

Risk stratification for obstructive sleep apnoea and optimal post-operative monitoring in an overnight stay ward

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KEY WORDS

Obstructive sleep apnoea, elective surgical procedures, post-operative period, hypoxemia, CPAP, screening tool

ABSTRACT

Objectives

Prospective data is required to clarify the role of a one night stay ward (23-hour ward, 23HW) for the post-operative monitoring of surgical patients with obstructive sleep apnoea (OSA). The aim was to use a modified American Society of Anesthesiologists (ASA) screening tool to stratify the perioperative risk of OSA related complications and evaluate the role of a 23HW in the post-operative management of this patient group.

Design

Prospective cohort study.

Setting

Tertiary referral centre.

Subjects

Patients identified in pre-anaesthetic clinic as having a mild to moderate risk of complications from OSA were scheduled for post-operative monitoring in a 23HW.

Outcome measures

Primary end points were incidence of desaturation events (Continuous pulse oximetry measuring SpO₂ 90-94% mild, <90% severe) in the recovery unit and in the 23HW. Secondary endpoints included type of anaesthetic, utilisation of continuous positive airway pressure (CPAP) and oxygen therapy, and major adverse events.

Results

One hundred seventy three patients (median age 56) were identified. Of these, 61 had previous formal diagnosis of OSA by sleep study while the remaining 112 patients were provisionally diagnosed in pre-anaesthetic clinic by clinical parameters. Ninety-four patients received a general anaesthetic, 79 patients received regional anaesthesia with sedation. The incidence of desaturation events was 4.0% in the Recovery Unit and 22.0% in the 23HW.

Conclusion

The ASA screening tool can identify perioperative patients at risk of developing respiratory complications from OSA, enabling their safe monitoring in a 23HW, thus avoiding the need for limited High Dependency Unit resources.

INTRODUCTION

Obstructive sleep apnoea (OSA) is characterised by intermittent and recurrent episodes of partial or complete obstruction of the upper airway during sleep. The long-term health-related consequences of OSA have been previously documented, including increased rate of motor vehicle accidents, hypertension, diabetes mellitus, congestive heart failure, stroke, and all-cause mortality (Sharma et al 2010; Tregear et al 2009; Marshall et al 2008; Tasali et al 2008; Yaggi et al 2005; Peppard et al 2000).

The prevalence of OSA in the general population is between 2% and 25%, depending on how OSA is defined. Young et al (1993) demonstrated that the prevalence of OSA, defined as hypo-apnoea index (AHI) ≥ 5 /hour was 9% for women and 24% for men, however the prevalence in the elective surgery population may be higher. Its prevalence has been increasing in developed countries, linked to a rise in obesity (Australian Bureau of Statistics; WHO website).

Surgical patients with OSA are at increased risk of having perioperative complications, including difficult intubation, hypoxaemia, cardiac arrhythmias, prolonged hospital stay and unanticipated admission to an Intensive Care Unit (ICU) (Liao et al 2009; Monahan et al 2009; Siyam and Benhamou 2002; Gupta et al 2001; Hiremath et al 1998). The days following general anaesthesia are characterised by disturbances in the rapid eye movement (REM) phases of sleep (Dette et al 2013, Rosenberg et al 1994; Knill et al 1990), resulting in longer apnoeic episodes and more frequent oxyhaemoglobin desaturation (Findley et al 1985). Therefore, surgical patients require careful post-operative monitoring. Previously at the Queen Elizabeth Hospital patients with OSA were monitored post-operatively in the High Dependency Unit (HDU). However, this heavy burden on limited HDU beds was unlikely to be sustainable. Therefore a method to risk-stratify patients pre-operatively was introduced, thus monitoring lower-risk patients in a less resource-intensive surgical ward such as a 23-hour ward (23HW). The surgical 23HW provides short-term 23 hour or overnight nursing care requirements for lower risk surgical patients prior to their discharge. The idea of a 23HW (one night stay ward) is not new (Ryan et al 2005; Abenhaim et al 2000), but its role for patients with OSA had not previously been explored.

The risk of OSA-related post-operative respiratory complications was stratified by the pre-operative use of an OSA screening tool published by the American Society of Anesthesiologists (ASA) (Gross et al 2006). A modified version (table 1) was used to screen all patients going through the pre-anaesthetic clinic. With a significant proportion of OSA in the population remaining undiagnosed (Singh 2013; Chung, Yuan and Chung 2008), the OSA screening tool served a secondary purpose of identifying previously undiagnosed patients.

The objectives of this study were to define a model of perioperative care for OSA, incorporating pre-operative risk-stratification, assess the suitability of a 23HW, with clinical management guidelines and continuous oximetry, and record any OSA-related perioperative problems.

METHODS

Patient selection and pre-operative pathway

In 2008 the Queen Elizabeth Hospital undertook formal internal evaluation of perioperative procedures for patients with OSA, integrating many of the recommendations published in the contemporary ASA practice guidelines for perioperative management of OSA (Gross et al 2006). Following a period of medical and nursing staff education, a modified version of the pre-operative OSA screening tool was implemented for patients attending the pre-anaesthetic clinic. Ethics approval for publication of this research was granted by the Human Research Ethics Committee (TQEH/LMH/MH).

Clinical indicators of OSA (table 1) were used to identify the likelihood and severity of OSA based on a risk

score (table 2). Patients with mild to moderate risk (score up to 4) were recommended for post-operative monitoring in the 23HW, while those with high risk scores (4 or greater) were recommended for monitoring in HDU (or ICU if indicated for other anaesthetic and surgical reasons). A proforma (table 2) was added to the generic pre-anaesthetic assessment form to help clinicians assess the risk of OSA-related perioperative complications and therefore book the appropriate post-operative bed.

Only patients identified as suitable to be managed post-operatively in the 23HW for monitoring of their OSA were followed-up. Those undergoing surgery suitable for same-day discharge and those who required HDU/ICU post-operatively were excluded from the study.

Table 1: Modified ASA Clinical Assessment of OSA

OSA Symptoms & Signs	
History:	Frequent Snoring Loud snoring Observed pauses in breathing during sleep Awakens from sleep with choking sensation Frequent arousal from sleep Headache
Somnolence:	Frequent Somnolence or fatigue despite adequate sleep Falls asleep easily in non stimulating environment (eg. watching TV, reading, driving a car)
Examination:	BMI of 35kg/m ² Neck circumference 17 inches in men and 16 inches in women Craniofacial abnormalities affecting the airway Anatomical nasal obstruction Large tonsils nearly touching in midline
Clinical Signs and symptoms of two or more of above categories - diagnosed as OSA In absence of sleep study consider as Moderate OSA If more than one sign is markedly abnormal they may be considered as Severe OSA. Source: ASA Practice guidelines	

Table 2: OSA RISK SCORING SYSTEM

A. Severity based on Sleep study:	
None	0
Mild	1
Moderate	2
Severe	3
(If symptomatic but no sleep study, treat as moderate sleep apnoea)	
B. Invasiveness of surgery and anaesthesia	
Superficial surgery under local or Peripheral nerve block without sedation	0
Superficial surgery with moderate sedation or GA	1
Peripheral surgery with Spinal or Epidural with less than moderate sedation	1
Peripheral surgery with GA	2
Airway surgery with moderate sedation	2

Major surgery with GA	3
Airway surgery with GA	3
C. Requirement of post-operative opioids	
None	0
Low dose oral opioids	1
High dose opioids: oral, parenteral or neuraxial	3
Risk score = sum of A + B + C	

Recommended post-operative bed booking pathway:

Risk score < 4 : book OSA bed in 23 hour ward, Risk score \geq 4 : book HDU

If HDU or OSA bed on 23 hour ward not available, book general ward bed with 1:1 nurse special.

Source: ASA Practice guidelines

23 HOUR WARD (23HW)

The 23HW is a protocol-driven model of post-operative care that is suitable for short-term, 'intermediate level' monitoring between that provided by an HDU and a regular ward. The 23HW has a 1:4 nurse-to-patient ratio. It also has a small geographical footprint, which allows staff to hear the pulse oximeter alarms more easily. All nurses employed in the 23HW underwent additional training in a variety of skill-sets, including the use of continuous pulse oximetry monitoring, use of a variety of home CPAP devices, and early recognition of adverse cardiorespiratory events. Protocols ensured consistent standards of care.

POST-OPERATIVE PATHWAY

Patients received standard monitoring of vital signs in the Recovery Unit, with routine initial oxygen therapy via a mask at 6L/min or flow rate required to maintain oxygen saturation level. On recovering from the effects of anaesthesia, and pain relief medication, patients were commenced routinely on their own home CPAP if the patient was already on home CPAP prior to surgery. Those not on home CPAP were placed on routine supplemental oxygen via nasal cannula or oxygen mask at a level sufficient to maintain their oxygen saturation above 94%. Once general and surgery-specific discharge criteria were met, patients were transferred to the 23HW where they continued the same oxygen supplementation that they received in recovery. Desaturation events were defined as pulse oximetry reading 90-94% (mild) or below 90% (severe). Patients were discharged home directly from the 23HW on the day after surgery, unless any cardiorespiratory events occurred and required referral to HDU or the general ward for further monitoring.

STATISTICAL METHODS

Continuous variables were analysed using the 2-tailed student t-test. Categorical variables were analysed using Fisher's exact test. Statistical significance was set at $p=0.05$. As this was a pilot study with no prior data to use for the calculation of required sample size, no such calculation was performed.

RESULTS

Between July 2008 and July 2009, 4,692 patients were screened in the pre-anaesthetic clinic using the modified ASA screening tool. One hundred seventy three patients, who were planned for multi-day stay, were identified as having a mild to moderate risk of developing OSA-related cardiorespiratory complications in the post-operative period. Surgical procedures were a typical case mix for a metropolitan tertiary referral centre

including the disciplines of general surgery, urology, ear-nose-throat, plastics, orthopaedics, gynaecology and vascular surgery. There were no cardiac or neurosurgical procedures.

Table 3: Demographic data

Age (mean, range)	53, 20-86
Gender	98 males, 75 females
General anaesthetic	94
Regional with sedation	79

Table 4: Respiratory complications in the 23-hour ward

CPAP: Pre-operative sleep study, on CPAP (continuous positive airway pressure).

Non-CPAP: no pre-operative sleep study and no CPAP

	CPAP n = 61	Non-CPAP n = 112	P value
Mean duration of continuous monitoring. Hours	9	9	1.00
Desaturation events in recovery. Number (%)	1 (1.6%)	6 (5.4%)	0.42
Desaturation events in 23HW. Number (%)	17 (28%)	21 (19%)	0.18
Major adverse events. Number	0	1	1.00

Desaturation events were detected in about one third of patients, with most events occurring in the 23HW. Due to a limited number of OSA beds in the 23HW, a high demand for HDU beds and a reluctance to cancel theatre lists, 12 patients were admitted to general ward beds with 1:1 nurse special, with routine post-procedure observations and continuous pulse oximetry monitoring. One of these 12 patients experienced frequent apnoeic episodes during the first post-operative night, with moderate desaturation, hypotension and reduced consciousness, resuscitated successfully with no obvious short or long-term sequelae. The patient had not been previously diagnosed with OSA, had elective hip arthroplasty surgery under subarachnoid block with propofol sedation and post-operative oxycodone patient-controlled intravenous analgesia.

DISCUSSION

OSA is associated with increased risk of a variety of perioperative complications, particularly within the first 24 hours after surgery. It is therefore necessary to provide a post-operative care environment that allows for careful patient assessment and early identification of complications. The rising prevalence of OSA amongst surgical patients may lead to an increasing burden to the health care system, warranting an alternative strategy that is both safe and economically more efficient. This study describes a perioperative pathway for patients with mild to moderate risk of perioperative complications related to OSA, involving formal pre-operative screening and the use of a 23HW that may improve the quality of care and reduce overall costs to the health care system.

In patients who were at mild-to-moderate risk of developing post-operative complications from OSA, the present study found that desaturation events were common, the majority occurring in the 23HW. Further, the incidence of desaturation events in the subset of patients previously not diagnosed with OSA (non-CPAP group, table 4) was comparable to those previously diagnosed with OSA (CPAP group). The researchers acknowledge this study was not necessarily statistically powered to find a difference, which may explain this result contradicting that of other studies that found CPAP to reduce post-operative respiratory complications and duration of hospital stay in patients with and without OSA (Liao et al 2009; Ferreyra et al 2008; Gupta et al 2001).

Importantly, despite the frequency of desaturation events, no major adverse respiratory or cardiac events occurred in the 23HW. Early detection of desaturation and corrective intervention may prevent major adverse respiratory or cardiac events. One major cardiorespiratory event did occur, in a patient who due to a lack of 23HW or HDU beds, was monitored in a general surgical ward (1:1 nursing), where the level of staff training was not guaranteed. This highlights the limitations of patient care within a framework of finite resources.

Observational studies and case reports indicate that post-operative monitoring with continuous pulse oximetry is effective in detecting hypoxaemic events (Olson et al 1999; Reeder et al 1992) and is associated with a lower incidence of rescue events and transfers to the ICU for a general surgery patient population (Taenzer et al 2010). When using continuous pulse oximetry, one major challenge in an institution with large sprawling wards is to ensure a timely response to audible alarms. Facilities without a 23HW may find providing appropriate post-operative monitoring of OSA patients can only be achieved in resource-intensive areas such as HDU, Coronary Care Unit or Intensive Care Unit. Universal implementation of continuous monitoring for all patients with OSA or suspected of OSA may place an unfeasible burden on health care resources. A stratified risk-screening model helps to rationalise the use of resources, thus hopefully allocating patients to a perioperative pathway best suited to their likelihood of complications. At the Queen Elizabeth Hospital a 23HW provides an alternative pathway at lower cost (about half) per patient compared to HDU. There is the added benefit that an OSA screening tool can identify risk factors in patients not previously diagnosed with OSA, thus presenting an opportunity for patient counselling and referral for further investigation.

At the time this study was implemented the only available OSA screening questionnaire was that published in the ASA guidelines (Gross et al 2006). A number of other screening questionnaires have since become popularised, amongst them are the Berlin questionnaire (BQ), and the “Snoring, Tiredness, Observed apnea, and high blood Pressure” (STOP) questionnaire. Chung et al (2008) applied the BQ, ASA checklist and STOP questionnaire to 2,467 patients, with 177 of these patients undergoing subsequent polysomnography. Sensitivity of these three screening questionnaires was 68.9–87.2, 72.1–87.2, and 65.6–79.5% respectively, at various apnea–hypopnea index cut-offs. There was no significant difference between the questionnaires in the predictive parameters.

The risk scoring system is not a substitute for a definitive diagnosis of OSA. It is possible that many patients who exhibited features of OSA on the modified ASA screening tool never went on to be diagnosed formally by polysomnography. Patients who experienced post-operative desaturation events were referred to a sleep physician but it was beyond the authors resources to follow up these patients. This important limitation is not dissimilar to the real-world anaesthetic encounters with patients undergoing elective surgery, in whom perioperative pathways must often be decided with no definitive diagnosis available to the anaesthetist and assessing risk scores and pathways may be similar for both the diagnosed and the suspected OSA patient.

Sleep architecture is disturbed for the first week following an anaesthetic, when there is initial suppression followed by an increased proportion of sleep associated with rapid eye movement, a phenomenon referred to as “rebound REM” sleep (Dette et al 2013, Rosenberg et al 1994; Knill et al 1990). Compared to non-REM sleep, REM sleep is associated with longer apnoeic episodes and more frequent oxyhaemoglobin desaturation (Findley et al 1985). Therefore, there is potential for respiratory function to deteriorate after discharge from a surgical facility. However, current trends towards ambulatory surgery pathways place a limit on the duration of post-operative inpatient stay, therefore optimisation must occur within these limitations of current standards of care.

This small study was conducted for audit purposes to assess the feasibility of a pre-operative OSA screening tool and 23HW for OSA patients. It was not designed as a comparative study and there is no certainty that sample sizes were adequate to detect differences in the comparisons made.

Due to the heterogeneous group of patients and operations, the anaesthetic techniques were not standardised. The impact of this variability on perioperative respiratory function is unknown. There are many causes for desaturation events in the post-operative period and no data was collected to help define the aetiology of these events. It cannot be confidently stated that the desaturation events were all related to OSA.

Sedation increases upper airway collapsibility and increases the risk of post-operative cardiorespiratory complications (Bailey et al 1990). There is a lack of literature supporting the superiority of any anaesthetic technique over another with regard to avoidance of this phenomenon (Dette et al 2013; Knill et al 1990). Therefore, it is advised that even in regional anaesthesia with sedation the same degree of precautionary monitoring is necessary to avoid adverse respiratory events.

CONCLUSIONS

Obstructive Sleep Apnoea represents increased risk to patients undergoing anaesthesia and has important economic and patient safety implications for perioperative health care. We suggest that combining a sensitive risk-stratifying screening questionnaire with an overnight ward (23HW) for continuous monitoring of patients with known or suspected OSA may be an economical and safe strategy for managing patients with mild to moderate risk of OSA-related complications. Larger comparison trials are necessary to definitively establish safety and cost-benefit analysis.

PROTOCOL REVISION

On completion of the present study and review of our unpublished data of a cohort of OSA patients monitored in HDU, our perioperative OSA protocol has been revised such that OSA risk score of up to and including 6 can safely be monitored in the 23HW, further reducing the demand on HDU beds.

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