Original Article

Perioperative care of obstructive sleep apnea patients: A survey of European anesthesiologists

ABSTRACT

Background: Obstructive sleep apnea (OSA) is prevalent in the surgical patient population and is associated with high risk of perioperative complications. There are limited guidelines and wide practice variations regarding the perioperative care of obese and OSA patients. This is a study of European anesthesiologists' clinical practice of perioperative care of OSA patients.

Methods: This survey evaluated United Kingdom anesthesiologists' clinical practice of the perioperative care of OSA patients. Outcomes and variables were compared between 4100 anesthesiologists of different clinical experience and hospital settings.

Results: Approximately 45% of respondents manage OSA patients rarely, 42% occasionally, and 13% regularly. Most respondents order OSA screening tests if patients have tonsillar hypertrophy, head/neck tumor, BMI >35, increased neck circumference, craniofacial anomaly, and right-sided electrocardiography (ECG) anomaly. Majority request preoperative polysomnography, ECG, overnight pulse oximetry, and arterial blood gas analysis. Majority recommend preoperative weight loss, optimisation, smoking cessation, reduction of substance use, and regular mask-CPAP use. Majority consider endoscopy, and ophthalmology as appropriate day case procedures, but not laparoscopy. Majority postpone elective airway, laparoscopic, laparotomy, and head/neck surgery; if patients are not optimized preoperatively. For major surgery, combined general + neuraxial anesthesia was ranked as 3rd option. For major limb surgery, neuraxial anesthesia without sedation was ranked as 1st option, nerve block without sedation was ranked 2nd, and general anesthesia + nerve block was ranked 3rd or 4th. At anesthesia emergence, majority ensure that patients have normal consciousness, respiration and neuromuscular function. Majority ensure postoperative oximetry, telemetry, and oxygen supplementation.

Conclusion: This study highlights variations in anesthesiologists' perioperative care of OSA patients; even in developed countries with advanced medical training and standards. The study outcomes will improve perioperative care of OSA patients.

Key words: Bariatric anesthesia; obesity anesthesia; obstructive sleep apnea; OSA; perioperative OSA complications; postoperative OSA respiration; preoperative OSA optimisation; preoperative OSA screening

Introduction

The prevalence of obstructive sleep apnea (OSA) is increasing in the general population, especially in obese patients.[1-4] OSA is prevalent in the surgical patient population.[1,2,5] OSA may be present, but undiagnosed in surgical patients.[1,5]

Access this article online	
Website: www.saudija.org	Quick Response Code
DOI: 10.4103/sja.sja_1010_20	

How to cite this article: Bamgbade OA, Oluwole O, Khalaf WM, Namata C, Metekia LM. Perioperative care of obstructive sleep apnea patients: A survey of European anesthesiologists. Saudi J Anaesth 2021;15:101-8.

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Submitted: 05-Oct-2020, **Accepted:** 28-Oct-2020, **Published:** 01-Apr-2021

OSA is associated with high risk of perioperative airway, cardiac and respiratory complications.[5,6] Surgical patients with OSA may present significant perioperative challenges to anesthesiologists, and require special perioperative care.[7,8] There are few limited guidelines for perioperative care of obese or OSA patients.[9] There are variations among anesthesiologists regarding the perioperative care of obese and OSA patients. Also, there is inadequate information regarding contemporary perioperative practice.

This is a survey of United Kingdom (UK) anesthesiologists' clinical practice, focusing on patterns of anesthesia and perioperative care of obese and OSA patients. The aim of the study is to evaluate the practice and preferences of anesthesiologists, regarding the perioperative care of obese and OSA patients. It compares the practice between anesthesiologists who manage OSA patients rarely (≤5 cases/year), occasionally (6-12 cases/year), or regularly (≥13 cases/year). The study compares the perioperative practice between anesthesiologists in university teaching hospitals (UTH) and district general hospitals (DGH).

Methods

A regional pilot survey of anesthesiologists in Northern England was conducted in 2008, which enabled the modification and validation of the survey questionnaire.[10] The validated electronic survey was conducted from January 2013 to January 2016.

A census in 2010, by the Royal College of Anaesthetists UK, reported a total of 6849 consultant anesthesiologists in the UK.[11] Our study population was consultant anesthesiologists (n = 4100) who manage obese adult surgical patients in hospitals which have critical care units.

The survey was approved by the institutional review board (IRB) of Pennine Acute Hospitals, Manchester, UK; who confirmed that formal consent was not required from survey participants. The questionnaire was emailed to consultant anesthesiologists, in appropriate anesthesia departments throughout the UK; comprising 96 UTH and 204 DGH in England, 7 UTH and 32 DGH in Scotland, 6 UTH and 15 DGH in Wales, plus 6 UTH and 6 DGH in Northern Ireland.

Completed questionnaires were received from 2089 consultant anesthesiologists (51% response rate). From the survey, we identified 3 groups of anesthesiologists based on the number of OSA patients managed per year and categorized them as: rarely (managed ≤5 cases/year), occasionally (managed 6–12 cases/year), or regularly (managed ≥13 cases/year). We compared the clinical practice between anesthesiologists in university teaching hospitals (UTH) and district general hospitals (DGH).

Data were analysed with IBM® SPSS® Statistics 23 (IBM, Armonk, NY); using Student's t-test (for continuous variables) and Pearson Chi-square test (for categorical variables). *P* value <0.05 was considered significant.

Results

Anesthesiologists characteristics [Table 1].

The study population of 2089 comprised UTH anesthesiologists (57%), and DGH anesthesiologists (43%). Approximately 45% of the anesthesiologists managed OSA patients rarely, 42% occasionally, and 13% regularly.

Patient features that indicate preoperative OSA screening or sleep studies [Table 2].

More than half of anesthesiologists (52%), mostly who manage OSA occasionally or regularly, order preoperative OSA screening tests if patients have tonsillar hypertrophy. Majority, mostly who manage OSA occasionally or rarely, order OSA screening tests if patients have head and neck tumor. Regardless of their clinical experience of OSA management, majority (>80%) usually order OSA screening tests if patients have BMI > 35 or increased neck circumference. Majority (60%), mostly who manage OSA occasionally or regularly, order OSA screening tests if patients have craniofacial anomaly. More than half (58%) do not order OSA screening tests if patients mostly have polycythemia, but this was not statistically significant. More than half (54%), mostly who manage OSA occasionally or rarely, order OSA screening tests if patients have right-sided electrocardiography anomaly.

Preoperative symptoms usually inquired from obese surgical patients with suspected OSA [Table 3].

Regardless of their clinical experience of OSA management, majority (>80%) inquire about snoring and witnessed sleep apnoea episodes. Majority (54%) inquire about arousal from sleep with choking sensation. Majority (57%), mostly who manage OSA occasionally or rarely, do not inquire about morning headaches. Majority (77%) inquire about daytime sleepiness.

Preoperative investigations for obese elective surgery patients with suspected OSA [Table 4].

Regardless of their clinical experience of OSA management, majority (60%) request preoperative polysomnography (PSG)

Table 1: Anesthesiologists characteristics

Hospital type	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total *n* (%)
University hospital	606 (29)	439 (21)	146 (7)	1191 (57)
General hospital	334 (16)	438 (21)	126 (6)	898 (43)
Total	940 (45)	877 (42)	272 (13)	2089 (100)

Table 2: Patient features that indicate preoperative OSA screening or sleep studies

Anesthesiologist orders preoperative OSA screening tests if patient has	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
BMI >35	No	188 (9)	149 (7)	22 (1)	359 (17)	
	Yes	752 (36)	728 (35)	250 (12)	1730 (83)	0.005
Increased neck circumference	No	209 (10)	125 (6)	63 (3)	397 (19)	
	Yes	731 (35)	752 (36)	209 (10)	1692 (81)	0.001
Craniofacial abnormality	No	397 (19)	271 (13)	63 (3)	731 (35)	
	Yes	543 (26)	606 (29)	209 (10)	1358 (65)	0.001
Polycythemia	No	564 (27)	501 (24)	147 (7)	1212 (58)	
	Yes	376 (18)	376 (18)	125 (6)	877 (42)	0.334
Right-sided ECG anomaly or strain	No	418 (20)	397 (19)	147 (7)	962 (46)	
	Yes	522 (25)	480 (23)	125 (6)	1127 (54)	0.017
Tonsillar hypertrophy	No	543 (26)	355 (17)	105 (5)	1003 (48)	
	Yes	397 (19)	522 (25)	167 (8)	1086 (52)	0.001
Head or neck tumor	No	418 (20)	397 (19)	147 (7)	962 (46)	
	Yes	522 (25)	480 (23)	125 (6)	1127 (54)	0.001

Table 3: Preoperative symptoms commonly inquired from obese surgical patients with suspected OSA

Symptoms commonly inquired by anesthesiologist if OSA suspected	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
Snoring	No	146 (7)	62 (3)	22 (1)	230 (11)	
	Yes	794 (38)	815 (39)	250 (12)	1859 (89)	0.001
Witnessed sleep apnea	No	167 (8)	62 (3)	22 (1)	251 (12)	
	Yes	773 (37)	815 (39)	250 (12)	1838 (88)	0.001
Arousal with choking sensation	No	439 (21)	418 (20)	105 (5)	962 (46)	
	Yes	501 (24)	459 (22)	167 (8)	1127 (54)	0.007
Morning headaches	No	543 (26)	522 (25)	125 (6)	1190 (57)	
	Yes	397 (19)	355 (17)	147 (7)	899 (43)	0.019
Daytime sleepiness	No	292 (14)	167 (8)	22 (1)	481 (23)	
	Yes	648 (31)	710 (34)	250 (12)	1608 (77)	0.001

and electrocardiography (ECG) for patients with suspected OSA. Majority (55%), mostly who manage OSA occasionally or regularly, request preoperative overnight pulse oximetry. Majority (67%), mostly who manage OSA occasionally or rarely, request preoperative arterial blood gas analysis.

Preoperative interventions to optimize obese elective surgery patients with suspected OSA [Table 5].

Regardless of their clinical experience of OSA management, majority (53%) recommend preoperative weight loss and smoking cessation. Majority (51%) mostly who manage OSA occasionally or regularly, recommend preoperative reduction of substance or opioid use. Majority (>75%) recommend preoperative optimisation of co-morbidities and regular use of mask CPAP (continuous positive airway pressure) as indicated by PSG.

Elective ambulatory surgery considered appropriate in obese patients with suspected OSA [Table 6].

Regardless of their clinical experience of OSA management, majority (56%) do not consider minor laparoscopic surgery as appropriate daycase procedure. Majority (>70%) consider endoscopy, ophthalmology, minor urology, minor orthopedic, minor plastic, minor gynecology and minor general surgery as appropriate daycase procedures.

Elective surgery postponed in obese OSA patients who are not optimized for anesthesia [Table 7].

Table 4: Preoperative investigations for obese elective surgery patients with suspected OSA

Patient investigations requested by anesthesiologist if OSA suspected	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
Polysomnography	No	397 (19)	272 (13)	125 (6)	794 (38)	
	Yes	543 (26)	605 (29)	147 (7)	1295 (62)	0.001
Overnight pulse oximetry	No	460 (22)	522 (25)	167 (8)	1149(55)	
	Yes	480 (23)	355 (17)	105 (5)	940 (45)	0.001
Arterial Blood Gas	No	647 (31)	626 (30)	125 (6)	1398 (67)	
	Yes	293 (14)	251 (12)	147 (7)	691 (33)	0.001
Electrocardiogram	No	334 (16)	355 (17)	63 (3)	752 (36)	
	Yes	606 (29)	522 (25)	209 (10)	1337 (64)	0.001

Table 5: Preoperative interventions to optimize in obese elective surgery patients with suspected OSA

Optimization interventions advised by anesthesiologist if OSA suspected	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total *n* (%)	*P*
Weight loss	No	460 (22)	418 (20)	105 (5)	983 (47)	
	Yes	480 (23)	459 (22)	167 (8)	1106 (53)	0.001
Modify alcohol, sedative, opioid use	No	522 (25)	397 (19)	105 (5)	1024 (49)	
	Yes	418 (20)	480 (23)	167 (8)	1065 (51)	0.001
Smoking cessation	No	439 (21)	418 (20)	125 (6)	982 (47)	
	Yes	501 (24)	459 (22)	147 (7)	1107 (53)	0.321
CPAP use if indicated by sleep study	No	251 (12)	167 (8)	63 (3)	481 (23)	
	Yes	689 (33)	710 (34)	209 (10)	1608 (77)	0.001
Optimize co-morbidities	No	188 (9)	104 (8)	42 (2)	334 (16)	
	Yes	752 (36)	773 (37)	230 (11)	1755 (84)	0.001

Regardless of their clinical experience of OSA management, majority (>75%) will postpone elective airway, laparoscopic, laparotomy, major head/neck, or plastic surgery; if patients are not optimized. Majority (63%) will postpone elective major orthopedic surgery; if patients are not optimized.

Anesthesiologist preference of general + neuraxial anesthesia for major surgery in OSA patients [Table 8].

For major surgery in OSA patients, combined general + neuraxial anesthesia was ranked as 4th option by most anesthesiologists; especially by those who manage OSA rarely or occasionally. The technique was ranked as 3rd option by anesthesiologists who manage OSA regularly.

Anesthesiologist preference of neuraxial anesthesia for major limb surgery in OSA patients [Table 9].

For major limb surgery in OSA patients, neuraxial anesthesia without sedation was ranked as 1st option by most anesthesiologists; especially by those who manage OSA rarely or occasionally. The technique was ranked as 2nd option by some anesthesiologists who manage OSA regularly.

Anesthesiologist preference of nerve block as sole anesthesia for major limb surgery [Table 10].

For major limb surgery in OSA patients, nerve block as sole anesthesia was ranked as 2nd option by most anesthesiologists; regardless of their clinical experience of OSA management.

Anesthesiologist preference of general anesthesia + nerve block for major limb surgery [Table 11].

For major limb surgery in OSA patients, general anesthesia + nerve block was ranked as 3rd or 4th option by most anesthesiologists; especially by those who manage OSA rarely or regularly. The technique was ranked as 4th option by anesthesiologists who manage OSA occasionally.

Sedation for obese OSA patients in gastrointestinal endoscopy clinic [Table 12].

Regardless of their clinical experience of OSA management, majority (>80%) of anesthesiologists usually provide sedation for gastrointestinal (GIT) endoscopy in obese patients with OSA.

Factors ensured before emergence from general anesthesia in obese OSA patients [Table 13].

Before emergence/extubation from general anesthesia, majority (>80%) of anesthesiologists ensure that patients are fully awake, in upright posture, have normal respiration and

Table 6: Elective ambulatory surgery considered appropriate in obese patients with suspected OSA

Elective ambulatory surgery type	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
Minor laparoscopic surgery	No	501 (24)	459 (22)	209 (10)	1169 (56)	
	Yes	439 (21)	418 (20)	63 (3)	920 (44)	0.001
Gastrointestinal endoscopy	No	146 (7)	125 (6)	105 (5)	376 (18)	
	Yes	794 (38)	752 (36)	167 (8)	1713 (82)	0.001
Minor orthopedic surgery	No	230 (11)	146 (7)	125 (6)	501 (24)	
	Yes	710 (34)	731 (35)	147 (7)	1588 (76)	0.207
Minor general surgery	No	146 (7)	146 (7)	147 (7)	439 (21)	
	Yes	794 (38)	731 (35)	125 (6)	1650 (79)	0.001
Ophthalmic surgery	No	104 (5)	62 (3)	105 (5)	271 (13)	
	Yes	836 (40)	815 (39)	167 (8)	1818 (87)	0.001
Minor urology surgery	No	146 (7)	146 (7)	147 (7)	439 (21)	
	Yes	794 (38)	731 (35)	125 (6)	1650 (79)	0.001
Minor plastic surgery	No	251 (12)	208 (10)	147 (7)	606 (29)	
	Yes	689 (33)	669 (32)	125 (6)	1483 (71)	0.001
Minor gynecology surgery	No	146 (7)	146 (7)	147 (7)	439 (21)	
	Yes	794 (38)	731 (35)	125 (6)	1650 (79)	0.001

Table 7: Elective surgery postponed in obese OSA patients who are not optimized for anesthesia & surgery

Elective surgery type	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total *n* (%)	*P*
Airway surgery -Nasal, pharyngeal, or laryngeal	No	188 (9)	188 (9)	63 (3)	439 (21)	
	Yes	752 (36)	689 (33)	209 (10)	1650 (79)	0.137
Laparotomy	No	146 (7)	125 (6)	63 (3)	334 (16)	
	Yes	794 (38)	752 (36)	209 (10)	1755 (84)	0.973
Major laparoscopic surgery	No	188 (9)	208 (10)	84 (4)	480 (23)	
	Yes	752 (36)	669 (32)	188 (9)	1609 (77)	0.207
Major head/neck surgery	No	146 (7)	167 (8)	63 (3)	376 (18)	
	Yes	794 (38)	710 (34)	209 (10)	1713 (82)	0.160
Major plastic surgery	No	251 (12)	188 (9)	84 (4)	523 (25)	
	Yes	689 (33)	689 (33)	188 (9)	1566 (75)	0.045
Major orthopedic surgery	No	418 (20)	292 (14)	63 (3)	773 (37)	
	Yes	522 (25)	585 (28)	209 (10)	1316 (63)	0.001

Table 8: Anesthesiologist preference of general anesthesia + spinal/epidural block for major surgery in OSA patients

Ranking of GA + spinal/epidural as preferred anesthesia mode	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
1st	83 (4)	21 (1)	21 (1)	125 (6)	
2nd	104 (5)	63 (3)	63 (3)	230 (11)	
3rd	272 (13)	375 (18)	84 (4)	731 (35)	
4th	501 (24)	418 (20)	84 (4)	1003 (48)	
Total *n* (%)	960 (46)	877 (42)	252 (12)	2089 (100)	0.001

reversed from neuromuscular blockade. Majority (>75%) of anesthesiologists do not check arterial blood gas or acid-base balance before emergence/extubation.

Postoperative care after post-anesthesia care unit (PACU) stay, in obese OSA patients [Table 14].

After initial PACU patient care, majority (>80%) of anesthesiologists ensure postoperative oximetry, telemetry, supplemental oxygen and/or extended PACU care for obese OSA patients. Majority (>70%) of anesthesiologists ensure postoperative HDU care and/or mask-CPAP in known OSA patients with known OSA.

Discussion

There are few limited guidelines regarding the perioperative care of OSA patients.[9,12] Anesthesiologists have practice

Table 9: Anesthesiologist preference of spinal and/or epidural anesthesia for major limb surgery in OSA patients

Ranking of spinal and/or epidural as preferred sole anesthesia mode	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
1st	522 (25)	710 (34)	104 (5)	1336 (64)	
2nd	230 (11)	125 (6)	84 (4)	439 (21)	
3rd	188 (9)	42 (2)	42 (2)	272 (13)	
4th	21 (1)	0 (0)	21 (1)	42 (2)	
Total *n* (%)	961 (46)	877 (42)	251 (12)	2089 (100)	0.001

Table 10: Anesthesiologist preference of nerve block as sole anesthesia for major limb surgery in OSA patients

Ranking of nerve block as preferred sole anesthesia mode	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
1st	251 (12)	313 (15)	63 (3)	627 (30)	
2nd	376 (18)	480 (23)	105 (5)	961 (46)	
3rd	146 (7)	21 (1)	63 (3)	230 (11)	
4th	188 (9)	63 (3)	21 (1)	42 (2)	
Total *n* (%)	961 (46)	877 (42)	251 (12)	2089 (100)	0.001

Table 11: Anesthesiologist preference of general anesthesia + nerve block for major limb surgery in OSA patients

Ranking of GA + nerve block as preferred anesthesia mode	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
1st	125 (6)	63 (3)	21 (1)	209 (10)	
2nd	272 (13)	146 (7)	42 (2)	460 (22)	
3rd	334 (16)	272 (13)	104 (5)	710 (34)	
4th	229 (11)	418 (20)	63 (3)	710 (34)	
Total *n* (%)	960 (46)	899 (43)	230 (11)	2089 (100)	0.001

Table 12: Anesthesiologist provides sedation for OSA patients in gastrointestinal tract (GIT) endoscopy clinic

	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total. *n* (%)	*P*
Sedation for GIT endoscopy	No	167 (8)	125 (6)	42 (2)	334 (16)	
	Yes	773 (37)	752 (36)	230 (11)	1755 (84)	
Total *n* (%)		940 (45)	877 (42)	272 (13)	2089 (100)	0.035

variations and limited knowledge regarding the perioperative care of OSA patients.[10,13,14] There are few studies of anesthesiologists' perioperative management of OSA patients; but they are limited in scope, size, reliability and validity.[13,14] The current study is better because it involves a large population of anesthesiologists across the United Kingdom, homogeneous population of consultant anesthesiologists, high survey response rate, pilot study, validated electronic questionnaire, objective outcome measures and comprehensive data collection. The study compared anesthesiologists' clinical experience levels of OSA management between those who manage OSA patients rarely, occasionally, and regularly.

Most respondents order OSA screening tests if patients have BMI >35 or increased neck circumference; and this corroborates recent evidence.[15-18] Anesthesiologists who manage OSA occasionally or regularly, order OSA screening tests if patients have tonsillar hypertrophy or craniofacial anomaly. Anesthesiologists who manage OSA occasionally or rarely, order screening tests if patients have head/neck tumor or right-sided electrocardiography anomaly. These are unique findings with clinical implications. Most respondents do not order screening tests if patients mainly have polycythemia; and this contradicts recent evidence.[16,19]

Most respondents inquire about snoring, witnessed sleep apnea, arousal with choking sensation and daytime sleepiness; and this corroborates recent evidence.[15-18] Anesthesiologists who manage OSA occasionally or rarely, do not inquire about morning headaches: this is a unique finding, but it contradicts recent evidence.[15,19] Most respondents request preoperative PSG, ECG, and overnight pulse oximetry; and this corroborates recent evidence.[15-18] Most anesthesiologists who manage OSA occasionally or rarely, request preoperative arterial blood gas analysis;

Table 13: Factors ensured before emergence/extubation from general anesthesia in obese patients with OSA

Factors ensured before emergence from general anesthesia	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total *n* (%)	*P*
Reversal of residual neuromuscular blockade	No	125 (6)	84 (4)	0 (0)	212 (10)	
	Yes	835 (40)	791 (38)	251 (12)	1877 (90)	0.001
Patient fully awake	No	105 (5)	84 (4)	0 (0)	189 (9)	
	Yes	857 (41)	813 (39)	230 (11)	1900 (91)	0.061
Patient in upright posture	No	42 (2)	63 (3)	0 (0)	105 (5)	
	Yes	898 (43)	835 (40)	251 (12)	1984 (95)	0.003
Check for normal arterial blood gas & acid/base balance	No	731 (35)	710 (34)	209 (10)	1650 (79)	
	Yes	212 (10)	185 (9)	42 (2)	439 (21)	0.090
Normal respiratory rate, volume & pattern	No	146 (7)	167 (8)	21 (1)	334 (16)	
	Yes	752 (36)	773 (37)	230 (11)	1755 (84)	0.001

Table 14: Postoperative care after initial post-anesthesia care unit (PACU) stay, in obese patients with OSA

Postoperative care interventions after PACU	Response	Manage OSA rarely *n* (%)	Manage OSA occasionally *n* (%)	Manage OSA regularly *n* (%)	Total *n* (%)	*P*
Pulse oximetry & telemetry	No	125 (6)	105 (5)	84 (4)	314 (15)	
	Yes	835 (40)	773 (37)	167 (8)	1775 (85)	0.001
Extended PACU care	No	125 (6)	146 (7)	84 (4)	355 (17)	
	Yes	815 (39)	752 (36)	167 (8)	1734 (83)	0.001
Elective HDU care	No	209 (10)	185 (9)	63 (3)	457 (22)	
	Yes	732 (35)	711 (34)	189 (9)	1632 (78)	0.631
Supplemental Oxygen	No	84 (4)	63 (3)	0 (0)	147 (7)	
	Yes	857 (41)	835 (40)	251 (12)	1943 (93)	0.001
Mask CPAP	No	209 (10)	272 (13)	125 (6)	606 (29)	
	Yes	732 (35)	626 (30)	125 (6)	1483 (71)	0.001

and this is a unique finding. Most respondents recommend preoperative weight loss, optimisation of co-morbidities, smoking cessation and regular use of chronic CPAP; and this corroborates recent evidence.[15,19] Anesthesiologists who manage OSA occasionally or regularly, recommend preoperative reduction of substance use; and this is a unique finding with potential clinical impact.

Most respondents do not consider minor laparoscopic surgery as appropriate daycase procedure; and this is a unique finding. Most respondents consider endoscopy, ophthalmology, minor urology, minor orthopedic, minor plastic, minor gynecology and minor general surgery as appropriate daycase procedures: this is a unique finding and supports current clinical practice. Most respondents postpone elective airway, laparoscopic, laparotomy, major head/neck, major orthopedic or plastic surgery, if patients are not optimized preoperatively; and this is a unique finding with clinical implications.

For major limb surgery, combined general and neuraxial anesthesia was ranked 4th choice by most anesthesiologists who manage OSA rarely or occasionally; and 3rd choice by anesthesiologists who manage OSA regularly. General anesthesia plus nerve block was ranked as 3rd or 4th option by most anesthesiologists. Neuraxial anesthesia without sedation was ranked 1st choice by those who manage OSA rarely or occasionally; and 2nd choice by those who manage OSA regularly. These findings corroborate recent evidence, and highlight that general anesthesia should be avoided if possible.[9,12,13] Nerve block, as sole anesthesia, was ranked as 2nd choice by most anesthesiologists; and this is a unique finding that requires exploration.

Most respondents provide sedation for gastrointestinal endoscopy, and this finding corroborates recent evidence.[20] Sedation for endoscopy has been shown to be safe and tolerable in morbidly obese and OSA patients.[20] Procedural sedation using newer agents, such as dexmedetomidine, has been shown to be suitable, popular and effective in obese and OSA patients.[3,20,21]

Most respondents ensure that patients are awake, semi-sitting and breathing normally before extubation; and this conforms with acceptable perioperative care standards or guidelines.[1,7,9] Most respondents ensure postoperative oximetry, telemetry, and supplemental oxygen for OSA patients. Postoperative supplemental oxygen therapy is proven to improve oxygenation in OSA patients.[22,23] Most respondents ensure postoperative mask-CPAP therapy in OSA

patients; and this has been shown to reduce postoperative respiratory complications.[23-25]

Conclusion

There are variations in the guidelines and clinical practice of the perioperative care of OSA patients. This study confirms the variations of contemporary anesthesiologists' knowledge, clinical experience and perioperative care of OSA patients, even in developed countries with advanced medical training and standards. This reliable study produced unique findings with clinical implications; that will inform and improve anesthesiologists' knowledge, optimisation, and perioperative care of OSA patients. The outcomes of this extensive study provide a basis for anesthesiologists to ensure consistent and adequate perioperative care of OSA patients. It will enhance the formulation of robust international standards and guidelines.

Acknowledgement

This study was approved and registered by the institutional review board of Pennine Acute Hospitals, Manchester, United Kingdom. Institutional support is acknowledged.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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