ORIGINAL ARTICLE

Can Measurement of Cephalic Shadow Predict Obstructive Sleep Apnoea- Result of an Analysis

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Abstract

Polysomnography is the gold standard for diagnosing OSA. But as it is costly, effort intensive, and not easily available. Hence, an effective and easy screening test is necessary for predicting OSA.

We tested several measurements from the shadow of head and neck of patients with polysomnography based diagnosis of OSA. These shadows were taken and subsequent different measurements on them were done observing a defined protocol; we named it cephalic shadowmetry. These measurements were compared with polysomnography derived variables and their co relationships were tested by Pearson's co relation co-efficient.

There was no statistically significantly co-relationship with. Apnea-hypopnea index (AHI) and any of the cephalometric measurements.

Keywords: Obstructive Sleep Apnoea (OSA), Apnoea Hypopnea Index (AHI), Body Mass Index (BMI), Cephalometry.

Introduction

Obstructive Sleep Apnoea (OSA) is a common but underdiagnosed clinical problem. The reason of OSA being grossly underdiagnosed are many; one of them being that PSG (the gold standard of diagnosing OSA) is not a widely available test and it is also costly, effort intensive and requires significant expertise to get it done and interpreted. These logistics being highly deterrent to address the patients with prospective OSA especially in the setting of the developing world.

Hence, a number of screening tests has been attempted. They are not uniformly efficient, simple and acceptably predictive in most of the time.

We attempted an innovative and simple method for predicting OSA by taking photography of shadows of the head and neck of the patients of OSA, measuring different distances and ratios to name it cephalic shadowmetry and finally comparing it with the PSG derived diagnostic variables. The purpose was to find out the capacity of any of the measurements or ratio of measurements to predict the presence of OSA in these subjects.

Methods

This study was done in sleep laboratory of the Institute of Pulmocare and Research, Kolkata between January 2006 to July 2006 after proper clearance from Ethics committee of the Institute. Fifteen newly diagnosed cases of OSAs willing to participate in this study were incorporated.

The Inclusion Criteria for Recruitment

a) newly diagnosed cases of OSA with AHI >5/hour, b) able to stand in a defined position in fixed extended neck.

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c) willing to participate in this study. Subjects not fulfilling these criterias or having significant spinal problems (e.g., Kyphosis, scolisis, or both) were excluded.

Before taking the head and neck shadow, the demographic details such as age, sex, height, weight, neck circumference etc. were noted. Thereafter, we took the photographs of the shadow of head and neck of these participants observing a defined protocol.

OSA was diagnosed by Polysomnography done with Embla S8000 machine and Somnologica software. Following parameters were measured in all patients- a) EEG b) EOG, c) EMG, d) nasal airflow, e) snoring, f) Oxygen saturation, g) Pulse rate h) Thoracoabdominal movements, i) ECG and j) body position.

The Shadow Taking Procedure

A patient who volunteered for the study stood erect at a distance of 75 cm form the wall with the heels touching each other over a straight line drawn on the floor. He kept his head straight with extended neck. A board was placed vertically on the wall with its centre passing through a line drawn perpendicular to the previous line on the floor as mentioned. The board was placed in such a fashion that the head and neck shadow could be casted on it when the light source placed at about 150 cm away form the patient on the other side. The light source was kept at the level of the ear of the patient (Figure 1).

When the light was projected on the patient, a shadow of the head with neck was casted on the board. The board was adjusted up and down to accommodate the shadow in it's centre. After a proper shadow is available the picture of the shadow ware taken by a digital camera that was kept at the height of the shoulder of the patient The coronal pictures were taken while the patient was looking at the board and the sagital pictures were taken while the patients looked right or left perpendicular to the previous plane.. Necessary precautions were taken so that the shadow of the camera did not encroach the board but just fell on the margin of the board.

Three to five photographs of the head-neck shadow were taken for each patient in each position and the photographs of the shadow were transferred to computer. The best of them has been incorporated for measurement in the "Shadow Cephalometry"

With help of CAD (Computer Aided Design) software three points have been fixed over the periphery of the shadow – (Figure 2)

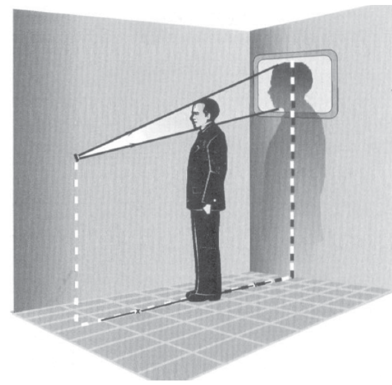

Figure 1: Shows shadow taking procedure of the patient. A light source is present about 150 cm from the patient. The shadow is casted on a board placed vertically on a wall on the opposite site.

1. shadow of nasion (i.e. junction between forehead and root of nose)
2. shadow of mentum.
3. the most distant point in shadow of vertex and from point (2)
4. shadow of Adam's apple

   Distance between point (1) and (2), (1) and (3), (2) and (3), (3) and (4) are named as A, B, C and D respectively. The ratio of them were also measured as A/B,A/C,A/D etc

The dependent variables available from the polysomnography were age, BMI, AHI, AI, HI. Independent variables have been taken from several measurements as mentioned above. The results were recorded for analysis.

Results and Analysis

Statistical analysis was performed with different variables and the relationship between independent and dependent variables was tested by Pearson's correlation co-efficient.

Fifteen Variable Correlation Matrix was Formed in Table 1

This table shows that age is positively correlated with A/C, B/C, B/D but negatively correlated with C/D, all are being significant statistically. BMI is negatively correlated

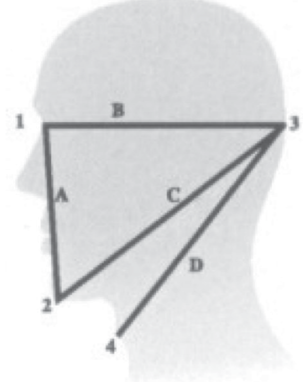

Figure 2: It is photograph of head neck region of the patient. Points have been fixed over the periphery of the hadow with help of CAD Software.

with A/C, A/D, B/C and B/D.

AHI has got no relation with any of the cephalometric shadow measurements.

OAI is seen to be positively correlated with A/B, A/D, though it is not significant statistically.

Similarly, AHI is found negatively correlated with A/B, A/C and A/D but not the relationship are statistically significant.

Discussion

The pre-polysomnography screening is a very important clinical practice in view of predicting the possibility of OSA since PSG is costly, effort intensive and not easily available. People have tried several methods to screen the high risk individual for OSA (2, 3). The Epworth Sleepiness Scale (ESS) has been tried widely (4), but it has several limitations (4, 5). Though ESS score >10 is considered positive, in OSA patients it varies between 4 to 21 (5). So, in many a times ESS fails to predict this ailment.

People have tried to asses the measurements of soft tissue from lateral view of head & neck x-rays in cephalometry (6,7). In some cases cephalometry can predict OSA from findings of craniofacial abnormalities and soft tissue dispotitions (8), but absence of any much abnormality does not rule out OSA.

Similarly measurement of neck circumference has been attempted to predict OSA (9). Obese patient with High BMI are found to have higher risk for OSA (10) and it is found that increasing neck circumference has a better predictive value to asses the severity of OSA than BMI (11). Again, association of increased neck circumference is not always helpful as in nearly 50% cases OSA occurs in lean nonobese subjects.

Nocturnal pulse-oximetry during sleep shows desaturation in OSA (12) but only in severe disease this change is appreciable. So pulse-oximetry can miss mild to moderate obstructive sleep apnoeas.

Hence, we decided to look for a simple method of shadow cephalometry. In our small effort, we tried to see whether measurements derived from the head neck shadow may help to predict OSA. Since OSA is a diagnosis of PSG, we incorporated only the patients diagnosed by PSG in this study. Different measurements taken from head and neck shadow and their ratios (e.g. A, B, C, D, A/B, A/C etc) have been correlated with different clinical and polysomnographic parameters .We could not find any correlation of AHI, AI, HI with any of the independent variables .

Although there were no correlations of AHI with any of the independent variables, there were positive a correlations of A/B, A/D with apnea index only. However it was not statistically significant. Incidentally, with the same variables when we compared the hypopnea index the correlation ship was a negative one. This has been difficult to explain. We did not find any correlation with BMI and AHI; this is observed by previous workers also. We also could not find any independent variable that correlated significantly with AHI or any other important parameters of OSA.

There was serious problems in defining the test. We have tried to standardize the shadow taking procedure as far as possible. But the most important weakness is that we could not fix any point on the scalp for presence of hair which also contributed to the dimension of the head shadow. Probably doing the same on bald people could help us to fix points of reference on the shadow more precisely.

Overall, the primary impression from the study is that shadow cephalometry tried by us is apparently inefficient to predict OSA. However, further studies are required to decide the actual status of shadow cephalometry in predicting a diagnosis of OSA.

Abbreviation used in the test

OSA Obstructive Sleep Apnea

Table 1

	AGE	BMI	A	B	C	D	A/B	A/C	A/D	B/C	B/D	C/D	AHI	OAI	HI
AGE	1.00	-.50	-.20	-.23	-.29	-.26	.20	.46	.36	.61	.63	-.47	-.43	-.36	-.01
	.	.02*	.24	.20	.15	.17	.24	.04*	.10	.01*	.00**	.04*	.05	.09	.48
BMI		1.00	-.25	-.20	-.16	-.17	-.34	-.51	-.49	-.52	-.66	.28	.32	.11	.22
		.	.19	.23	.28	.27	.11	.02*	.03*	.02*	.00**	.16	.11	.33	.21
A			1.00	.99	.98	.98	.30	.09	.23	-.23	-.04	.36	.00	.10	-.10
			.	.00**	.00**	.00**	.14	.37	.20	.20	.43	.09	.49	.36	.36
B				1.00	.99	.99	.18	-.01	.12	-.28	-.10	.39	-.00	.05	-.05
				.	.00**	.00**	.25	.48	.33	.16	.36	.07	.49	.43	.43
C					1.00	.99	.14	-.09	.06	-.37	-.17	.47	.01	.06	-.04
					.	.00**	.31	.38	.41	.09	.27	.04*	.47	.41	.43
D						1.00	.16	-.05	.09	-.32	-.14	.42	.01	.06	-.04
						.	.28	.43	.37	.12	.30	.06	.48	.41	.43
A/B							1.00	.87	.95	.34	.41	-.19	.01	.36	-.44
							.	.00**	.00**	.11	.07	.24	.48	.10	.05
A/C								1.00	.95	.75	.73	-.60	-.07	.17	-.30
								.	.00**	.00**	.00**	.01*	.39	.27	.14
A/D									1.00	.55	.65	-.33	-.08	.23	-.40
									.	.02*	.00**	.12	.39	.20	.07
B/C										1.00	.84	-.90	-.16	-.13	.01
										.	.00**	.00**	.29	.32	.47
B/D											1.00	-.53	-.30	-.20	-.10
											.	.02*	.14	.24	.36
C/D												1.00	.01	.05	-.11
												.	.48	.42	.35
AHI													1.00	.77	.38
													.	.00**	.07
OAI														1.00	-.26
														.	.16
HI															1.00

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (1-tailed).

PSG Polysomnography

EEG Electroencephalography

EOG Electrooccolography

EMG Electromyography

ECG Electrocardiography

AHI Apnea hypopnea index

AI Apnea index

HI Hypopnea index.

ESS Epworth Sleepiness Scale.

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