Original Article on Clinical Update Sleep 2023

Screening and treatment of pre-bariatric surgical patients with obesity related sleep disordered breathing

Michael C. F. Cheng[1,2,3], Patrick B. Murphy[1,2], Kai Lee[2,4], Barbara McGowan[5], Nicholas Hart[1,2], Amanda Piper[3], Joerg Steier[1,2,6]

[1]Lane Fox Respiratory Physiology Research Unit, Guy's and St Thomas' NHS Foundation Trust, London, UK; [2]Centre for Human and Applied Physiological Sciences, King's College, London, UK; [3]Central Clinical School, Faculty of Medicine, University of Sydney, Sydney, Australia; [4]Department of Respiratory Medicine, King's College Hospital, London, UK; [5]Department of Diabetes and Endocrinology, Guy's and St Thomas' NHS Foundation Trust, London, UK; [6]Sleep Disorders Centre, Guy's and St Thomas' NHS Foundation Trust, London, UK

Contributions: (I) Conception and design: MCF Cheng, N Hart, J Steier; (II) Administrative support: MCF Cheng, N Hart, PB Murphy, J Steier; (III) Provision of study materials or patients: MCF Cheng, B McGowan; (IV) Collection and assembly of data: MCF Cheng; (V) Data analysis and interpretation: MCF Cheng, N Hart, J Steier; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Michael C. F. Cheng, MBBS, FRACP. Lane Fox Respiratory Physiology Research Unit, Guy's and St Thomas' NHS Foundation Trust, Westminster Bridge Road, London SE1 7EH, UK; Centre for Human and Applied Physiological Sciences, King's College, London, UK; Central Clinical School, Faculty of Medicine, University of Sydney, Sydney, Australia. Email: Michael.cheng@gstt.nhs.uk.

Background: There is a significant burden of sleep disordered breathing (SDB) in patients living with severe and complex obesity undergoing pre-bariatric surgery assessment. This longitudinal observational study evaluated the burden of obesity hypoventilation syndrome (OHS) in this cohort of patients and the therapeutic compliance of patients commenced on positive airway pressure treatment.

Methods: All pre-bariatric surgery patients referred to the sleep clinic for review after an abnormal screening study between 2018 and 2022 were included. We collected data on their sleep study results, anthropometrics, co-morbid medical conditions, clinical observations, spirometry and arterial blood gas (ABG). Patients commenced on therapy were followed-up longitudinally and compliance data collected via remote monitoring.

Results: A total of 116 patients were included [age: mean ± standard deviation (SD) 48.8±10.8 years; body mass index (BMI) 49.2±8.5 kg/m^2; Epworth Sleepiness Scale (ESS) 8.7±5.1 points]. Fifteen patients (12.9% of cohort) were diagnosed with hypercapnic respiratory failure (pH 7.40±0.02; pO_2 11.00±1.04 kPa; pCO_2 6.15±0.08 kPa). Compared to eucapnic obstructive sleep apnoea (OSA) patients, they were older (51.1 *vs.* 48.5 years; P=0.311), had a higher BMI (51.5 *vs.* 48.9 kg/m^2; P=0.266), more likely to be female (66.7% *vs.* 53.5%; P=0.275) and had a higher ESS score (10.4 *vs.* 8.5 points; P=0.177). On binomial regression analysis insulin dependent diabetes was the only patient characteristic of significance with prevalence increased in patients with OHS (26.7% *vs.* 8.9%; P=0.042). Forced vital capacity (FVC) and oxygen saturation (SpO_2) cut-offs demonstrated high specificity (96.8%) but low sensitivity (13.3%) to diagnosed hypercapnia. Fifty percent of the patients with hypercapnia required bi-level ventilation. On follow-up 44.9% of patients were compliant with therapy (>4 hours usage/night).

Conclusions: In minimally symptomatic patients living with severe and complex obesity who have an abnormal overnight oximetry, over 1 in 10 demonstrated chronic respiratory failure. Clinic spirometry and daytime SpO_2 excluded those with hypercapnia. Overall adherence to prescribed therapy is low. Screening, appropriate pre-operative optimisation and peri-operative planning are important in preventing complications in this patient cohort.

Keywords: Respiratory failure; obesity hypoventilation syndrome (OHS); screening; treatment

Submitted Jan 24, 2023. Accepted for publication Jun 30, 2023. Published online Jul 14, 2023.
doi: 10.21037/jtd-23-112
View this article at: https://dx.doi.org/10.21037/jtd-23-112

Introduction

Sleep disordered breathing (SDB) is recognised as a risk factor of cardiorespiratory peri-operative complications. The American Society of Anesthesiologists (ASA) recommends that screening for obstructive sleep apnoea (OSA), usually in the form of questionnaires, is an essential part of routine pre-anaesthetic assessment (1). Patients undergoing assessment for bariatric surgery are recognised as a cohort with a high risk of OSA and screening for SDB with an overnight study is recommended (2,3). We have previously shown that 40% of the patients have moderate to severe OSA (4). In addition to OSA, it is important to identify those bariatric surgical patients with obesity hypoventilation syndrome (OHS) as part of their phenotyping. In patients with a body mass index (BMI) above 40 kg/m^2 the reported OHS prevalence is as high as 1 in 5 (5,6). The identification of OHS patients is of clinical significance as they have a greater risk of complications including post-operative pneumonia, respiratory failure, increased incidence of re-intubation and requirement for tracheostomy as well as cardiovascular events when compared to the eucapnic OSA patients (7,8).

In this prospective study, we phenotyped patients referred to sleep clinic for assessment based on demonstrated SDB in a screening home sleep study prior to bariatric surgery. We recorded standard physiological measurements, such as daytime oxygen saturation (SpO_2), spirometry and daytime arterial blood gas (ABG) values. Our aim was to determine the prevalence of OHS in this minimally symptomatic population and assess the performance of our previously validated screening method to predict daytime hypercapnia using forced vital capacity (FVC) and daytime SpO_2. Finally, we wanted to appraise the acceptability of positive airway pressure therapy in this pre-surgical cohort by following their progress focusing on adherence. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-112/rc).

Highlight box

Key findings

- There is a high prevalence of chronic hypercapnic respiratory failure (CHF) in patients living with severe and complex obesity.

What is known and what is new?

- Minimally symptomatic patients with sleep disordered breathing identified via universal screening have a low compliance with positive airway pressure therapy.
- Clinic spirometry and oxygen saturation assessment identified patients who are at risk for OHS and require further investigation with arterial blood gas.

What is the implication, and what should change now?

- Treatment thresholds needs to be identified for those who are at risk for peri-operative complications from sleep disordered breathing.
- Focus resource on those at highest risk to improve their treatment compliance with pre-operative optimisation with positive airway pressure therapy.

Methods

All patients undergoing pre-bariatric surgery assessment were referred for a home-based sleep study. Abnormal results including moderate or severe OSA, and nocturnal hypoxaemia triggered referrals to sleep clinic for review. Patients referred for review were included between November 2018 and November 2022. Data were prospectively collected from systematic clinic assessments. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Guys' and St Thomas' NHS Foundation Trust as a prospective clinical audit (Project No. GSTT/2018/9651), and individual consent for this audit was waived.

Results of the home sleep study were collected including 4% oxygen desaturation index (4% ODI), mean SpO_2 and time spent with SpO_2 less than 90%. SDB was classified according to the 4% ODI with <15 events/hour as mild OSA, 15–30 events/hour as moderate OSA and >30 events/hour as severe OSA. Clinical assessments included the recording of medical co-morbidities, cardiovascular and respiratory observations and BMI. Epworth Sleepiness Scale (ESS) score was completed for all patients. ABG analysis was performed to identify patients who had OHS defined by BMI >30 kg/m^2 and pCO_2 >6 kPa. Clinic spirometry and serum bicarbonate levels, where available, were collected.

We assessed two screening methods in outpatient setting for patients that may be at risk for hypercapnia. The first method was based on the measurement of the full vital capacity (FVC) and the SpO_2—male subjects have been described to be at risk of hypercapnic respiratory failure if the FVC is <3.5 L and the SpO_2 <95%; female subjects are at risk if FVC <2.3 L and SpO_2 <93% (9). The second method was to use the measurement of serum bicarbonate levels (10,11).

Table 1 Patient characteristics presented based on diagnosis of eucapnic OSA and OHS

Patient characteristics	OHS (n=15)	OSA (n=101)	P value
Age (years)	51.5±8.4	48.5±11.1	0.311
Sex, females (%)	66.7	53.5	0.275
BMI (kg/m^2)	51.5±12.1	48.9±7.8	0.266
ESS (points)	10.4±5.7	8.5±5.0	0.177
Sleep study parameters			
4%ODI (/hour)	35.8±28.4	30.7±22.0	0.359
Mean SpO_2 (%)	91.2±4.1	92.7±2.7	0.058
%Time with SpO_2 <90% (%TST)	22.7±19.8	15.2±17.7	0.133
Hypertension, %	80	77.2	0.810
Airway disease, %			
Asthma	26.7	16.8	0.615
COPD	6.7	3.0	0.464
Smoking history, %			0.084
Non-smoker	73.3	43.6	
Ex-smoker	13.3	38.6	
Current smoker	13.3	17.8	
Diabetes, %			0.126
NIDDM	26.7	31.7	
IDDM	26.7	8.9	

Continuous data are presented as mean ± SD and compared using Student *t*-test. Categorical data were tested using χ^2 including proportional comparisons of smoking history and diabetes categorization. OSA, obstructive sleep apnoea; OHS, obesity hypoventilation syndrome; BMI, body mass index; ESS, Epworth Sleepiness Scale; 4%ODI, 4% oxygen desaturation index; SpO_2, oxygen saturation; %TST, % of time spent with oxygen saturation less than 90% during sleep study; COPD, chronic obstructive pulmonary disease; IDDM, insulin dependent diabetes mellitus; NIDDM, non-insulin dependent diabetes mellitus; SD, standard deviation.

Whenever positive airway pressure therapy was required, patients were referred for set-up with an auto-set-continuous positive airway pressure (CPAP) machine in the first instance (ResMed Air Sense 10 AutoSet, San Diego, CA, USA); patients with evidence of nocturnal hypoventilation in the screening diagnostic sleep study had further sleep studies on treatment to assess for control of SDB. If the CPAP therapy does not adequately control CO_2 levels, as defined by the AASM criteria, during an inpatient sleep study with transcutaneous capnography monitoring, they were switched from CPAP to non-invasive ventilation (NIV) (12). Additionally, patients who had poor tolerance of CPAP with poor therapeutic compliance, were offered a trial of NIV.

Compliance was collected at 3 months after commencement of therapy or at the time point when patients were assessed to be stabilised on therapy. Thirty-day compliance data was obtained from machine download and average daily usage was collected. Therapeutic compliance was defined by average daily usage of more than 4 hours/night.

Statistical analysis

Continuous variables were presented as means ± standard deviation (SD) and compared using Student's *t*-test. Proportions were compared using χ^2 test. We performed a binomial linear regression to identify patient characteristics predictive of hypercapnia. Differences were considered statistically significant when the P value was <0.05. Statistical analyses were performed with SPSS v.29 (IBM, USA).

Results

A total of 116 consecutive minimally asymptomatic patients living with severe and complex obesity (52 males) were reviewed over a 4-year period (*Table 1*). Two patients did not have OSA, 19 (16.4%) had mild OSA; 55 (47.4%) had moderate OSA and 40 (34.4%) had severe OSA. ABG was obtained in 112 of the patients (3 patients refused and 1 patient had a sample analyser error)—patients who did not have an ABG had their CO_2 levels assessed with transcutaneous capnography (CO_2) to exclude significant hypercapnia.

Fifteen (12.9% of total cohort) patients were hypercapnic of which 14 fulfilled criteria for diagnosis of OHS and also had co-existent moderate-severe OSA (14.7% of all patients with moderate-severe OSA); the patient who did not fulfill OHS criteria had a new diagnosis of chronic obstructive pulmonary disease—they had mild OSA on their screening sleep study and was referred for review of nocturnal hypoxaemia. One hundred and one (87.1%) patients were eucapnic.

Patients with hypercapnia were slightly older, had a higher BMI, more likely to be female and had a higher burden of daytime somnolence symptoms, although none

Table 2 Clinic tests used to assess screening criteria for patients at risk of hypercapnic respiratory failure

Clinic tests	All	Male			Female		
		OSA (n=45)	OHS (n=5)	P value	OSA (n=50)	OHS (n=10)	P value
ABG							
pH	7.41±0.02	7.42±0.03	7.40±0.02	0.03	7.42±0.02	7.40±0.02	0.02
pO_2 (kPa)	10.90±1.55	10.65±1.39	11.00±1.04	0.26	11.35±1.77	10.00±0.54	<0.01
pCO_2 (kPa)	5.32±0.51	5.22±0.38	6.15±0.08	<0.01	5.15±0.40	6.26±0.16	<0.01
Spirometry							
FEV_1 (L)	2.57±0.78	3.16±0.73	2.25±0.31	<0.01	2.27±0.52	1.69±0.33	<0.01
FVC (L)	3.16±0.95	3.88±0.82	3.02±0.21	<0.01	2.81±0.70	2.02±0.49	<0.01
SpO_2	96.79±1.78	96.25±1.47	95.00±3.39	0.23	97.33±1.64	97.40±1.17	0.43

Cohort divided based on sex and diagnosis of OSA and OHS. ABG, spirometry including FEV1 and FVC, and SpO_2 obtained during clinic assessment. Cut-offs used to determine patients at risk: males—FVC <3.5 L and SpO_2 <95%; females—FVC <2.3 L and SpO_2 <93% (9). Continuous data are presented as mean ± SD and compared using student *t*-test. OSA, obstructive sleep apnoea; OHS, obesity hypoventilation syndrome; ABG, arterial blood gas; FEV1, forced expiratory volume in 1 second; FVC, forced vital capacity; SpO_2, oxygen saturation; SD, standard deviation.

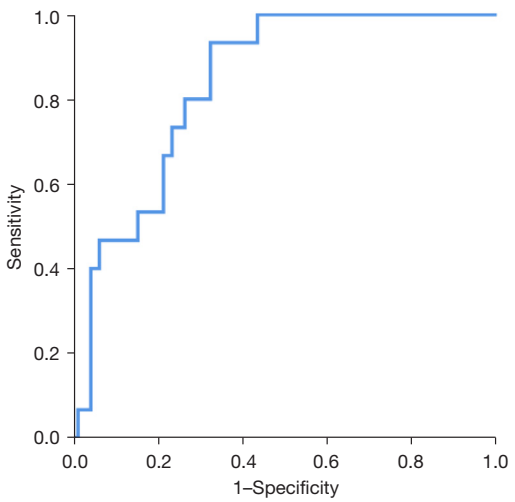

Figure 1 Receiver operator characteristic curve using combined clinic oxygen saturation and forced vital capacity as predictors for patients at risk for chronic hypercapnic respiratory failure. AUC =81.2%; 95% CI: 72.2–90.2%. AUC, area under the curve; CI, confidence interval.

of these differences in characteristics were statistically significant (*Table 1*). The mean SpO_2 and time spent with saturation less than 90% during the sleep study were both lower in patients with OHS. There was a higher prevalence of insulin dependent diabetes and asthma which may represent more advanced metabolic and inflammatory changes seen in these patients. Binomial regression analysis was performed with insulin dependent diabetes the only patient characteristic that came to significance in predicting hypercapnia (P=0.042).

Paired clinic spirometry measurements, SpO_2 and ABG results were available for 110 patients (*Table 2*). The combination of FVC and SpO_2 in morbidly obese patients identified patients at risk for hypercapnia with an area under the curve (AUC) of 0.812 (95% CI: 0.722–0.902) (*Figure 1*). Using the pre-specified male and female cut-off criteria described, there was a high specificity of 96.8%. However, the sensitivity was low at only 13.3%. We had 58 paired serum bicarbonate levels and ABG samples available of which 7 were hypercapnic. Whilst the sample size is too low to accurately assess serum bicarbonate as a screening tool, 2 out of 7 had a bicarbonate level less than 27.

Positive airway pressure therapy was requested for 105 patients with nine patients assessed not to require treatment and two patients refusing treatment. Ninety-three patients were commenced on CPAP therapy; 12 patients required NIV to control their nocturnal breathing of which six were hypercapnic (P<0.001).

Therapy compliance data were available for 89 patients (*Figure 2*). Nine patients had only recently commenced on therapy and did not fulfill the time-frame for compliance review. There were missing machine download data on the remaining seven patients; 44.9% of the patients used their therapy for more than 4 hours overnight. The mean usage was 182 (SD 171) minutes. The proportion of patients

that were compliant with therapy greater than 4 hours was slightly higher in those with severe OSA and chronic hypercapnic respiratory failure (*Table 3*).

Discussion

Our prospective observational study of patients living with severe and complex obesity undergoing assessment for bariatric surgery referred to sleep clinic with an abnormal screening home sleep study demonstrates a high prevalence of hypercapnic respiratory failure, although it is lower than in some of the previous studies of sleep clinic patients with similar BMI. This is likely due to the lower pre-test likelihood as our cohort was minimally symptomatic and identified based on a universal screening program. We evaluated a screening method using clinic spirometry and SpO_2 that can be easily implemented in a clinic setting to identify patients who are at risk for OHS—this was effective in identifying at risk patients who should be further investigated with an ABG.

Our sleep clinic evaluation of patients focussed on phenotyping and identifying high-risk features for peri-operative complications such as hypercapnic respiratory failure. It may lead to important changes to peri-operative anaesthetic management including choice of anaesthesia technique, approach to airway management and peri-operative monitoring (7). Once identified with moderate-severe OSA and/or OHS, patients are prescribed positive airway pressure therapy as part of their peri-operative optimisation. However, on follow-up of our cohort, there was poor acceptance of prescribed treatment with low adherence to therapy. This is reflective of the significant treatment burden in a minimally symptomatic pre-operative patient cohort.

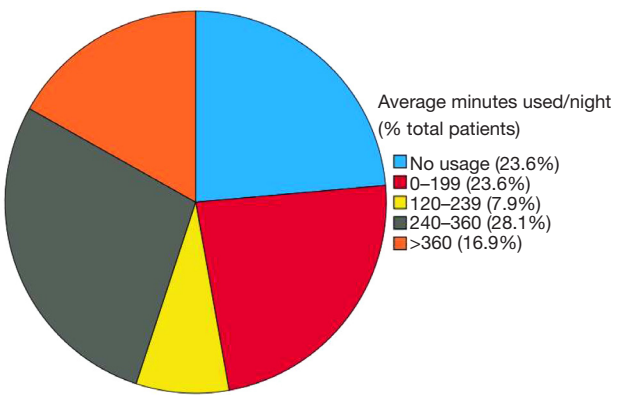

Figure 2 Distribution of compliance with therapy.

Epidemiology of OHS

This was an enriched cohort of patients as they had already undergone screening home sleep study, a standard part of pre-bariatric assessment, demonstrating abnormalities requiring sleep clinic review. Based on previous studies of the referral patterns and SDB prevalence in this cohort, this represents approximately 40% of the population undergoing pre-bariatric surgery assessment (4). Our incidence of OHS in our sleep clinic cohort was 14.7%; extrapolating this to the total pre-bariatric surgery obesity population undergoing home sleep study screening, the estimated prevalence would be around 6%. This is consistent with previous reports of patients who are undergoing bariatric surgery assessment (13).

Other previously published studies described the prevalence of OHS in cohorts of patients with a BMI >40 kg/m^2 as around 20%. This estimated prevalence was, however, based on symptomatic sleep clinic populations who have a high clinical pre-test likelihood (5,6). On the contrary, this compared to the 1.1% prevalence estimated in assessment of ambulatory patients living with obesity that were invited to attend a respiratory review based on a raised

Table 3 Compliance according to severity of SDB diagnoses including OSA and OHS

Severity of SDB	Compliance ≤4 hours (n=49), n (%)	Compliance >4 hours (n=40), n (%)
Mild OSA	6 (6.7)	2 (2.2)
Moderate OSA	25 (28.1)	14 (15.7)
Severe OSA	12 (13.5)	15 (16.9)
Hypercapnic/OHS	6 (6.7)	9 (10.1)
All patients	49 (55.1)	40 (44.9)

SDB, sleep disordered breathing; OSA, obstructive sleep apnoea; OHS, obesity hypoventilation syndrome.

serum bicarbonate level on routine blood tests. However, it should be noted that this this cohort did have a lower BMI of around 35 kg/m^2 (14).

Screening for hypercapnic respiratory failure

Despite the recognition that there is a high prevalence of hypercapnic respiratory failure in patients living with severe and complex obesity, including in our cohort, ABG is not performed routinely to diagnose OHS. This is due to both patient acceptability, as ABG is painful, and the requirement for the necessary equipment in clinic setting. The American Thoracic Society/European Respiratory Society (ATS/ERS) guideline recommends the use of serum bicarbonate as the initial screening test to risk stratify those patients at risk for OHS and therefore should have an ABG performed—in a pooled individual patient data meta-analysis performed as part of the guideline formation, this screening method was found to have a sensitivity and specificity of 86% and 77% (10). We had limited number of serum bicarbonate levels within our cohort including in 7 OHS patients; there were 2 false negatives reflecting its limitations as a screening test.

We assessed the performance of clinic spirometry and SpO_2 which can be easily obtained during outpatient reviews as screening method to identify patients at risk of hypercapnia. A derivative cohort had identified cut-off values with males that had FVC <3.5 L and SpO_2 <95%; and females with FVC <2.3 L and SpO_2 <93% identified to be at risk. In our cohort, the combination of these two assessments demonstrated a good performance in identifying OHS patients. The cut-offs showed a high specificity in our cohort. However, there was a low sensitivity which is likely a reflection of a high prevalence of restrictive ventilatory defect seen in morbidly obese patients.

Pre-operative optimisation

The aim of therapy for SDB in the pre-bariatric surgery setting is not necessarily symptom control or long-term cardiovascular disease modification but to optimise peri-operative management and prevent complications. In patients with OSA, pre-operative initialisation of positive airway pressure therapy helps to stabilise the upper airway, improve ventilation, and normalise the sympathetic tone which is important in the prevention of peri-operative cardiovascular and respiratory complications (3). In the post-operative period it prevents upper airway closure and limits the adrenaline surges associated with intermittent hypoxias that can lead to cardiac complications. There is additional risk associated with OHS due to pathophysiologic changes in the neural respiratory drive. The initiation of positive airway pressure therapy improves ventilation and lowers the nocturnal carbon dioxide levels leading to increased central sensitisation to elevated CO_2 levels decreasing the likelihood of peri-operative acute respiratory failure. Patients are more likely to have SDB which may not be adequately controlled by CPAP therapy requiring bi-level ventilation—this accounted for 50% of our cohort (15).

However, despite the peri-operative advantages which is offered by the initiation of positive airway pressure therapy, its acceptance in our minimally symptomatic cohort of patients is low. The only other published cohort examining therapy compliance in a pre-operative cohort commenced on CPAP therapy achieved 40% adherence and an average usage of 2.5 hours/night (16). This is similar to what was achieved within our cohort where the average adherence was 182 minutes/night. It is also important to point out that there is no clear guideline on treatment threshold for SDB and our clinical practice is to prescribe therapy for patients with moderate OSA. However, studies that have precisely phenotyped patients in the peri-operative setting have demonstrated that the increased peri-operative risk and therefore benefit for therapy is only seen in patients with severe OSA (17). The focus for future studies needs to be on identifying patient characteristics that are high risk for complications so that we can focus our resources on their pre-operative optimisation including improved adherence to positive airway pressure therapy.

Limitations to the study

There are several limitations to our study. Firstly, we assumed that if the patient's nocturnal sleep study did not demonstrate significant SDB (including nocturnal SpO_2 levels and qualitative review of the oxygen traces), this ruled out OHS. Based on previous published studies, we evaluated 40% of the cohort undergoing screening. In the evaluation of the serum bicarbonate levels, there was incomplete data which limited our capability to evaluate its performance in our cohort; nevertheless, even with the limited numbers there were 2 cases of false negatives seen with bicarbonate screening.

In our evaluation of the compliance data, there was incomplete data collection for the whole cohort. Overall, the low compliance seen is likely to be reflective of the minimal symptoms experienced by the patients we treated (18).

However, it is important to recognise that we included compliance data of all patients who were prescribed therapy—including those who took home machines but did not use it or turn it on. This is not always included in observational studies that examined therapy compliance based on machine usage. Patients at highest risk for non-compliance may not procure a machine in health systems where they had to pay for their therapy and therefore their machine usage not included in the compliance data; as our therapy was delivered in a health system with universal health coverage, most patients did not refuse to take home a machine. The proportion of patients that was minimally compliant (23.6%) is similar to some of the previous published data that examined prescription compliance (19).

Conclusions

The diagnostic and therapeutic pathways in identification and management of SDB can lead to potential significant delay in surgery for patients. There is low compliance with prescribed therapy within this cohort and the possibility of over-treatment has to be considered to avoid lengthy waiting lists which will impact on morbidity, if there is little gained by the provision of positive airway pressure therapy. Equally, it is important to work out screening methods for high risk OHS patients that is deliverable in clinical practice, as these patients should be the focus of resources for pre-operative optimisation. A well-designed randomised clinical trial may answer to questions about treatment thresholds to prevent avoidable peri-operative morbidities as well as value-based healthcare considerations (e.g., cost-effectiveness of screening).

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Journal of Thoracic Disease* for the series "Clinical Update Sleep 2023". The article has undergone external peer review.

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-112/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-112/dss

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-112/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-112/coif). The series "Clinical Update Sleep 2023" was commissioned by the editorial office without any funding or sponsorship. JS serves as the unpaid Guest Editor of the series and an unpaid editorial board member of *Journal of Thoracic Disease*. PBM has received grants, honoraria, travel grants and equipment from medical companies including Philips Respironics, Resmed, Fisher&Paykel, Chiesi, Genzyme and Breas Medical. The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This was a prospective audit study registered as a service review and approved by the institutional review board of Guy's and St Thomas' NHS Foundation Trust (Project No. GSTT/2018/9651) and individual consent for this audit was waived.

References

1. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. Anesthesiology 2014;120:268-86.

2. de Raaff CAL, de Vries N, van Wagensveld BA. Obstructive sleep apnea and bariatric surgical guidelines: summary and update. Curr Opin Anaesthesiol 2018;31:104-9.
3. Cheng MCF, Steier J. Pre-operative screening for sleep disordered breathing: obstructive sleep apnoea and beyond. Breathe (Sheff) 2022;18:220072.
4. Meurgey JH, Brown R, Woroszyl-Chrusciel A, et al. Peri-operative treatment of sleep-disordered breathing and outcomes in bariatric patients. J Thorac Dis 2018;10:S144-52.
5. Macavei VM, Spurling KJ, Loft J, et al. Diagnostic predictors of obesity-hypoventilation syndrome in patients suspected of having sleep disordered breathing. J Clin Sleep Med 2013;9:879-84.
6. Laaban JP, Chailleux E. Daytime hypercapnia in adult patients with obstructive sleep apnea syndrome in France, before initiating nocturnal nasal continuous positive airway pressure therapy. Chest 2005;127:710-5.
7. Kaw R, Wong J, Mokhlesi B. Obesity and Obesity Hypoventilation, Sleep Hypoventilation, and Postoperative Respiratory Failure. Anesth Analg 2021;132:1265-73.
8. Ayas NT, Laratta CR, Coleman JM, et al. Knowledge Gaps in the Perioperative Management of Adults with Obstructive Sleep Apnea and Obesity Hypoventilation Syndrome. An Official American Thoracic Society Workshop Report. Ann Am Thorac Soc 2018;15:117-26.
9. Mandal S, Suh ES, Boleat E, et al. A cohort study to identify simple clinical tests for chronic respiratory failure in obese patients with sleep-disordered breathing. BMJ Open Respir Res 2014;1:e000022.
10. Mokhlesi B, Masa JF, Brozek JL, et al. Evaluation and Management of Obesity Hypoventilation Syndrome. An Official American Thoracic Society Clinical Practice Guideline. Am J Respir Crit Care Med 2019;200:e6-e24.
11. Mokhlesi B, Tulaimat A, Faibussowitsch I, et al. Obesity hypoventilation syndrome: prevalence and predictors in patients with obstructive sleep apnea. Sleep Breath 2007;11:117-24.
12. American Academy of Sleep Medicine. International classification of sleep disorders, 3rd ed. Darien, IL: American Academy of Sleep Medicine; 2014.
13. Lecube A, Sampol G, Lloberes P, et al. Asymptomatic sleep-disordered breathing in premenopausal women awaiting bariatric surgery. Obes Surg 2010;20:454-61.
14. Borel JC, Guerber F, Jullian-Desayes I, et al. Prevalence of obesity hypoventilation syndrome in ambulatory obese patients attending pathology laboratories. Respirology 2017;22:1190-8.
15. Carlucci A, Ceriana P, Mancini M, et al. Efficacy of Bilevel-auto Treatment in Patients with Obstructive Sleep Apnea Not Responsive to or Intolerant of Continuous Positive Airway Pressure Ventilation. J Clin Sleep Med 2015;11:981-5.
16. Guralnick AS, Pant M, Minhaj M, et al. CPAP adherence in patients with newly diagnosed obstructive sleep apnea prior to elective surgery. J Clin Sleep Med 2012;8:501-6.
17. Chan MTV, Wang CY, Seet E, et al. Association of Unrecognized Obstructive Sleep Apnea With Postoperative Cardiovascular Events in Patients Undergoing Major Noncardiac Surgery. JAMA 2019;321:1788-98.
18. Cistulli PA, Armitstead J, Pepin JL, et al. Short-term CPAP adherence in obstructive sleep apnea: a big data analysis using real world data. Sleep Med 2019;59:114-6.
19. Lin HS, Zuliani G, Amjad EH, et al. Treatment compliance in patients lost to follow-up after polysomnography. Otolaryngol Head Neck Surg 2007;136:236-40.

Cite this article as: Cheng MCF, Murphy PB, Lee K, McGowan B, Hart N, Piper A, Steier J. Screening and treatment of pre-bariatric surgical patients with obesity related sleep disordered breathing. J Thorac Dis 2023;15(7):4066-4073. doi: 10.21037/jtd-23-112