Association of End-Tidal Carbon Dioxide Monitoring With Nurses' Confidence in Patient Readiness for Postanesthesia Discharge

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Purpose: *To determine if end-tidal carbon dioxide ($etCO_2$) value increased nurses' perceptions of confidence in patients' readiness for postanesthesia care unit (PACU) discharge.*

Design: *Prospective, cross-sectional, comparative, one-group (pre-post) design.*

Methods: *Nurses completed 2 assessments of confidence in readiness for discharge, before and after $etCO_2$ monitoring. Patient (discharge pain level, body mass index, sleep apnea history, and opioid use) and nurse factors were assessed. Analyses included descriptive and comparative statistics.*

Findings: *Of 133 patients, mean (standard deviation) $etCO_2$ was 36.1 (5.7) mm Hg. Nurses' confidence in readiness for discharge differed before and after $etCO_2$ assessment. Confidence score decreased when $etCO_2$ was low ($P = .003$) or high ($P = .005$), compared with normal values. In linear regression, $etCO_2$ remained a factor in nurses' confidence in readiness for discharge ($P < .001$).*

Conclusions: *In a PACU, $etCO_2$ monitoring changed nurses' perceptions of confidence in patients' readiness for discharge.*

Keywords: *end-tidal carbon dioxide value, discharge readiness, postanesthesia care unit, capnography.*

POSTSURGICAL PATIENTS ARE at risk for respiratory depression and postoperative apnea, particularly after opioid administration. In one study of 50 patients who received opioids in the postoperative period, researchers predicted that 18 were at high risk for reduced minute ventilation. Of the 18 cases, in 13 minute ventilation decreased to an unsafe category (defined as < 40% of predicted minute ventilation in liters/minute).[1] In another report, patients who received opioids had more low minute ventilation events and longer postanesthesia care unit (PACU) length of stay than patients

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not receiving opioids; however, in 93% of cases, low minute ventilation was not immediately preceded by low pulse oximetry readings.[2] Because pulse oximetry measures arterial oxygen saturation, not ventilation, respiratory depression may require monitoring that is more sensitive to hypoventilation. In two studies of patients who received sedation during endoscopy procedures, partial pressure end-tidal CO_2 ($etCO_2$) values and waveforms, also known as capnography monitoring, could detect additional hypoventilation, insufficient respiration, or apnea events compared with pulse oximetry.[3,4]

Capnography monitoring has been used to assess hypoventilation and apnea in multiple environments, including postoperative care,[5,6] emergency care,[7] and during endoscopy.[8] Furthermore, capnography monitoring is a requirement during moderate or deep sedation by anesthesia providers in the United States,[9] and in Canada, it is highly recommended to use capnography in provincial or district and referral hospitals.[10] In an adult PACU setting, capnography is not currently a gold-standard monitoring method. When capnography was used in children receiving care in a PACU environment, hypoventilation or apnea was detected in 45.5% of cases[11], and in another report, researchers found that there were more staff interventions when capnography monitoring values were available to health care providers.[12] In adults, very little research literature was available regarding identification of episodes of respiratory depression when capnography monitoring was used in a PACU setting. On a general postoperative care nursing unit, when capnography was randomly applied to 54 opioid-naïve patients for the first 36 hours after orthopaedic surgery, there were significantly more episodes of respiratory depression reported than among control group patients.[13] When researchers used a grounded theory approach to learn why capnography monitoring was not fully used in an acute care setting, six themes emerged, including a lack of evidence behind capnography use and questions about the impact of capnography on patient care.[14]

In a tertiary care medical center, $etCO_2$ monitoring was available but not routinely used in the PACU, unless ordered by providers. Specifically, $etCO_2$ values were not routinely used by nurses to determine patient readiness for discharge to the next level of care. In a PACU setting, capnography monitoring may be an important early indicator of hypoventilation and apnea. Thus, the purpose of this research study was to determine if $etCO_2$ values increased nurses' perceptions of confidence in patients' respiratory readiness for discharge. Research questions that guided this study were as follows: Does capnography monitoring for a short period (3 minutes) change nurses' confidence in readiness for discharge from the PACU? and Are (a) patient and (b) nurse factors associated with a significant change in nurses' confidence in readiness for discharge from precapnography to postcapnography monitoring?

Design and Methods

This research used a prospective, cross-sectional, and comparative one-group (pre-post) design. The hospital's institutional review board approved the study before initiation.

Setting and Sample

This study was conducted in a 19-bed PACU within Cleveland Clinic Hillcrest Hospital, a 500-bed tertiary care community hospital in Northeast Ohio. Participants included two groups: patients and PACU nurses. Patient participants were adults who received postoperative care after a surgical procedure with general anesthesia. Exclusion criteria were patients undergoing facial surgery and those with continuous capnography monitoring orders (generally, when intubated and mechanically ventilated) in the PACU. Nurse participants were a convenience sample of PACU nurses who were willing to assess patients' $etCO_2$ before discharge and complete a case report form. There were no exclusions to nurse participation. All nurses were previously educated on capnography monitoring equipment and waveform interpretation and carried out usual care procedures in relation to reporting abnormal findings.

Intervention

Patients met PACU discharge criteria based on a standard discharge readiness score that included 9 factors: level of consciousness, physical activity (move extremities), blood pressure, heart rate, respiratory stability (able to breathe and cough freely), oxygen saturation level, pain level, emetic

symptoms, and temperature. Then, nurses completed 3 processes. First, they provided their perception of confidence in patients' readiness for discharge. Second, they initiated $etCO_2$ monitoring using a CO_2 nasal cannula sampling device. The $etCO_2$ module was part of the hemodynamic monitoring system that displayed a waveform and numeric value. The $etCO_2$ was maintained for 3 minutes, and nurses observed waveforms and values. Third, when the $etCO_2$ was removed, nurses recorded the trended numeric value and provided a second perception of their confidence in patients' readiness for discharge.

Outcomes, Measurement, and Data Collection

To measure nurses' confidence in readiness for discharge from the PACU, participating nurses completed a 1-item question: *How confident are you that your patient is ready for discharge*? The nurses used a numerical scale from 0, not confident at all, to 10, completely confident, to record their response. No confidence scales were available on the topic of readiness for discharge. However, a single-item, numerical scale of self-efficacy, which resembled the scale developed for this study, was compared with a multiple-item scale and found to be positively correlated.[15] Patient factors included body mass index (BMI), history of obstructive sleep apnea, and opioid pain medicine administered in the PACU because these were considered important risk factors for hypoventilation.[16-18] Other factors studied were age, gender, race, marital status, insurance type (as a surrogate for socioeconomic status), pain score (from 0, no pain, to 10, highest pain possible), and surgical classification (trunk vs limb vs no incision). In addition, three outcomes were assessed: length of hospital stay, discharge status (home, home health, or outpatient vs hospital or rehabilitation center), and readmission within 30 days. Nurse factors included years as a nurse, years as a PACU nurse, and work environment before the PACU. The case report form containing the confidence scores and patient and nurse characteristics was developed by investigators. After receiving education about the study goals and nurse responsibilities, nurses who chose to participate retrieved case report forms, carried out the intervention steps and documented all patient opioid medications received. Patient characteristics were obtained from electronic medical records, and nurses' characteristics were self-reported.

Data Analysis Plan

Because many opioids were administered, they were reclassified using morphine-dose equivalency. Categorical variables were described as frequencies and column percentages. Continuous variables were reported as means (standard deviations [SDs]). Linear regression methods were used to assess the relationships among the differences between postconfidence and preconfidence scores and categorical and continuous measures. For categorical variables, the mean difference in nurses' perceptions of pre-post readiness for discharge for each level within a category were computed and pairwise mean comparisons with Tukey-Kramer adjustments for multiple comparisons were run to test for statistically significant mean differences. In each case, the number of means for comparisons was determined by the number of levels within a given category. For continuous measures, differences in nurse perceptions were regressed against the continuous measure and the slope of the resultant regression line was tested against the probability that the slope was significantly different from 0. All analyses were completed using SAS, version 9.4 (Cary, NC). In all analyses, a P value $< .05$ was considered statistically significant.

Findings

In total, 133 patients were assessed before and after $etCO_2$ monitoring by PACU nurses. Patients' mean age was 57.9 (16.0) years. By gender, patients were evenly matched, and 84.2% of patients were Caucasian. Of factors thought to be important in hypoventilation, mean (SD) BMI was 31.1 (7.5) kg/m^2, 12.1% of patients had a history of obstructive sleep apnea, and mean (SD) dose of opioids use in the PACU, using morphine equivalency, was 5.88 (6.23) mg. Nurses who participated in the study had a mean (SD) number of years as an RN of 9.2 (9.1). Other patient and nurse factors are provided in Table 1.

$etCO_2$ Values and Nurses' Confidence in Discharge Readiness

Among patients, mean (SD) $etCO_2$ level was 36.1 (5.7) mm Hg. Nurses' confidence scores in readiness for discharge from the PACU were similar before and after $etCO_2$ monitoring (9.6 [0.61] vs 9.7 [0.59], $P = .63$). $etCO_2$ values were categorized as low (< 30 mm Hg), normal (30-44 mm Hg), or high (>44 mm Hg). Nurses' confidence scores in readiness for discharge decreased from before to after $etCO_2$ monitoring for both low ($P = .003$) and high $etCO_2$ ($P = .005$) when compared with normal $etCO_2$.

Changes in Nurses' Confidence in Discharge Readiness after Adjusting for Patient and Nurse Factors

Of 13 patient factors studied, nurses' confidence in readiness for discharge, based on pre-$etCO_2$ monitoring versus post-$etCO_2$ monitoring, differed in only 2 factors, one of which was an outcome. There was a difference in the pre-post changes in nurses' confidence in discharge between male and female patients ($P = .044$). In female patients, nurses confidence in discharge readiness decreased in the post-$etCO_2$ assessment period, estimate (SE): −0.05 (0.05), and in males, it increased, estimate (SE): 0.10 (0.05). Of patients who were rehospitalized within 30 days of PACU discharge, there was a greater increase in nurses' confidence in discharge readiness after $etCO_2$ monitoring, estimate (SE): 0.33 (0.14), when compared with the change in confidence for those patients who were not rehospitalized, estimate (SE): 0.01 (0.04), $P = .028$; however, there was no differences in length of stay or discharge status based on nurses' confidence in discharge readiness; Table 2. Of the 3 nurse factors studied, none were associated with a change in scores of nurses' confidence in readiness for discharge from the PACU (pre-$etCO_2$ vs post-$etCO_2$).

Table 1. Patient and Nurse Characteristics, N = 133

Characteristics	Mean (SD)	n (%)
Patient factors		
Age, years	57.9 (16.0)	
Gender, female (vs male)		66 (49.6)
Body mass index*	31.1 (7.5)	
Race, black (vs white)		21 (15.8)
Marital status, married (vs all other options)		82 (61.7)
Insurance type, private + other (vs other options)		92 (69.2)
Surgical classification, trunk (vs limb or no incision)		72 (54.1)
Length of stay	1.01 (1.9)	
History: obstructive sleep apnea*, yes		16 (12.1)
Predischarge pain score*	2.3 (2.4)	
Readmission within 30 days, no		124 (93.2)
Discharge status, home or home health or outpatient (vs others)		125 (94.0)
Opioid dose, in PACU (morphine equivalent), mg	5.9 (6.2)	
Nurse factors		
Years as an RN	9.2 (9.1)	
Years as PACU RN	3.0 (2.9)	
Previous work setting, medical or surgical	91 (68.4)	

PACU, postanesthesia care unit; RN, registered nurse; SD, standard deviation.

*Data not available for all subjects. Missing values: body mass index = 1, obstructive sleep apnea = 1, pain score = 26.

Discussion

This is the first study to report that nurses' perceptions of confidence in readiness for discharge may change after assessing $etCO_2$ in nonintubated patients before PACU discharge. There were few reports in the literature on capnography as a means to reveal dangerous hypoxemia due to hypoventilation in nonintubated postoperative adults in a PACU setting. Anesthesia provider guidelines recommend $etCO_2$ analysis during general anesthesia.[9,19] In addition, in a PACU environment of care, $etCO_2$ monitoring is only suggested when available and indicated; however, practice recommendations do not provide specific indications.[20]

$etCO_2$ monitoring may be an important adjunct to a PACU discharge scoring tool. Our discharge scoring tool is a hospital-developed and validated measure of discharge readiness. Two PACU scoring tool factors are related to hypoventilation: (1) respiratory status of shallow breathing or

Table 2. Change in Nurses' Confidence (Based on $etCO_2$ Value) After Controlling for Patient Gender

Patient Factors	Level	Estimate	SE	*P* Value
Carbon dioxide level				< .001
	Low (< 30)	−0.31	0.11	
	Normal (30-44)	0.09	0.04	
	High (>44)	−0.67	0.23	
Gender				.044
	Female	−0.05	0.05	
	Male	0.10	0.05	
Race				.85
	Black	0.05	0.09	
	White	0.03	0.04	
Marital status				.82
	Married	0.04	0.05	
	Not married	0.02	0.06	
Payer				.32
	Government (Medicare or Medicaid)	−0.02	0.07	
	Private and other insurance	0.06	0.05	
Classification				.35
	Limb	−0.05	0.07	
	No incision	0.05	0.10	
	Trunk	0.07	0.05	
Obstructive sleep apnea				.76
	Yes	0.00	0.11	
	No	0.04	0.04	
Pain score				.55
	0	0.05	0.07	
	1 to < 4	0.03	0.08	
	4 to < 8	0.07	0.09	
	8-10	−0.33	0.27	
Readmission within 30 days				.028
	No	0.01	0.04	
	Yes	0.33	0.14	
Discharge status				.85
	Home or home health or outpatient	0.03	0.04	
	Hospital stay or rehab	−0.00	0.16	
Pain level				.16
	0-7	0.05	0.05	
	8-10	−0.33	0.26	
Morphine-dose equivalency				.99
	< 2 mg	−0.04	0.06	
	2-8	0.08	0.07	
	>8 mg	0.09	0.08	

coughing, evidence of apnea, dyspnea, tachypnea, or requiring airway support and (2) oxygen saturation level of less than 92% on room air. In an integrative review of PACU discharge readiness scoring methods[21] and in a newly developed discharge tool,[22] both factors were traditional components in determining safe PACU recovery. However, in one report, an oxygen saturation alarm (that reflected < 90% oxygen saturation) was labeled a false alarm in 93% of 113 alarms.[2] Furthermore, in a systematic review and meta-analysis of 9 studies (4 reports of oxygen saturation and 5 reports of capnography) of adult postoperative patients, authors concluded that oxygen

desaturation was a late finding and continuous $etCO_2$ monitoring was 6 times more likely to predict postoperative respiratory depression.[23] More research is needed to determine the value and outcomes of intermittent $etCO_2$ monitoring before PACU discharge. Also, more research is needed to learn about factors associated with nurses' confidence scores because a score could have reflected a belief that the $etCO_2$ value or waveform was inaccurate.

Female gender was the only patient characteristic that was associated with a change in nurses' confidence scores pre-$etCO_2$ monitoring versus post-$etCO_2$ monitoring. This finding was unexpected because we hypothesized that BMI, history of obstructive sleep apnea, and opioid pain medicine administered in the PACU would affect respiratory function,[6-8] and therefore were important factors in nurses' confidence ratings. Owing to a small sample size, we were unable to complete subanalyses (for example, gender based on obesity status and history of documented obstructive sleep apnea) that might have provided rationale for our findings. Thus, it is unknown if female gender was associated with factors we hypothesized as important. Because nurses' confidence in discharge readiness varied based on patient gender, it will be important to replicate our research findings in another setting, given that researchers who developed a predictive score to identify the risk of postoperative pulmonary complications did not include gender as an important variable.[24]

In this research study, nurses' confidence in discharge readiness was not associated with 2 of the 3 outcomes assessed, length of hospital stay and discharge status. Most patients had a short length of stay and were discharged home. Greater heterogeneity among the categories of these factors might be associated with different nurses' confidence results. More research is needed. We were surprised to learn that patients who had a higher difference in pre-post nurses' confidence scores were more likely to have a 30-day all-cause readmission. We cannot explain this finding; it may be that unstudied factors were contributors. New research using a multicenter, randomized controlled research design is needed.

Limitations

This study was conducted within a single PACU in a single community-based hospital. Results may not apply to other PACU settings. Only 9 patients (6.8%) were readmitted within 30 days. Replication of this research with a larger sample of patients, including more patients who were readmitted, will help PACU nurses understand the implications of study findings. Furthermore, although there was no significant change in nurses' confidence in discharge readiness based on patients' pain score, by category at discharge, the negative estimate value in the high pain score category reflected that nurses' confidence score was somewhat reduced after $etCO_2$ assessment. We did not complete multivariable modeling to learn the nature of the nurses' responses based on $etCO_2$ value because only 3 patients (2.83% of the total sample) had pain scores in the high category (scores between 8-10 on a 10-point scale). New research with a larger sample size is needed to learn more about the association of $etCO_2$ and high pain level at discharge. Nurses who provided data chose to participate without incentives. It is unknown if nurses who chose not to participate would have responded to the confidence level differently, especially because responders had over 2 years of PACU experience, reflecting expertise. An $etCO_2$ observation period of 3 minutes was used; it is unknown if a longer monitoring period would have changed nurses' confidence in readiness for discharge in a different way or promoted team communication or nursing interventions.

Conclusion

In a PACU setting, low and high $etCO_2$ values decreased nurses' perceptions of confidence in respiratory readiness for discharge. In addition, confidence in readiness for PACU discharge decreased after $etCO_2$ monitoring in female patients and increased after $etCO_2$ monitoring among patients who were rehospitalized within 30 days. Although we cannot explain findings related to changes in nurses' confidence in readiness to discharge based on gender and rehospitalization, future $etCO_2$ research that allows for monitoring beyond a 3-minute period is needed to learn if nuances in $etCO_2$ values and waveforms

over time could change nurses' confidence scores. Also, more research is needed on other factors related to nurses' perceptions of confidence in respiratory readiness for discharge.

References

1. Voscopoulus CJ, MacNabb CM, Freeman J, Galvagno SM Jr., Ladd D, George E. Continuous noninvasive respiratory volume monitoring for the identification of patients at risk for opioid-induced respiratory depression and obstructive breathing patterns. *J Trauma Acute Care Surg*. 2014;77:S208-S215.
2. Galvagno SM Jr., Duke PG, Eversole DS, George EE. Evaluation of respiratory volume monitoring (RVM) to detect respiratory compromise in advance of pulse oximetry and help minimize false desaturation alarms. *J Trauma Acute Care Surg*. 2016;81:S162-S170 (Proceedings of the 2015 Military Health System Research Symposium).
3. Slagelse C, Vilmann P, Hornslet P, Jørgensen H, Horsted T. The role of capnography in endoscopy patients undergoing nurse-administered propofol sedation: a randomized study. *Scan J Gastroenterol*. 2013;48:1222-1230.
4. Cacho G, Perez-Calle JL, Barbado A, Lledo JL, Ojea R, Fernandez-Rodriguez CM. Capnography is superior to pulse oximetry for the detection of respiratory depression during colonoscopy. *Rev Esp Enferm Dig*. 2010;102:86-89.
5. McCarter T, Shaik Z, Scarfo K, Thompson L. Capnography monitoring enhances safety of postoperative patient – controlled analgesia. *Am Health Drug Benefits*. 2008;1:28-35.
6. Kjorven M, Dunton D, Milo R, Gerein L. Bedside capnography: better management of surgical patients with obstructive sleep apnea. *Can Nurse*. 2011;107:24-26.
7. Long B, Koyfman A, Vivirito MA. Capnography in the emergency department: a review of uses, waveforms, and limitations. *J Emerg Med*. 2017;53:829-842.
8. Saunders R, Struya M, Pollock R, Mestek M, Lightdale J. Patient safety during procedural sedation using capnography monitoring: a systemic review and meta-analysis. *BMJ Open*. 2017;7:e013402.
9. No authors. Practice guidelines for moderate procedural sedation and analgesia 2018: a report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, and Society of Interventional Radiology. *Anesthesiology*. 2018;128:437-479.
10. Merry A, Cooper J, Soyannwo O, Wilson I, Eichhorn J. International standards for a safe practice of anesthesia 2010. *Can J Anaesth*. 2010;57:1027-1034.
11. Langham ML, Li FY, Lichtor JL. Respiratory depression detected by capnography among children in the postanesthesia care unit: a cross-sectional study. *Paediatr Anaesth*. 2016;10:1010-1017.
12. Langham ML, Li FY, Lichtor JL. The impact of capnography monitoring among children and adolescents in the postanesthesia care unit: a randomized controlled trial. *Paediatr Anaesth*. 2017;27:385-393.
13. Hutchison R, Rodriguez L. Capnography and respiratory depression. *Am J Nurs*. 2008;108:35-39.
14. Langhan ML, Kurtz J, Schaeffer P, Asnes A, Riera A. Experiences with capnography in acute care settings: a mixed-methods analysis of clinical staff. *J Crit Care*. 2014;29:1035-1040.
15. Hoeppner B, Kelly J, Urbanoski K, Slaymaker V. Comparative utility of a single-item vs. multiple-item measure of self-efficacy in predicting relapse among young adults. *J Subst Abuse Treat*. 2011;41:305-312.
16. Shetty S, Parthasarathy S. Obesity hypoventilation syndrome. *Curr Pulmonol Rep*. 2015;4:42-55.
17. Subramani Y, Singh M, Wong J, Kushida C, Mahotra A, Chung F. Understanding phenotypes of obstructive sleep apnea: applications in anesthesia, surgery and perioperative medicine. *Anesth Analog*. 2017;124:179-191.
18. Izrailtyan I, Qiu J, Overdyk FJ, Ersion M, Gan TJ. Risk factors for cardiopulmonary and respiratory arrest in medical and surgical hospital patients on opioid analgesics and sedatives. *PLoS One*. 2018;13:e0194553.
19. American Society of Anesthesiologists Committee on Standards and Practice Parameters. Standards for basic anesthetic monitoring (last amended Oct. 28, 2015). American Society of Anesthesiologists. Available at: http://www.asahq.org/quality-and-practice-management/standards-guidelines-and-related-resources/standards-for-basic-anesthetic-monitoring. Accessed July 9, 2018.
20. American Society of PeriAnesthesia Nurses. *2017-2018 Perianesthesia Nursing Standards, Practice Recommendations and Interpretative Statements*. 1st ed. Cherry Hill, NJ: American Society of PeriAnesthesia Nurses; 2016.
21. Hawker RJ, McKillop A, Jacobs S. Postanesthesia scoring methods: an integrative review of the literature. *J Perianesth Nurs*. 2017;32:557-572.
22. Street M, Phillips NM, Haesler E, Kent B. Refining nursing assessment and management with a new post-anaesthetic care discharge tool to minimise surgical patient risk. *J Adv Nurs*. 2018;74:2566-2576.
23. Lam T, Nagappa M, Wong J, Singh M, Wong D, Chung F. Continuous pulse oximetry and capnography monitoring for postoperative respiratory depression and adverse events: a systematic review and meta-analysis. *Anesth Analg*. 2017;125:2019-2029.
24. Mazo V, Sabaté S, Canet J, et al. Prospective external validation of a predictive score for postoperative pulmonary complications. *Anesthesiology*. 2014;121:219-231.