

Sleep disordered breathing in morbidly obese patients prior to bariatric surgery - a retrospective analysis of a single centre cohort

Christian M. Horvath^{1,3}, Juri Jossen¹, Anne-Kathrin Brill¹, Philipp Nett², Florent Baty³, Sebastian R. Ott¹

¹ Department of Pulmonary Medicine, University Hospital and University of Bern, Bern, Switzerland

² Department of Gastroenterology, University Hospital and University of Bern, Bern, Switzerland

³ Department of Pulmonary and Sleep Medicine, Kantonsspital St. Gallen, Switzerland

Introduction

Obstructive sleep apnea (OSA) is a common disease in the general population. Obesity is a major risk factor of OSA and its prevalence is continuously increasing with an estimated number of 1.1 billion obese individuals (BMI>30 kg/m²) by 2030. Bariatric surgery is an intervention that produces substantial and sustained weight loss in adults. Due to the increased peri- and postoperative risk in these patients an assessment for sleep apnoea prior to bariatric surgery is recommended. The aim of this retrospective cohort study was to investigate prevalence and independent predictive factors of OSA (AHI>5/h) in obese patients prior to bariatric surgery in a single university centre.

Material and Methods

We analysed data of all morbidly obese patients (BMI>35 kg/m²) who underwent a home respiratory polygraphy prior to bariatric surgery between January 2012 to July 2015. Sleep study was scored according to the AASM scoring manual 2.1. using the acceptable rules for hypopnea. Additional demographic data, laboratory values, pulmonary function testing and data from sleep questionnaires (STOPBang, Epworth Sleepiness Scale (ESS), Fatigue Severity Scale (FSS)) were analysed. All data are reported descriptively using median together with interquartile range. Sensitivity, specificity, negative and positive predictive values were inferred using confusion matrix analyses.

Results (1)

265 patients were included (76% female; median age 39 years (IQR 29-48); BMI 42.1 kg/m² (IQR 38.5-46.7). Overall OSA (AHI>5/h) was present in 43% of patients (females 35%, males 68%, p<0.001), moderately to severe OSA (AHI>15/h) was detected in 21% (females 13%, males 48%, p=0.002). The STOPBang was statistically predictive (p<0.001) in univariate analysis for all severities of OSA, FSS was predictive for an AHI>30/h, ESS was not predictive (table 1). Age (p<0.05) and neck circumference (p<0.05) were statistically significant predictive risk factors for OSA in the multiple linear regression analysis for an AHI>5/h (Table 1).

Variables	AHI				Univariate p-value			Multivariate p-value ≥5/h	All
	0-4.9	5-14.9	15-29.9	≥30	5-14.9	15-29.9	≥30		
Age	36 (26-44)	43 (33-53)	46 (38-54)	46 (41-58)	p<0.001	p<0.001	p<0.001	p<0.05	39 (29-48)
Female gender (%)	86	76	59	37	p>0.05	p<0.001	p<0.001	p>0.05	76
BMI	41.26 (37.76-44.99)	42.71 (39.08-45.39)	46.19 (39.56-51.65)	45.11 (41.50-49.70)	p>0.05	p<0.005	p<0.001	p<0.05	42.11 (38.46-46.67)
Neck circumference (cm)	40.0 (37.3-42.0)	41.0 (40.0-45.0)	45.0 (41.5-47.5)	46.2 (43.8-48.0)	p<0.005	p<0.001	p<0.001	p<0.05	41 (39-45)
FEV1 (l)	3.07 (2.74-3.51)	2.98 (2.64-3.37)	2.83 (2.36-3.44)	3.00 (2.48-3.74)	p>0.05	p>0.05	p>0.05	p>0.05	3.00 (2.63-3.48)
FVC (l)	3.83 (3.44-4.48)	3.76 (3.30-4.13)	3.58 (3.11-4.30)	4.02 (3.31-4.80)	p>0.05	p>0.05	p>0.05	p>0.05	3.78 (3.31-4.47)
STOPBANG	3 (2-3)	3 (3-4)	4 (3-5)	5 (4-6)	p<0.001	p<0.001	p<0.001	p>0.05	3 (2-4)
ESS	6 (4-9)	6 (4-10)	7 (4-9)	11 (7-14)	p>0.05	p>0.05	p>0.05	p>0.05	6 (4-10)
FSS	3.11 (2.22-4.39)	4.00 (2.56-5.00)	3.33 (2.33-4.11)	4.89 (2.83-5.45)	p>0.05	p>0.05	p<0.05	p>0.05	3.4 (2.3-4.9)
ODI (4%)	2.2 (1.0-3.9)	10.1 (6.9-12.9)	25.8 (20.2-29.8)	47.8 (41.6-74.2)	p<0.001	p<0.001	p<0.001	p>0.05	5.2 (1.9-14.7)
SPO2 mean (%)	93.8 (93.0-94.9)	92.85 (91.80-94.00)	92.4 (90.3-93.5)	86.9 (89.3-91.1)	p<0.001	p<0.001	p<0.001	p>0.05	93.4 (92.0-94.5)
SPO2<90% (min)	2.15 (0.30-16.55)	15.7 (5.2-15.1)	33.4 (18.2-165.2)	185.8 (89.8-260.5)	p>0.05	p<0.001	p<0.001	p>0.05	9.2 (1.2-62.3)
AHI supine position	1.4 (0.3-3.3)	9.5 (5.2-15.1)	22.5 (14.2-37.5)	53.2 (24.4-66.9)	p<0.001	p<0.001	p<0.001	p>0.05	3.5 (0.7-11.6)
PH	7.43 (7.42-7.45)	7.44 (7.42-7.45)	7.43 (7.42-7.45)	7.45 (7.43-7.45)	p>0.05	p>0.05	p>0.05	p>0.05	7.44 (7.42-7.45)
PACO2 (mm Hg)	35 (32-37)	36.5 (34.5-38.0)	37 (34-39)	36 (34-39)	p<0.05	p<0.05	p>0.05	p>0.05	35 (33-38)
HCO3- (mm Hg)	24.0 (23.0-24.8)	24.7 (23.8-25.4)	25.1 (24.2-25.9)	25.0 (23.1-26.4)	p<0.001	p<0.005	p<0.005	p>0.05	24.3 (23.1-25.3)
PAO2 (mm Hg)	85.0 (79.1-92.0)	79.5 (71.5-86.5)	76.0 (70.0-86.0)	69.0 (63.0-75.5)	p<0.001	p<0.001	p<0.001	p>0.05	82.0 (73.8-88.1)
Cholesteroline	4.85 (4.16-5.60)	4.95 (4.32-5.63)	5.15 (4.50-5.71)	5.10 (4.27-5.64)	p>0.05	p>0.05	p>0.05	p>0.05	4.95 (4.27-5.62)
HDL	1.27 (1.08-1.50)	1.20 (0.96-1.39)	1.22 (1.14-1.46)	1.13 (1.01-1.25)	p<0.05	p>0.05	p<0.05	p>0.05	1.23 (1.05-1.48)
LDL	2.90 (2.34-3.59)	3.04 (2.49-3.68)	3.11 (2.50-3.65)	2.91 (2.49-3.52)	p>0.05	p>0.05	p>0.05	p>0.05	3.01 (2.40-3.63)
Triglyceride	1.24 (0.93-1.65)	1.45 (1.02-2.01)	1.47 (1.08-1.81)	1.70 (1.26-2.28)	p>0.05	p<0.05	p<0.001	p>0.05	1.34 (1.00-1.84)
TSH	2.03 (1.44-2.97)	1.86 (1.34-2.69)	1.97 (1.63-2.85)	2.31 (1.93-3.12)	p>0.05	p>0.05	p>0.05	p>0.05	2.05 (1.47-2.91)
Cortisol	284 (208-408)	298 (230-396)	374 (292-474)	346 (272-436)	p>0.05	p<0.05	p>0.05	p>0.05	318.5 (223.0-422.3)
Oestradiol	162 (95-340)	108 (69-190)	104 (52-119)	108 (79-187)	p<0.05	p<0.05	p>0.05	p>0.05	133 (79-256)
LH	5.6 (3.5-8.2)	7.1 (4.2-19.1)	6.6 (4.8-11.9)	5.2 (3.7-7.3)	p<0.05	p>0.05	p>0.05	p>0.05	5.7 (3.7-10.9)
FSH	5.10 (3.55-7.45)	7.10 (3.80-25.00)	7.80 (4.10-19.80)	5.80 (5.00-9.00)	p<0.001	p>0.05	p>0.05	p>0.05	5.7 (3.8-9.6)

Table 1: Patient demographics, AHI and factors predictive for OSA, bold characters denote p<0.05

Results (2)

In the gender specific subgroups the STOPBang was significant in females for an AHI>5/h (p<0.005), in males it was not significant. The only other predictive questionnaire result was the ESS in males for an AHI>30/h. In multivariate analysis no single item was predictive for an AHI>5/h in females and males (Table 2 and 3).

Variables	AHI				Univariate p-value			Multivariate p-value ≥5/h
	0-4.9	5-14.9	15-29.9	≥30	5-14.9	15-29.9	≥30	
Age	36 (26-44)	42 (31-54)	50 (38-55)	47 (43-49)	p<0.005	p<0.001	p<0.005	p>0.05
BMI	41.26 (38.03-44.90)	42.64 (39.15-45.10)	45.91 (39.56-48.61)	48.62 (42.10-54.36)	p>0.05	p>0.05	p<0.001	p>0.05
Neck circumference (cm)	39 (37-41)	40 (39-41)	43 (41-44.5)	43.5 (43-44.0)	p>0.05	p<0.001	p<0.001	p>0.05
STOPBANG	2 (2-3)	3 (2-4)	4 (2-5)	5 (4-5)	p<0.005	p<0.001	p<0.001	p>0.05
ESS	6 (4-9)	6 (4-10)	6 (2.5-9)	7 (6-12)	p>0.05	p>0.05	p>0.05	p>0.05
FSS	3.11 (2.22-4.39)	4 (1.95-4.56)	3.33 (2.33-4.33)	5.06 (1.78-6.11)	p>0.05	p>0.05	p>0.05	p>0.05
SPO2 mean (%)	93.8 (93.0-94.9)	92.9 (91.8-94.0)	92.4 (90.3-93.5)	89.3 (86.9-91.1)	p<0.001	p<0.005	p<0.001	p>0.05
SPO2<90% (min)	2 (1-17)	16 (5-42)	33 (18-165)	186 (90-260)	p<0.001	p<0.001	p<0.001	p>0.05
PH	7.44 (7.42-7.46)	7.44 (7.43-7.45)	7.44 (7.42-7.45)	7.46 (7.45-7.46)	p>0.05	p>0.05	p>0.05	p>0.05
PACO2 (mm Hg)	34 (32-36)	36 (34-36)	36 (34-38)	35 (34-36)	p>0.05	p<0.05	p>0.05	p>0.05
HCO3- (mm Hg)	23.80 (22.90-24.65)	24.70 (23.80-26.60)	25.10 (24.1-25.90)	25.10 (22.50-26.20)	p<0.001	p<0.01	p>0.05	p>0.05
PAO2 (mm Hg)	86 (81-92)	80 (74-88)	80 (75-87)	70 (64-72)	p<0.001	p<0.05	p<0.001	p>0.05
FSH	5.3 (3.7-7.5)	8.0 (5.4-36.6)	9.55 (4.05-38.7)	9.0 (4.6-11.1)	p<0.001	p<0.05	p<0.05	p>0.05

Table 2: Female patient demographics, AHI and factors predictive for OSA, bold characters denote p<0.05

Variables	AHI				Univariate p-value			Multivariate p-value ≥5
	0-4.9	5-14.9	15-29.9	≥30	5-14.9	15-29.9	≥30	
Age	36 (25-43)	43 (40-50)	43 (38-49)	46 (37-58)	p>0.05	p>0.05	p<0.001	p>0.05
BMI	40.62 (36.54-45.98)	43.42 (39.08-48.84)	46.73 (39.68-52.64)	42.52 (41.03-48.44)	p>0.05	p>0.05	p>0.05	p>0.05
Neck circumference (cm)	45.5 (43-49)	45.8 (44-50)	48 (46-50)	47 (46.3-49)	p>0.05	p>0.05	p>0.05	p>0.05
STOPBANG	5 (4-6)	4 (4-6)	5 (3.5-5)	4 (5-6)	p>0.05	p>0.05	p<0.005	p>0.05
ESS	6 (5-8)	8 (5-14)	8.5 (7-9)	11.5 (7-14)	p>0.05	p>0.05	p<0.005	p>0.05
FSS	3.84 (2.56-4.56)	4.67 (3.45-5.45)	3.33 (2.39-3.78)	4.86 (3.22-5.33)	p>0.05	p>0.05	p<0.001	p>0.05
SPO2 mean (%)	93.8 (92.6-94.5)	93.0 (91.9-94.9)	92.01 (89.3-93.1)	89.4 (86.8-91)	p>0.05	p>0.05	p<0.001	p>0.05
SPO2<90% (min)	5 (1-34)	16 (3-22)	39 (25-185)	166 (73-266)	p>0.05	p>0.05	p<0.001	p>0.05
AHI supine position	2.4 (0.9-3.3)	9.2 (3.2-13.9)	20.7 (11.0-43)	56 (9.1-65.5)	p>0.05	p<0.005	p<0.001	p>0.05
PH	7.43 (7.42-7.45)	7.42 (7.41-7.43)	7.43 (7.42-7.45)	7.44 (7.42-7.45)	p<0.05	p>0.05	p>0.05	p>0.05
PACO2 (mm Hg)	37 (37-39)	38 (36-41)	38 (35-39)	37 (34-40)	p>0.05	p>0.05	p>0.05	p>0.05
HCO3- (mm Hg)	24.55 (23.9-24.45)	24.5 (23.6-25.4)	25.05 (24.35-25.75)	26 (23.6-26.6)	p>0.05	p>0.05	p>0.05	p>0.05
PAO2 (mm Hg)	78 (70-89)	75 (69-79)	71 (65-78)	66 (60-78)	p>0.05	p>0.05	p<0.05	p>0.05
Cortisol	280 (193-160)	328 (288-364)	371 (316-424)	356 (331-476)	p>0.05	p>0.05	p<0.05	p>0.05

Table 3: Male patient demographics, AHI and factors predictive for OSA, bold characters denote p<0.05

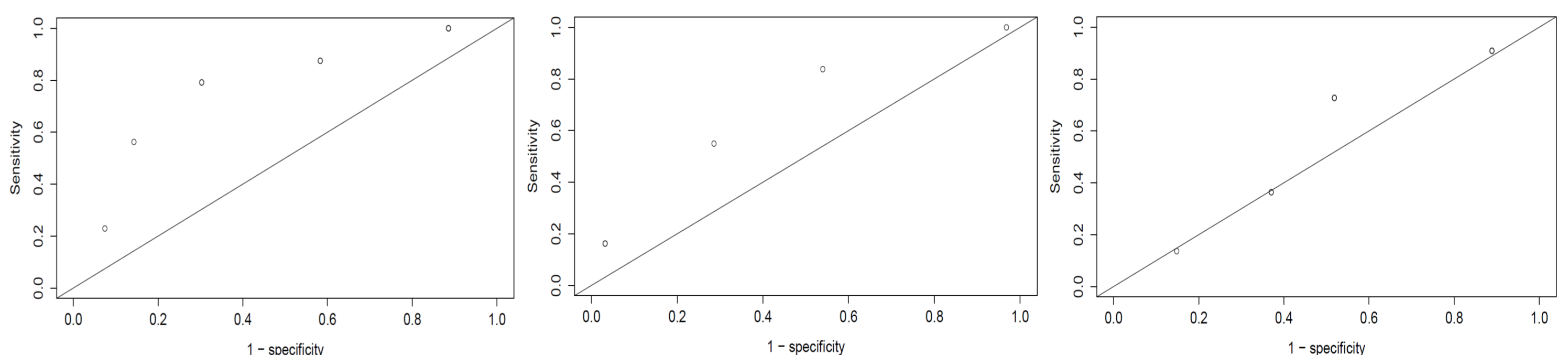


Figure 3 a) STOPBang receiver operator curve overall AHI>15/h Figure 3 b) STOPBang receiver operator curve for female AHI>15/h Figure 3 c) STOPBang receiver operator curve for male AHI>15/h

The best negative predictive items with the respective negative predictive values, sensitivity and cutoff for an AHI >15/h were an age of ≤43 (87%, 64%), a neck circumference of ≤43 cm (94%, 82%), a BMI of ≤45.71kg/m² (86%, 52%) and a STOPBang of ≤4 (92%, 79%) (Figure 3 a). For females the respective values were an age of ≤43 (93%, 70%), a neck circumference of ≤42.41 cm (94%, 63%), a BMI of ≤45.54 kg/m² (93%, 59%) and a STOPBang of ≤4 (94%, 69%) (Figure 3b). The best cutoff for males were an age of ≤42 (65%, 62%), a neck circumference of <45.28 cm (84%, 88%), a BMI of ≤44.54 kg/m² (63%, 55%) and a STOPBang of ≤5 (68%, 73%) (Figure 3 c).

Conclusions

- In our predominantly female cohort the prevalence of OSA is relatively low compared to other studies, probably due to the younger cohort and less severe obesity.
- Screening for OSA prior to bariatric surgery should be considered.
- Better screening algorithms are needed to identify patients at risk.