Frequency of obstructive sleep apnea (OSA) in patients with gastroesophageal reflux disease (GERD) and the effect of nasal continuous positive airway pressure

Amany Shaker a,*, Mohamed Magdy b

a Chest Department, Faculty of Medicine, Zagazig University, Egypt
b Tropical Department, Faculty of Medicine, Zagazig University, Egypt

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KEYWORDS
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Abstract The prevalence of GER disease (GERD) is as high as 20% in the Western world with up to 10% of people reporting symptoms of nocturnal reflux exclusively. Obstructive sleep apnea (OSA) has estimation of affection in 4% of men and 2% of women in USA and the rates continue to increase. The aim of this work is to determine the frequency of OSA in patients with GERD studying the association between GERD and OSA, and to evaluate the effect of nCPAP on GERD symptoms.

Subjects and methods: One hundred and thirty-six subjects suspected to have GERD were subjected to the following: (1) thorough medical history stressing on OSA symptoms, (2) clinical examination, (3) chest X-ray, (4) routine investigations (complete blood count, liver and kidney functions, fasting blood sugar), (5) upper GIT endoscopy, (6) Epworth questionnaire, and (7) polysomnography for patients who were suspected to have sleep-disordered breathing upon Epworth questionnaire (109 patients). The patients were classified according to endoscopic findings into 2 groups: Group I: erosive reflux disease (ERD) group which included 65 patients; 42 males and 23 females with a mean age of 55.3 ± 7.2 and Group II: non-erosive reflux disease (NERD) group which included 71 patients; 49 males and 22 females with a mean age of 53.8 ± 6.8. Nasal CPAP therapy was prescribed for all OSA patients (41 patients diagnosed by polysomnography) according to the clinical protocol then they were further recruited for post nCPAP therapy assessment. All the following parameters were measured at time of recruitment and 1 week later after initiation of nCPAP: BMI, pulmonary function tests: FEV1% and FVC%, sleep characteristics: AHI (event/hour slept), arousal index (event/hour slept), minimum SpO2 (%), SpO2 (%), total sleep time (min), sleep efficiency index (%) and GER symptoms including nocturnal GER (nGER).

Results: There was a statistically significant high frequency of OSA among NERD patients than that among ERD ones. Also there was a statistically highly significant increase in apnea/hypopnea...
index (AHI) (event/hour) and arousal index (AI) (event/hour) in NERD group than that in ERD one. A statistically significant increase in total sleep time (min) and Epworth sleepiness scale score was found in NERD group when compared to ERD one. There were statistically highly significant decreased percentages of OSA patients who had any nocturnal symptoms and frequent nocturnal symptoms after use of nCPAP and also a statistically highly significant decrease in GERD score in OSA patients after nCPAP therapy.

**Conclusion:** (1) A high risk for OSA development is more frequent in GERD patients especially NERD ones and who experience nighttime symptoms, (2) there is a mutual relationship between OSA and GERD reinforcing each other, and (3) CPAP therapy has a good role in the treatment of both OSA and GERD symptoms.

Introduction

Obstructive sleep apnea (OSA) is a condition characterized by repetitive sleep related obstruction of the upper airway which leads to oxygen desaturation and arousals from sleep [1]. Gastroesophageal reflux (GER) is a chronic condition in which gastric contents enter and remain in the lower esophagus, and without treatment, can lead to esophagitis, Barrett’s esophagus, bleeding and cancer [2]. A relationship between GER and OSA has been suggested with patients being predisposed to both conditions, with the same etiologic risk factors such as obesity and alcohol use [3]. “The prevalence of GER disease (GERD) is as high as 20% in the Western world with up to 10% of people reporting symptoms of nocturnal reflux exclusively” [4]. OSA has estimation of affectation in 4% of men and 2% of women in USA and the rates continue to increase [5]. The aim of this work is to determine the frequency of OSA in patients with GERD studying the association between GERD and OSA, and to evaluate the effect of nCPAP on GERD symptoms.

**Subjects and methods**

This study was conducted from December 2013 to November 2015 in Chest and Tropical Departments, Zagazig University Hospitals. Full written consent was taken from all patients enrolled in this study before taking and performing any procedure.

Potential subjects reporting symptoms of GERD were recruited from gastroenterology outpatient clinic. They were 185 subjects with a mean age of 55.2 ± 7.2 years.

These symptoms included heartburn and/or acid regurgitation ≥3 times a week [6].

**Exclusion criteria** [6,7]

1. Using anti-reflux medication.
2. Use of drugs as psychotropics, narcotics or benzodiazepines which might affect sleep architecture or subjective sleep quality.
3. Known psychological disorders as depression and anxiety.
4. Other medical comorbidities that might interfere with sleep quality such as bronchial asthma, chronic obstructive pulmonary disease (COPD), renal failure or other systemic diseases requiring medical therapy.
5. History of gastrointestinal surgery, peptic ulcer disease or gastroduodenal neoplasm.

Diagnosis of GERD was achieved on clinical basis. Patients were required to have a history of GERD symptoms (e.g. heartburn and regurgitation) [8]. These patients were subjected to the following reflux questionnaire [9]. The subjects were asked to respond to questions regarding the weekly frequency of typical reflux symptoms such as heartburn and acid regurgitation and to rate them on a scale of 1–5; (0): none, (1): less than once a month, (2): approximately once a week, (4): more than twice a week and (5): every day.

One hundred thirty-six subjects from 185 were suspected to have GERD. Those patients (136) were subjected to the following:

1. Thorough medical history stressing on OSA symptoms: - day time symptoms (excessive day time sleepiness, day time fatigue, tiredness, morning headache, cognitive defects, morning confusion, impaired concentration, personality and mood changes and loss of libido), and - nocturnal symptoms (snoring, dry mouth, witnessed apneas, gasping and choking sensations, nocturia, insomnia, nocturnal enuresis, sweating) [10].
2. Clinical examination (general and local).
5. Upper GIT endoscopy.
6. Epworth questionnaire.
7. Polysomnography for patients who were suspected to have sleep-disordered breathing upon Epworth questionnaire (109 patients).

**Upper GIT endoscopy**

Upper endoscopy should be performed in all patients with classic symptoms of GERD who also report alarm symptoms (dysphagia, odynophagia, weight loss, anorexia, evidence of gastrointestinal bleeding or iron deficiency anemia) [11].
After an overnight fast, subjects were placed in the left lateral decubitus position and sedation was achieved with a combination of midazolam and meperidine. The endoscope (Olympus GIF 140) was inserted via the mouth and into the esophagus. Careful examination of the distal esophagus was performed to determine the presence of mucosal injury [6].

Endoscopic findings for GERD were described according to the Los Angeles (LA) classification of esophagitis [12].

The patients were classified according to endoscopic findings into 2 groups:

Group I: erosive reflux disease (ERD) group included 65 patients; 42 males and 23 females with a mean age of 55.3 ± 7.2.

ERD: was defined as endoscopy findings indicating mucosal breaks at the gastroesophageal junction, classified as from A to D according to LA classification [12].

Group II non-erosive reflux disease (NERD) group included 71 patients; 49 males and 22 females with a mean age of 53.8 ± 6.8.

NERD: patients are those experienced typical GERD symptoms such as heartburn or acid regurgitation for more than once a week but didn’t experience erosive esophagitis. If a patient had symptoms but had minimal changes at gastroesophageal junction, then the patient was excluded from ERD group and included in NERD group [12].

Epworth sleepiness scale score [13]

It was done for all patients with GERD (no = 136) to define the severity of day time hyposomnolence. It is a self report questionnaire which measures an individual’s likelihood of falling asleep in routine life situations. Patients who were suspected to have OSA upon Epworth questionnaire would be subjected to polysomnography.

Sleep study (polysomnography)

Polysomnography was started at 9 P.M. and ended at 6.30 A.M. All patients suspected to have OSA (109 patients) underwent an overnight sleep study using a computerized polysomnogram system (Somno Screen plus RC Compi Portable Polysomnography, Somnomedics, Co., Germany) at the sleep laboratory, Chest Department, Zagazig University. Sixteen channels were used to document the following parameters: Sleep stages (4-channel, EEG), electrooculogram, Chin electromyogram, ECG, airflow at nose and mouth (thermistors), chest and abdominal respiratory movement (respiratory impedance), oxygen saturation (pulse oximetry), snoring (microphone), and body position. Recordings were manually scored according to standard criteria [14]. Apnea was defined as cessation of airflow for > 10 s, and hypopnea was defined as obvious decrease in airflow from baseline (<50%) associated with a fall in oxygen saturation ≥4% from baseline [15].

After polysomnography study of 109 patients, 41 patients had OSA as AHI > 5 and 68 patients didn’t have OSA as they were symptomatic but AHI < 5.

All GERD patients with OSA snored and reported excessive day time sleepiness or two or more other features such as impaired concentration, unrefreshing sleep, witnessed apneas, restless sleep and irritability/personality changes [16].

Nasal CPAP therapy

It was prescribed for all OSA patients (41) according to the clinical protocol, and all of them agreed to try nCPAP therapy. The patients received 1 week CPAP treatment at the optimal therapeutic level as determined in the initial polysomnography. They were further recruited for post nCPAP therapy assessment [17].

All the following parameters were measured at time of recruitment and 1 week later after initiation of nCPAP [17]:

1. BMI was calculated from body weight and height measured by a scale (Detecto Scale, Webb City, MO).
2. Pulmonary function tests: FEV1% and FVC%.
3. Sleep characteristics: AHI (event/hour slept), arousal index (event/hour slept), minimum SpO2 (%), SpO2 (%), total sleep time (min), and sleep efficiency index (%).
4. GER symptoms including nocturnal GER (nGER).

Results

Table 1 shows statistically non-significant differences between ERD group and NERD one as regards age, sex, BMI, cigarette smoking and nGER (P > 0.05). Table 2 shows statistically significant high frequency of OSA among NERD patients than that among ERD ones (P = 0.0363). Table 3 shows that there was no statistically significant difference between GERD patients with or without OSA regarding age, sex, BMI and cigarette smoking (P > 0.05). Table 4 shows the polysomnographic data of GERD patients who have OSA. Table 5 shows a statistically highly significant increase in apnea/hypopnea index (AHI) (event/hour) and arousal index (AI) (event/hour) in NERD group than that in ERD one (P < 0.0001) and (P = 0.0002) respectively. A statistically significant increase

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All studied patients (n = 136)</th>
<th>ERD group (n = 65)</th>
<th>NERD group (n = 71)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean ± SD)</td>
<td>54.7 ± 7.1</td>
<td>55.3 ± 7.2</td>
<td>53.8 ± 6.8</td>
<td>0.2137</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>91 (66.9%)</td>
<td>42 (64.6%)</td>
<td>49 (69%)</td>
<td>0.586</td>
</tr>
<tr>
<td>Female</td>
<td>45 (33.1%)</td>
<td>23 (35.4%)</td>
<td>22 (31%)</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m2) (mean ± SD)</td>
<td>34.18 ± 5.74</td>
<td>34.25 ± 5.56</td>
<td>34.11 ± 6.03</td>
<td>0.8886</td>
</tr>
<tr>
<td>Cigarette smoking, No. (%)</td>
<td>18 (13.2%)</td>
<td>11 (16.9%)</td>
<td>7 (9.9%)</td>
<td>0.229</td>
</tr>
<tr>
<td>Nocturnal GER, No. (%)</td>
<td>31(22.8%)</td>
<td>12 (18.5%)</td>
<td>19 (26.8%)</td>
<td>0.2494</td>
</tr>
</tbody>
</table>
in total sleep time (min) and Epworth sleepiness scale score was found in NERD group when was compared to ERD one ($P = 0.0245$) and ($P = 0.0253$) respectively. Table 6 shows statistically highly significant decreased percentages of OSA patients who had any nocturnal symptoms and frequent nocturnal symptoms after use of nCPAP ($P = 0.0004$) and ($P = 0.0077$) respectively, also, a statistically highly significant decrease in GERD score in OSA patients after nCPAP therapy ($P < 0.0001$).

**Discussion**

Nocturnal heartburn and its affection on sleep became an important issue. “Reflux symptoms are common in patients referred to sleep laboratories for unexplained daytime sleepiness”. It is common that patients with reflux symptoms have arousal from sleep and their sleep-related quality of life is worse [18]. “GERD can be associated with OSA in general population”. Recent studies observed that there is a close correlation between symptomatic GERD and OSA. “But the causative relationship still is not clear”. The frequency of GERD is near to 60% in OSA patients compared to only 20% in general population [3]. “Patients with OSA are at a significant risk for nocturnal GER” [19]. Although there is information about the epidemiologic link between those conditions, the exact nature of the link between GERD and OSA is complicated and incompletely known. “Specifically, it is unclear whether the co-occurrence of these conditions represents a causal relationship or is simply a reflection of shared risk factors” [8]. As the co-occurrence of GERD and sleep disorders is still controversial, the aim of this study is to determine the frequency of OSA in patients with GERD studying the association between GERD and OSA, and to evaluate the effect of nCPAP on GERD symptoms. In this study, there were statistically non-significant differences between NERD and ERD groups regarding age, sex, BMI, cigarette smoking and nGER symptoms (Table 1). Multivariate analyses showed a higher risk of any of frequent nGER symptoms with increasing age. Our result is in consistent with some previous reports of an increased risk of GER symptoms with increasing age [20,21], although others have observed no effect of age [22]. Gender is not an independent factor that can affect the risk of any or frequent nGER symptoms in the general population [23]. Our result is in consistence with this finding and also with previous studies of either nGER or GER symptoms [19,24]. But our result is in disagreement with those of Valipour et al. [25] who found a 60% increased risk of overall GER symptoms for females but this increase was statistically non-significant. The mechanism by which increased BMI may attribute to GER has yet to be known clearly but “could relate to the effect of raised intragastric pressure in obese individuals and resultant increase in gastroesophageal pressure gradient” [26]. Also the obese individuals are more prone to have hiatus hernia which itself is an independent risk factor of GER [27].

**Table 2** Frequency of OSA among GERD patients, and in ERD and NERD subgroups.

<table>
<thead>
<tr>
<th>OSA (n = 41)</th>
<th>GERD patients (n = 136)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (41)</td>
<td>14</td>
<td>0.0363</td>
</tr>
<tr>
<td>% (30.15)</td>
<td>21.54</td>
<td>38.03</td>
</tr>
</tbody>
</table>

**Table 3** Demographic characteristics of GERD patients underwent polysomnography (No. = 109) who have OSA in comparison to those did not have OSA.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GERD patients who have OSA (n = 41)</th>
<th>GERD patients who did not have OSA (n = 68)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean ± SD)</td>
<td>54.7 ± 7.5</td>
<td>55.2 ± 7.9</td>
<td>0.7630</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>29 (70.7%)</td>
<td>45 (66.2%)</td>
<td>0.7305</td>
</tr>
<tr>
<td>Female</td>
<td>12 (29.3%)</td>
<td>23 (33.8%)</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m^2) (mean ± SD)</td>
<td>34.12 ± 5.11</td>
<td>33.75 ± 4.89</td>
<td>0.7256</td>
</tr>
<tr>
<td>Cigarette smoking, No. (%)</td>
<td>8 (19.5%)</td>
<td>10 (14.7%)</td>
<td>0.0994</td>
</tr>
</tbody>
</table>

**Table 4** Polysomnographic data of GERD patients who have OSA (No. = 41).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean ± SD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI (event/hour)</td>
<td>48.32 ± 13.08</td>
<td></td>
</tr>
<tr>
<td>Arousal index (event/hour)</td>
<td>43.7 ± 11.21</td>
<td></td>
</tr>
<tr>
<td>Total sleep time (min)</td>
<td>390 ± 65</td>
<td></td>
</tr>
<tr>
<td>Sleep efficiency index (%)</td>
<td>68 ± 12.5</td>
<td></td>
</tr>
<tr>
<td>Minimum SpO2 (%)</td>
<td>66.72 ± 17.1</td>
<td></td>
</tr>
<tr>
<td>SpO2 (%)</td>
<td>86.31 ± 6.73</td>
<td></td>
</tr>
<tr>
<td>Epworth sleepiness scale score</td>
<td>16 ± 7</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5** Polysomnographic data of GERD patients with OSA in relation to their upper GIT endoscopic findings.

<table>
<thead>
<tr>
<th>Sleep characteristics</th>
<th>ERD group (n = 14)</th>
<th>NERD group (n = 27)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI (event/hour)</td>
<td>31.01 ± 9.62</td>
<td>48.92 ± 13.3</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Arousal index (event/hour)</td>
<td>29.32 ± 8.51</td>
<td>44.2 ± 11.81</td>
<td>0.0022</td>
</tr>
<tr>
<td>Total sleep time (min)</td>
<td>345 ± 52</td>
<td>392 ± 65</td>
<td>0.0245</td>
</tr>
<tr>
<td>Sleep efficiency index (%)</td>
<td>72 ± 15.3</td>
<td>66 ± 12.1</td>
<td>0.1771</td>
</tr>
<tr>
<td>Minimum SpO2 (%)</td>
<td>71.41 ± 15.01</td>
<td>65.5 ± 16.3</td>
<td>0.2654</td>
</tr>
<tr>
<td>SpO2 (%)</td>
<td>88.53 ± 19.01</td>
<td>82.3 ± 18.7</td>
<td>0.3206</td>
</tr>
<tr>
<td>Epworth sleepiness scale score</td>
<td>14 ± 3</td>
<td>17 ± 4.3</td>
<td>0.0253</td>
</tr>
</tbody>
</table>

**Table 6** Frequencies of OSA among GERD patients, and in ERD and NERD subgroups.

<table>
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<th>OSA (n = 41)</th>
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</tbody>
</table>
The above finding is in concordance with our result. The current study showed statistically significant increase in percentage of OSA in NERD patients than that in ERD ones and high overall percentage of OSA in GERD patients (Table 2). Also, in our study, when a comparison was done between NERD group and ERD one, there was a statistically highly significant increase in AHI (event/hour) and arousal index (event/hour) in NERD group than that in ERD one. Total sleep time (min) and Epworth sleepiness scale score showed a statistically significant increase in NERD group than ERD one. But there were statistically non-significant differences between both groups as regards sleep efficiency index (%), minimum SpO2(%) and SpO2 (%) (Table 5). Several studies observed that OSA was more common in GERD patients than in general population and a recent one reported that the frequency of OSA was higher over 10% in GERD patients compared with general population [28] and our result (30.15%) is in agreement with this finding. Also Guda et al. [18] found that AHI was significantly higher in group with reflux symptoms in their study, suggesting that the apneic events are more in patients with reflux symptoms than those without reflux symptoms but the prevalence of sleep apnea was the same in both groups. These data suggest that reflux is not the only mechanism of sleep apnea “which would increase the prevalence of apnea in subjects with reflux”. Patients with high number of apneic events may have a higher predisposition to reflux due to the presence of high negative intrathoracic pressure generated during recovery from an apneic episode. “In addition, people with nighttime reflux have a higher prevalence of symptoms in the oral cavity and airways (oropharyngeal, laryngeal and pulmonary manifestations)” [29]. Our result is in disagreement with that of Yang et al. [8] who found that GER events did not cause apnea, arousals, or awakening. The fact that subjective sleep measures of patients showed improvement with proton pump inhibitors (PPI) with no improvement of objective parameters suggests that these drugs affect sleep by mechanism other than antisecretory one. When GER occurs with awakening or arousal episode, the sleep onset and/or returning to sleep may be delayed. Also Ing et al. [3] found weak relation between OSA and GER as in their study population, only 53.4% of GER events occurred with apneas or hypopneas and 46.8% of all apneas occurred with GER. So a direct relation between OSA and GER cannot be present. You et al. [7] observed high risk for OSA was more in patients with NERD than in those with ERD and control and our result is in agreement with this finding. You et al. [7] suggested that NERD patients may show extraesophageal symptoms. “Most studies have shown that NERD patients have other digestive symptoms, such as functional dyspepsia and irritable bowel syndrome, as well as non-digestive symptoms, such as chest pain, urinary symptoms, mood disorder and sleep dysfunction with a higher frequency than that observed in ERD patients” [30]. In agreement with our result, Maher and Darwish, [31] observed that NERD Egyptian patients had pulmonary manifestations more than ERD patients in their study. “The pathophysiological mechanisms proposed to link GERD and OSA are not mutually exclusive, and it seems possible that the two conditions may in fact interact, creating a kind of self-perpetuating positive feedback loop” [32]. During the apneic period in OSA patients, transdiaphragmatic pressure changes significantly and makes easy migration of the gastric content toward the esophagus. On the other hand, an irreversible destruction of the phrenoesophageal ligament occurred due to repetition of this pressure changes causing lower esophageal sphincter (LES) insufficiency which is a cause of GERD development. The large and repeated changes of the pressure gradient also, presumably, play a role in maintaining the duration of the refluxate clearance [33].

### Table 6

<table>
<thead>
<tr>
<th>GERD symptoms in OSA patients (n = 41)</th>
<th>Before CPAP therapy</th>
<th>After CPAP therapy</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any symptoms (%)</td>
<td>27 (65.85%)</td>
<td>20 (48.78%)</td>
<td>0.1227</td>
</tr>
<tr>
<td>Frequent symptoms (%)</td>
<td>11 (26.83%)</td>
<td>7 (17.07%)</td>
<td>0.2921</td>
</tr>
<tr>
<td>Nocturnal GER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any nocturnal symptoms (%)</td>
<td>17 (41.46%)</td>
<td>3 (7.32%)</td>
<td>0.0004</td>
</tr>
<tr>
<td>Frequent nocturnal symptoms (%)</td>
<td>9 (21.95%)</td>
<td>1 (2.44%)</td>
<td>0.0077</td>
</tr>
<tr>
<td>GERD scores (Mean ± SD)</td>
<td>9.3 ± 2.1</td>
<td>1.8 ± 0.2</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

During the apnea period, there is high pressure gradient, which may cause a migrant reflux up to the pharyngeal region, is easy to occur and cause microaspiration triggering asthmatic or coughing attacks and upper airway edema and narrowing. Several forms of sleep-disordered breathing, such as OSA or snoring could occur due to increased narrowing of pharyngeal region. In support of this concept, it is found that during REM sleep, apneahypopnea numbers increased in children with nGER when compared to children without nGER. During sleep, the muscle control of the respiratory drive is depressed, so a muscle tone relaxation in the pharyngeal region is present. Many mechanisms have been suggested to increase GER in OSA patients including; low negative intrathoracic pressures, arousals, movements, low esophageal sphincter tone, and an elevation in the pressure gradient from the stomach to the lower esophagus [34]. Heinemann et al. [35] “found that 68–76% of patients with OSA had significant GERD. Conversely, nocturnal acid regurgitation, repetitive microaspiration of gastric acid and vagal reflex may induce OSA in GERD patients”. Sleep itself causes proximal migration of gastric acid and aspiration into the tracheobronchial tree. So many patients with GERD suffer from nocturnal reflux symptoms [32]. Inflammation and edema of upper airway can result from proximal movement of refluxed gastric and microaspiration of acid during sleep. This affections of upper airway, as well as bronchoconstriction predispose to OSA. The refluxed gastric acid in the distal esophagus in GERD also stimulates a vagal reflex that can cause bronchospasm [36]. There are many possible reasons for subjects with OSA to be prone to nocturnal GER. Firstly, the increase in negative intrathoracic pressures during upper airway...
obstructions may cause breach of the lower esophageal sphincter, the primary protection against reflux. Secondly, these obstructive events are stopped by disruption of sleep which caused increased awareness of events and their frequency because nGER events usually occur in short arousals or awakening from sleep [37]. There is information that, in patients with GERD, treatment with a PPI or CPAP therapy decreases OSA severity and also nGERD [17]. Following CPAP therapy, there were decreases in the number of GER episodes and this points to the presence of physical factors in a causal association between apnea and reflux [38]. A second possible pathway of the hypothesis of apnea-reflux association includes chemical factors and the refluxate matter (acidic, alkaline and neutral contents as well as gas) as possible stimulants of apnea. “Acidification of the proximal or distal esophagus as the mechanism of OSA has been suggested in both children and adults” [39]. Laryngeal or pharyngeal neuromuscular activity can be changed because of GER and this may be due to the direct toxic effect of acid or because of neural reflex activity and this may be considered as a third potential pathway [40]. Prolonged exposure to acid may impair swallowing reflexes in OSA patients. Local edema of the respiratory tract and increased secretion of the respiratory mucus may occur due to long exposure of the respiratory tract to stomach contents and acid, and also may cause lymphoid tissue enlargement [41]. The damage of subglottic mucosa and vocal folds may occur as a result of exposure to pepsin from the stomach [42]. In the current study, after one week of nCPAP therapy, there was a statistically highly significant decrease in percentage of OSA patients (41) who had any nGER symptoms or frequent nGER. And also, a statistically highly significant decrease in GERD score in OSA patients after nCPAP therapy was found, but there was a statistically non-significant decrease in percentage of any GER symptoms and frequent GER symptoms after nCPAP therapy in those patients. CPAP therapy decreases the prevalence of GER, but the mechanism is debated. CPAP can prevent airway obstruction and decrease inspiratory effort, so it can increase the intrathoracic pressure. Also, CPAP causes transmission of positive pressure to the intrathoracic airways. The risk of GER should be decreased after increasing the intraesophageal pressure in OSA patients with no importance of reflux mechanism involved. Other involved mechanism that decrease GER after CPAP therapy in OSA patients is an elevation of LES pressure by either reflex mechanisms or by direct mechanical compression of mid-esophagus [43]. Alternatively, the decrease in reflux episodes may be related to the decrease in arousal and movement frequency in OSA patients. When, a follow-up study was done on patients with both OSA and GERD using overnight CPAP therapy, both sleep fragmentation events, distal esophageal acid exposure time and reflux episode duration were decreased significantly [8]. In concordance with our result, Kerr et al. [44] found a significant decrease in arousal and awakening, and also there was a marked decrease in GER frequency and duration after CPAP therapy. Further, CPAP therapy also, caused increase the intraesophageal and LES pressures significantly and decrease GER inpatients who did not have OSA. So, the reduction of esophageal acid exposure in patients with OSA who used CPAP is a result of decreasing and weakening the physiologic changes during sleep events and increasing esophageal pressures [8]. Also, Diaz et al. [45] reported that the successful treatment of 5 patients with OSA complaining of severe refractory reflux esophagitis with the use of CPAP”. The reflux parameters including; the 24-hour acid contact time (ACT), the mean reflux duration and the mean length of the longest reflux event improved after CPAP therapy. Shepherd et al. [23] reported that nGER symptoms improved sufficiently after 1–6 months of CPAP therapy. “Indeed, there was a striking decrease in the prevalence of nGER in OSA patients after treatment with CPAP, to levels similar to or lower than that observed in the low risk group in the general population”.

Conclusions

(1) A high risk for OSA development is more frequent in GERD patients especially NERD ones and who experience nighttime symptoms.

(2) There is a mutual relationship between OSA and GERD reinforcing each other.

(3) CPAP therapy has a good role in the treatment of both OSA and GERD symptoms.

Conflict of interest

There is no conflict of interest.

References


Frequency of obstructive sleep apnea


