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ORIGINAL CONTRIBUTIONS

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Obstructive Sleep Apnoea Screening Preoperatively with the Epworth Questionnaire: Is It Worth It…?

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Abstract

Background The prevalence of obstructive sleep apnoea (OSA) in the bariatric population has been reported to be as high as 60–83%. The Epworth Sleepiness Scale (ESS) is a validated, self-administrated eight-item questionnaire that measures subjective daytime sleepiness and thus helps to identify high-risk for OSA.

Objectives To find the prevalence of OSA in patients undergoing bariatric surgery who do not routinely undergo polysomnography (PSG) and are screened by the ESS.

Methods All consecutive 425 patients who underwent bariatric surgery in our tercier referral centre from January 2012 to June 2017 were included in this prospective study. Patient demographics and ESS score were recorded prior to the bariatric surgery and patients were divided into low-risk (ESS < 11), high-risk (≥ 11) and "known-OSA" groups.

Results The community-based OSA prevalence was 14% (59 patients). ESS-positive predictive value was 60%. There was no significant difference in BMI and excess body-weight, but patients with OSA were older and had a lower female ratio (75% vs 42%). The unplanned ICU admission rate was comparable amongst the low- and high-ESS group (2.2% and 2.1%, respectively); similarly, the respiratory and chest complication rate were similar. The median hospital stay for patients diagnosed with OSA was a half day longer; the high-score patients stayed significantly longer than the low-score patients ($p = 0.017$).

Conclusion In our study, the OSA prevalence was low (20%). We think that the ESS does not have significant predicting value before bariatric surgery and overall the OSA is "overhyped" in the bariatric pathway.

Keywords Risk prediction · Obstructive sleep apnoea · Gastric bypass · Preoperative screening · Bariatric surgery

Introduction

The prevalence of morbid obesity has exceeded all previous expectations, becoming the "pandemic" of the twenty-first century [1]. The expense of palliating the comorbid conditions associated with obesity is rising to astronomic proportions [2]. Currently, bariatric surgery is the only effective method of treating morbid obesity. The quest for the safest way to perform bariatric procedures is a priority amongst bariatric professionals; various risk-reducing screening tools have been developed to identify and potentially optimise patients with obesity-related comorbidities [3–5].

The short- and medium-term outcomes following bariatric surgery [6], as well as the improvement of metabolic comorbidities (especially diabetes [7]) have been extensively published. Another important, but less highlighted comorbidity is obstructive sleep apnoea (OSA). However, the risks associated with OSA are to date, not entirely quantified or qualified. This condition could be highly prevalent in patients being evaluated for bariatric surgery, but possibly underdiagnosed [8]. The prevalence of OSA in the normal population is estimated around 3.9% in males and 1.2% in females [9], but can be 12–30 times higher in the obese population [10]; this has been reported to be as high as 60–83% [8, 11–13]. Even those morbidly obese patients who do not meet diagnostic criteria for OSA may experience upper airway resistance syndrome (UARS). This condition is an extension of the

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pathophysiology of obstructive sleep apnoea/hypopnea (OSA/H), less severe pharyngeal collapse during sleep but which also leads to sleep fragmentation and excessive daytime sleepiness [14]. Several studies have suggested that morbidly obese patients (body mass index (BMI) of 35 kg/m^2 or more) are at increased risk for perioperative complications; the markedly increased prevalence of OSA in the obese has been advocated as a mechanism [15–19]. Despite assumptions that OSA itself is a significant independent risk factor for postoperative complications and the formulation of practice guidelines based on this assertion [20–22], little evidence exists to support this association in any patient population [23–27].

The Epworth Sleepiness Scale (ESS) is a validated, self-administrated eight-item questionnaire that measures subjective daytime sleepiness and thus helps to identify high-, moderate- or low-risk for OSA [28]. However, it has a low specificity (60–75%) and a low negative predictive value of 21% [29, 30]. Therefore, the authors have hypothesised that, based on the current literature and the use of ESS as a lone screening tool for diagnosing OSA, many patients with undiagnosed OSA (false negatives) may have undergone surgery within their unit. This theoretically could have resulted in a higher incidence of perioperative complications and ICU admissions in patients undergoing bariatric surgery.

The objective of this study was to ascertain the prevalence of OSA in patients undergoing bariatric surgery who do not routinely undergo polysomnography (PSG) and are screened by the Epworth Sleepiness Score (ESS). The incidence of perioperative complications in patients not diagnosed to with OSA (based on their low ESS scores) was compared to those who had either diagnosed OSA or high ESS score which lead to perform polysomnography to identify OSA.

Material and Methods

All consecutive patients who underwent bariatric surgery within the Doncaster Royal Infirmary tertiary referral centre, UK, from January 2012 to June 2017 were included in this prospective study. Patients diagnosed with OSA and established on continuous positive airway pressure (CPAP) treatment prior to assessment in the bariatric clinic were assessed separately.

Preoperative evaluation of candidates for bariatric surgery was conducted 1 to 3 months before elective surgery by a multi-disciplinary team (MDT) including a surgeon, bariatric physician, dietitian, clinical psychologist and bariatric nurse specialist. The possibility of OSA was considered in all bariatric surgical candidates, and every patient was asked to complete the standard Epworth sleepiness questionnaire. ESS score ranges between 0 and 24, with scores higher than 10 reflecting pathological sleepiness and possible OSA. These patients were referred for formal sleep studies to confirm the

presence of OSA. Where a preoperative diagnosis of OSA was established (Apnoea-Hypopnea Index (AHI) > 15), 2 to 3 months of CPAP treatment was initiated prior to surgical intervention in order to reduce AHI [31] and ultimately make the anaesthetic safer; however, the rationale for this time frame is empirical. The same anaesthetic technique was used for all patients irrespective of the presence of OSA. All procedures were completed laparoscopically and enhanced recovery protocol followed postoperatively. This included mobilising patients 4 hours after the procedure and providing thromboprophylaxis using a combination of stockings and sequential compression devices, as well as a daily dose of low molecular weight heparin (LMWH). Routine observations were carried out every 2 h in the 24 h postoperatively reducing to four hourly after this. Patients were typically discharged home 48 h after the procedure.

Electronic and paper records were collected and critically reviewed for patient characteristic information, comorbid conditions, type of surgery, intensive care unit (ICU) stay, and duration of hospital admission. Immediate postoperative complications (resulting in change in normal postoperative management or delay in discharge) were noted (such as bleeding, pulmonary/respiratory complications, myocardial infarction, dysrhythmias, stroke, thrombo-embolic events, sepsis, liver injury and failure and acute kidney injury). These were triaged according to the Clavien-Dindo complication scale [32]. Complications within 30 days of surgery were also noted including readmissions to hospital, wound infections, anastomotic leak, re-operation and morbidities.

All statistical analyses were performed using the SPSS software package version 22.0 (IBM, Armonk, NY, USA). Categorical and continuous variables were reported as frequencies (%) and mean ± SD, respectively. Comparison between the groups was performed by chi-square test and one-way ANOVA statistical tests, with a post-hoc Bonferoni analysis where applicable. The Fischer-exact test was employed when the number was low (< 5) and the chi-square test was invalid. Differences were calculated by independent samples t test. A p value of 0.05 was considered significant.

Results

Baseline Characteristics

During the data collection period, 425 patients underwent bariatric surgery for morbid obesity. The mean age was 45.2 years (range 20–70 years); the mean preoperative weight was 139.5 kg (range 90–226 kg) and mean preoperative BMI was 49.7 kg/m^2 (range 34–75 kg/m^2). Out of these, 59 patients were already diagnosed with sleep apnoea and established on CPAP; therefore, the initial (community-based) OSA prevalence was 14%.

OSA Screening

Amongst the 366 patients without pre-diagnosed OSA, the median Epworth score was 5 (interquartile range, 2 to 8) (Fig 1).

Polysomnography (PSG) is recommended for patients with a score of 11 or more. Therefore, PSG was initiated in 48 patients. Of these, 29 patients were diagnosed to have OSA (60% positive predictive value when ESS ≥ 11); seven patients were started on CPAP therapy prior to surgery. A total of 318 patients had an ESS of below 11 and therefore did not undergo any form of sleep study (Table 1 and Fig. 2). The comparison of baseline demographics of the patients according to the OSA risk (including the community-diagnosed OSA) did not show any difference in BMI and excess body weight (Table 1); it did however reveal that patients with OSA were older with a higher proportion of males compared to females.

Operative Procedures

A Roux-en-Y gastric bypass was performed in 288 patients, sleeve gastrectomy in 99 and an adjustable gastric band was placed in 38. Detailed descriptions of these procedures and the short- and medium-term outcomes were previously published in detail in this journal [6].

Peri- and Postoperative Outcomes

Overall, out of the 425 patients, 54 (12.7%) developed complications in the early postoperative period. Most of these complications were minor, postoperative fevers and chest infections.

A comparison was made between the low ESS (group A), high ESS (group B) and community-diagnosed OSA ("C") patients to identify the possible risk-association of suspected OSA (Table 2).

The postoperative elective HDU/ICU admissions were not compared, as in the early years of our bariatric programme, most of our patients were observed on HDU for 24 to 48 h electively. The HDU/ICU admission was based on the outcome of the preoperative assessment. The decision making was quite often based on the diagnosis or suspicion of OSA; therefore, the high ESS score initiated the ICU admissions pre-emptively. Overall, half of the high score patients were admitted to ICU. Unplanned ICU admission rates were, however, comparable to those with a low ESS score; consequently, following this study, we discontinued the practice of routine ICU admission. Similarly, the chest and respiratory complication rates did not differ significantly between the three groups.

The median hospital stay for patients diagnosed with sleep apnoea was a half day longer; the high-score patients stayed significantly longer than the low-score patients ($p = 0.017$).

Discussion

Obstructive sleep apnoea is an entity that causes concern to both surgeons and anaesthetists, and it is therefore imperative that it is accurately diagnosed and treated, especially prior to bariatric surgery [22]. It is possible that OSA is significantly underdiagnosed in the bariatric patient population [8, 33].
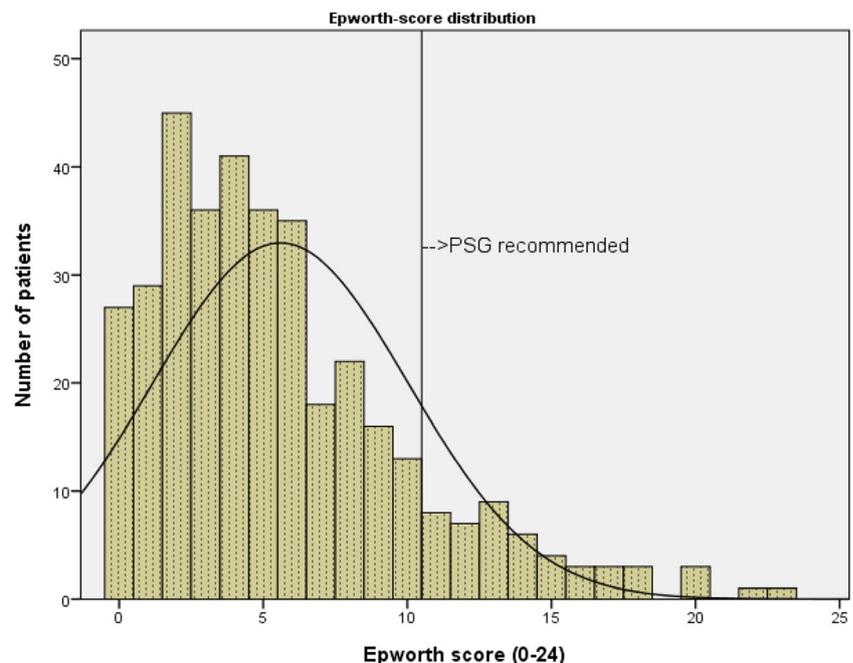
Fig. 1 Epworth score distribution (with normal curve)

Table 1 Baseline demographics of the patients, according to OSA-screening status

Baseline demographics	No diagnosis of OSA, ESS < 11 (N = 318)	Preop. screening positive, ESS ≥ 11 (N = 48)	Community diagnosed OSA (N = 59)	p value
Age (years)	44.09 ± 11	46.97 ± 10.8	49.37 ± 10.3	0.002
Female % (N)	79.5% (253)	72.9% (35)	42.4% (25)	0.02
Initial Weight (Kg)	138.24 ± 23	141 ± 26	147 ± 24	0.017
Excess body weight (Kg)	68.61 ± 19.24	72.9 ± 22.9	71.6 ± 21.2	0.193
BMI (Kg/m^2)	49.69 ± 6.47	51.4 ± 7.7	49.4 ± 5.8	0.172
ESS score	4.27 ± 2.77	14.4 ± 3.08	N/A	0.01

Recent studies have raised questions about the appropriateness of the Epworth Sleepiness Scoring questionnaire to screen OSA, both from the medical perspective [34] and from non-medical utilisation of it [35].

The number of patients within this study diagnosed with OSA was low, as were the number of postoperative complications.

Debate exists as to whether or not all patients considered for bariatric surgery should undergo preoperative PSG evaluation and screening for OSA [13, 36], as opposed to only those selected patients where the clinical history, examination or a screening tool predicts a high-risk of sleep apnoea [8]. A recent expert guideline confirms that PSG remains the gold standard for diagnosing OSA; patients with OSA should be continuously monitored with pulse oximetry in the early postoperative period [37]. However, PSG is a time- and resource-consuming method, and it is impractical to carry out in every patient. Therefore, the majority of patients undergo nocturnal pulse oximetry in order to reduce the number of patients requiring PSG. Recently, a simple sleep monitor used as a screening method was tested and validated (so far in only 50 patients) with 100% sensitivity and 69% specificity [38]. This may present the opportunity to find a valid and cost-effective screening method for exclusion of moderate and severe OSA in bariatric patients without the need of PSG.

Existing guidelines for the perioperative care of OSA patients are based primarily on expert opinion [20, 34], rather than on objective evidence that OSA is a risk factor for perioperative complications.

Interestingly, within this study, the pre-referral (community-based) OSA prevalence (14%) was similar to other studies [8, 12], but the overall detected OSA prevalence
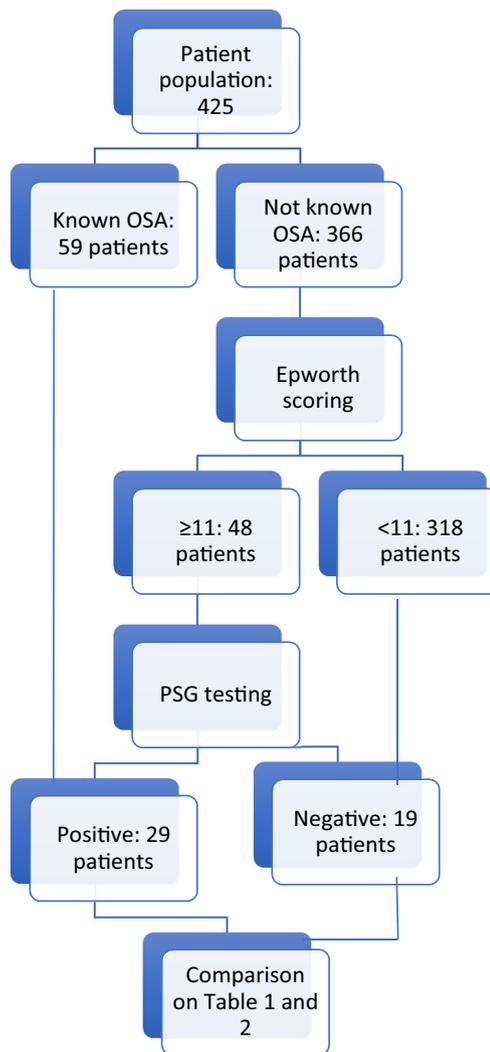

Fig. 2 Study logic flow

Table 2 Patient outcomes in three groups (group A: ESS < 11, group B: ESS > = 11, group C: community diagnosed OSA). *N/A*, not applicable

Epworth score (N)	"A"; ESS < 11 (N = 318)	"B"; ESS ≥ 11 (N = 48)	"C"; OSA (N=59)	p value between A and B
Proven sleep apnoea	0	29	59	N/A
HDU/ICU admission N (%)	55 (17.3%)	24 (50%)	29 (49%)	N/A
Unplanned N (%)	7 (2.2%)	1 (2.1%)	3 (5.1%)	0.428
CPAP-treatment on ICU, N	5	12	22	0.026
Complications N:				
Clavien-Dindo 1-3a	28	7	6	0.285
Clavien-Dindo 3b-5	11	1	3	
Chest/respiratory complication, N	9	2	3	0.460
Bleeding, leak or re-op required, N	8	1	2	N/A
Median hospital stay, days	3.04 ± 2.09	3.74 ± 1.94	3.43 ± 2.1	0.017

(20%) and complication rates remained considerably lower than has been previously published. Given that the hypothesis leading to this study was that unidentified and untreated OSA may lead to significantly higher complication rates in patients undergoing bariatric surgery, the authors think that the almost 80% female ratio might partially explain these favourable observation, which is similar to a recently published study [39].

Only a few studies have attempted to assess OSA as a risk factor for complications in non-airway surgery. Gupta and colleagues [23] performed a case-control study in orthopaedic patients with OSA and found an increased risk of overall complications and unplanned ITU admissions. Ahmad et al. performed a study of 41 individuals with preoperative PSG testing followed by bariatric surgery and concluded that obese patients desaturate frequently in the postoperative period, despite supplemental oxygen. Therefore, perioperative management strategies should include measures to prevent postoperative hypoxaemia [40]. Hwang and colleagues [24] found that the frequency of desaturations in preoperative overnight oximetry is associated with postoperative complications, but such desaturations are not specific for OSA. Their definitions of "complications" included the need for supplemental oxygenation and postoperative bleeding (a surgical complication rather than physiological); making this association less logical. In contrast, Sabres and colleagues [26] found that OSA was not a significant risk factor for unanticipated hospital admissions after elective surgery.

Another large prospective, observational study by Flum et al. [41] found a history of deep venous thrombosis or pulmonary embolism, a self-reported diagnosis of OSA and impaired functional status to be independent risk factors for developing 30-day major composite outcome (death, thrombotic event, surgical re-intervention, or failure to be discharged) in primary bariatric surgery patients. They could not however determine if OSA itself is a true independent risk factor, or simply a marker of other factors resulting in adverse outcomes [41].

This study demonstrated that females are less likely to develop OSA: the female ratio was 79% vs 42% amongst non-OSA and OSA-diagnosed patients, respectively. This finding correlates with others' observation, where the female gender was found to be protective of OSA [8, 36, 39].

Nevertheless, this study, based on 425 patients showed the prevalence of OSA to be much lower than reported by others, 20%; however, a recent publication found similar prevalence in 251 bariatric patients [39]. Furthermore, the positive predictive value of the ESS as a screening tool is also low, because it identified only 29 of the 48 patients (60%). It is not possible to calculate the specificity or sensitivity of ESS for this cohort, as sleep studies were not performed on all patients and the real OSA prevalence is not known. Given that the literature suggests a very high prevalence rate of OSA in bariatric patients (up to 77%) [28, 36, 42] as well as a poor screening value of ESS [34], one might hypothesise that there may have been a large number of patients with undiagnosed OSA. Based on this assumption and on the current available evidence, these patients with undiagnosed OSA should have a higher incidence of perioperative complications, which was not supported by this study. The number of patients undergoing bariatric surgery and the incidence of perioperative complications were comparable to other series in the literature [39, 40, 43]. The low incidence of complications and hospital

stay found in this study supports the fact that undiagnosed and untreated OSA does not necessarily increase perioperative complications and morbidity, similarly confirmed by others [44, 45].

Therefore, it is possible that the number of patients undergoing bariatric surgery who have OSA is much lower than previously reported; based on this study, could be around 20% only (based on PSG results, initiated in the high-OSA-risk patient). Therefore, the authors of this study do not support the routine use of PSG. With thorough perioperative observation, early mobilisation and using incentive spirometry, the risk of perioperative OSA-related complications is low [45].

One could debate that the use of other screening tools (Berlin, Stop-Bang) might have a higher predictive value to identify OSA preoperatively; this was confirmed recently [39], but in males, their predictive value remains low. However, the low perioperative OSA-related complication rate somewhat makes the necessity of OSA screening less important.

Our study has important economic and patient-related implications, because OSA screening is time- and resource-consuming. There is also a significant time and cost implication associated with performing PSG; patients identified on the ESS as requiring PSG who consequently are often found to be negative for OSA may have been investigated unnecessarily. Therefore, by adopting a sensible approach, clinically identifying patients who would most benefit from PSG and treatment for OSA, the surgical pathway for bariatric patients can be optimised. Our study also highlights that the unplanned ICU admission rate is no different between patients who score low or high on the Epworth questionnaire; therefore, these patients can safely be operated upon in a centre with ICU backup, without necessarily preoperatively planning admission [46]. The elective ICU admission was based on the outcome of the preoperative assessment and amongst other indicators and not solely on the ESS results. This is showing on Fig. 2, and on Table 2, where we show that 55 out of the 318 ESS low-risk patient also had HDU/ICU admission. The authors pose that routine ICU admission is not required in everyday bariatric practice. The unplanned ICU admission rate was the same low (2.1% and 2.2%) regardless of the ESS score.

A limitation of this study was that only a small number of patients were diagnosed with OSA and on CPAP; this prevented any kind of statistical analysis between the two groups (OSA and non-OSA) as regards to perioperative complications. Another limitation was that PSG is not routinely used in all patents; therefore, it was not possible to ascertain the actual incidence of OSA in this cohort of patients. The actual utility of ESS in screening patients with OSA was not assessed.

Conclusion

ESS does not appear to be an effective screening tool to predict OSA, as it does not help to positively identify the incidence of OSA in bariatric patients. However, with a low ESS score, it appears to be safe to avoid or omit PSG preoperatively. The complication rates in undiagnosed cases of OSA in bariatric patients were not found to be any higher than in those with OSA, suggesting that routine use of a resource-consuming polysomnography in these patients as a pre-anaesthetic assessment tool may not be necessary. Further prospective studies with randomisation of bariatric patients into preoperative sleep studies versus treatment as usual would be needed to confirm these findings; this could indeed be of an economic benefit if it is demonstrated that this time and resource consuming test (PSG) is unnecessary and elective ICU admission is avoidable.

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