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Implementation of an Obstructive Sleep Apnea Protocol in the Postanesthesia Care Unit for Patients Undergoing Spinal Fusion Surgery

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Purpose: *The purpose of this project was to implement and evaluate the effectiveness of a postanesthesia care unit (PACU) obstructive sleep apnea (OSA) protocol in patients undergoing spinal fusion surgery.*

Design: *The structure of this project was a preimplementation and post-implementation design.*

Methods: *A convenience sample of 63 patients admitted to the PACU after spinal fusion surgery, with diagnosed or high-risk OSA, was included in protocol implementation.*

Findings: *The prevalence of diagnosed and high-risk OSA at the project implementation site totaled 74% in the spinal fusion population. The incidence of oxygen desaturations was 41% in the preimplementation group and 35% in the postimplementation group. The PACU to intensive care unit transfers were 10% in the preimplementation group and 3% in the postimplementation group.*

Conclusions: *Protocols for surgical patients with OSA require further examination but may function as a guide for postoperative nursing care.*

Keywords: *obstructive sleep apnea, PACU, STOP-Bang questionnaire, spinal fusion surgery.*

OBSTRUCTIVE SLEEP APNEA (OSA) is a serious form of sleep-disordered breathing characterized by a repetitive upper airway obstruction. Approximately 12% of the general population suffers from OSA.[1] In the surgical population, an estimated 25% of patients have OSA and approximately 80% of the affected patients lack a formal diagnosis.[2] In the perioperative setting, OSA has serious implications that include risks for pulmonary complications including oxygen desaturations, respiratory failure, emergent intubation, and prolonged mechanical ventilation.[3] Cardiac events such as atrial fibrillation and cardiac arrest have also been independently associated with OSA in the perioperative period.[4] The pulmonary and cardiac implications of OSA increase the risk for unplanned intensive care unit (ICU) admissions and total hospital length of stay (LOS) in days.[4]

OSA is an independent risk factor for perioperative complications in the spinal fusion surgery

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patient population.[5] Patients with OSA who undergo spinal fusion surgery experience a 50% higher incidence of perioperative blood transfusions, critical care utilization, mechanical ventilation, prolonged hospital LOS, and increased costs when compared with patients without OSA.[5] Therefore, it is of paramount importance to address OSA preoperatively through disease identification, evidence-based interventions, and guidelines. Without institutional guidelines, management of patients with OSA can vary greatly between providers.[6] Thus, the combination of suboptimal disease identification and the lack of institutional protocols exposes patients with OSA to substantial perioperative risks.

Literature Review

The American Society of Anesthesiologists (ASA) and the American Society of PeriAnesthesia Nurses (ASPAN) are the primary organizations influencing the perioperative management of patients with OSA through their published practice guidelines and recommendations.[7,8] These guidelines have functioned as the foundation for many published OSA protocols. Common OSA protocol components include interventions such as screening, continuous monitoring, which includes pulse oximetry and capnography, and noninvasive positive pressure ventilation (NPPV) such as continuous positive airway pressure (CPAP), automatic positive airway pressure, and bi-level positive airway pressure. The utilization of these interventions in an OSA protocol addresses the primary challenges of OSA in the surgical population, which includes preoperative disease identification, monitoring, and respiratory complications. An OSA protocol not only addresses the challenges of OSA but also can improve postoperative outcomes for the surgical population as well.[9]

The first step in an OSA protocol is preoperative disease identification through diagnostic testing or screening tools.[7,8] Polysomnography (PSG) is the gold standard for OSA diagnosis. It assesses the frequency of apneic and hypopneic events of sleeping patients in a laboratory setting and measures an apnea-hypopnea index (AHI). The AHI is used to categorize the severity of OSA based on the following categories: AHI less than 5 events per hour equates as nondiagnostic, AHI counts of 5 to 20 events per hour correlate with mild OSA, AHI counts of 21 to 40 events per hour correlate with moderate OSA, and an AHI counts greater than 40 events per hour correlate with severe OSA.[10] Although PSG testing is considered the gold standard for OSA diagnosis, it has noted limitations. First, less than 60% of patients with suspected OSA obtain a sleep study for reasons, which include its cost, timely access, and challenges to coordinating an overnight testing.[10] Second, the reliability of PSG testing is not well validated in the literature. This is attributable to variability in AHI measurement scales and methods across different sleep study centers.[10] In addition, PSG yields the chance of a missed diagnosis because of altered sleep patterns in the laboratory setting. Therefore, a negative PSG result should be regarded with a degree of caution. It is important for providers to recognize these limitations and understand where screening tools like the STOP-Bang questionnaire aid in OSA identification.

The STOP-Bang questionnaire is a validated OSA screening tool that includes a series of eight "yes" or "no" questions related to the clinical features of OSA.[11] The "STOP" refers to snoring, tiredness, observed apnea, and high blood pressure. The "Bang" refers to body mass index (BMI), age, neck circumference, and male gender. For each yes answer, one point is added for a total score between 0 and 8. Scores less than 3 indicate a low risk of OSA whereas scores greater than or equal to 3 indicate a high risk of OSA. The STOP-Bang questionnaire has demonstrated a sensitivity of 84% at detecting OSA for STOP-Bang scores greater than or equal to 3 at an AHI greater than 5 events per hour.[12] It has a sensitivity of 93% at detecting moderate to severe OSA at an AHI greater than 15 events per hour, and 100% sensitivity in detecting severe OSA based at an AHI greater than 30 events per hour.[12] The corresponding specificities for these findings are 56%, 43%, and 37%, respectively.[12] The STOP-Bang questionnaire is an essential tool in achieving the first step of disease identification in an OSA protocol because of its ease of clinical use, efficiency, and high sensitivity, and specificity.

Continuous postoperative monitoring is essential to OSA protocols and includes the use of pulse oximetry and capnography. Pulse oximetry is effective in detecting hypoxic events, whereas capnography is a sensitive indicator of ventilation.[7,13] The combination of continuous monitoring tools alerts postanesthesia care unit (PACU) nurses to respiratory changes allowing for timely interventions.[14] Another necessary component for OSA protocols is intervention to support ventilations such as NPPV. The use of NPPV has been shown to significantly reduce hospital LOS, postoperative AHI, and improve oxygenation when compared with patients with OSA who do not receive postoperative NPPV interventions.[15,16]

The implementation of OSA protocols can be particularly beneficial in vulnerable populations such as spinal fusion surgery. Patients with OSA undergoing spinal instrumentation surgeries are at high risk for developing major postoperative complications.[5] This is attributable to a prolonged surgical duration, excessive blood loss, and upper airway edema secondary to the intraoperative use of the prone position to facilitate surgery. The excessive blood loss and upper airway edema exacerbate OSA symptoms by perpetuating hypoxia and upper airway obstruction. This is evidenced by a threefold higher incidence of postoperative mechanical ventilation, blood transfusions, ICU admission, and longer hospital stays compared with patients without OSA.[5] The recommended clinical management of patients with OSA undergoing spinal fusion surgery includes early OSA identification, continuous pulse oximetry, capnography, and postoperative NPPV as needed.[5] The implementation of these interventions has the potential to reduce oxygen desaturations, ICU admissions, and hospital costs in patients with OSA undergoing spinal fusion surgery.

Purpose and Aims

The purpose of this project was to implement and evaluate the effectiveness of an evidence-based PACU OSA protocol in patients undergoing spinal fusion surgery. The specific aims were to (1) identify the prevalence rates of OSA and population characteristics in patients with either an *International Classification of Diseases* (ICD)-9 or an ICD-10 OSA diagnosis code or a STOP-Bang score greater than or equal to 3 undergoing spinal fusion surgery, (2) determine the efficacy of a PACU OSA protocol through the evaluation of oxygen desaturations, airway management techniques, and postoperative disposition in patients undergoing spinal fusion surgery with either an ICD-9 or an ICD-10 OSA diagnosis code or a STOP-Bang score greater than or equal to 3, and (3) evaluate PACU nursing staff compliance with the PACU OSA protocol in patients after spinal fusion surgery with either an ICD-9 or an ICD-10 OSA diagnosis code or a STOP-Bang score greater than or equal to 3.

Methods

Design and Sample

This quality improvement project used a preimplementation and a postimplementation design to evaluate the impact of an evidence-based PACU OSA protocol in patients undergoing spinal fusion surgery. A convenience sample of patients scheduled for spinal fusion surgery was used during the project time frame. Patients were included if they were aged 18 years or older, had either an ICD-9 or an ICD-10 OSA diagnosis code or a STOP-Bang score greater than or equal to 3, and were admitted to the PACU after spinal fusion surgery. Exclusion criteria included patients who were at low risk of OSA (STOP-Bang score less than 3), patients with postoperative invasive mechanical ventilation, and patients who bypassed PACU admission.

Organization Setting

The setting was a 957-bed tertiary academic affiliated hospital that performs 16,966 inpatient and 21,368 outpatient surgeries each year. The Spine Surgery Division serves patients from across the United States and performs more than 1,200 spine surgeries annually. The PACU includes over 100 bed spaces with 10 spaces dedicated to neurosurgical procedures. Each recovery bay is equipped with a computer for documentation, standard vital signs monitors, oxygen, ambu bag, suction, and other various recovery supplies. The nursing to patient staffing ratio is 1:2 during the PACU admission until discharge from the PACU.

Implementation and Data Collection

PREIMPLEMENTATION. The preimplementation period included a 2-week reference period in which data were collected via manual chart reviews, patient interviews, STOP-Bang questionnaire screening, and PACU observation. The primary assessment measures included patient demographics, surgical data, and clinical findings.

Specific patient demographic data collected included age, preanesthesia testing (PAT), gender, ASA physical status classification, and BMI. Surgical data measures included the number of spinal levels surgically fused. The patient's STOP-Bang questionnaire screening score was documented from the PAT visit. Patients were screened for OSA in the preoperative holding area before surgery if screening did not occur during PAT. The patients included in the reference period were observed during the entirety of their PACU admission beginning with observations every 15 minutes in the first hour, every 30 minutes for the second hour, and then hourly until discharge from the PACU. The clinical data collected included oxygen desaturations, airway management techniques (NPPV or mechanical ventilation), and postoperative disposition (stepdown or ICU). Following the reference period, the PACU nurses received an educational intervention, which included a presentation on OSA, its perioperative implications, and the created OSA protocol.

POSTIMPLEMENTATION. The PACU OSA protocol was implemented immediately after the educational intervention. The protocol was developed in a collaborative approach with a multidisciplinary team to include anesthesia, respiratory care, and PACU nursing staff. The basis of the protocol was influenced by the perioperative OSA practice guidelines and recommendations from the ASA[7] and ASPAN[8]. In conjunction with the literature, committee members, and the current state of practice in the PACU, the protocol was established. The protocol included screening with the STOP-Bang questionnaire, the use of continuous pulse oximetry, and NPPV as needed. The patient's STOP-Bang questionnaire screening score was documented from the PAT visit. Patients were screened for OSA in the preoperative holding area before surgery if screening did not occur during PAT. Continuous pulse oximetry was used to monitor for hypoxemic events. Oxygen saturation of 94% or less was used as a hypoxemic threshold based on ASPAN[8] practice recommendations. Patients who experienced a sustained period of oxygen desaturation less than 94% or three repetitive oxygen desaturations less than 94% in the PACU received NPPV interventions, which included the use of their home CPAP machine, if available, or the use of the hospital's equipment (Figure 1).

The postimplementation period included a 4-week period in which data were collected on patient demographics, surgical data, and clinical findings. Data were collected in the same manner as the preimplementation group. The primary assessment measures for the implemented protocol included oxygen desaturations, airway management techniques (NPPV or mechanical ventilation), and postoperative disposition (stepdown or ICU).

Statistical Analysis

Statistical analyses were conducted for the entire sample (N = 105) and inclusion group preimplementation and postimplementation (n = 63). Patient characteristics (eg, age, gender, ASA, BMI) were compared using independent t tests for continuous variables and χ^2 or Fisher's exact tests for categorical variables. For aim (1), OSA prevalence was compared between preimplementation and postimplementation using a Fisher's exact test. For aim (2), airway management techniques, oxygen desaturations, and postoperative disposition were compared between preimplementation and postimplementation using χ^2 tests or Fisher's exact tests. For aim (3), compliance was evaluated with descriptive statistics (n, %) postintervention. G*Power[17] software was used to estimate the minimum sample size needed to achieve statistical significance for a χ^2 test based on power set to 0.80, a large effect size (0.50), and α value set to 0.05. The results estimated that a sample of 48 patients (24 preimplementation and 24 postimplementation) would be adequate.

Results

OSA Prevalence and Population Characteristics

A total of 105 patients presented for spinal fusion surgery during the project period (Table 1). The preimplementation group contained 48 patients and the postimplementation group contained 57 patients. The incidence of patients at high risk for OSA (STOP-Bang scores greater than or equal to 3) was 69% in the preimplementation group and 68% in the postimplementation group. In the preimplementation group, 10% of patients had a preexisting OSA diagnosis (ICD-9 or ICD-10) whereas 23% of patients in the postimplementation group had a previous OSA diagnosis. The total prevalence

Post Anesthesia Care Unit Obstructive Sleep Apnea Protocol for Spinal Fusion Surgery

Protocol

1. Determine OSA Status
Review electronic medical record for patients OSA diagnosis or STOP BANG Questionnaire scores.

2. Monitor Oxygen Saturations
Oxygen desaturations will be considered as <u>3 separate desaturations</u> or <u>a sustained desaturation (> 1 min) of 94% or less on supplemental oxygen</u>.

3. Treat Oxygen Desaturations
Patients with OSA diagnosis will receive home NPPV and RT is available for assistance. If patients (with an OSA diagnosis or SBQ ≥ 3) do not have an NPPV machine available, notify the anesthesia attending for an NPPV order.

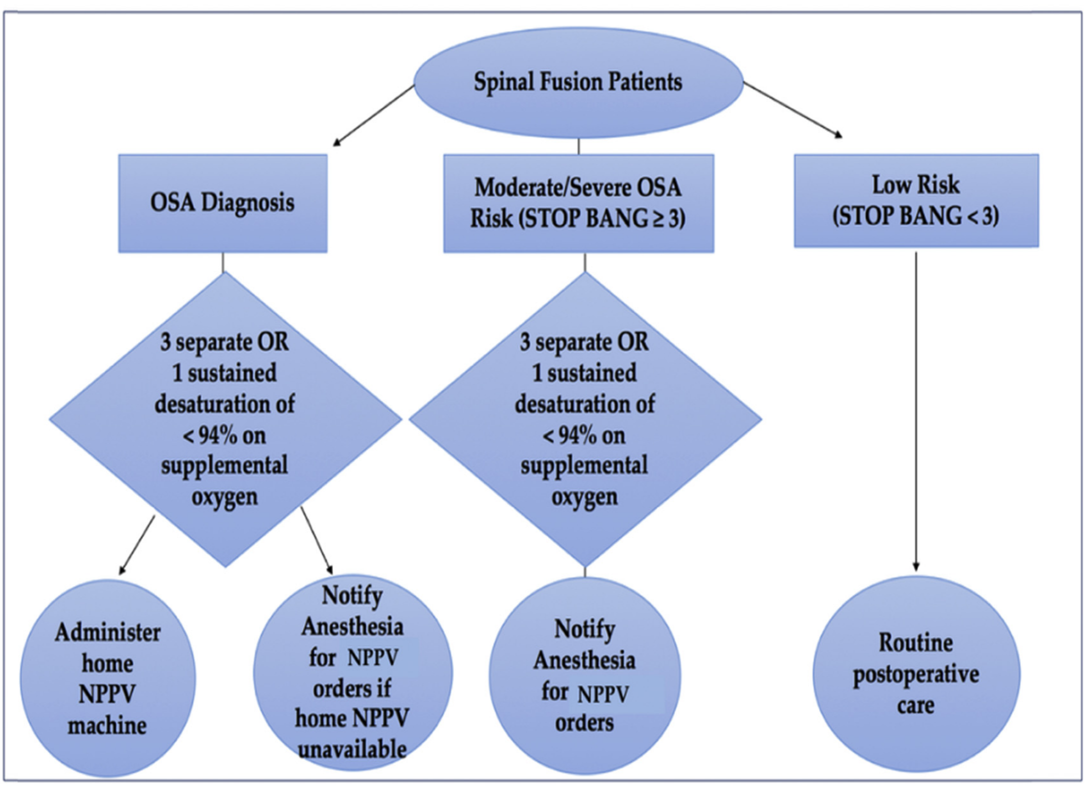

Figure 1. Postanesthesia care unit OSA protocol for patients undergoing spinal fusion surgery. NPPV, noninvasive positive pressure ventilation; OSA, obstructive sleep apnea; RT, respiratory therapist; SBQ, STOP-Bang questionnaire. This figure is available in color online at www.jopan.org.

Table 1. Descriptive Statistics of Patients Undergoing Spinal Fusion Surgery

	Total (N = 105)	Preimplementation (n = 48)	Postimplementation (n = 57)	
	Mean (SD)	Mean (SD)	Mean (SD)	*P* Value
Age (y)	62.18 (11.37)	63.00 (12.14)	61.49 (10.75)	.501
BMI (kg/m^2)	29.63 (6.57)	27.94 (5.84)	31.04 (6.87)	.015*
	N (%)	n (%)	n (%)	
Preanesthesia testing				.798
Visit	86 (81.9)	39 (81.3)	47 (82.5)	
Phone	7 (6.7)	4 (8.3)	3 (5.3)	
None	12 (11.4)	5 (10.4)	7 (12.3)	
Gender				.560
Male	54 (51.4)	23 (47.9)	31 (54.4)	
Female	51 (48.6)	25 (52.1)	26 (45.6)	
ASA physical status				.777
1	2 (1.9)	1 (2.1)	1 (1.8)	
2	28 (26.7)	15 (31.3)	13 (22.8)	
3	75 (68.6)	31 (64.6)	41 (71.9)	
4	3 (2.8)	1 (2.1)	2 (3.5)	
BMI (kg/m^2)				.123
$<$ 18.50	1 (0.9)	1 (2.1)	0 (0.0)	
18.50-24.99	23 (21.9)	13 (27.1)	10 (17.5)	
25.00-29.99	36 (34.3)	19 (39.6)	17 (29.8)	
$>$30.00	45 (42.9)	15 (31.3)	30 (52.6)	
STOP Bang $\geq$ 3*	60 (68.9)	30 (69.8)	30 (68.2)	.999
Diagnosed OSA	18 (17.1)	5 (10.4)	13 (22.8)	.121
Total OSA prevalence (OSA diagnosis or SB $\geq$ 3)	78 (74.3)	35 (72.9)	43 (75.4)	.825

ASA, American Society of Anesthesiologists; BMI, body mass index; OSA, obstructive sleep apnea; SB, STOP-Bang score.
*$P < .05$

of diagnosed or high-risk OSA was 73% and 75% in the preimplementation and postimplementation groups, respectively. An in-person PAT visits was noted for 82% of the patient population. The mean age of the total population was 62 years (SD, 11.37) and the population was nearly equal (male, 51%; female, 49%). The mean BMI was 29.6 kg/m^2 (SD, 6.57) and 23% of the patients were classified as obese. The most prevalent ASA physical status classification was an ASA 3 (69%). The patients in the postimplementation group had a statistically significant higher BMI when compared with the preimplementation group BMI ($t = -2.472$; $df = 103$; $P = .015$). There was no significant difference in age, gender, PAT, and ASA physical status classification between groups.

A total of 78 patients were eligible for the PACU OSA protocol. Fifteen patients were excluded because of direct ICU admission after surgery. A total of 63 patients with an OSA diagnosis or a STOP-Bang score greater than or equal to 3 were admitted directly to the PACU after spinal fusion surgery and met the protocol inclusion criteria (Table 2). The incidence of diagnosed OSA was 17.2% in the preimplementation group and 32.4% in the postimplementation group. There was no significant difference in age ($P = .160$), gender ($P = .600$), PAT ($P = .971$), ASA physical status classification ($P = .934$), and the number of spinal levels fused ($P = .795$) between groups.

Protocol Efficacy and Compliance

The protocol-based findings of the 63 patients that were admitted to the PACU after spinal fusion surgery with diagnosed or high-risk OSA are presented in Table 3. The preimplementation group had a 41% incidence of oxygen desaturations. There was no use of any form of NPPV for oxygen

Table 2. Descriptive Statistics of Patients With Diagnosed OSA or a STOP-Bang Score Greater Than or Equal to 3 Admitted to PACU After Spinal Fusion Surgery

	Total (N = 63)	Preimplementation (n = 29)	Postimplementation (n = 34)	
	Mean (SD)	Mean (SD)	Mean (SD)	*P* Value
Age (y)	64.36 (8.86)	66.07 (8.22)	62.91 (9.25)	.160
BMI (kg/m^2)	31.24 (6.73)	29.97 (5.51)	32.33 (6.73)	.137
	N (%)	n (%)	n (%)	
Preanesthesia testing				.971
Visit	55 (87.4)	25 (86.2)	30 (88.2)	
Phone	4 (6.3)	2 (6.9)	2 (5.9)	
None	4 (6.3)	2 (6.9)	2 (5.9)	
Gender				.600
Male	40 (63.5)	17 (58.6)	23 (67.6)	
Female	20 (36.5)	12 (41.4)	11 (32.4)	
ASA status				.934
1	0 (0.0)	0 (0.0)	0 (0.0)	
2	14 (22.2)	7 (24.1)	7 (20.6)	
3	47 (74.6)	21 (72.4)	26 (76.5)	
4	2 (3.2)	1 (3.4)	1 (2.9)	
BMI				.372
0	0 (0.0)	0 (0.0)	0 (0.0)	
1	6 (9.5)	3 (10.3)	3 (8.8)	
2	25 (39.7)	14 (48.3)	11 (32.4)	
3	32 (50.8)	12 (41.4)	20 (58.8)	
STOP Bang >3	47 (100.0)	24 (100.0)	23 (100.0)	—
Diagnosed OSA	16 (25.4)	5 (17.2)	11 (32.4)	.247
Number of spinal levels fused				.795
1-2	32 (50.8)	14 (48.3)	18 (52.9)	
3-5	26 (41.3)	12 (41.4)	14 (41.2)	
>5	5 (7.9)	3 (10.3)	2 (5.9)	

ASA, American Society of Anesthesiologists; BMI, body mass index; OSA, obstructive sleep apnea; PACU, postanesthesia care unit.

desaturations in the preimplementation group. The rate of ICU admission after PACU discharge was 10.3% and 89.7% were admitted to the stepdown unit after PACU discharge. In the postimplementation group the incidence of oxygen desaturations was 35%. The use of NPPV for oxygen desaturations in the postimplementation group included home NPPV machines (6%), automatic positive airway pressure (3%), CPAP (12%), and bi-level positive airway pressure (3%). The prevalence of PACU to ICU transfers was 3% and the PACU to stepdown unit transfers was 97% in the postimplementation group. There was no statistical significance between implementation groups for oxygen desaturations ($P = .795$), NPPV utilization ($P = .099$), or PACU discharge disposition ($P = .326$). Of the 41% of patients who experienced oxygen desaturations in the postimplementation group, 67% of those patients received an NPPV intervention. Thus, the protocol compliance rate was 67%.

Discussion

The overall goals of this project were to implement a PACU OSA protocol in patients undergoing spinal fusion surgery, assess the incidence of diagnosed and high-risk OSA, determine the effectiveness of the protocol, and evaluate compliance by PACU staff. The protocol included evidence-based interventions such as screening, postoperative monitoring, and various modes of NPPV, which in isolation increase OSA identification and improve symptom management. The collective

Table 3. PACU OSA Protocol Interventions at Preimplementation and Postimplementation for Patients With Diagnosed OSA or STOP-Bang Score Greater Than or Equal to 3 Admitted to PACU After Spinal Fusion Surgery

	Total (N = 63)	Preimplementation (n = 29)	Postimplementation (n = 34)			
	N (%)	n (%)	n (%)	Difference	95% CI	*P* Value
Oxygen desaturations	24 (38.1)	12 (41.4)	12 (35.3)	6.1	0, 30.2	.795
Noninvasive positive airway pressure						.099
Home machine	2 (3.2)	0 (0.0)	2 (5.9)	5.9	0, 13.8	
APAP	1 (1.6)	0 (0.0)	1 (2.9)	2.9	0, 8.5	
CPAP	4 (6.3)	0 (0.0)	4 (11.8)	11.8	1.0, 22.6	
BiPAP	1 (1.6)	0 (0.0)	1 (2.9)	2.9	0, 8.5	
None	55 (87.3)	29 (100.0)	26 (76.5)	23.5	9.2, 37.8	
PACU discharge disposition						.326
Stepdown and intermediate	59 (93.7)	26 (89.7)	33 (97.1)	7.4	0, 19.8	
ICU	4 (6.3)	3 (10.3)	1 (2.9)	7.4	0, 19.8	

APAP, automatic positive airway pressure; BiPAP, bi-level positive airway pressure; CI, confidence interval; CPAP, continuous positive airway pressure; ICU, intensive care unit; PACU, postanesthesia care unit.

implementation of these tools, in the form of a protocol, was aimed to improve OSA identification, increase NPPV utilization, reduce the incidence of OSA-related oxygen desaturations, and decrease ICU admissions.

The incidence of OSA in the project population was more than 70% compared with the 25% incidence in the general surgical population. The factors contributing to this may be because of the lack of recognized or diagnosed OSA before surgery, which may underestimate the OSA prevalence in the surgical population as a whole. Most patients, in the project population, completed a PAT visit before spinal fusion surgery. The purpose of the PAT visit is to evaluate patients' current health status and optimize comorbidities such as OSA before surgery. OSA optimization focuses on applying a standardized approach to disease identification, perioperative management, patient counseling, and discharge planning.[18] Patients with diagnosed OSA should be counseled on the importance of regular NPPV use and instructed to have personal equipment available on the day of surgery. Patients with OSA risk factors benefit from screening with a validated tool like the STOP-Bang questionnaire. In addition, patients at risk for OSA should be educated on screening results, diagnostic follow-up, and the likelihood of needing NPPV after surgery. For patients with an OSA diagnosis and suspected OSA, essential clinical management includes a knowledgeable surgical team, reduced opioid pain management techniques, adequate respiratory monitoring, and the use of noninvasive modes of ventilation during the perioperative period.[18]

The lack of NPPV utilization for OSA-related oxygen desaturations during the preimplementation phase highlighted an area of needed focus for the PACU staff educational intervention. The PACU nursing staff has as an important role in risk reduction and safety outcomes. Thus, adequate nursing staff education and training is essential in the efficacy of protocols.[6] Key areas for PACU nursing education intervention included identification of patients with OSA, through ICD diagnosis codes or screening results, and interpretation of screening tools like the STOP-Bang questionnaire. In addition, ideal training for the PACU providers includes instruction on how to identify OSA-related oxygen desaturations and when to recommended NPPV to the attending provider.[6] The benefit of staff education on the perioperative management of OSA is evidenced by changes to clinical management that can determine postoperative disposition.

The most common reasons for ICU admission in the OSA population include cardiovascular, respiratory, and cerebrovascular events.[19] Patients admitted to the ICU because of respiratory events experience a significantly higher incidence of postextubation NPPV and higher ICU readmission rates.[19] In addition, OSA is strongly associated with cardiovascular events in the ICU because of stressors like hypoxemia and increased sympathetic nervous system activation.[19] A reduction in ICU admissions offers cost savings to the health system and the patient. ICU admissions represent a large portion of health care spending.[20] The average daily cost of an ICU admission ranges from $3,000 to $7,000. The costs more than double with addition of mechanical ventilation.[21]

Limitations

Several limitations were noted in this project. The simultaneous implementation of multiple projects using similar patient populations may have impacted the intervention. The collection process limited the number of patients included in the observation. The data collection included manual chart reviews and postoperative observation. The postoperative observation required being present in the PACU, from admission to discharge, for each patient that met the inclusion criteria during the project time frame. This time commitment resulted in a limiting factor. The education sessions for the OSA protocol to the PACU staff could have been presented in multiple sessions to allow for repetition and exposure to more staff members.

Further Research

The findings of this quality improvement project suggest the need for protocol adjustment and further research. An OSA protocol that includes additional patient education, discharge planning, and follow-up may elicit information on the long-term outcomes of OSA protocols. Nearly 14% of spinal fusion surgical patients experienced respiratory distress on the stepdown floor. This anecdotal finding suggests that there may be value in extending the OSA protocol beyond the PACU period to obtain data on patients' clinical course throughout their hospitalization. In addition, the integration of the OSA protocol in pre-existing institutional electronic medical records may increase provider awareness, utilization, and compliance. Future OSA protocol implementations comparing clinical characteristics of patients, who were directly admitted to the PACU versus the ICU, may highlight additional perioperative risk factors. The implementation of an OSA protocol in other surgical populations may reveal benefits in other at-risk populations such as bariatric and orthopaedic surgery.

Conclusions

OSA is a form of sleep-disordered breathing that is highly prevalent in the surgical population. Patients with diagnosed or high-risk OSA have a higher incidence of postoperative complications especially after spinal fusion surgery. These complications often result in increased morbidity, mortality, and health care expenditure. The incidence of OSA-related postoperative complications may be reduced through the implementation of OSA protocols. OSA protocols include evidence-based interventions such as validated screening tools, continuous monitoring, and ventilatory support. Protocols for surgical patients with OSA require further examination but may function as a guide for postoperative nursing care.

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