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The Obstructive Sleep Apnoea Syndrome – Experience of a Referral Centre

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ABSTRACT

Objective: The aims of this study were: (i) to document the presence and severity of obstructive sleep apnoea (OSA) in patients who complained of heavy snoring and other symptoms suggestive of the OSA syndrome; (ii) to examine the correlation between the clinical and polygraphic findings, and (iii) to document the efficacy and compliance of nasal continuous positive airway pressure (CPAP) among these Asian snorers with OSA.

Methods: We analysed our clinical and nocturnal polysomnographic data between January 1986 and December 1995 for physician-referred patients who had complained of snoring and other symptoms suggestive of OSA.

Results: A total of 277 diagnostic studies were performed of which 145 (52%) were positive to OSA. For studies performed in the last 2 years (n = 125), 72 of the 125 were positive for OSA. Anthropometric data was not discriminative between the OSA positive snorers and the OSA negative snorers. We found that hypertension and choking were the most significantly related to OSA, conferring a 7 and 4 times relative risk respectively. Nasal CPAP eliminated snoring, apnoeas and oxygen desaturations completely in almost all cases and there were only minor mask-related side effects.

Conclusion: OSA may not be uncommon among Asian snorers. Of the major traits for OSA risk among our local population, a history of hypertension and reports of nocturnal choking were the most significantly related. We have also shown that nasal CPAP is safe and effective among our local snorers and should be considered a first-line treatment for OSA.

Keywords: obstructive sleep apnoea, snoring, apnoea-hypopnoea index, nasal continuous positive airway pressure

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INTRODUCTION

The obstructive sleep apnoea (OSA) syndrome consists of nocturnal snoring interrupted by recurrent obstructive apnoeas and hypopnoeas[1] and daytime hypersomnolence as a consequence of sleep fragmentation. Less common but reported features include morning headache, intellectual deterioration, personality changes, nocturnal enuresis, abnormal motor activity during sleep, impotence[2] and psychosis[3]. Diagnosis is confirmed by overnight polysomnography.

Patients with OSA suffer considerable morbidity, and there is increasing evidence that they have an increased mortality[4,5]. The two main effects of OSA are: (i) sleep fragmentation which may lead to dangerous daytime sleepiness[6,7], and (ii) nocturnal hypoxaemia which may lead to cardiac failure, hypertension and cerebrovascular disease[8,9].

While this disorder was found to be common in the West, its prevalence is uncertain in South East Asia[10]. There have been only a few small series case reports of OSA in this region[11,12]. Although an estimate of the prevalence is not possible, underdiagnosis is the clinical impression[10,12]. This paper represents our 10-year experience with snorers referred for suspected OSA to the Department of Respiratory Medicine, Tan Tock Seng Hospital, Singapore, from 1986 to 1995.

METHODS

We analysed our clinical and nocturnal polysomnographic data for physician-referred patients who had complained of symptoms suggestive of OSA. These patients were referred to the Respiratory Medicine Outpatient Department of our hospital. The main reason for referral was heavy snoring in all cases. Other symptoms included variable daytime hypersomnolence, unrefreshed sleep, early morning headaches, nocturnal choking and/or apnoeas during sleep observed by a bed-partner, recent memory deterioration or a change in personality in the last 6 months, sexual impotence, lack of concentration at work, a decrease in work performance and a recent major road traffic accident. A detailed clinical history and physical examination was performed in each patient.

Sleep studies

Polysomnographic records of all sleep studies performed at our institution between January 1986 and December 1995 were reviewed. All patients underwent physician-monitored overnight sleep studies for at least six hours. The following parameters were simultaneously and continuously recorded: oro-nasal airflow was measured by a thermistor (Somniprobe, Somnotec Inc., Van Nuys, CA), while thoraco-abdominal movements were qualitatively measured with the use of respiratory inductive phlethysmography (Respitrace System, Respitrace Corp., Ardsley, NY) after calibration with the isovolume manoeuvre. Arterial oxyhaemoglobin

saturation (SaO_2) and heart rate were measured with a pulse ear oximeter (Ohmeda Biox III, Ohmeda Corp., Boulder, CO). All studies between 1986 – 1993 (n = 175) were recorded on a multichannel recorder (Gould 2800S, Gould Inc., Cleveland, OH) and were scored manually. Studies in the last two years (1994 – 1995, n = 145) were performed in a dedicated sleep laboratory and recorded and stored into a digital multichannel recorder (Somnostar 4100, Sensormedics, Ver: ISS-0804-05). These studies were first manually reviewed and then scored with the aid of a computer programme.

All patients were monitored throughout the night by an attending doctor. Sleep studies were repeated in patients who required nasal continuous positive airway pressure (CPAP) for titration and treatment of OSA. Nasal CPAP was provided either with a Sleep Easy II System (studies between 1986 – 1993) or a Respironics BIPAP System used in the CPAP mode (both systems by Respironics Inc., Murrysville, PA) through a snugly fitting nasal mask. The airway pressure was monitored with a calibrated pressure transducer (Validyne MP 45-871, Northbridge, CA) connected to a port of the nasal mask by rigid tubing. Positive airway pressure was titrated in order to determine the airway pressure which alleviated the apnoeas, snoring and desaturations.

Studies were classified into two main categories: baseline/diagnostic studies (DG) and nasal CPAP studies.

Analysis of sleep data

Apnoea was defined as the cessation of oro-nasal airflow for at least 10 seconds in duration. Obstructive apnoea was defined as the cessation of oro-nasal airflow despite the presence of respiratory movements as measured by inductive plethysmography while central apnoea was the absence of both oro-nasal airflow and respiratory movements. Mixed apnoea was defined as the occurrence of central apnoea early in the episode of apnoea followed by obstructive apnoea later in the episode. Hypopnoea was defined by a reduction in airflow by 50% or greater for at least 10 seconds. The apnoea-hypopnoea index (AHI) was derived from the ratio of the total number of apnoeas/hypopnoeas observed to the total sleep time in hours. Total sleep time was estimated from the total bedtime. Allowing for potential differences between the two values, the calculated AHI would underestimate rather than overestimate the value. Sleep apnoea was defined as more than 5 episodes of apnoea or hypopnoea per hour of sleep (mild OSA defined as AHI 5 to < 20, moderate OSA, AHI 20 to < 50, severe OSA defined as AHI $\geqslant 50$).

Detailed subset analyses were performed for studies done in the last two years as more data were collected with the introduction of the digital multichannel recorder system and all case records were still available for reference. In addition, a survey was performed in April 1996 for all our patients who were started on nasal CPAP in the last 10 years, to determine compliance of nasal CPAP therapy and side effects of nasal CPAP. Subjective reports of resolution of daytime sleepiness, side effects of nasal CPAP, number of nights per week and number of hours per night of nasal CPAP use, and total duration of therapy from the beginning of CPAP usage to the time of the survey were used to assess effectiveness and compliance.

Statistical analyses of data

The anthropometric data was analysed by student's t-test. The clinical data were grouped into the presence or absence of polygraphic criteria for OSA and compared using chi-squared test. Significance was assumed if $p < 0.05$. The clinical variables from the various sub-groups that were statistically significant for OSA (hypertension, nocturnal choking, daytime hypersomnolence, recent memory loss, recent personality change, lack of concentration at work and presence of thick neck) were then analysed by multiple logistic regression analysis. Odds ratios with 95% confidence intervals were then calculated by means of a logistic regression model (SPSS for MS Windows Release 6.0).

RESULTS

All studies performed (1986 – 1995)

A total of 320 sleep studies were performed over the 10-year period. These included: diagnostic (DG) = 277 and nasal CPAP = 43. Of the 277 DG studies, 145 (52.3%) were positive for OSA. Of those positive for OSA, the male : female ratio was 15:1, and the ethnic breakdown was as follows: Chinese 71%, Malays 17.9%, Indians 8.3% and Others 2.8%.

Studies performed in 1994 – 1995

Detailed analysis of the DG studies performed in the last 2 years (n = 125) yielded the following results: mean age for all snorers was 37.2 years (SD ± 13.1) and the average body mass index (BMI) was 28 kg/m^2 (SD ± 7.2). Seventy-two of the 125 studies (57.6%) were positive for OSA (mild = 32, moderate = 16, severe = 24). The average AHI of these 72 positive cases was 33.9 (SD ± 23.8) and the mean BMI was 29.4 kg/m^2 (SD ± 8.3). Twenty patients were treated with nasal CPAP in the last two years. The mean AHI of the 20 cases before nasal CPAP therapy was 40.2 events per hour (SD ± 20.5) and the mean oxygen saturation 89.7% (SD ± 7.9); the corresponding figures while on nasal CPAP were AHI 1.1 events per hour (SD ± 2.7), and mean oxygen saturation 95.2% (SD ± 3.6).

There was a predominance of men in both groups (OSA positive and OSA negative), but the sex distribution within the two groups was not significantly different. Snorers with OSA were not significantly heavier or taller than their counterparts who were negative for OSA (Table I). Age was also not a discriminating factor between the two groups of snorers. Thus there were no statistically significant differences in the age, sex distribution, weight, height or body mass index (BMI) between the OSA positive and OSA negative snorers.

Table I – Anthropometric details of OSA negative versus OSA positive snorers

	OSA -ve snorers (n = 53)	OSA +ve snorers (n = 72)	*p* value
Age	34.6 ± 13.5	39.1 ± 12.5	0.06
*Sex	43 M : 10 F	66 M : 6 F	0.14
BMI (body mass index)	26.4 ± 4.7	29.4 ± 8.3	0.07
Weight	73.4 ± 13.6	81.4 ± 26.1	0.21
Height	166.7 ± 7.8	166.6 ± 10.8	0.30

$p > 0.05$ for all variable by Student's t-test (*sex was anlysed by chi-squared test).
-ve : negative
+ve : positive

Table II – Comparison of symptoms in OSA negative versus OSA positive snorers

Symptom	OSA -ve snorers (n = 53) (%)	OSA +ve snorers (n = 72) (%)	*p* value
*Daytime hypersomnolence	27/53 (51)	56/72 (78)	0.003
*Nocturnal choking	8/53 (15)	39/72 (54)	< 0.0001
*Recent memory loss (within 6 months)	2/53 (4)	19/72 (26)	0.002
*Personality change (within 6 months)	2/53 (4)	14/72 (19)	0.02
Headache	4/53 (8)	10/72 (14)	0.41
Sexual impotence/loss of libido	0/53 (0)	6/72 (8)	0.08
*Lack of concentration at work	10/53 (19)	33/72 (46)	0.003
Decreased performance at work	4/53 (8)	13/72 (18)	0.15
Road traffic accident	0/53 (0)	2/72 (3)	0.62

*p < 0.05 by chi-squared analysis for daytime hypersomnolence, nocturnal choking, recent memory loss, personality change and lack of concentration at work. Above values given as proportion of the group total; percentages are given in parenthesis.

Table III – Comparison of co-morbid medical conditions in OSA negative versus OSA positive snorers

Medical condition	OSA -ve snorers (n = 53) (%)	OSA +ve snorers (n = 72) (%)	*p* value
*Hypertension	2/53 (4)	23/72 (32)	0.0002
Ischaemic heart disease	1/53 (2)	4/72 (6)	0.57
Diabetes mellitus	0/53 (0)	2/72 (3)	0.62
Cor pulmonale	0/53 (0)	4/72 (6)	0.73

*$p < 0.05$ for hypertension, by chi-squared anlaysis. Above values given as proportion of the group total; percentages are given in parenthesis

Table IV – Comparison of ear, nose, throat (ENT) abnormalities in OSA negative versus OSA positive snorers

ENT abnormality	OSA -ve snorers (n = 53) (%)	OSA +ve snorers (n = 72) (%)	*p* value
*Thick neck	4/53 (8)	23/72 (32)	0.002
Long uvula	7/53 (13)	21/72 (29)	0.06
Enlarged tonsils	17/53 (32)	30/72 (42)	0.36
Rhinitis	7/53 (13)	16/72 (22)	0.29
Deviated nasal septum	2/53 (4)	3/72 (4)	0.73
Chronic sinusitis	6/53 (11)	9/72 (13)	0.94

*p < 0.05 for thick neck only, by chi-squared analysis. All values given as proportions of the group total; percentages are given in parenthesis.

All our patients (OSA positive and negative, n = 125) had a history of snoring (100%). Among those with OSA (n = 72), 78% also had daytime hypersomnolence and 46% complained of a lack of concentration while at work (Table II). Nocturnal choking (observed by a bed partner) was a feature in 54%, morning headache in 14%, recent memory loss (within the previous 6 months) in 26% and personality change (within the last 6 months) in 19%. Eighteen percent noted a decrease in their work performance. Eight percent complained of sexual impotence or a loss of libido and 3% were involved in a major road traffic accident within the last two years.

In comparing the presenting symptoms between the OSA positive and OSA negative snorers, we found that the following five variables were significantly more prevalent in the snorers with positive sleep studies: i) daytime hypersomnolence; ii) reports of nocturnal choking; iii) recent memory loss; iv) recent personality change, and v) lack of concentration at work (Table II).

In studying the co-morbid medical conditions among the patients, we found the presence of hypertension to be highly significant for the OSA positive snorers (Table III). The presence of a thick neck (subjectively assessed) was the only significant variable on ENT examination that significantly distinguished OSA positive patients from OSA negative patients (Table IV).

The seven clinical variables that were significantly related to OSA on univariate analysis (daytime hypersomnolence, nocturnal choking, recent memory loss, recent personality change, lack of concentration at work, hypertension and thick neck) were then analysed by a multiple logistic regression model, and odds ratios with 95% confidence intervals were calculated. We found that hypertension and nocturnal choking were the most significantly related for OSA, conferring a seven-fold and four-fold relative risk respectively (Table V).

OSA and nasal CPAP therapy (1986 – 1995)

A total of 43 patients who had been diagnosed with OSA were started on nasal CPAP over a 10-year period. The mean pressure was 8.5 cm water (range 3 – 15 cm water, SD ± 2.8). The average AHI before nasal CPAP therapy was 51.3 (SD ± 27.8) while the mean oxygen saturation was 87.2% (SD ± 7.7). The mean lowest oxygen saturation for this group of patients was 69.9% (SD ± 14.7). While on nasal CPAP, the mean AHI was 1.9 (SD ± 3.9) and average oxygen saturation 94.4% (SD ± 4.4). The mean lowest oxygen saturation was 84.6% (SD ± 6.4).

All patients were polygraphically monitored either immediately or a few days after nasal CPAP treatment. They were then followed-up in the out-patients' clinic, and were periodically visited by the product specialists or technicians to assist in usage as well as to assure proper functioning of the equipment. Nasal CPAP eliminated snoring, apnoeas and oxygen desaturations completely in almost all cases during sleep. Excessive daytime sleepiness (EDS) markedly improved in those with severe OSA treated with CPAP.

Table V – Odds ratios and 95% confidence intervals, adjusted for age and body mass index, for the clinical variables that were significantly related for OSA

Variable	Odds ratio	95% confidence interval
*Hypertension	7.24	1.34 – 39.97
*Choking	3.76	1.20 – 11.84
Daytime hypersomnolence	1.95	0.75 – 5.06
Recent memory loss	1.43	0.18 – 11.33
Recent personality change	1.98	0.27 – 14.58
Lack of concentration at work	1.44	0.45 – 4.63
Thick neck	1.0	0.22 – 4.32

*A history of hypertension and reports of nocturnal choking were the most significantly related for obstructive sleep apnoea, conferring approximately a seven and four-fold relative risk respectively

Five of the 43 patients had problems adapting to nasal CPAP and stopped using it within a month. Two of these patients chose alternative treatment (surgery) because of dissatisfaction with nasal CPAP. The other three patients elected for no treatment on a long-term basis and continued to report a high level of symptoms. A survey of the remainder 38 patients was performed in April 1996 to determine the compliance and side effects of nasal CPAP treatment.

None of the patients on nasal CPAP therapy died, though one suffered a cerebral haemorrhage and another a brain-stem infarction, both occurring despite being on regular CPAP therapy. No patient in the entire population developed pneumothorax.

Only minor complaints like nasal stuffiness, soreness due to tight fitting interface and dry throat or nose were reported. Thirty-one of the 38 patients were still using nasal CPAP, giving a compliance estimate of 82%. Among these 31 who were still using nasal CPAP, the average duration of therapy was 33 months while the average nasal CPAP usage was 5 hours per night, for 6.5 nights per week. Dry throat was mentioned by 42% of the patients, dry nose by 39%. The majority of these patients added a humidifier to overcome these symptoms. Headache was reported by 10%, sleepiness by 3% (one patient), fatigue by 7% and rhinorrhoea by 7%. The patient who reported sleepiness was re-evaluated and it was found that the machine pressure had changed to a value below what was originally prescribed. Mask discomfort was volunteered by 20% of our patients. One patient developed mild conjunctivitis which resolved with symptomatic treatment and adjustment of mask size. There were no major complications observed among those treated with nasal CPAP.

DISCUSSION

Obstructive sleep apnoea is a fairly common medical condition that is under-diagnosed and easily overlooked. Nocturnal polysomnography remains the definitive mode of diagnosis. All our patients had a history of snoring. The majority also had symptoms suggestive of OSA such as daytime tiredness and hypersomnolence, snorting, choking or gasping episodes interspersed with periods of apnoea during sleep observed by a bed-partner, loss of concentration in the day while at work, recent memory loss or a change in personality in the previous six months. Loud disruptive snoring and excessive daytime sleepiness were the outstanding symptoms. Interestingly, most of our patients had accepted their chronic symptoms as quite 'normal' and therefore delayed seeking medical attention. Most of our patients were referred to us for evaluation by their primary physician or their spouses.

Although we have not determined the prevalence of OSA in Singapore, we have shown that the condition is perhaps not uncommon in Asian snorers. Epidemiologic studies from the West estimate that OSA affects 2 to 4% of middle-aged adults[13]. Though ours was a selected pool of patients who were referred for snoring and the possibility of OSA, it is unique in that this is, we believe, one of the largest study among a South East Asian population to date. There are no large demographic data in this region on the prevalence and severity of OSA among snorers, or studies demonstrating the efficacy, side effects and compliance of nasal CPAP therapy. One reason for this is the complexity and cost of a full polysomnographic recording. Another reason is the lack of awareness of the condition.

Tan[14] in 1991, studied 37 snorers in Singapore using an ambulatory recording system (Vitalog CA) and found that 28 of them (76%) had OSA based on polygraphic criteria. The conclusion of this evaluation was that OSA may not be uncommon in Asian patients. .

The prevalence of OSA among patients referred for polysomnography depends critically upon definitions and where one draws the arbitrary line between normality and abnormality. We have used the conventional definition of an AHI greater than 5 per hour to be significant. Although this is a selected subset of patients who were specifically referred for snoring, it is interesting to compare this with Western data on polygraphic studies in subjects with symptoms. Berry et al[15] studied 46 heavily snoring men over 30 years of age in the sleep laboratory, recruited via newspaper advertisements. Six had apnoea index (AI) values of more than 5 per hour, giving a 13% prevalence rate of OSA among snorers.

Gislason et al[16] studied 61 selected men who had the highest ratings for snoring and sleepiness and found that 26% (16 patients) had AHI values of more than 5 per hour. Cirignotta et al[17] studied 40 snorers with overnight polysomnography and 50% (20 patients) had an AI of more than 5 per hour. From the above, it will be clear that the prevalence of OSA in symptomatic subjects varies greatly, and such studies are fraught with problems of bias in sampling, and of not being sure if techniques to extract a high risk subgroup for further study are particularly sensitive or specific. We studied all patients referred for snoring and suspected OSA and found a high prevalence rate of 52% for OSA. The high incidence in our group of patients could well be due to the obvious referral bias.

The ethnic mix of our patients reflects the local demographic distribution among the various races in our country, which is predominantly Chinese

(Chinese 80%, Malays 14% and Indians 6%). OSA is also well known to affect males more commonly than females and we found a strong male predominance in our study population (M:F = 15:1).

As with patients in most sleep clinics, the patients in this study were obese (average BMI 28 kg/m^2, BMI for OSA positive snorers 29.4 kg/m^2). It has also been reported that obesity is associated with a more severe form of disease[18]. Although moderate weight loss has been shown to be effective in treating OSA[19], we encountered problems in motivating our obese patients to lose weight. In the community however, the association between obesity and sleep apnoea is not as strong[20].

The major traits for OSA in our study were daytime hypersomnolence, reports of nocturnal choking, a history of hypertension, recent memory loss or personality change, a lack of concentration at work and the presence of a thick neck. Of these, hypertension and nocturnal choking were most significantly related to OSA, conferring a seven and four-fold risk, respectively. Systemic hypertension is well known to be a result of OSA, and occurs in 40% – 60% of patients with OSA[1] and its severity may be related to apnoea severity[21]. Several studies have also shown that 22% – 30% of patients with systemic hypertension also have OSA[22-24]. This association between hypertension and OSA appears to be mainly due to similar risk factors (eg. obesity, age) for both conditions. It is thus important to consider the diagnosis of sleep disordered breathing in patients with systemic hypertension, and further diagnostic studies may be indicated in the presence of other features which suggest OSA.

We also found that 56 out of 72 patients who had OSA complained of daytime hypersomnolence. This was assessed subjectively from the history and is less sensitive than the score from a multiple sleep latency test (MSLT). Although we inquired into recent memory loss and personality change, no formal assessment of memory retention, spatial skills or psychological testing were performed on our patients. Psychological testing in patients with sleep disordered breathing has demonstrated significant deficits in thinking, perception, memory, and the ability to learn[25]. Among the ENT abnormalities, the presence of a thick neck was a common finding in our patients with OSA.

In patients presenting to clinics because of possible sleep apnoea, the main symptoms found to be common in those subsequently found to have OSA were sleepiness[26], nocturnal choking[27], impotence[26], and bed partner's observation of apnoeas[27]. However, none of these are sufficiently specific to be diagnostically useful. Features on examination found to be suggestive of OSA include being male[27], obese[27], hypertensive[28], and the presence of a narrowed pharynx with an enlarged uvula[26]. However, even when symptoms and examination were combined, only about 50% of patients with OSA and 70% of patients without it were correctly identified by an experienced clinician[26] and thus further investigation is essential.

Nasal CPAP was first described in 1981 by Sullivan and his colleagues as an effective treatment for OSA[29,30]. We first routinely started using this form of treatment for our OSA patients in 1988. The patient population placed under nasal CPAP was generally more symptomatic, with more severe indices of sleep apnoea and more severe oxygen desaturations.

Nasal CPAP improved clinical symptoms, particularly daytime sleepiness, and gave objectively good polygraphic results during the first few days of treatment. At the time of our survey, 31 patients were continuing its use, giving a fairly good compliance rate of 82%. The evaluation of compliance depends on whether or not we consider patients who selected another treatment or who could not adapt to nasal CPAP and elected not to use it. Thus, if we include the initial five who could not tolerate nasal CPAP therapy, a strict compliance rate of 72% is found.

In our patients, side effects of nasal CPAP were minor and easily treated, usually with adjustment of the interface or with the addition of a humidifier. A study of side effects of nasal CPAP among 193 OSA patients in two French sleep centres at Lyon and Grenoble revealed that 50% of the patients complained of at least one side effect due to the nasal mask[31]. Dry nose or mouth in the morning affected 65% of the patients, nasal congestion affected 25%. They did not observe any correlation between the side effects and the level of nasal CPAP pressure. The rate of compliance in that study was very high with an average daily use of 6.5 hours, with 88% of the patients using the device every night.

In summary, nasal CPAP in our study was well accepted in patients to whom it was recommended, and overall compliance was higher than had been expected.

CONCLUSION

We found about half the patients referred to be positive for OSA. Anthropometric data was not discriminative. The major traits for OSA risk among our patients were reports of nocturnal choking, daytime hypersomnolence, recent memory loss or personality change, lack of concentration at work, a history of hypertension, and the presence of a thick neck. Of these traits, a history of hypertension and reports of nocturnal choking were the most significantly related to OSA, conferring a seven and four-fold relative risk respectively.

Excessive daytime sleepiness and sleep hygiene markedly improved in severe OSA treated with nasal CPAP. This form of treatment can rapidly result in the resolution of symptoms supported by an improvement in all polygraphic indices in patients with OSA. We documented a nasal CPAP compliance estimate of about 80%, for an average duration of therapy of 33 months. Finally, nasal CPAP was well-tolerated and no major complications were observed on follow-up. We conclude that OSA may not be uncommon among Asian snorers and that nasal CPAP is effective and safe among Asians and should be considered as a first-line treatment for OSA.

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