

Relationship between Chronic Intermittent Hypoxia and Intraoperative Mean Arterial Pressure in Obstructive Sleep Apnea Patients Having Laparoscopic Bariatric Surgery

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Terminology





Medical Terms

- trocar
- hypoxia
- hypopnea
- hypoxemia
- hypotension
- baroreceptor
- vasopressors
- intraoperative
- cardiovascular
- polysomnography
- pneumoperitoneum
- oxyhemoglobin saturation
- laparoscopic bariatric surgery
- sympathetic adrenergic activity



Terms (cont.)

- a priori
- post hoc
- confounders
- consequent to
- confidence interval
- multivariable regression model
- retrospective observational study

Goals

Using what we have learned in our data science tutorial...



Abstract



Abstract

Background: Recurrent nocturnal hypoxemia in obstructive sleep apnea enhances sympathetic function, decreases baroreceptor sensitivity, and weakens peripheral vascular responses to adrenergic signals. The authors hypothesized that the percentage of total sleep time spent at oxyhemoglobin saturation (SaO_2) less than 90% and minimum nocturnal SaO_2 on preoperative polysomnography are associated with decreased intraoperative mean arterial pressure.

Methods: The authors examined the records of all patients who had laparoscopic bariatric surgery at Cleveland Clinic between 2005 and 2009 and an available polysomnography study. The authors assessed the relationships between the percentage of total sleep time spent at SaO_2 less than 90% and minimum nocturnal SaO_2 , and the time-weighted average of mean arterial pressure. The authors used multivariable regression models to adjust for prespecified clinical confounders.

Results: Two hundred eighty-one patients were included in the analysis. The average change in the time-weighted average of mean arterial pressure was -0.02 (97.5% CI, -0.08 , 0.04) mmHg for each 1% absolute increase in the percentage of sleep time spent at SaO_2 less than 90% ($P = 0.50$). The average change was -0.13 (97.5% CI, -0.27 , 0.01) mmHg, for each 1% absolute decrease in the minimum SaO_2 ($P = 0.04$ > significance criterion of 0.025, Bonferroni correction). An unplanned analysis estimated 1% absolute decrease in minimum SaO_2 was associated with -0.22 (98.75% CI, -0.39 , -0.04) mmHg, change in mean arterial pressure ($P = 0.002$) in the time period between endotracheal intubation and trocar insertion.

Conclusion: Recurrent nocturnal hypoxemia in obstructive sleep apnea is not a risk marker for intraoperative hypotension.



Materials and Methods





Patients

- eligible were all patients who had laparoscopic bariatric procedures between June 2005 and December 2009 and had a diagnosis of OSA with a polysomnography study performed within two preoperative years
 - patients 1) who did not have a polysomnography report available and/or those whose polysomnography reports were missing critical exposure variables such as the percentage of total sleep time spent at SaO_2 less than 90%, or minimum nocturnal SaO_2 , 2) missing any of the prespecified potential confounders, and 3) with severe cardiopulmonary disease associated with respiratory insufficiency and/or requiring oxygen supplementation during daytime or sleep were excluded
- the apnea/hypopnea and arousal indices were estimated by dividing the number of all events occurring during sleep with the total sleep time calculated as the sum of all sleep stage periods



Anesthetic Management

Vasopressors such as ephedrine, phenylephrine, or epinephrine were used to maintain blood pressure within 20% of preoperative level.



Outcomes and Exposures

- time-weighted average intraoperative MAP was the main outcome in our analysis
- our main exposure variables were the percentage of total sleep time spent at SaO_2 less than 90% and the minimum nocturnal SaO_2 listed in polysomnography reports, two parameters indicating the nocturnal oxygenation status of the patients with OSA



Statistical Analysis

- the time-weighted average of MAP is equal to the sum of the portion of each time interval in-between two adjacent MAP measurements multiplied by the average of the corresponding two MAP measurements and divided by the time interval between the first and the last MAP measurements
- 11 potential confounders including age, sex, race, body mass index, smoking status, diabetes mellitus, hypertension, coronary artery disease, preoperative use of antihypertensive medications, continuous positive airway pressure therapy, and type of bariatric surgery



Secondary Analyses





Secondary Analyses

- also evaluated the relationship between percentage of total sleep time spent at SaO_2 less than 90% and minimum nocturnal SaO_2 , and intraoperative use of vasopressor (yes vs. no), including ephedrine, epinephrine, and phenylephrine, each using a multivariable logistic regression
 - among patients who received vasopressor, further assessed the relationship between percentage of total sleep time spent at SaO_2 less than 90% and minimum nocturnal SaO_2 , and the total dose of vasopressor, using a multivariable regression model
- also conducted four unplanned exploratory analyses focusing on the associations between the percentage of total sleep time spent at SaO_2 less than 90% and minimum nocturnal SaO_2 , and the intraoperative time-weighted average of MAP, separately for the time periods spanning from endotracheal intubation to trocar insertion and from trocar insertion until the end of case, using the same statistical methods as in the primary analysis



Results





Secondary Analyses

- receiving vasopressor was not significantly associated with either percentage of total sleep time spent at SaO₂ less than 90% ($P = 0.86$) or minimum nocturnal SaO₂ ($P = 0.39$)
- the estimated average change in the total dose of vasopressor was -3 (97.5% CI, -14 to 8) μg for each 1% absolute increase in the percentage of total sleep time spent at SaO₂ less than 90% ($P = 0.59$), after adjusting for age, sex, and preoperative use of antihypertensive medications
- the estimated change in the dose was 9 (-16 , 34) μg for each 1% absolute decrease in the minimum nocturnal SaO₂ ($P = 0.41$), after adjusting for age, sex, smoking, diabetes, and preoperative use of antihypertensive medications



Exploratory Analyses

- consistently with our primary analysis, found that neither the percentage of total sleep time spent at SaO_2 less than 90% nor the minimum nocturnal SaO_2 , was associated with time weighted average of MAP, during the period spanned from trocar insertion to end of case
- however, the lower minimum nocturnal SaO_2 in the preoperative polysomnography was significantly associated with lower time-weighted average of MAP during the time period spanned from endotracheal intubation to trocar insertion ($P = 0.002$)



Discussion





Discussion

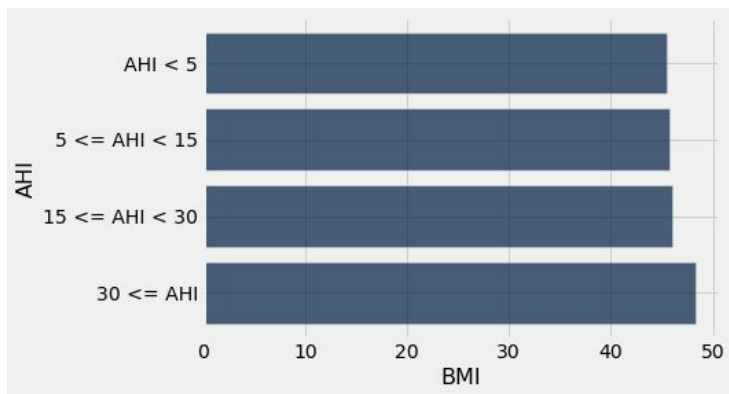
After adjusting for prespecified potential confounders, intermittent nocturnal hypoxia (measured by the percentage of total sleep time spent at SaO_2 less than 90% and the minimum nocturnal SaO_2) was not significantly associated with intraoperative MAP during laparoscopic bariatric surgery in patients suffering from OSA.

Jupyter Hub

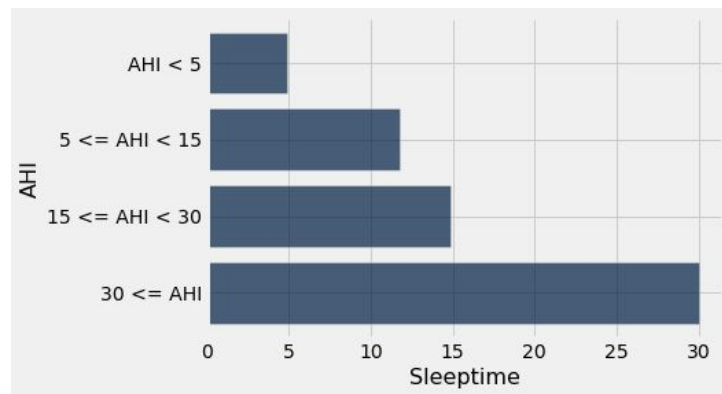
reference material for our markdown document

Bar Graphs

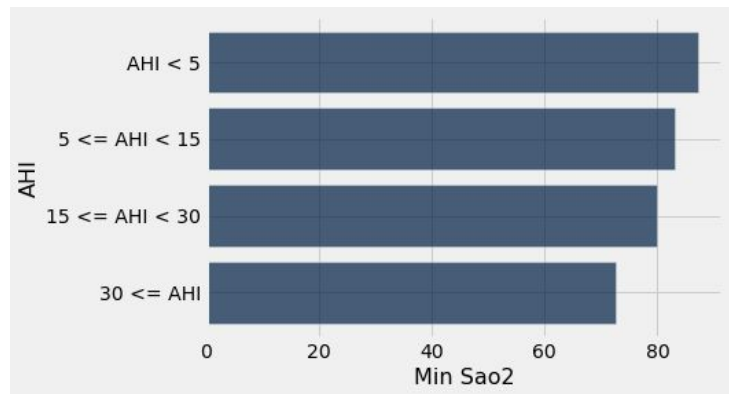
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in_order.select("BMI", "AHI").barh("AHI")
```



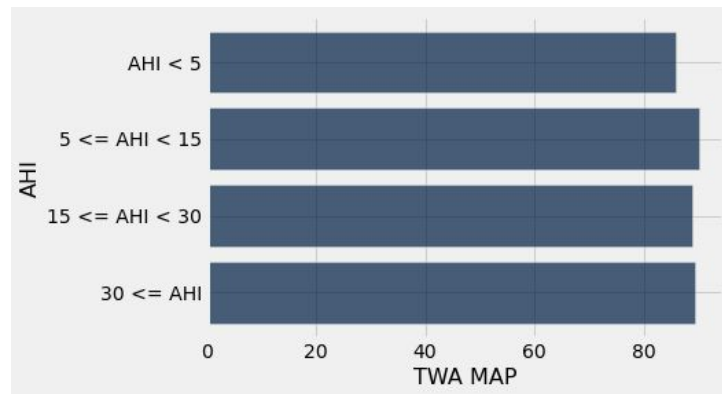
```
in_order.select("Sleeptime", "AHI").barh("AHI")
```



```
in_order.select("Min Sao2", "AHI").barh("AHI")
```

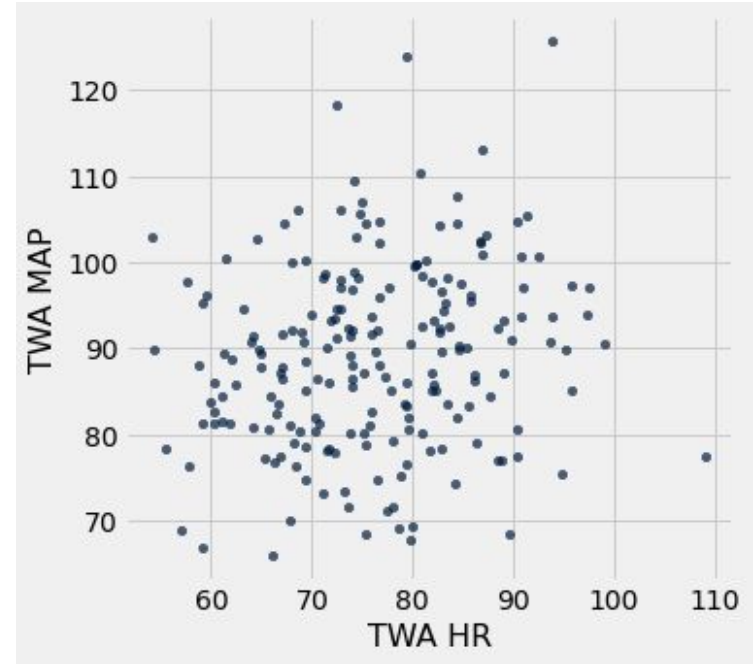
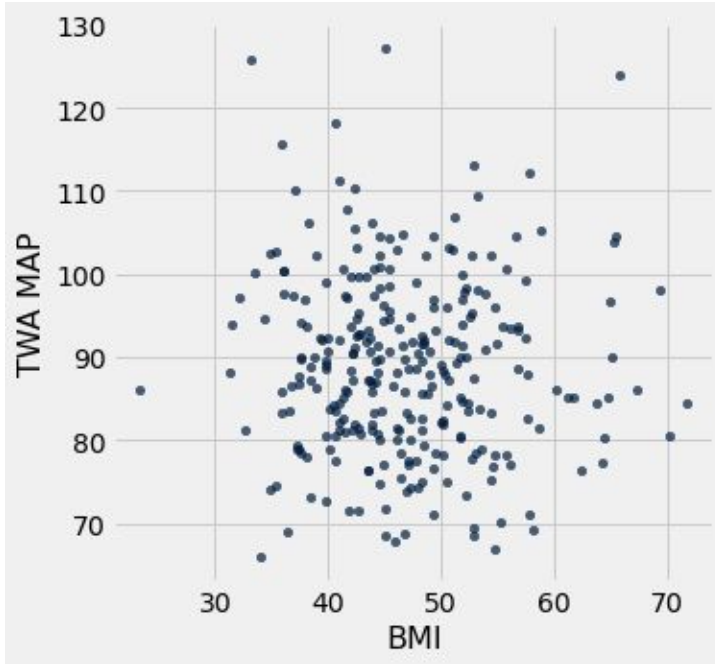


```
in_order.select("TWA MAP", "AHI").barh("AHI")
```



Correlation Coefficient r

No Correlation ($r=0$)



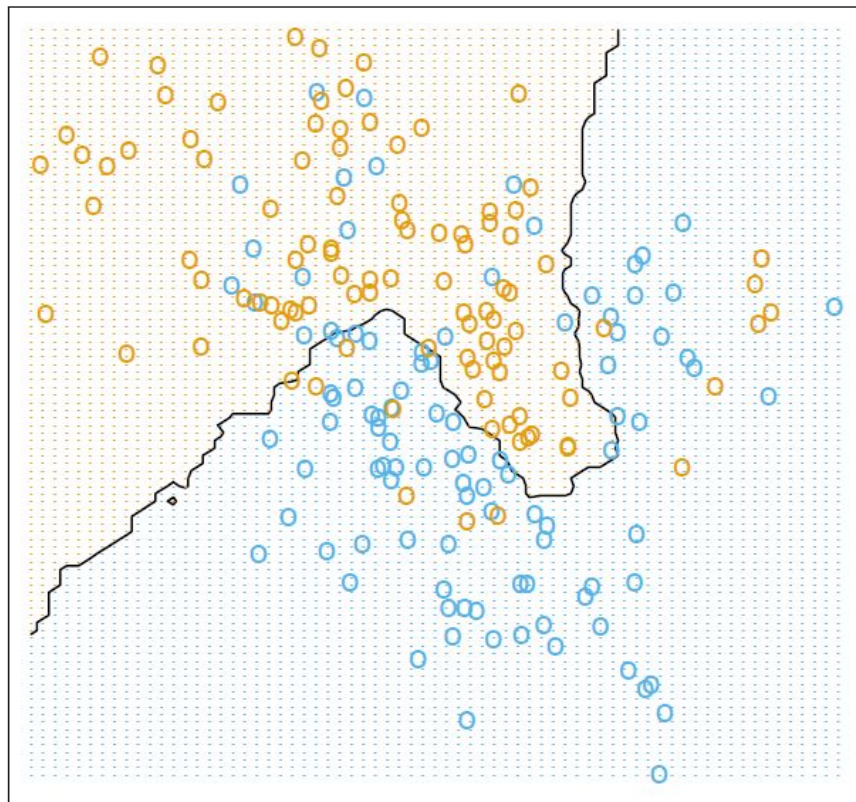
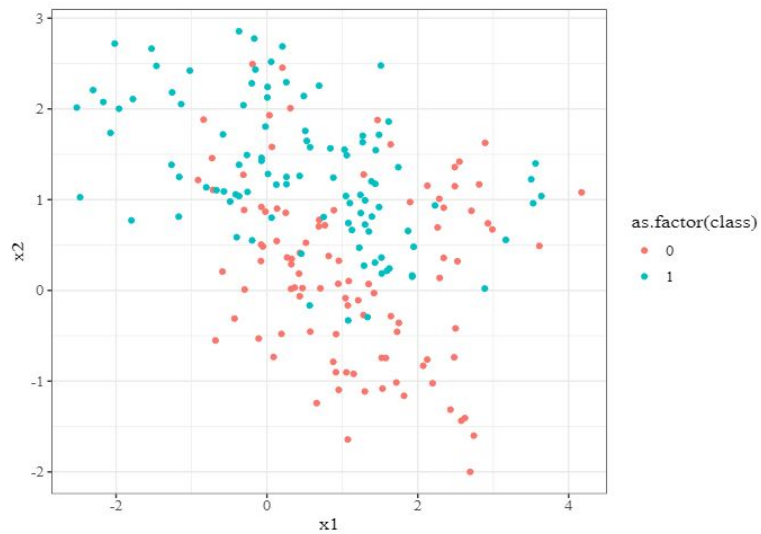


Classification



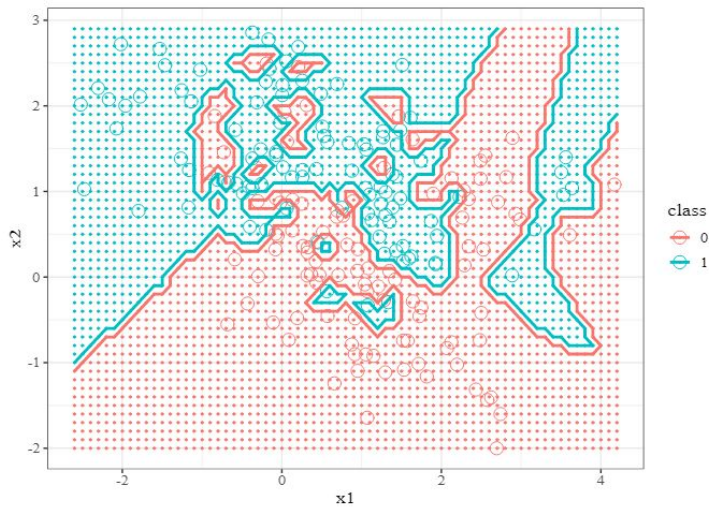


k-Nearest Neighbors

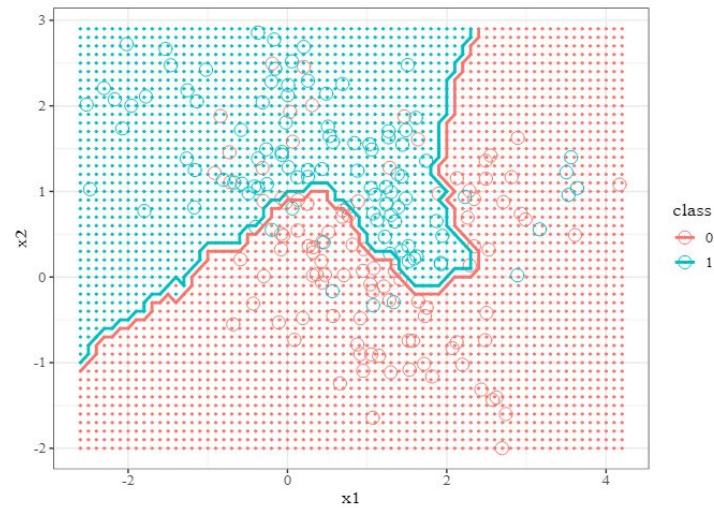


Decision Boundary

$k = 1$



$k = 15$



Markdown Tips & Tricks



Formatting



Make sure you select `Markdown` from the dropdown menu!

- | | |
|--|--|
| • headers | <code>#</code> |
| • bold, italic | <code>*text* or **text**</code> |
| • lists, quotes | <code>* text or > text</code> |
| • links | <code>[title](url)</code> |
| • pictures | <code>![title](image address)</code> |
| • lines, font sizes | <code>--- or \size</code> |
| • LaTeX (mathematical symbols and equations) | <code>\$math\$ (inline) or \$\$math\$\$ (display)</code> |

Tables Generator (click [here](#))

Questions?

Thank you!