A novel algorithm to predict desaturation in sedated patients with obstructive sleep apnea

Shao-Yun Hou, Shao-Chun Wu, Min-Hsien Chiang

Department of Anesthesiology, Kaohsiung Chang Gung Memorial Hospital and
Chang Gung University College of Medicine, Taiwan

Background and Goal of Study:

Obstructive sleep apnea (OSA) is a clinical condition characterized by frequent upper airway collapses during sleep. The prevalence of OSA is 3 to 7% generally and 2.1 to 4.5% in Asian population. Propofol-induced sedation was widely used in many medical procedures. However, hypoxia/hypoxemia was reported as common sedation-related complications. Patients with OSA and/or obesity were prompt to desaturation and need careful care with more preparation in maintain upper airway patency. Hence, the purpose of this study was to investigate the possible predictive factors of desaturation, develop a predictive algorithm and validate its accuracy finally.

Materials and Methods:

After obtained approval of the Institutional Review Board of Chang Gung Memorial Hospital, patients received surgical intervention for sleep apnea and proceeded with drug-induced sleep endoscopy were enrolled in our study. All medical history, demographic data, anesthesia record and polysomnogram (PSG) results between Jan 2010 and Feb 2012 were reviewed and collected. Patients who were suspected to have abnormal electroencephalographic activity (e.g. epilepsy, organic brain lesion or cerebrovascular accident) were excluded. Each patient didn't have any pre-medications (e.g. midazolam, dexmedetomidine etc). Intravenous lidocaine 1mg/kg and atropine 0.5mg were immediately given to prevent hyperactive mucosa response. Propofol was administrated to desired effect, settled by effect-site steering of the pharmacokinetic Schnider model. During the DISE, the patient was maintained with BIS=40-70. All clinical signs of heart rate, respiratory rate, blood pressure, pulse oximeter saturation and BIS were continuously monitored and recorded.

First 35 cases of PSG parameters (predictive factors) and desaturation outcome (lowest saturation<95% during DISE) were used to develop the predictive algorithm. Then the following 31 cases were used to validate the accuracy, sensitivity and specificity of algorithm. Two independent sample t test was used for continuous variables and categorical data was performed by chi-square or fisher's exact test. In order to predict desaturation, we did receiver operating characteristic (ROC) curve analysis for searching cut-off point (maximal sum of sensitivity and specificity) and being proved by the odds ratio of dichotomous comparison. In univariate analysis, potential significant predictors presented an area under curve (AUC) more than 0.7 or P<0.1 by chi-square or fisher's exact test were selected into a multiple binary logistic regression model.

Results and Discussion:

Among first 35 patients, there were 20 patients had desaturation during DISE. We test age, gender, BMI and PSG parameters. In ROC analysis (AUC>0.7 with P<0.1), we found six potential predictors, including AHI-total, AHI-REM, mO₂ < 90%, Average SpO₂, Lowest SpO₂, De-saturation index(Table.1). In our stepwise multiple logistic regression models, we found Average SpO₂ and AHI-REM were independent predictors(Table.2). Collectively, the simple algorithm to predict desaturation under sedation is the following: Average

SpO₂ < 95.05 or Average SpO₂ ≥ 95.05 with AHI-REM > 16.5. Otherwise, desaturation is nil(Figure 2).

The following 31 patients were used to validate the simple algorithm. There were 24 patients had desaturation during DISE. The predictive accuracy, sensitivity, positive predictive value and negative predictive value is 84% (26/31), 100%, (24/24), 83% (24/29) and 100%(2/2).

Table 1. Receiver operating characteristic (ROC) curve analysis and chi-square test in prediction of desaturation (SpO₂ < 95%) during DISE

Variables	AUC	Cut-off value	OR(95% C.I.)	P-value
Age	0.652	>42.5	6.00(1.27-28.25)	0.018*
BMI	0.485	>26.15	1.40(0.36-5.35)	0.625
ESS	0.538	>10.5	0.85(0.19-3.77)	1.000
AHI-TST	0.712	>24.25	4.57(1.03-20.35)	0.04*
AHI-REM	0.728	>16.5	8.50(1.71-42.28)	0.006*
AHI-NREM	0.667	>22.35	3.50(0.79-15.58)	0.144
Apnea-longest	0.579	>34.75	2.67(0.59-12.02)	0.266
Hypopnea-longest	0.485	>45.95	1.50(0.34-6.56)	0.712
mO ₂ <90%	0.743	>3.05	6.42(1.44-28.51)	0.011*
AverageSpO ₂	0.733	<95.05	17.11(1.87-156.26)	0.003*
LowestSpO ₂	0.732	<79.5	4.13(0.97-17.63)	0.050
De-saturation index	0.717	>14.2	3.50(0.86-14.30)	0.076
Arousal index	0.665	>27.4	3.00(0.74-12.13)	0.118
Snoring index	0.527	>136.05	1.24(0.31-4.93)	0.762

Table 2. Stepwise multiple logistic regression analysis of selected dichotomous variables (AUC>0.7 or P<0.1 in Table 1) in prediction of desaturation during DISE

Factors	OR (95% C.I.)	p
AHI-REM>16.5	7.45(1.18-47.07)	0.033
Average SpO ₂ <95.05	15.16(1.43-160.30)	0.024

Figure 1. An Algorithm (PSG data) to predict desaturation in sedated patients with obstructive sleep apnea during DISE