Can Apneagraphy Change Our Approach in Management of Snoring and Sleep Apnoea?

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Abstract To evaluate role of overnight domiciliary apneagraph in diagnosing severity of sleep apnoea. Prospective audit of 37 patients with Epworth sleepiness score over ten and all patients with history of sleep apnoea presenting to ENT outpatient clinic investigated with apneagraph. Data analysed initially with pulse oximetry findings alone followed by analysis with full apneagraph findings. Results: Data analysed with pulse oximetry alone showed 31 patients to be simple snorers, but on analysis with apneagraph, 11 of these were shown to be suffering from moderate and one with severe sleep apnoea. There was no correlation between Epworth sleepiness score and severity of sleep apnoea. Conclusion: Management plan can be more evidence based by using apneagraph as a mini sleep study in investigating patients with history of obstructive sleep apnoea. Apneagraph could also be used in diagnosing the level of obstruction in snorers; however, this aspect needs further studying.

Keywords Apneagraph · Obstructive sleep apnoea · Snoring · Sleep study

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Introduction

The estimated prevalence of snoring in United Kingdom is 25–40%, around 10 million adults being possible snorers [1]. According to the British Lung Foundation [2], 110,000 people in UK suffer from some degree of sleep apnoea and three in every thousand men suffer from severe sleep apnoea. The incidence of sleep apnoea itself is considerably higher in long distance drivers such as lorry drivers, consequences of undiagnosed and untreated cases here can be obviously fatal or serious. Only one in every ten sufferers is diagnosed and treated; the provision of treatment to diagnosed cases is also estimated to be lower in UK as against most developed countries [3].

Snoring is a coarse sound made by vibrations of the soft palate and other tissues in the mouth, nose & throat. A variety of procedures have been described to widen and stiffen the upper pharyngeal airway, however, the success rates of these surgeries vary from 40 to 80% [4]. Finding the site of obstruction is the key to successful outcomes in management of snoring. Tvinnereim [4] has demonstrated good objective outcomes following use of coblation device in the region of soft palate.

Obstructive sleep apnoea (OSA) is defined as cessation of airflow during sleep preventing air from reaching lungs due to an obstruction. It can range from mild to severe depending on the number of apnoeic and hypopnoeic attacks per hour at sleep, i.e. apnoea/hypopnoea index (AHI). This can be measured by sleep study with polysomnography or apneagraphy. OSA is a known risk factor for developing hypertension, cardiac arrhythmias and cardiovascular accidents [5, 6]. Hence severe sleep apnoea sufferers should be provided with continuous positive airway pressure (CPAP) therapy. However, the compliance with use of CPAP is known to be poor [7].

In current practice, history, clinical judgement and pulse oximetry are the most commonly used tools in screening obstructive sleep apnoea. Diagnosis and severity of OSA is confirmed by polysomnography (PSG). Patients who give a history of sleep apnoea noticed by their sleep partners, or those suspected to have sleep apnoea on the basis of excessive daytime sleepiness giving a high Epworth sleepiness score (ESS), are initially investigated with overnight pulse oximetry to notice any significant drop in oxygen saturation. Suspected patients are then investigated with PSG to confirm the diagnosis and determine the severity of OSA.

The apneagraph is a relatively new, useful diagnostic tool, which aids the precise diagnosis of obstructive sleep related breathing disorders and also shows the site of obstruction [4]. It stores and analyses the cardio-respiratory pattern of a patient and simultaneously records changes in pressure at two different sites in the upper airway, thus identifying the segment of airway obstruction during sleep. It is an ambulatory device consisting of a nasal catheter with pressure and temperature sensors, which is connected to a data logger. There is a pulse oximetry probe which is also connected to the data logger. This data logger stores all the information in a data card and it can be set into automatic mode to start recording at a set time and stop automatically after 6 h. Information from the data card can then be transferred into a computer with help of software and stored for future analysis. It is a mini sleep study which can be used only for the diagnosis of sleep apnoea. This sleep study is validated against full PSG [8]. It is highly cost-effective as against PSG; it does not require a sleep technician or a sleep physician for interpretation of results. Also it does not need overnight stay in hospital.

Methodology

Thirty-seven patients with snoring & symptoms of OSA were investigated with apneagraph in a pilot audit study. These patients were assessed with detailed history from patient & partner including ESS and intensity of snoring on visual analogue scale (VAS), clinical examination and apneagraphy to record overnight pulse oximetry, AHI and site of obstruction.

The apneagraph results were split into two arms; one arm showing overnight pulse oximetry findings alone and other arm containing full detailed apneagraph findings which included AHI, level of obstruction and pulse oximetry.

One trained clinician was randomly presented with the clinical details and pulse oximetry findings of patients and asked to give opinion regarding diagnosis, level of obstruction and management plan.

Following this, the same clinician was randomly presented with clinical details and apneagraph findings of these patients and asked to give opinion regarding diagnosis, level of obstruction and management plan.

The differences in diagnosis and management plan obtained with each arm of investigation were then compared.

Results

Data collection was done with help of a proforma being filled in clinic. This was to aid in availing complete data on one sheet of paper. 37 case notes were reviewed.

The following standards were taken into consideration to compare our results with:

- ESS < 10: normal [9]
- ESS 10–14: possible sleep disorder [9]
- ESS > 14: definite sleep disorder [9]
- Apnoea/Hypopnoea index (AHI) < 5: normal
- AHI 5–14.99: mild OSA
- AHI 15–29.99: moderate OSA
- AHI > 30: severe OSA

Male to female ratio was 29:8. The age range was 29 to 78 years; average age of 48.05 years. BMI range was 21.6 to 38.9 with a mean of 29.98. The ESS ranged from 1 to 17. The individuals with ESS < 10 were ones who had a clinical history of sleep apnoea. On the apneagraphy findings, the AHI ranged from 0.6 to 88.3. 31 patients showed obstructive type of sleep apnoea and six patients had mixed sleep apnoea (obstructive apnoeic spells and central apnoeic spells). As per the AHI classification, seven patients were simple snorers, 12 patients had mild OSA, 12 patients had moderate OSA and four patients had severe OSA on apneagraphy. Of the four patients diagnosed as severe OSA, two patients were overweight, one was obese and one was very obese (Table 1).

We compared the ESS of patients against their severity of OSA (Table 2). It was seen that of eight patients who

Table 1 BMI correlation in patients with OSA

BMI	Simple snorer	Mild OSA	Moderate OSA	Severe OSA	Total
<25	1	1	1	0	3
25–29.99	3	7	5	2	17
30–34.99	3	3	3	1	10
>35	0	1	3	1	5
Total	7	12	12	4	35

BMI body mass index, OSA obstructive sleep apnoea

Table 2 ESS correlation with OSA

ESS	Snorer	Mild OSA	Mod OSA	Severe OSA	Total
<10	2	3	3	0	8
10–14	2	6	8	3	19
>15	0	3	1	1	5
Total	4	12	12	4	32

ESS Epworth sleepiness scale, OSA Obstructive sleep apnoea

had ESS < 10, only two were found to be simple snorers, three had mild OSA and three had moderate OSA. This clearly shows that it is extremely difficult to identify patients with OSA on the basis of ESS score.

As per the history, 13 patients admitted to history of sleep apnoea, noticed by partners. Of these two were diagnosed as simple snorers, three patients had mild OSA, five patients had moderate OSA and three patients had severe OSA. Even more interesting is the fact that one patient who denied any sleep apnoea, had severe OSA on apneagraphy and seven patients who denied sleep apnoea had moderate OSA. This strengthens the fact that it is not possible to identify patients with sleep apnoea on the basis of history and more so, it is not possible to rule out sleep apnoea on history alone.

We then compared the pulse oximetry findings with the apneagraphy findings. The criterion used to investigate patients with low oxygen saturation is not clear yet. However, patients with O₂ saturation below 90% may need further investigation. It also depends on the duration of such dip. In our set of patients it was seen that almost all patients had an amount of drop in saturation below 90%. Amongst snorers, the lowest saturation noted was 88% lasting less than a minute. It was found that patients could have a varied duration of drop in O₂ saturation depending on the severity of sleep apnoea; however, there is no set pattern to classify the sleep apnoea on the basis of drop in O₂ saturation. Even patients with moderate sleep apnoea have demonstrated drop in O₂ saturation below 65%.

A comparison of the diagnosis with and without apneagraphy findings is summarised in Table 3. It is seen that with pulse oximetry and clinical findings, the diagnoses were mainly in 3 groups; simple snorers, snorers with

possible apnoea and snorers with definite apnoea. Whereas, with apneagraphy, the diagnosis is more precise; snorers without apnoea and snorers with mild, moderate or severe sleep apnoea. 31 patients were diagnosed as simple snorers on basis of clinical diagnosis whereas only six of these were truly simple snorers. 13 of these had mild degree of sleep apnoea, 11 had moderate OSA and one had severe OSA. This shows a 3% possibility of missing out severe OSA and treating a patient with severe OSA as a simple snorer. Out of 14 patients with moderate OSA only three were diagnosed clinically as possible OSA.

With apneagraphy, the level of obstruction is classified as upper segment involvement (soft palate and above), lower segment (base tongue and below) or mixed involvement. There were 18 patients with upper segment involvement, 15 with lower segment involvement and five with upper and lower segment involvement (i.e. multilevel involvement). The clinical diagnosis only identified palatal level of obstruction in all of them and nasal level in some. This indicates that operating on palate/nose on all these patients on the basis of clinical diagnosis alone could be the reason for failure to achieve success in improvement in snoring.

Finally, we compared the management plan between the two groups (Table 4). It can be seen that a lot more patients would be referred for CPAP therapy following apneagraphy. Also, few of those who will be operated on palate would need counselling regarding possible failure or unsatisfactory results due to presence of multilevel pathology. Patients who are overweight or obese would be suggested weight loss regardless of their sleep study as it is known to reduce the intensity of snoring. A mini sleep study like apneagraphy may help in counselling patients for weight reduction and encourage more commitment on their behalf.

Discussion

An audit of snoring service presented by our ENT department at the Royal College of Surgeons in 2002 showed only 70% success due to difficulty in identifying the site of obstruction [10]. An initial retrospective audit was performed in 2008 to check the postoperative results in terms of improvement of snoring. This audit demonstrated

Table 3 Comparative diagnosis with and without apneagraphy

Diagnosis with clinical findings and pulse oximetry	Diagnosis with apneagraphy				
	Simple snorer	Mild OSA	Mod OSA	Severe OSA	Total
Simple snorer	6	13	11	1	31
OSA	0	0	0	3	3
Possible OSA	0	0	3	0	3

OSA Obstructive sleep apnoea

Table 4 Comparative management plan with and without apneagraphy

Management plan	Wt loss	CPAP	Surgery on palate	Treatment to nose	Other
Without apneagraph	19	6	13	10	1 (Tonsillectomy)
With apneagraph	19	16	9 (Four with counselling regarding possible failure)	8	0

CPAP continuous positive airway pressure

79% improvement in VAS scores of >2 points following coblation palatoplasty and 70% improvement in VAS scores of >2 points following somnoplasty. The lacunae identified in this audit were mainly lack of objective outcome measures to estimate the success rates of these procedures. Also, the decision regarding suitability for surgery and the type of surgery offered has been on clinical grounds and on surgeon's choice of available armamentarium. Possible associated sleep apnoea was diagnosed on the basis of history, Epworth sleepiness score (ESS) and body mass index (BMI) followed by pulse oximetry in suspected sleep apnoea cases. Only patients with severe sleep apnoea could be screened this way and these would need further sleep study for confirmation of diagnosis.

Sleep related breathing disorders account for a large number of referrals to the ENT and chest service in our Trust. In 2005–2006 the numbers of new patients seen in ENT clinics were 5,000 of which sleep disorders accounted for 400 (8%). With the existing management practice in patients presenting with snoring in an ENT clinic, there is a possibility of missing out people who may have associated sleep apnoea, but do not commit to this in their history due to financial and social reasons or may not have recognised this problem due to ignorance. Keeping all these facts in mind, we did a literature search on the available diagnostic modalities to aid a more evidence based approach to our practice in management of snoring and sleep apnoea. Tvinnereim [4] has documented use of apneagraph in their study to evaluate the effectivity of coblation palatoplasty in these patients. This certainly looks like an economically attractive, domiciliary investigatory tool, which could help in informing our management practice.

There is a huge amount of literature available on surgical management of snoring and sleep apnoea. However, the basic problem is the lack of knowledge on diagnosing the exact level of obstruction which could be different in different groups of snorers and there could be multiple level involvements in some individuals [1]. Thus, one operation cannot be the answer to every snorer. The commonest procedures performed in management of snoring are at the soft palatal level. This could be due to easy accessibility. Other procedures include nasal surgeries like septoplasty and polypectomy, base tongue volume reduction, mandibular advancement surgeries etc. Again, the use of apneagraph

could aid in diagnosing the level of obstruction and thus guide in the choice of appropriate surgery for snorers.

Our study has shown that apneagraphy has helped in identifying many more snoring patients with sleep apnoea than pulse oximetry alone. Our management plan has changed, to be more evidence based, with many more referrals for CPAP therapy and appropriate selection of patients for palatoplasty. Those patients, who showed multilevel obstruction, were offered palatoplasty with a guarded prognosis. We do not yet perform surgeries for reduction of volume of tongue base in our trust. However, this could be one option offered in patients with huge tongue base clinically and lower segmental obstruction apart from referral to oral and maxillofacial surgeon for trial of mandibular advancement devices. In this study, we have not followed up our patients with post op apneagraphy. It will be useful to compare the pre-op and post op results of apneagraphy to check for any improvement following surgery. It will also give us an idea of the accuracy of this tool in diagnosing the level of obstruction. This area needs further evaluation and is still in the preliminary phase. There are no such trials in literature which prove the usefulness of this device in diagnosing level of obstruction, although, use of pressure transducers for diagnosis of level of obstruction is known [1]. Weight loss is one of the management options which remain the same in both groups of patients where BMI suggests overweight or obesity. This shows that clinical examination and judgement also do play an important role in the diagnosis of snoring and sleep apnoea. This is the first line management in overweight patients and should remain so. Patients who fail to lose weight should also be counselled with the possibility of poorer outcome post surgery. Also, the apneagraphy only tends to define a broad segment of airway obstruction. For example, upper segment obstruction means anywhere from nose to palate. Here again the clinical judgement plays an important role to decide upon the appropriate treatment for example treatment of intrinsic/allergic rhinitis, septoplasty, palatal surgery etc. There is no alternative to expertise in clinical otolaryngology skills of the surgeon in management of snoring.

We presented this audit in our departmental audit meet and also in Royal College of surgeons, Edinburgh, audit symposium. There were some suggestions and recommendations proposed in our departmental audit meet, which are being

implemented in the second phase of this audit cycle. These are as follows:

- Repeat apneagraph following surgery (6 weeks post op)
- Compare pre and post surgery ESS
- Compare pre and post surgery apneagraphy
- Further audit after above

Conclusion

Management plan can be more evidence based by using apneagraph as a mini sleep study in investigating patients with history of OSA. Apneagraph also determines the level of obstruction as upper or lower. This information can be used in deciding the type of surgery for patients with snoring. The implications for treatment decisions are profoundly influenced if patients also suffer from moderate or severe sleep apnoea as compared to simple snoring. Further audit on comparing apneagraph findings after treatment will be useful.

Conflict of interest The authors declare that they have no conflict of interest.

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