Sleep disorders in the Surgical Patient

Dr Sophie West
Newcastle Regional Sleep Service

Sophie.west@nuth.nhs.uk ,@sophiedwest
Over 25% of the adult population are obese
Most patients with OSA are obese
Most cases of OSA are undiagnosed
The NHS performs over 10 million operations each year
“Back of the envelope calculation” at least 500,000 patients with undiagnosed OSA have surgery each year
Does this matter?
Obstructive sleep apnoea

Common in the general population

>70 year olds = 15-20%
Men with Type 2 diabetes = 23%
Diabetic macular oedema = 50%
Bipolar disorders = 21% - 51%
Marfan’s Syndrome = 33%
AAA = 41%

Bariatric surgery waiting list = 70%:
40% severe OSA
Only 13% known OSA prior to going onto waiting list
Switzerland cohort
n=2121 with PSG

Moderate to severe OSA in
50% men 23% women
Incidence of OSA in surgical populations


- Cohort study of 14,962 patients undergoing inpatient surgery
- A prior diagnosis of OSA was found in 13%
- Four screening tools identified 10-42% of the remainder as at high risk of OSA.
- Combining these tools the authors concluded that 22% of their population was likely to have undiagnosed OSA before operation.
- Other estimates 15-70%
Proportion of surgical patients with undiagnosed obstructive sleep apnoea

M. Singh¹,², P. Liao¹, S. Kobah¹, D. N. Wijeysundera¹,³, C. Shapiro⁴ and F. Chung¹

- 819 Surgical patients (Toronto) screened with STOP Bang and polysomnography
- 111 (14%) already had OSA
  - 58% not identified by surgeon pre-op
  - 11% not identified by anaesthetist pre-op
- 33% of rest had moderate/severe OSA

Fig 2. The percentage of undiagnosed OSA cases among the PSG study-identified OSA subjects, according to the severity of OSA (n=485). The severity of OSA based on AHI, with mild (AHI >5–15), moderate (AHI >15–30), or severe OSA (AHI >30). The error bars represent the 95% CIs. OSA, obstructive sleep apnoea; PSG: polysomnography.
COMPOSA Study
Obstructive sleep apnoea and post-operative complications

- Cohort, observational study
- Entry criteria
  - Major elective surgery
  - CPX test
  - BMI 30+
  - Not known OSA
- Polygraphy as a “gold standard” pre op
- Trace archived (not reported)
- Prospective ward follow up post op
- POMS score collected on post op days 3,5,7,14

66% had moderate or severe OSA
Respiratory pathophysiology and OSA

- **Obesity**
  - Difficult airway
  - Reduced lung volumes
  - Rapid desaturation with apnoea
  - Increased post operative atelectasis

- **OSA**
  - All of the above
  - Increased likelihood of post anaesthetic airway obstruction
  - Airway oedema
  - Increased respiratory sensitivity to sedatives/analgesics
n= 3942

- 13 studies identified up to 2010
- All with control group (cohort or case-control studies; some retrospective or using historical controls)
- OSA identified by screening questionnaire, oximetry, or polysomnography
- Variable definitions of OSA
- Cardiac and respiratory complications main focus
- **Low overall complication rate (about 13%)**
- Very heterogeneous surgical populations
- CPAP usage not always specified
### Complication

<table>
<thead>
<tr>
<th>Complication</th>
<th>OR for OSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac event</td>
<td>2.07</td>
</tr>
<tr>
<td>Respiratory event</td>
<td>2.43</td>
</tr>
<tr>
<td>Desaturation</td>
<td>2.27</td>
</tr>
<tr>
<td>ICU transfer</td>
<td>2.81</td>
</tr>
<tr>
<td>Reintubation</td>
<td>2.05</td>
</tr>
</tbody>
</table>

**Increased LOS with OSA (mean 1.8 days) in the 2 studies where reported**
• Systematic search
• 2 medico-legal reports and 15 case reports

Table 3 Summary of characteristics of risk factors associated with critical complications. Cx, Complications; NA, Not available; OSA, Obstructive sleep apnoea; CRE, Critical respiratory events; AHI, Apnoea hypopnoea index; CPAP, Continuous positive airway pressure; OR, Operating room; PACU, Post anaesthesia care unit

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age [Mean(SD)], sex</td>
<td>60 patients. 62% males [49(9) yr] and 38% females [46(8) yr]</td>
</tr>
<tr>
<td>Body habitus (Mean so)</td>
<td>Overall BMI: 4 ± (13) kg m⁻²</td>
</tr>
<tr>
<td>Outcomes reported (n=60)</td>
<td>26 deaths, 17 anoxic brain injury, 12 CRE, 5 other serious complications</td>
</tr>
<tr>
<td></td>
<td>(2 cardiac arrest: resuscitated, 3 heart block)</td>
</tr>
<tr>
<td>AHI data (events h⁻¹) (n=4)</td>
<td>Mean preoperative AHI 30: 2 CRE, 1 death</td>
</tr>
<tr>
<td>CPAP use (n=50)</td>
<td>Postoperative AHI 81: 1 CRE</td>
</tr>
<tr>
<td>OSA diagnosed preoperatively: 50</td>
<td>CPAP treatment: 11</td>
</tr>
<tr>
<td>Did not receive CPAP/treatment or information NA: 39</td>
<td></td>
</tr>
<tr>
<td>Timing of critical complications (n=60) %</td>
<td>92 (45/49)–1st 72h,</td>
</tr>
<tr>
<td></td>
<td>80 (39/49)–1st 24h,</td>
</tr>
<tr>
<td></td>
<td>12 (6/49)–24–72h,</td>
</tr>
<tr>
<td></td>
<td>8 (4/49)–&gt;72h,</td>
</tr>
<tr>
<td></td>
<td>Complication timing: NA (n=11)</td>
</tr>
<tr>
<td></td>
<td>OR: 13 (8/60)</td>
</tr>
<tr>
<td></td>
<td>PACU: 18 (11/60)</td>
</tr>
<tr>
<td></td>
<td>Ward: 67 (40/60)</td>
</tr>
</tbody>
</table>
| Location of critical complications (n=60) %     | 75 (45/60) OSA patients with death or near-death received opioids,
How to screen for OSA pre-operatively?

Screening tool for OSA: STOP-Bang

Does the patient snore loudly (louder than talking or loud enough to be heard through closed doors)? Y/N

Does the patient often feel tired, fatigued, or sleepy during the day? Y/N

Has anyone observed the patient stop breathing during their sleep? Y/N

Does the patient have, or is the patient being treated for, high blood pressure? Y/N

Does the patient have a BMI of more than 35? Y/N

Age. Is the patient older than 50? Y/N

Is the patient's neck circumference greater than 40cm? Y/N

Gender. Is the patient male? Y/N

Scoring: Y ≥ 3 = high risk of OSA
Y < 3 = low risk of OSA

One person in five in the UK is affected by lung disease. We offer hope and support at every step, so that no one has to face it alone. We campaign for positive change in the nation's lung health. We fund vital research into new treatments and cures. We are the UK's lung charity, leading the fight against lung disease.

www.btf.org.uk/osa
STOP-Bang Questionnaire
A Practical Approach to Screen for Obstructive Sleep Apnea

Frances Chung, MBBS; Hairil R. Abdullah, MBBS; and Pu Liao, MD

• 8 domain score
  - The loud Snoring, Tiredness, Observed apnea, high blood Pressure (STOP)-Body mass index (BMI), Age, Neck circumference, and Gender (Bang) questionnaire
Screening questionnaires

- give suggestion of “risk”, not diagnosis
- Need sleep study to diagnose OSA
- ESS indicates who is likely to benefit most from CPAP
- Can be used to prioritise referrals
No UK guidelines on screening for OSA pre-operatively

From the American society of Anaesthesiologists:
- A focused history of snoring, arousals and episodes of daytime somnolence
- Screening protocols or questionnaires may be useful
  • They support the use of CPAP in the peri-operative period in patients with known OSA
  • They contain no strong recommendations for managing the problem raised by the high incidence of undiagnosed OSA in the surgical population.

*Practice guidelines for the peri-operative management of patients with OSA: an updated report by the American Society of Anaesthesiologists Task Force. Anaesthesiology 2014;120:268-86*
Variations in practice across the UK in the pre-operative screening for obstructive sleep apnoea

UK Postal survey of pre-operative detection of OSA
92 respondents /180 (51%)
96% said all patients at high risk of OSA should be screened
40% had a policy for screening for OSA

- 19% All patients screened with questionnaire
- 9% Certain surgical groups screened e.g. bariatric
- 4% Patients with high BMI screened
- No policy
Conclusions part 1

- OSA and obesity prevalent,
- High incidence of undetected OSA in surgical patients
- Probably increased surgical risk independently (lack of high quality evidence)
- Screen for OSA pre-operatively with STOP-BANG Questionnaires and polygraphy
- But high economic cost, delay to surgery, Patient anxiety, Follow up?
Opioids and OSA

- N=60 with OSA (only 15 with AHI ≥ 20 events/hr)
- Double blind, randomised cross-over study
- 40 mg controlled release morphine or placebo
- Ventilatory chemoreflex and overnight polysomnography

**ORIGINAL ARTICLE**

The effect of acute morphine on obstructive sleep apnoea: a randomised double-blind placebo-controlled crossover trial


Opioids and OSA

<table>
<thead>
<tr>
<th></th>
<th>Placebo mean</th>
<th>Morphine mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>T90</td>
<td>4.0</td>
<td>6.2</td>
</tr>
<tr>
<td>SpO₂ nadir</td>
<td>87.2</td>
<td>86</td>
</tr>
<tr>
<td>Mean PtcCO₂ mmHg</td>
<td>43.7</td>
<td>45.9</td>
</tr>
<tr>
<td>Mean SpO₂</td>
<td>95.4</td>
<td>94.9</td>
</tr>
<tr>
<td>AHI</td>
<td>19.1</td>
<td>20.7</td>
</tr>
<tr>
<td>ODI</td>
<td>14.3</td>
<td>15.6</td>
</tr>
</tbody>
</table>

Small changes only BUT
Relatively low dose of opioid ≈ 13 mg morphine iv in 12 hours
More marked effect in severe group
Marked individual variation in effect
Previous small study (n=10) with remifentanil showed more marked SpO₂ effect
Multiple peri-operative factors may augment opioid effect
Factors Associated with Postoperative AHI

### Univariate Analysis

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Comparison</th>
<th>Estimate (95% CI)</th>
<th>P Value</th>
<th>Estimate (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI (events per hour)</td>
<td>Age, yr</td>
<td>+1</td>
<td>0.023 (0.010-0.035)</td>
<td>&lt;0.001</td>
<td>0.018 (0.004-0.031)</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>Sex</td>
<td>Male vs. female</td>
<td>0.578 (0.297-0.861)</td>
<td>&lt;0.001</td>
<td>0.303 (-0.042 to 0.648)</td>
<td>0.085</td>
</tr>
<tr>
<td></td>
<td>Body mass index, kg/m²</td>
<td>+1</td>
<td>0.022 (-0.002 to 0.045)</td>
<td>0.071</td>
<td>0.004 (-0.023 to 0.030)</td>
<td>0.783</td>
</tr>
<tr>
<td></td>
<td>Neck circumference, cm</td>
<td>+1</td>
<td>0.065 (0.030-0.102)</td>
<td>&lt;0.001</td>
<td>0.023 (-0.018 to 0.064)</td>
<td>0.268</td>
</tr>
<tr>
<td></td>
<td>Oxygen therapy</td>
<td>Yes vs. no</td>
<td>0.053 (-0.200 to 0.307)</td>
<td>0.679</td>
<td>-0.012 (-0.292 to 0.268)</td>
<td>0.937</td>
</tr>
<tr>
<td></td>
<td>Procedure invasiveness</td>
<td>Moderate vs. minor</td>
<td>-0.049 (-0.399 to 0.302)</td>
<td>0.456</td>
<td>0.285 (-0.677 to 0.108)</td>
<td>0.153</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major vs. minor</td>
<td>-0.242 (-0.744 to 0.302)</td>
<td>0.785</td>
<td>-0.705 (-1.265 to -0.145)</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>Anesthesia type</td>
<td>GA vs. RA</td>
<td>-0.266 (-0.557 to 0.212)</td>
<td>0.069</td>
<td>-0.068 (-0.391 to 0.255)</td>
<td>0.677</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes vs. no</td>
<td>0.053 (-0.200 to 0.307)</td>
<td>0.679</td>
<td>-0.012 (-0.292 to 0.268)</td>
<td>0.937</td>
</tr>
<tr>
<td></td>
<td></td>
<td>72 h opioid dose, mg</td>
<td>0.005 (0.002-0.007)</td>
<td>&lt;0.001</td>
<td>0.005 (0.002-0.007)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preop baseline AHI</td>
<td>0.034 (0.027-0.041)</td>
<td>&lt;0.001</td>
<td>0.027 (0.019-0.035)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

### Multivariate Analysis

*Estimates were from generalized linear mixed model analysis with log transformation of dependent variable.*

AHI = apnea–hypopnea index; Apnea index = average hourly number of apnea episodes; GA = general anesthesia; Preop = preoperative; RA = regional spinal anesthesia; REM percentage = percentage of rapid eye movement sleep in total sleep time; SWS = slow wave sleep (stage 3 and 4).
Non-opioid analgesic modes of pain management are associated with reduced postoperative complications and resource utilisation: a retrospective study of obstructive sleep apnoea patients undergoing elective joint arthroplasty

C. Cozowicz 1, 2, J. Poeran 3, N. Zubizarreta 3, J. Liu 3, S.M. Weinstein 1, L. Pichler 1, 2, M. Mazumdar 3, S.G. Mentsoudis 1, 2

- Retrospective cohort study n=181,182
- Elective joint arthroplasty with known OSA
- New York 2006-2016
- Multi-modal analgesia increasingly used
- Opioid + nerve block, NSAI, gabapentin, ketamine etc
### Opioid prescription by multimodal use

<table>
<thead>
<tr>
<th></th>
<th>Opioids only</th>
<th>1 mode</th>
<th>2 modes</th>
<th>2+ modes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical ventilation</strong></td>
<td>1.5%</td>
<td>1.2%</td>
<td>0.7%</td>
<td>0.4%</td>
</tr>
<tr>
<td><strong>Critical Care Admission</strong></td>
<td>2.5%</td>
<td>2.3%</td>
<td>2.1%</td>
<td>1.8%</td>
</tr>
<tr>
<td><strong>Total opioids</strong></td>
<td>350</td>
<td>323</td>
<td>299</td>
<td>270</td>
</tr>
<tr>
<td><strong>Respiratory adverse events</strong></td>
<td>4.6%</td>
<td>3.9%</td>
<td>3.4%</td>
<td>2.8%</td>
</tr>
<tr>
<td><strong>CNS adverse events</strong></td>
<td>1.1%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

**BUT**

Time related changes in practice
Multi-modal used more in larger hospitals
Different patient base in different institutions
Anaesthetising the obese is now mainstream

Considerable bariatric surgery experience

Consider all obese (BMI>30) as OSA risk
  - Local techniques
  - Opioid avoidance/minimisation
  - Level 2 monitoring post procedure
Obesity hypoventilation syndrome
or obesity related respiratory failure

• Obesity, BMI >30
• Awake daytime hypercapnia – am headache
• Plus sleep disordered breathing

Up to 25% of those with BMI 40 have OHS
Postoperative Complications in Obesity Hypoventilation Syndrome and Hypercapnic OSA: CO₂ Levels Matter!

AHI 45, 3% ODI 2, T90 0 min
Arousal index 50

AHI 45, 3% ODI 43, T90 9 min
Arousal index 36

AHI 45, 3% ODI 47, T90 77 min
Arousal index 43
Meet entry criteria = 519

ABG criteria for OHS: Yes 194 No 325

- Definite OHS 81
- COPD 35
- Restrictive 1
- Incomplete data 77

= OSA controls

OHS group vs controls

Significantly:
- Older 63 vs 58
- Higher BMI 41 vs 38
- More pre op CPAP
- More PMH of COPD, IHD, T2DM, CRF, BP, Smoking
- Given fewer general anaesthetics

Retrospective cohort
Elective non cardiac surgery n=1800
BMI >30
PSG before and within 5 years of surgery
ABG x2
### Post op outcomes

<table>
<thead>
<tr>
<th></th>
<th>OHS n=194</th>
<th>OSA n=325</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resp failure</td>
<td>21%</td>
<td>2%</td>
<td>10.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>8%</td>
<td>0%</td>
<td>5.4</td>
<td>0.002</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>2%</td>
<td>1%</td>
<td>3.8</td>
<td>0.002</td>
</tr>
<tr>
<td>ICU transfer</td>
<td>21%</td>
<td>6%</td>
<td>10.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Prolonged intubation,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reintubation. Death at 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>days, Death at 1 year</td>
<td></td>
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- High index of suspicion for OSA and hypercapnia in patients with high STOP-Bang score and unexplained elevated serum bicarbonate
- Perform sleep testing and measurement of arterial blood gases before elective surgery to further risk stratify patients
Conclusions part 2

- Care with opioids
- Post-op monitoring likely HDU setting
- Patients with obesity hypoventilation syndrome likely higher risk
- Consider venous bicarb pre-op to risk stratify
Does CPAP post-operatively improve outcome?
A Matched Cohort Study of Postoperative Outcomes in Obstructive Sleep Apnea

Could Preoperative Diagnosis and Treatment Prevent Complications?


- Hypothesis that CPAP reduces risk of post-operative respiratory & cardiac complications
- Matched cohort analysis from health administrative database
- OSA cases include both pre-op diagnosed and post op diagnosed using CPAP
- Up to 5 year post op follow up data
- N=16,277 low risk controls
- N=1571 pre op undiagnosed OSA
- N=2640 pre op diagnosed OSA
Prospective RCT
Orthopaedic patients only (hip or knee arthroplasty)
“High risk” of cardiac events excluded
Flemens sleep apnoea score performed
High score randomised to either standard care or CPAP post operatively: 138 enrolled; 52 low risk to usual care
Primary end points
- Reduced LOS
- Reduced post-op complications
Perioperative Auto-titrated Continuous Positive Airway Pressure Treatment in Surgical Patients with Obstructive Sleep Apnea

A Randomized Controlled Trial

Pu Liao, M.D.,* Guanwei Luo, M.D.,† Hisham Eisaad, M.D.,‡ Weimin Kang, M.D.,‡ Colin M. Shapiro, F.F.C.F.C.,§ Frances Chung, M.B.B.S.‖

- Prospective RCT
- Screening of peri-operative patients by STOP-BANG
- STOP- BANG >=3 home PSG
- AHI > 15/h randomised usual care v peri-operative auto-set CPAP
- Primary outcome AHI by polysomnography on night 3
- 2659 screened
- Mixture of surgery (mostly orthopaedic)

<table>
<thead>
<tr>
<th></th>
<th>CPAP</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>87</td>
<td>90</td>
</tr>
<tr>
<td>BMI</td>
<td>33.5</td>
<td>32.9</td>
</tr>
<tr>
<td>AHI (pre-op)</td>
<td>30</td>
<td>26</td>
</tr>
<tr>
<td>Age</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>Opioid use</td>
<td>63</td>
<td>53</td>
</tr>
<tr>
<td>Non-compliance/withdrawal</td>
<td>73%</td>
<td>79%</td>
</tr>
<tr>
<td>Complications excluding hypoxaemia</td>
<td>1.1%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Hypoxaemia</td>
<td>48.3%</td>
<td>48.3%</td>
</tr>
</tbody>
</table>
Continuous positive airway pressure (CPAP) during the postoperative period for prevention of postoperative morbidity and mortality following major abdominal surgery (Review)

Ireland CJ, Chapman TM, Mathew SF, Herbison GP, Zacharias M

<table>
<thead>
<tr>
<th>Number of studies</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>413</td>
</tr>
<tr>
<td>GRADE quality</td>
<td>Very low</td>
</tr>
</tbody>
</table>
CPAP for all?

- PRISM study
- International multi-centre study
- 1:1 randomisation CPAP post op v usual care
- Elective major abdominal surgery
- Plan to recruit 4800 patients

Primary outcome
- Composite endpoint of
  - Pneumonia
  - Re-intubation
  - 30 day mortality
- Completion due 2019
Final conclusions

- OSA and obesity prevalent
- High incidence of undetected OSA in surgical patients
- Probably increased surgical risk independently (lack of high quality evidence)
- Screen for OSA pre-operatively with STOP-BANG Questionnaires and polygraphy
- Are there alternatives to screening?
  - CPAP for all
  - OSA Anaesthetic protocol for all but high HDU usage
- No high quality evidence for any approach
- Need for a method to detect much higher risk cases
I reviewed this gentleman in preassessment clinic as a work up for an aortic aneurysm repair (58mm). I would be grateful if you would see him regarding potential obstructive sleep apnoea.

M    on scores highly for obstructive sleep apnoea using STOPBANG criteria. He describes daytime somnolence, falling asleep regularly during the day, not feeling refreshed on waking, and has less concentration than he used to.

Other past medical history includes BMI of 36, peripheral vascular disease, hypotension, type 2 diabetes, atrial fibrillation (on apixaban), high cholesterol and COPD. Pulmonary function tests were good in preassessment clinic on his current inhalers (FEV1 2.97, FEV1/FVC 73%). His cardiopulmonary exercise test was difficult to interpret. The test was stopped due to leg pain. He did not reach anaerobic threshold, maximum watts 63 and peak VO2 reached 10.4ml/kg/min (bearing in mind his weight of 116kg). His ventilatory equivalent slope was raised (44) and there was some evidence of desaturation during the test (to high 80's). An echo was therefore requested, which showed reasonable left and right ventricular function and no valve disease which was reassuring.

I spoke with M    on regarding his smoking status, exercise tolerance, weight management and diabetes control. He agreed to try cut down/ stop smoking and lose weight, but is keen to proceed with EVAR if deemed appropriate following the MDT.

I wondered whether it is worth considering sleep studies to determine whether treatment may be of any use to this gentleman. I informed him I would refer to yourself for consideration of further