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Original Article

Postoperative Complications in Patients With Obstructive Sleep Apnea Syndrome Undergoing Hip or Knee Replacement: A Case-Control Study

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- ***Objective*: To identify and assess the impact of postoperative complications in patients with unrecognized or known obstructive sleep apnea syndrome (OSAS) undergoing hip replacement or knee replacement compared with control patients undergoing similar operations. Although OSAS is a risk factor for perioperative morbidity, data quantifying the magnitude of the problem in patients undergoing non–upper airway operations are limited.**
- ***Patients and Methods*: This retrospective, case-control study from a single academic medical institution included patients diagnosed as having OSAS between January 1995 and December 1998 and undergoing hip or knee replacement within 3 years before or anytime after their OSAS diagnosis. Patients with OSAS were subcategorized as having the diagnosis either before or after the surgery and also, regardless of time of diagnosis, by whether they were using continuous positive airway pressure (CPAP) prior to hospitalization. Matched controls were patients without OSAS undergoing the same operation. Interventions were defined specifically as administration of a particular treatment in the context of each complication, eg, supplemental oxygen, implementation of additional monitoring such as oximetry for hypoxemia, or transfer to the intensive care unit (ICU) for cardiac ischemia concerns. Postoperative complications were assessed for all patients in the different categories and included respiratory events such as hypoxemia, acute hypercapnia, and episodes of delirium. Serious complications were noted separately, including unplanned ICU days, reintubations, and cardiac events. The length of hospital stay was also tabulated.**
- ***Results*: There were 101 patients with the diagnosis of OSAS in this study and 101 matched controls. Thirty-six patients had their joint replacement before OSAS was diagnosed, and 65 had surgery after OSAS was diagnosed. Of the latter 65 patients, only 33 were using CPAP at home preoperatively. Complications were noted in 39 patients (39%) in the OSAS group and 18 patients (18%) in the control group (P=.001). Serious complications occurred in 24 patients (24%) in the OSAS group compared with 9 patients (9%) in the control group (P=.004). Hospital stay was significantly longer for the OSAS patients at a mean ± SD of 6.8±2.8 days compared with 5.1±4.1 days for the control patients (P<.007).**
- ***Conclusion*: Adverse postoperative outcomes occurred at a higher rate in patients with a diagnosis of OSAS undergoing hip or knee replacement compared with a group of matched control patients.**

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BMI = body mass index; CPAP = continuous positive airway pressure; ICU = intensive care unit; OSAS = obstructive sleep apnea syndrome; PSG = polysomnography; RDI = respiratory disturbance index; REM = rapid eye movement; Spo_2 = oxygen saturation by pulse oximetry

The prevalence of obstructive sleep apnea syndrome (OSAS) is estimated at 5% to 9% and most often affects obese, middle-aged men.[1,2] The incidence of this disorder is thought to be even higher in the elderly. In 1 study, 62% of predominantly elderly patients were found to have a respiratory disturbance index (RDI) of 10 or higher (normal <5).[1]

Numerous studies have confirmed the complexity of the respiratory management of these patients during and after anesthesia with emphasis on special needs for these patients to prevent or minimize respiratory complications.[3-9] OSAS is considered a risk factor for perioperative morbidity and mortality.[3,6,10-12] However, data are minimal to quantify the magnitude of the problem in patients undergoing a non–upper airway type of operation.

The incidence of early and late postoperative nocturnal hypoxemic episodes in healthy patients undergoing elective abdominal surgery or consecutive patients undergoing abdominal vascular surgery has been reported in various studies.[7,10,13,14] Significant episodic oxyhemoglobin desaturations (oxygen saturation by pulse oximetry [Spo_2] <85%) occurred in up to 50% of these patients.[7] OSAS is often either not suspected preoperatively or not considered clinically important enough to warrant intervention. For this reason, therapeutic intervention may not be planned preoperatively or initiated after complications have occurred.[15]

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The objective of our study was to evaluate the incidence and nature of postoperative complications that occur in patients undergoing hip replacement or knee replacement who have previously diagnosed or unrecognized OSAS compared with a matched group of patients without OSAS also having hip or knee replacement. We were also interested in noting the pattern of use of continuous positive airway pressure (CPAP) and its impact on the postoperative outcome.

PATIENTS AND METHODS

Inclusion Criteria

Mayo Clinic Total Joint Registry and Sleep Center databases were used to identify the patients with a clinically suspected or objectively documented diagnosis of OSAS between January 1995 and December 1998 and undergoing hip or knee replacement at our institution. Patients with OSAS who had their orthopedic surgery within 3 years before or anytime after the diagnosis were included. We assumed that, if the operation was done within 3 years before the diagnosis, the patient had unrecognized OSAS at the time of the operation. The diagnosis was ultimately based on supporting physical signs and symptoms in addition to either an RDI of 5 or higher per hour on polysomnography (PSG) or a highly abnormal pattern of activity on overnight oximetry strongly suggestive of OSAS.

Patients without objective data to confirm the diagnosis of OSAS and patients who did not undergo joint replacement at our institution were excluded.

Diagnostic Criteria

Polysomnography confirmed the diagnosis of OSAS in 84 patients, and the remaining 17 patients had highly abnormal overnight oximetry consistent with OSAS (desaturation index for >4% reductions in Spo_2 was >15/h). Patients with abnormal oximetry also had clinical history and examination findings compatible with OSAS, including habitual snoring and observed apneic episodes. The reference PSG at our institution was done according to our routine clinical protocol, which is based on nationally accepted guidelines.[16]

Matched Population

This study was conducted in a case-control manner. The Total Joint Registry contains prospectively collected data on more than 67,000 joint replacements. This database was used to select a corresponding number of control patients matched for age, sex, operated side (right vs left), type of operation (knee replacement vs hip replacement and revision vs primary operation), mode of fixation of the components (cemented vs uncemented), year of operation, surgeon, and the type of anesthesia.

Data Collection

A detailed review of the medical record was used to extract data about demographics, comorbidities (as mentioned in problem list or sleep or preoperative evaluation), sleep disorders, preanesthesia evaluation, and postoperative course. We were particularly diligent to record the details regarding the amount and type of narcotic used and the types of postoperative complications, including the details of any therapeutic interventions, the reason for intensive care unit (ICU) transfers if applicable, and the details regarding the use of CPAP, particularly prior to hospitalization. The length of hospital stay and any reason for delayed discharge of the patient from the hospital were also recorded. In addition, each patient's weight and height at the time of OSAS diagnosis and at the time of joint replacement were noted.

Postoperative Complications

The medical records were studied to identify the details of recognized postoperative complications together with the particulars of any interventions to treat or minimize the impact of each complication. The following historically recognized events were identified as complications: occurrence of reintubation; acute hypercapnia ($Paco_2$ >45 mm Hg on a blood gas obtained for clinical concerns and need for CPAP/bilevel PAP); episodic desaturations (Spo_2 <90% and >4% reduction from last recorded value either in association with witnessed apneic episodes or not explained by other events such as pneumonia, atelectasis, thromboembolism); arrhythmia (events associated with clinical symptoms needing therapy or prompting additional monitoring); myocardial ischemia or infarction; and delirium (as noted by caregivers).

An "intervention" performed in response to the historically reported complication was defined as administration of a new treatment (such as supplemental oxygen) or implementation of additional monitoring (such as pulse oximetry). "Serious complications" were defined as those requiring transfer to an ICU, as for acute cardiac ischemia or arrhythmia, or those with an urgent need for respiratory support.

Data Analysis

The data analysis was divided into 3 parts. Initially, we investigated the distribution and the incidence of complications and correlated the outcome between the control patients and patients with the diagnosis of OSAS. Following this, the data were split, and comparisons were made between patients whose OSAS was diagnosed within 3 years before the joint replacement and those whose OSAS was

diagnosed at any time after their operation. The third set of comparisons were made between patients with recognized OSAS who were receiving home CPAP and those with OSAS, whether previously diagnosed or not, who were not using home CPAP at the time of joint replacement.

The paired *t* test and the McNemar test were used to analyze continuous and categorical data, respectively. Level of significance was set at $P<.05$. Data are displayed as mean ± SD unless otherwise specified.

RESULTS

A total of 122 patients met the time period criterion set forth for inclusion. Of these, 21 patients were excluded, 18 because they lacked objective data (oximetry or PSG) to confirm clinical suspicion of OSAS and 3 because their PSG was performed elsewhere and no details were available. For the sake of simplicity in data presentation, the remaining 101 study patients were grouped by diagnostic status.

Group 1A consisted of 36 patients with OSAS undiagnosed before their joint replacement. These patients had their operation at a mean of 1.8 years (range, 0.12-3 years) before the diagnosis of OSAS. Group 1B included 65 patients with confirmed diagnosis of OSAS at the time of their joint replacement. Among the 65 patients from group 1B were 33 patients who were using home CPAP at the time of their operation. The remaining 32 patients were not using home CPAP either because of noncompliance (11 patients) or because they were not prescribed home CPAP based on the mild severity of their OSAS, especially in the supine position (21 patients). Thus, 68 patients (36 from group 1A and 32 from group 1B) of the patients with OSAS were not using home CPAP before admission to the hospital. Group 2 (the control group) consisted of 101 patients without underlying OSAS who were selected from the Total Joint Registry. Baseline characteristics of all patients are shown in Table 1.

Surgical Data

All operations in both the OSAS group and the control group were elective. All except 3 patients were admitted to the hospital on the morning of the operation. Patients received either spinal anesthesia (42 patients) or general anesthesia (59 patients) in both the OSAS group and the control group. No significant difference in the occurrence of complications ($P=.19$) was noted by the type of anesthesia administered (spinal or general). The type of operation that patients in each group received is outlined in Table 1.

Postoperative Analgesia

According to our institution's standard protocol for administration of analgesia, all patients received similar doses of narcotic for pain control. We converted the narcotic dose given on the hospital ward into morphine milligram equivalents as described by Foley[17] and noted the use for the first 4 postoperative days. No significant difference in narcotic use was noted between patients with or without OSAS ($P=.67$). The narcotic use was not significantly different between patients with OSAS who developed complications and those who did not develop complications ($P=.80$).

Postoperative Oxygen

All patients in this study received supplemental oxygen delivered by nasal cannula or face mask in the postanesthesia recovery room. This supplemental oxygen was continued for a variable time after the operation. The majority of patients did not require oxygen after the second postoperative day. We found significantly more patients with OSAS required supplemental oxygen at a higher flow rate ($P<.003$) and for a longer duration ($P<.001$) than the control patients.

Complications

Table 2 shows the number of episodes of different types of complications encountered in OSAS patients and compares the incidence of the same complications with the control group. No significant difference in the incidence of comorbidities was evident between the control patients and those with the diagnosis of OSAS ($P=.38$). The incidence of procedure-specific complications, as outlined in Table 2, showed no significant difference. The overall incidence of other postoperative complications was significantly higher in the OSAS patients compared with the control patients ($P=.001$). Two patients in the OSAS group required reintubation for severe hypercapnia that was noted in the postanesthesia recovery room. No patient in the control group required reintubation. In addition, a significantly higher percentage of patients with OSAS suffered serious complications ($P=.004$) or needed unplanned ICU transfers ($P=.003$) compared with the control patients (Table 3). Furthermore, data subanalysis revealed that the incidence of serious complications ($P=.02$) and unplanned ICU transfers ($P=.003$) were also significantly higher in patients with OSAS who were not using home CPAP compared with patients with OSAS who were using CPAP at home (Table 3).

Six unplanned ICU transfers occurred in the control group, 3 for cardiac ischemia, 1 for cardiac arrhythmia, 1 for myocardial infarction, and 1 because of postoperative hemorrhage. Twenty unplanned transfers to the ICU occurred in the OSAS group, for reintubation in 2, hypercapnia without reintubation in 2, myocardial infarction in 1, cardiac ischemia in 5, severe hypoxemia in 6, and arrhythmia in 4.

Table 1. **Baseline Patient Characteristics***

	Group 1 (OSAS)			Group 2 (control)	
	1A (n=36)	1B (n=65)	Total (n=101)	(n=101)	*P* value
Sex, M/F	24/12	46/19	70/31	70/31	…
Mean ± SD age (range) (y)	69.7±7.1 (36-83)	66.7±7.9 (40-79)	68.1±7.3 (36-83)	69.4 (36-82)	.91
Mean ± SD BMI at time of operation (kg/m^2)	33.9±6.8	33.2±5.0	…	30.2±8.2	.06
Mean ± SD change in BMI (kg/m^2) (OSAS diagnosis + operation)	0.2±2.3	–0.4±4.8	0.1±3.6	0.21±8.2	.23
No. of patients using home CPAP at time of operation	0	33	33	0	…
Mean ± SD CPAP pressure (cm H_2O)	7.96±1.65	8.1±1.7	…	…	.86
Mean ± SD RDI	47.8±30.2	39.6±29.7	…	…	.24
Supine	69.0±37.6	71.7±41.6	…	…	.80
No. of patients by type of operation					
Primary TKA		51	…	51	…
Revision TKA		8	…	8	…
Primary THA		36	…	36	…
Revision THA		6	…	6	…
No. of patients by side of operation					
Right		41	…	41	…
Left		60	…	60	…
No. of patients by type of anesthesia					
General		59	…	59	…
Spinal		42	…	42	…
No. of patients with comorbidities					
COPD	7	7	14	11	.52
CAD	12	15	27	21	.32
HTN	21	38	59	48	.12
Arrhythmia	5	11	16	19	.58

*Group 1A included patients with undiagnosed obstructive sleep apnea syndrome (OSAS) at the time of operation; group 1B, patients with diagnosed OSAS at the time of operation; group 2, control patients without clinical or objective evidence of OSAS. BMI = body mass index; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; CPAP = continuous positive airway pressure; HTN = hypertension; RDI = respiratory disturbance index; THA = total hip arthroplasty; TKA = total knee arthroplasty.

The length of hospital stay was significantly higher at a mean ± SD of 6.8±2.8 days for patients with OSAS compared with 5.1±4.1 days for patients in the control group (*P*=.007). The length of hospital stay for patients with OSAS who were using home CPAP and the patients with OSAS who were not using home CPAP was also significantly different, 6.0±2.1 days vs 7.2±3.1 days, respectively (*P*=.03).

The majority of the cardiorespiratory or neuropsychiatric postoperative complications occurred within 72 hours after the joint replacement (Figure 1). The first evening appeared to be the most vulnerable time for these patients.

We evaluated the impact of severity of OSAS (for patients with PSG, n=84) as measured by the absolute value of RDI on the incidence of postoperative complications. We did not detect any association between the severity of OSAS and the incidence of postoperative complications. Furthermore, the mean value of total RDI was not significantly different between patients who developed complications (RDI = 50.0±28.3; supine RDI = 63.7±39.8) and those who did not (RDI = 39.0±30.0; supine RDI = 69.5±42.3). Interestingly, in group 1B, patients not using home CPAP had milder OSAS severity by the reference PSG compared with those using home CPAP (RDI = 24.0±15.5 vs RDI =

Table 2. **Postoperative Complications***

Complications	Group 1 (OSAS) (n=101) 1A (n=36)	Group 1 (OSAS) (n=101) 1B (n=65)	Group 2 (control) (n=101)	*P* value
General				
Reintubation	2 (5.5)	0 (0.0)	0 (0)	.16
Acute hypercapnia	2 (5.5)	5 (7.7)	2 (2)	.41
Episodic hypoxemia	9 (25.0)	12 (18.5)	8 (8)	.08
Myocardial infarction	1 (2.7)	0 (0.0)	1 (1)	.47
Myocardial ischemia	5 (13.8)	4 (6.2)	3 (3)	.56
Arrhythmia	3 (8.3)	3 (4.6)	5 (5)	.76
Delirium	5 (13.8)	5 (7.7)	3 (3)	.07
Unplanned ICU transfer	12 (33.3)	8 (12.3)	6 (6)	<.001
Planned ICU transfer	2 (5.5)	0 (0.0)	2 (2)	…
Total	41	36	30	<.001
Orthopedic				
Wound infection	2 (2)		1 (1)	.60
DVT/PE	6 (6)		4 (4)	.58
UTI	3 (3)		7 (7)	.20
Hematoma	5 (5)		4 (4)	.74
Revision	3 (3)		1 (1)	.31
Patellar fracture	2 (2)		1 (1)	.60
Stiffness (knee)	6 (6)		2 (2)	.08
Periprosthetic fracture	0 (0)		1 (1)	.33
Nerve palsy	3 (3)		2 (2)	.58
Subluxation	1 (1)		1 (1)	…
Deep infection	2 (2)		1 (1)	.69
Keloid	1 (1)		0 (0)	.38

*Groups are described in the footnote to Table 1. Values are number (percent) unless indicated otherwise. DVT/PE = deep vein thrombosis/pulmonary embolism; ICU = intensive care unit; OSAS = obstructive sleep apnea syndrome; UTI = urinary tract infection.

53.0±33.8; *P*<.001), yet the former patients had worse outcomes (Table 3). Notably, the supine RDI in home CPAP users and nonusers was fairly similar (76.6±44.0 vs 64.5±39.5).

CPAP Utilization

CPAP utilization during the postoperative period was low even in patients who were using it at home (Table 4). When CPAP was used, it was usually ordered for nocturnal use alone. Planned CPAP use in the postanesthetic recovery area occurred in only 3 patients. Many patients, however, developed complications on the first evening. The 14 patients listed as having received prophylactic CPAP did not develop any complication on the first evening. Of those who received routine CPAP from the first postoperative night, only 2 patients developed complications. One patient developed atrial fibrillation on the night of the operation, and the other patient developed hypoxemia while having difficulty tolerating the CPAP but improved after becoming compliant wearing the CPAP mask. It was not clear if the patient who developed atrial fibrillation was, at the time of developing arrhythmia, wearing the CPAP mask or not. Seventy patients with OSAS did not receive or require any CPAP postoperatively. No patient in the control group required CPAP postoperatively.

Body Weight Data

The mean ± SD body mass index (BMI) of patients with previously diagnosed OSAS (group 1B) at the time of joint replacement vs OSAS diagnosis was 33.2±5.8 kg/m^2 vs 32.8±7.2 kg/m^2. This was not significantly different from the mean BMI of patients with undiagnosed OSAS (group 1A), which was 34.1±7.0 kg/m^2 at the time of diagnosis and 33.9±6.8 kg/m^2 at the time of joint replacement (*P*=.82). At the time of operation, the BMI of patients in the control group at 30.2±8.2 kg/m^2 was slightly less than the BMI of patients with a diagnosis of OSAS at 33.3±7.7 kg/m^2, but this difference was not statistically different (*P*=.06).

DISCUSSION

Unexpected and unexplained postoperative deaths, within 7 days of an operation, most often occur at night.[18] Cardio-

Table 3. **Postoperative Outcomes***

	Group 1 (OSAS)					
		1B (n=65)				
	1A (n=36)	No home CPAP (n=32)	Home CPAP (n=33)	Total (n=101)	Group 2 (control) (n=101)	*P* value†
Any complication	18 (50)	12 (37.5)	9 (27.3)	39 (39)	18 (18)	.001
Serious complication‡	12 (33.3)	9 (28.1)	3 (9.1)	24 (24)	9 (9)	.004
Total ICU	14 (38.9)	8 (25.0)	1 (3.0)	23 (23)	8 (8)	.003
Unplanned ICU	12 (33.3)	7 (21.9)	1 (3.0)	20 (20)	6 (6)	.003
Hospital stay (d)	7.4±2.9	6.9±3.3	6.0±2.1	6.8±2.8	5.1±4.1	.007

	No home CPAP (n=68)	Home CPAP (n=33)	*P* value§
Any complication	30 (44.1)	9 (27.3)	.10
Serious complication‡	21 (30.9)	3 (9.1)	.02
Total ICU	22 (32.3)	1 (3)	.001
Unplanned ICU	19 (27.9)	1 (3)	.003
Hospital stay (d)	7.2±3.1	6.0±2.1	.03

*Groups are described in the footnote to Table 1. Values are number (percent) or mean ± SD unless indicated otherwise. CPAP = continuous positive airway pressure; ICU = intensive care unit; OSAS = obstructive sleep apnea syndrome.

†Comparison between groups 1 and 2 (cumulative).

‡Serious complications were cardiac events and complications needing ICU transfer or urgent respiratory support such as intubation or application of CPAP.

§Comparison between groups with and without CPAP.

pulmonary events related to sleep have been proposed as the most likely cause of postoperative mortality at night.[19] Gill et al[20] showed that prolonged episodes of myocardial ischemia, as recorded by electrocardiogram, occurred during hypoxemia.

Many factors influence the development of respiratory instability and episodic desaturation in the postoperative period, including sleep, cardiac output, respiratory depressant effects of anesthesia and opioid analgesia, and hypoxemia itself. The effect of opioids on respiratory drive may not be the same as their effects on respiratory pattern.[21] Irregularities of respiratory pattern are associated with opioid analgesia after major operation and may contribute to patient hypoxia, apneas, and cardiovascular deterioration.[10,22,23] Postoperative respiratory obstructions are associated with large fluctuations in systolic and diastolic blood pressures in patients with OSAS.[24,25]

Nasal CPAP was used to treat respiratory complications that developed in some of the patients with OSAS in our study (Table 4). However, the low rate of CPAP used at home or postoperatively in the present study shows that OSAS as a risk factor for postoperative complications may be underemphasized. Less than half of the patients who were using home CPAP received routine CPAP therapy during the first postoperative night, which reflects the lack of a routine policy for CPAP use in the hospital. Our observations raise the possibility that use of home CPAP somehow offered a carryover protection for the first postoperative day, as patients who were using home CPAP had a significantly lower rate of complications, even though most of them did not receive CPAP in the hospital. Possible mechanisms for such carryover protection include a temporary decrease in upper airway inflammation or edema and increased upper airway stability. If special attention to these patients accounted for this finding, then we would have expected more planned ICU admissions, which was not the case. Patients with OSAS also exhibit genioglossus dysfunction that is normalized after treatment with CPAP.[26]

Based on our data, we can only infer an association with OSAS rather than causality for respiratory and nonrespiratory complications. Although we evaluated and recorded the incidence of procedure-specific complications (Table 2), we did not detect any significant difference

between OSAS and control patients. We included ischemic or arrhythmic cardiac events and delirium in the present study because hemodynamic changes and gas exchange abnormalities, associated with OSAS, can contribute to the pathogenesis of these events.[25,27] Several studies have reported a relationship between postoperative episodic hypoxemia and myocardial ischemia.[12,20,28,29] Pathogenesis of postoperative delirium remains unproven, but in some patients, this phenomenon may be secondary to OSAS-induced hypoxemia, as extensive physical investigations have failed to identify other possible primary etiology.[27,28,30-32] Other neuropsychiatric complications, including cognitive impairment, personality change, violent outbursts, anxiety, depressive episodes, nocturnal panic attacks, and psychosis with an organic flavor, are also associated with OSAS.[27,30,32,33] Continuous nocturnal hypoxemia, rapid eye movement (REM) sleep deprivation, and severe sleep fragmentation due to OSAS also may significantly impair cerebral function and increase these patients' vulnerability to develop delirium in reaction to hypoxemia.[33]

The frequency and severity of upper airway obstructions in patients with OSAS undergoing joint replacement are likely to be high for several reasons. First, because of the nature of the operation, these patients are expected to remain supine postoperatively. The RDI has been shown to be at least twice as high in the supine position as in the lateral position.[34,35] Second, uniform use of moderate amounts of intravenous narcotics in the postoperative period is likely to precipitate or aggravate the respiratory complications in patients with OSAS.[3]

This study found that most complications occur in the first 24 hours. This may be due to the combined effect of anesthetic agents, sedatives, and narcotics, which tend to relax upper airway dilator muscles and increase upper airway resistance, thus aggravating OSAS.[3] One study monitoring patients for apnea after cholecystectomy or total hip replacement showed that most observed apneas were obstructive in nature and were more common in the elderly.[10] The persistence of complications up to 72 hours postoperatively and a dropoff thereafter may occur for several reasons. In the majority of the patients, intravenous narcotics were switched to the oral route or the dose reduced on postoperative day 2 or 3. Furthermore, studies have shown that marked rebound in REM sleep, which is known to occur on the second or third postoperative night, is likely to cause disordered breathing.[13,19,36] These factors in combination may explain why almost all cardiorespiratory complications occur within the first 72 hours after surgery.

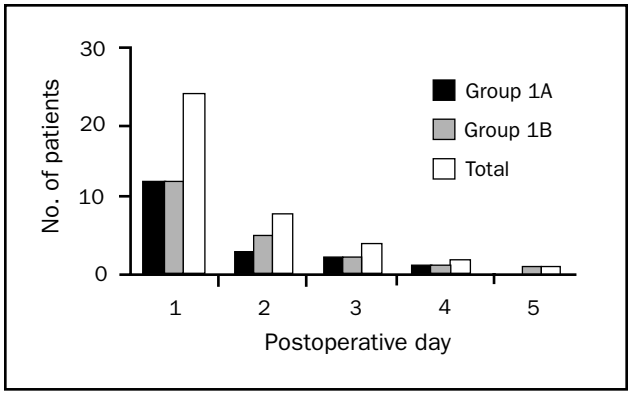

Figure 1. Time course of postoperative complications in group 1. Group 1A included patients with undiagnosed obstructive sleep apnea syndrome (OSAS), and group 1B included patients with OSAS that had been diagnosed at the time of operation.

A possible limitation in our study is that the recorded postoperative complications in a retrospective study may underestimate the extent of untoward events, as only events that provoke great concern in caregivers may appear in the hospital records. Some patients may have a milder degree of OSAS and therefore a lower likelihood for developing postoperative complications. We analyzed our data in several different ways and found no relationship between severity of OSAS, as measured by total RDI, and occurrence of complications. Interestingly, we found that supine RDI was high in the majority of patients

Table 4. **Postoperative CPAP Use***

		Group 1B (n=65)		
	Group 1A (n=36)	No home CPAP preadmission (n=32)	Home CPAP preadmission (n=33)	Total (n=101)
Prophylactic CPAP	0	2	12	14
CPAP after complication	7	3	7	17
No CPAP	29	27	14	70

*Groups are described in the footnote to Table 1. CPAP = continuous positive airway pressure.

in our study, even in those patients with a low total RDI. Only 10 patients had supine RDI less than 20 in this study. It can be argued that supine RDI should be used as a measure of OSAS severity.

Another possible weakness of the study may be the fact that control patients were not matched for BMI. Because we were concerned about the increased incidence of OSAS in patients with higher body weight, we deliberately did not match the control patients for BMI for fear of including occult OSAS in this group. As the incidence of other comorbidities increase in the obese patient, this may have introduced a bias in the study. We did, however, thoroughly search the clinical records for the presence of coexistent comorbidities and do not feel that the incidence of serious comorbidities was significantly higher in the OSAS patients compared with the control patients. The small 3-kg weight difference observed between the control and OSAS groups was not significant and was unlikely to have had an impact on the reported outcomes. The change in weight between operation and diagnosis of OSAS for our patients was also documented to be insignificant. In general, only weight loss greater than 10% of body weight is thought to have any significant impact on RDI.[37]

CONCLUSIONS

In this study, we have shown that the presence of OSAS in patients undergoing elective hip replacement or knee replacement is associated with a considerable number of complications in the postoperative period. Almost one third of the patients with OSAS in our study suffered a substantial respiratory or cardiac complication. Patients who were not using CPAP prior to hospitalization had a significantly higher incidence of serious complications. Patients diagnosed with OSAS have been shown to be heavy consumers of health care resources for several years prior to diagnosis and the utilization decreases after starting treatment in patients who adhere to the treatment.[38,39] Prospective studies are needed to see if prior awareness of OSAS and earlier intervention for these patients is associated with better outcome.

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