Deviations in Endotracheal Cuff Pressure During Intensive Care

Adequate sealing of the extra-luminal airway in endotracheally intubated patients is pivotal to allow efficient positive pressure ventilation and to avoid micro-aspiration of subglottic secretions into the lower respiratory tract potentially causing ventilator-associated pneumonia (VAP). On the other hand, excessive cuff pressure causes tracheal damage resulting in substantial morbidity such as fistula or stenosis formation. As such, the endotracheal cuff pressure must ensure adequate sealing while, simultaneously, avoiding compromised tracheal perfusion. In general, this objective corresponds with a cuff pressure that ranges 20 to 30 cm H₂O.

In the past decades, distinct endotracheal tubes have been developed to either reduce the risk of tracheal damage or optimize sealing capacity. Despite innovative endotracheal tube designs, maintaining an optimal cuff pressure remains an Achilles heel. Indeed, endotracheal cuff pressure may decrease over time and is also influenced by position changes, core temperature, ventilator pressures, and tracheal suctioning. A recent survey about cuff pressure management indicated that 53% of nurses check cuff pressure only every 8 hours and frequently by means of finger palpation of the pilot balloon. This practice has been shown to result in excessive cuff pressure, whereas monitoring the cuff with a manometer yields fewer postintubation complications. To anticipate alterations in cuff pressure and poor monitoring practice, a continuous automatic cuff pressure control device has been developed. This device successfully keeps cuff pressure within target limits. Yet, any benefits in terms of reduced risk of VAP were absent. Therefore, its use remains an unresolved issue in the prevention of VAP. Perhaps the favorable effect of continuous cuff pressure monitoring and control is more within the reduced risk of tracheal damage, but until now such data are lacking.

In the March 2011 issue of the American Journal of Critical Care, Sole et al described the results of a study to evaluate the effect of an intervention to adjust endotracheal cuff pressure. When pressure fell out of a predefined range (20-30 cm H₂O) an alarm warned the nurse who set cuff pressure at 22 cm H₂O. In the control group, cuff pressures were monitored, however, no alarm signal occurred when they went out of range. In addition, all caregivers were blinded for monitored cuff pressure values. In the intervention group, cuff pressure values were less frequently out of range (11% of the observation time vs 52%).

The work done by Sole et al is unmistakably an additional call for increased attention for cuff pressure monitoring and surely will contribute to an increased awareness among nurses, respiratory therapists, and anesthesiologists. In previous research Sole et al identified some factors influencing cuff pressure. We wonder if their present study brought deeper insights in particular care aspects inciting alterations in endotracheal cuff pressure. We want to congratulate Sole and colleagues with their valuable work and would greatly appreciate if they could elaborate on this matter.

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REFERENCES

None Reported

FINANCIAL DISCLOSURES

None Reported

Response:

We thank our international colleagues for their meaningful review and comments related to our study. Similar to our previous study, we found that endotracheal tube (ETT) cuff pressure was not a static measure. We reviewed the digital tracings from the study and made several clinical observations related to cuff pressure variability.

During the synchronous intermittent mandatory ventilation mode, the peak cuff pressure was higher during the mandatory breaths, likely related to changes in airway pressure. We observed changes in pressure during and after turning, attributed to position of the head and neck and its influence on the ETT cuff itself.

We observed transient pressure increases during coughing and suctioning the endotracheal tube; the pressure quickly returned to baseline. We also observed that in patients who were agitated, greater variability in ETT cuff pressure occurred, and that variability decreased after the patient received sedation (Figure). During agitation and some movement, the ETT cuff pressure often “dipped,” potentially increasing the risk for aspiration of oropharyngeal secretions.

These clinical observations demonstrate the challenges associated with maintaining the ETT cuff pressure within a narrow range, and why ensuring constancy in pressure (such as with a controller device) has resulted in mixed effects on prevention of aspiration and ventilator-associated pneumonia (VAP). In Valencia’s study, no significant decreases in VAP were noted, whereas Nseir reported a significant reduction in aspiration, pepsin levels in tracheal secretions, and VAP.

The observations also emphasize the importance of adjusting the pressure to a midpoint therapeutic range (such as 25 cm H2O) anticipating that “dips” in pressure may occur. Furthermore, the importance of regular suction of oropharyngeal secretions and ensuring patency of ETT with subglottic secretion ports cannot be underestimated in preventing microaspiration of secretions should dips occur.

Further research is needed to identify if similar changes in ETT cuff pressure occur with tubes designed with the newer thin-walled polyurethane cuffs. And although it is important to maintain the cuff pressure at a level to prevent aspiration of secretions, the relationship between cuff pressure and the development of tracheal stenosis warrants additional study.

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REFERENCE


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Endotracheal Cuff Pressure Monitoring: Another Alarm in the ICU?

I read with interest the article by Sole and colleagues’ on continuous monitoring of cuff pressure. The authors evaluated the impact of an intervention to reduce underinflation and overinflation of tracheal cuffs in intensive care unit (ICU) patients.

During the intervention period, cuff pressure was continuously monitored and an alarm was used to inform nurses that cuff pressure was out of range (20-30 cm H2O) in order to adjust it. The intervention was successful because the percentage of cuff pressure values out of range was significantly reduced.
during the intervention period compared with the control period (11.1% vs 57.1%, p <0.001). However, an alarm sounded 7 to 190 times/day/patient during the intervention period (mean 35, SD, 35). The authors stated that most of these alarms did not require intervention and were transient high-pressure alarms associated with coughing, suction, turning, and agitation. Adjustment of cuff pressure was only performed if a low alarm (<20 cm H₂O) was sustained for more than 15 seconds, or a high alarm (>30 cm H₂O) was sustained for more than 15 minutes. Surprisingly, the number of intervention was small mean ±SD 8±3 (range 2-14 per patient).

Reducing the time spent with overinflation and underinflation of cuff pressure is probably beneficial for ICU patients because previous studies suggested that this kind of intervention might reduce microaspiration, VAP, and tracheal ischemic lesions. However, adding another alarm in the ICU is probably not the best intervention to reduce variations in cuff pressure. There are several available cuff pressure monitors allowing efficient continuous control of cuff pressure without human intervention and without alarm. Alarms and noise in the ICU are one of the major risk factors for post-traumatic stress syndrome in ICU patients and for burn-out in ICU physicians and nurses. In addition, alarms are one cause for sleep disturbances in the ICU. Recent studies showed that sleep was important for healing and survival of critical illness.

Although the number of nurse interventions to adjust cuff pressure was not very high, the number of alarms was high. One could argue that nurses might have first checked if the alarm lasted enough to justify an intervention or not which might have represented a large amount of time. In a busy ICU, the impact of such an intervention on nurse workload should be evaluated.

Could the authors explain why adjustments were only made if a high alarm was sustained for more than 15 minutes? Previous animal and human studies clearly showed that overinflation of cuff pressure (>30 cm H₂O) was associated with severe tracheal ischemic lesions and possible severe complications such as tracheal stenosis. Again, available automatic cuff regulators allow immediate and continuous cuff pressure regulation without exposing the patient to potential complications.

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Response:
We value and appreciate Dr Nseir’s comments and questions regarding our clinical study, as he is the international leader in the area of endotracheal tube (ETT) cuff pressure management to prevent microaspiration. In previous studies, we found that ETT cuff pressure decreased over time, often to extremely low levels for extended intervals when the ETT cuff pressure was not measured. In this study, we wanted to determine if assessing cuff pressure values in a dynamic fashion would assist in maintaining the pressure within a recommended range.

Since we had demonstrated the ability to monitor the ETT cuff pressure with the bedside monitor, we used this mechanism as a means to test this strategy of managing ETT cuff pressure. By doing so, we recognized many events that occur during dynamic ETT cuff management, including frequent alarms and variation during clinical events. The intent of the study was to use this technology to monitor ETT cuff pressure while responding to changes beyond acceptable clinical limits. We recognize that the high rate of alarms are not practical for regular clinical use and appreciate the concern that application of this technology is unrealistic in delivering routine care in the critical care unit. We did learn, however, that the frequency of monitoring and intervention may need to increase. The frequency of adjustment of the ETT pressure is an area still under investigation.

We made our decision to wait 15 minutes before intervening for a high pressure based on our preliminary work that found most increases in pressure
were transient and clinical intervention was unnecessary, as is the case with many parameters measured in the ICU.4 We were aware of the risk for decreased perfusion and tracheal stenosis; however, we were also concerned about removing air from the cuff to lower the pressure and then seconds later having the pressure fall below recommended therapeutic levels, increasing the risk for microaspiration.

At the time we conceptualized the study, data related to automatic control of cuff pressure were limited. Although ETT cuff pressures have been maintained with these automatic devices, an earlier study did not find any effect of these devices on ventilator-associated pneumonia.5 In a prepublication, Dr Nseir reports significant reduction in aspiration of gastric contents and ventilator-associated pneumonia with use of an automatic cuff pressure controller.6 Further outcome studies are needed on the automatic ETT cuff pressure controllers that are marketed in different countries. This research need provides an opportunity for international collaboration. Thank you.

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Technology and Caring
Throughout my practice as a nurse, in both critical care and in simulation nursing education, I have been surrounded by computers and other forms of technology. This exposure intensified my interest in and passion about the benefits and risks in advancing technology in nursing as presented by Funk.1 It seems health care has become so consumed with keeping up with technology and using gadgets that are supposed to facilitate patient care that some providers have lost the ability to care. I am an advocate for technology that makes nursing easier in a fast paced, complex work environment—but it should not cloud judgment or become the final word.

For example, I spent 5 years in a cardiovascular intensive care unit and frequently took care of postoperative coronary artery bypass graft patients and patients receiving intra-aortic balloon pump (IABP) therapy. I occasionally witnessed nurses documenting lower limb assessments on IABP patients and placing the pulse oximeter probe on patients’ toes to monitor pulses. Between hourly checks of the lower extremity that is fine, but it does not replace the hourly checks.

Atrial fibrillation was a common occurrence in the postoperative population, and many times it was only identified after someone asked why the sounding central monitor was being ignored. I strongly believe that when a patient monitor is alarming, the first response should be to check on the patient, not the alarms.

Most nurses enter health care to care for others, and health care is not possible without care. The people we serve need more than technological interventions, and we as providers are capable of maintaining caring and meaningful connections with those people in a rapidly changing environment.7 As technology advances and innovative monitoring devices increase in number, what will happen to nursing? Will nurses become more dependent on technology to tell them what is wrong with the patient? I certainly hope not. It is up to nurse leaders to provide the example and teach others about caring for the patient and not relying completely on technology.

NURSES MAKING A DIFFERENCE

I thoroughly enjoyed the article by Giuliano et al, “Impact of Protocol Watch on Compliance With the Surviving Sepsis Campaign.”1 As nursing leaders, we have the responsibility to ensure we are providing the highest quality of care to our patients. With the many differing presentations of sepsis and related patient comorbidities, nurses as frontline providers, must have the expert knowledge and skills to identify the patient...
whose condition is deteriorating as a result of newly developed sepsis.

The article clearly states the need for 100% compliance with sepsis treatment bundles and their related effect on patient mortality, however less is known about the impact of earlier sepsis recognition. Evidence demonstrates that although the definitive diagnosis of sepsis in hospital patients is often made by a physician, the clinical review leading to the diagnosis is often facilitated by the bedside nurse who recognizes the signs and symptoms indicative of the onset of systemic inflammatory response syndrome, sepsis, or both.2

I commend the authors on their pilot study supporting the use of clinical decision support systems. I am a member of an institutional team that is currently developing a nursing education tool geared toward early recognition of systemic inflammatory response syndrome and sepsis for patients outside of the intensive care unit. Currently an adult nursing sepsis algorithm, management tool, and order set are being piloted. If a nurse suspects sepsis, the algorithm leads to the initiation of an order set where baseline diagnostic tests are ordered and the rapid intervention team is notified (if applicable). If the patient meets criteria, the algorithm then directs the physician to the institutional sepsis bundle. Future plans include implementing an electronic clinical decision support system.

Early sepsis recognition and treatment is everyone's responsibility. Nurses can independently impact outcomes of sepsis through early recognition and triggering of a sepsis algorithm. The use of clinical decision support systems along with ongoing education are key tools in helping nurses identify and seek early evidence based treatment for their patients.

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None Reported

REFERENCES
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New Technologies Create Communications Challenges

I am writing this letter in response to the July issue's editorial, “Scalpel, Stethoscope, iPad: The Future Is Now in the Intensive Care Unit.”1 I am concerned that it is implied that text messaging is an acceptable form of communication for the purpose of physician orders.

As a nursing leader, I strongly feel that effective communication is a cornerstone of patient and nursing safety. The Joint Commission does not recognize text messaged physician orders as an acceptable form of communication. Text messaging does not allow opportunity to read back and verify, as recommended by the Joint Commission.2 Critical clinical conversations may be missed by communicating by text messaging,3 and it does not provide an opportunity to converse with the provider to clarify orders. The Joint Commission states that institutions should establish a method of standardization for orders that are not written by the physician.4

Organizations should pursue policy changes that promote improved communication methods and address today’s technology. A solution to this nonstandardized form of communication is to encourage prioritizing computerized physician order entry (CPOE). This allows for direct entry of medical orders by the person with privileges to do so. CPOE systems facilitate safe, effective care for patients by insuring that clinical care directions and orders are communicated in a timely, accurate, and complete manner.5 Text messaging of orders does not have a signature attached to verify proof of the provider. A nurse could possibly accept a text message order from an unlicensed person, which would place his or her license at risk. CPOE allows for real-time authentication of physician orders.

Text messaging is not in compliance with the health insurance portability and accountability act (HIPAA) regulations and standards for encryption. Cell phones are usually personal property that people take home at the end of the day. Using your personal cell phone as a way to communicate patient information places you at risk of exposing patient information to people in the community, resulting in a HIPAA violation.6

It is important to establish institutional standards that make effective and safe communication a priority to protect the safety of the nurses and patients. Rather than identifying convenient ways of communication such as text messaging, we should move forward to a standardized method of communication that prioritizes the safety of the patient and meets HIPAA and Joint Commission guidelines.

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FINANCIAL DISCLOSURES
None Reported

REFERENCES
Response:

Thank you for your comments. We never meant to imply that text messaging should be used for physician orders. We completely agree that computerized physician order entry is important, and that patient privacy is always of the utmost importance.

The American Journal of Critical Care and the American Association of Critical-Care Nurses do not in any way support or condone non-Health Insurance Portability and Accountability Act compliant communication in any form.

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Consider Alcohol as an Element in Ventilator Weaning Failure

As a critical care nurse for 22 years I commend you for addressing the psychological aspects of weaning patients off the ventilator in the intensive care unit (ICU) in your July, 2011 article by Chen et al.¹

It has been my experience that the focus of the weaning process has had more emphasis on the dynamics of ventilation and perfusion, and not the psychosocial components. One of the stressors of the ICU nurse is to ensure that patients are safe from self-extubating. An important aspect of delirium that needs more investigation is the undetected alcohol withdrawal patient, since this can make weaning from the ventilator more difficult.

A history of alcohol intake might prove difficult since many patients admitted to the ICU are too sick to provide a history, or many times patients and families do not consider the daily use of alcohol as information that needs to be disclosed. The critical care nurse should carefully ask patients and families about alcohol intake history since this can prove to be a determinant of failure to wean a patient, since alcohol withdrawal symptoms might be exacerbating the problem.

As a critical care nurse and manager, it is important to consider all aspects of the weaning process since the care of ventilator patients is one of the highest costs in the ICU according to Zilberberg et al.² Corfee³ also notes that most ICU patients arrive to the unit with an altered consciousness, delirious, or intubated, thus being unable to provide important assessment information, such as alcohol intake. It is important to expand the knowledge on the contribution of alcohol withdrawal in the ICU to the inability to wean patients off the ventilator.

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Technology and Caring
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