that plateau pressures of 16 cmH_2O or less were associated with a decreased risk of postoperative respiratory complications. It is suggested that attempts should be made to ventilate using the lowest possible plateau pressures, even in patients without ALI (Ladha et al., 2015).

Fraction of inspired oxygen (FiO_2). Use of high FiO_2 can lead to the development of atelectasis, especially after induction of anesthesia (Neto et al., 2015). Atelectasis increases ventilation-perfusion mismatch (Neto et al., 2015). Animal models have indicated that high FiO_2 may induce pulmonary injury via increased levels of reactive oxygen-derived free radicals (Neto et al., 2015).

Project Methods

Goals and objectives.

The objectives and goals of project were to increase the utilization of lung protective ventilation, reduce postoperative respiratory complications, reduce hospital length of stay and hospital cost, and decrease the generation of atelectasis during general anesthesia. The objectives and goals of the clinical practice guide are to discuss the utilization of lung protective ventilation in the perioperative setting, discuss the origin of lung protective ventilation, review the physiological effects of mechanical ventilation on the pulmonary system, discuss possible postoperative complications related to general anesthesia and mechanical ventilation, review the components of lung protective ventilation, influence further DNP projects to build upon, and encourage providers to share information with peers. The objectives and goals of the educational handout are to reinforce the education tool and promote utilization of lung protective ventilation techniques.

Setting and group. This project took place at Southern Illinois midsize hospital. The study group included anesthesia providers and post anesthesia care unit staff.

IRB information. The SIUE Institutional Review Board (IRB) reviewed and approved on May 1, 2017 to April 1, 2018. The Belleville Community Institutional Review Board (BCIB) reviewed and approved on June 1, 2017.

Tools and measures. This project was measured using a pre/post-test evaluation tool. The pre-test included eleven clinical survey questions and four demographic survey questions. Answers were scored using a Likert scale. The post-test was identical with an addition of a free text box for comments on the project.

Resources and supports. Strengths of the project include utilization of up-to-date literature, ease of distribution of PowerPoint, and ease of evaluation.

Risks and threats. Weaknesses and threats to this project included a small sample size and isolation to one facility. An additional major threat was lack of participation in the program.

Evaluation

Implementation and results.

A clinical practice guide were developed and distributed at Belleville Memorial Hospital on June 23, 2017. A PowerPoint presentation was presented at an anesthesia staff meeting and a post anesthesia care unit staff meeting. Following each PowerPoint presentation, a brief question period was allotted. After the question period, pre-surveys were administered and collected from each group. Post-surveys were distributed via employee mailbox on July 25, 2017. Post-surveys were collected through August 7-18. Forty pre-surveys and forty post-surveys were administered during these times. Twenty-five completed the pre-surveys, and twelve completed the post-surveys.

Impact on Practice

The results of this project indicated an increase in knowledge of lung protective ventilation and an increase in utilization of the components of lung protective ventilation. It appears that as providers' knowledge increased, they were more willing to employ these ventilation strategies. This demonstrates that practice change can occur through education. The predicted long-term impact will be continued use of lung protective ventilation, continued interest to increase knowledge education, and the dissemination of said education to students and peers.

This project can be replicated on an even larger scope. Recommendations include expanding to more than one facility, expanding the sample size, and offering multiple presentation days. Additionally, post-surveys could be collected at a subsequent staff meeting to potentially increase participation. A major limitation of this project was lack of participation because the sample size was small and limited to one facility. Additionally, because the pre and post surveys contained the same questions, bias existed from knowledge of questions from the pre-survey. Also, because there was no coding system for the pre and post surveys, there was no way directly compare individual results A follow-up project could look at the utilization of lung protective ventilation strategies in daily practice.

Conclusion

Lung protective ventilation has been utilized in critical care patients, and adoption of this strategy in the perioperative setting has demonstrated a reduction in lung inflammation and pulmonary and non-pulmonary sepsis complications (Patel et al., 2016). More research is still required to determine the optimal ventilator settings intraoperatively (Kilpatrick & Slinger, 2010). However, benefits to protective ventilation have been demonstrated by the IMPROVE trial with the following set of parameters: Tidal volume of 6-8mL/kg/PBW, PEEP of 6-8 cmH_2O, a plateau pressure of less than 30 cmH_2O, the use of recruitment maneuvers (30 cmH_2O for 30 seconds) every 30 minutes, and a FiO_2 of less than 50% (Patel et al., 2016).

This project assessed the impact of an educational program on anesthesia staff and post-anesthesia care unit staff on knowledge and utilization of lung protective ventilation. The results of this project indicated an increase in knowledge and utilization after implementation of an educational program, which included a PowerPoint presentation, a clinical practice guide, and a calculation tool. Through continuing education, the promotion of lung protective ventilation can be expanded in subsequent projects and educational programs. As knowledge increases, providers will understand the impact of lung protective ventilation settings, thereby expanding its use.

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