SLEEP-RELATED LARYNGOSPASM

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SUMMARY - Seven patients (mean age 46.6; range 33-58; 6M,1F) presented with sleep-related choking episodes and were found to have features in common that distinguished them from other known causes of choking episodes during sleep. The characteristic features include: an awakening from sleep with an acute choking sensation, stridor, panic, tachycardia, short duration of episode (less than 60 seconds), infrequent episodes (typically less than 1 per month), and absence of any known etiology. The disorder most commonly occurs in middle-aged males who are otherwise healthy. In one patient an episode of laryngospasm was polysomnographically documented to occur during stage 3. The clinical features and the polysomnographic findings suggest spasm of the vocal cords of unknown etiology.

KEY WORDS: laryngospasm, vocal cord spasm, choking, stridor, sleep.

Laringospasmo relacionado ao sono

RESUMO - Sete pacientes (média de idade = 46,6; variação de 33-58; 6M,1F) apresentavam episódios de sufocamento estritamente relacionados ao período de sono. Esses episódios tinham características que os diferiam de outras causas conhecidas de sufocamento durante o sono. Estas características incluem: despertar com súbita sensação de sufocamento, estridor, pânico, taquicardia. Os episódios eram breves (< 60s), infrequentes (< 1 por mês) e não apresentam qualquer evidência de etiologia conhecida. O distúrbio ocorre em homens saudáveis de meia idade. Em um paciente um episódio foi documentado polissonograficamente durante o estágio 3. Os aspectos clínicos e polissonográficos sugerem espasmo das cordas vocais de etiologia desconhecida.

PALAVRAS-CHAVE: laringospasmo, espasmo de cordas vocais, sufocamento, estridor, sono.

Choking episodes with associated stridor have been reported in a variety of disorders due to irritative lesions of the upper airway[1,7], CNS disease[4,6-8,14,25,27,28,35,41,46] and metabolic disorders[7]. Although laryngospasm can be produced by gastroesophageal reflux, the association has only been documented in infant patients and two adults[9,36,37]. Psychogenic causes of laryngospasm have also been reported[5,11-13,15,26,38,40,42-44]. However, laryngospasm that occurs solely during sleep has only rarely been reported[4,14,25,27,29,35]. Choking episodes during sleep are commonly reported by patients with the obstructive sleep apnea syndrome[19], and stridor can occur if the sleep apnea is accompanied by gastroesophageal reflux[18]. Stridor that occurs only during sleep has been reported in association with vocal cord paresis due to multiple system atrophy with autonomic failure (MSA-AF)[8,14,25,27,35,46], olivo-ponto-cerebellar atrophy (OPCA)[28] and epilepsy[4]. Stridor that occurs solely during sleep and not associated with a known organic cause, was first noted by Kryger who polysomnographically studied four patients. However, due to the rarity of episodes, he was unable to polysomnographically document any episodes of laryngospasm[29].

We describe the clinical features of seven patients with choking and stridor during sleep. In one patient an episode was documented polysomnographically.

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MATERIALS AND METHODS

Seven patients (mean age 46.6; range 33-58; 6M,1F) were evaluated at a sleep disorders center because of choking during sleep. Six patients were submitted to a standard polyssonographic study with continous monitoring of central, parietal and occipital EEG leads, two eletroculogram leads, chin and bilateral anterior tibialis EMG, EKG, chest and abdomen respiratory movement belts and digital oximetry[3].

As this is the first report of the clinical features of this disorder, the individual case reports are presented and summarized in the accompaying Table.

Table. *Clinical features, symptoms, investigations and findings for the seven patients with sleep-related laryngospam.*

Patient	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Age/Sex	59 M	36 M	58 M	35 M	52 M	54 M	33 F
Height (feet)	6.2	6.8	7.1	7.2	6.9	6.5	6.3
Weight (pounds)	160	206	170	304	190	175	126
Episodes/year/night	2/1	4/1	300/1	16/1	2/1	12/1	2/1
Duration of episodes (seconds)	90	40	60	90	20	30	30
Symptoms:							
Choking	+	+	+	+	+	+	+
Gasping	+	+	+	+	+	+	+
Stridor	+	+	+	+	+	+	+
Hoarseness	+	=	=	+	=	=	+
Tachycardia	+	+	+	+	+	+	+
Cyanosis	=	=	=	+	=	=	=
Mental stress	-	+	+	+	-	+	-
Polysomnogram	+	+	+	+	+	=	+
Apnea/ Hypopnea Index	0	0	0	11.5	6	-	0
ENT Examination	+	+	+	+	+	=	=

CASE REPORTS

Case 1. A 59-year-old male presented because of six episodes of acute gasping that occurred during sleep within the previous three years. The episodes were witnessed by his wife who was awoken because of their intensity. The patient leaped out of bed with difficulty in inspiring, sturdier, pallor, panic and tachycardia. After about 30 seconds the obstruction would spontaneously resolve, sometimes helped by drinking cold water, and there followed: loud breathing, gasping, hoarseness, and sweating. The whole episode subsided within minutes and the patient was able to resume sleeping. There were no abnormal respiratory events preceding the choking episodes. Other than a history of mild snoring there were no features of obstructive sleep apnea syndrome, gastroesophageal reflux, swallowing disorders, epilepsy or psychiatric disorders. However, he was noted on psychological examination to have a mild degree of chronic anxiety and rumination with occasional impulsive behavior. Otolaryngological and general physical examinations performed the day following one of the episodes failed to demonstrate any upper airway pathology or medical illness. Hematological and biochemical testing was normal. An all-night polysomnogram was performed and demonstrated no abnormalities, in particular no obstructive sleep apnea events. No choking episodes occurred during the recording. The episodes spontaneously resolved after the evaluation and ten years later he continued to be free of episodes.

Case 2. A 36-year-old male presented with four episodes of choking during sleep. The episodes were characterized by stridor, panic, tachycardia, and were relieved by drinking cold water. No hoarseness was noted. The episodes lasted less than one minute. All episodes had occurred in the middle of his habitual sleep episode. There was no history of apneic episodes, or gurgling sounds preceding the choking episodes. The patient did report snoring and mild sleepiness, however, other typical features of obstructive sleep apnea syndrome were not present. Otolaryngological and general physical examination, biochemical and hematological tests were normal. Psychological evaluation indicated a somewhat tense and rigid man prone to anxiety, compulsive behavior and rumination, however a psychiatric disorder was not present. An all-night polysomnogram demonstrated a normal night of sleep without respiratory or other disturbance. No choking episodes occurred during the recording. Over a six year period following the initial evaluation he had experienced only one further episode.

Case 3. A 58-year-old male presented with nightly episodes of choking during sleep. Five episodes had occurred over a five year period until one month prior to presentation when they began to occur nightly. The episodes were characterized by suddenly sitting bolt upright in bed, with an inability to inspire, that occurred about two hours after sleep onset. The intense stridorous sound would awaken his wife. There was tachycardia and panic until the episode subsided about 20 seconds later. Drinking water appeared to help the episodes to subside. Subsequently, the episodes were partially prevented by sleeping in a semi-reclining position. There were no abnormal respiratory events preceding the choking episodes. There was no history of other sleep disorders, gastrointestinal disorders or epilepsy. Psychological evaluation demonstrated a man with anxiety traits who regarded himself as a "worrier", but no psychiatric disorder was evident. General physical, otolaryngological, biochemical and hematological examinations were normal. A chest X-ray showed mild emphysema. A Holter monitor performed during one of the episodes demonstrated mild tachycardia only. An all-night polysomnogram demonstrated a choking episode with stridor, that occurred 45 minutes after sleep onset following stage three sleep. The episode was not associated with any preceding cardiorespiratory abnormality. The sleep period was otherwise normal without any further events. The patient was put on amitriptyline 50 mg at bedtime with almost total relief of the symptoms. After approximately six months the medication was stopped without resumption of further episodes over the ensuing year.

Case 4. A 35-year-old male patient presented with episodes of choking that occurred approximately once every two months over a 15-year period. Initially the episodes had rarely occurred during the daytime but subsequently occurred solely during the sleep period. The nighttime episodes were characterised by sudden choking with inability to breathe, intense stridor, panic and tachycardia. During several episodes his wife had observed him become cyanotic and almost lose conciousness. Each episode lasted approximately ten minutes. The patient had been noted to have features of typical but mild obstructive sleep apnea syndrome that were unrelated to the choking episodes. There was no history of gastrointestinal disorders. Psychologically he tended to be tense without specific anxieties, but had occasional nightmares. He had a history of postnasal drip and nasal congestion, however an otolaryngological examination did not demonstrate any pathology. General physical examination revealed obesity and mild hypertension. An all-night polysomnogram demonstrated 8 obstructive apneas, 44 central apneas, and 25 hypopneas giving an apnea/hyponea index of 11.5. The oxygen saturation fell to 88%. No choking occurred during the recording.

Case 5. A 52-year-old male presented with episodes of choking during sleep. The first episode occurred during a nap in a chair, and subsequent episodes occurred during the habitual sleep period. They were characterised by stridor, panic and tachycardia. There was a history of snoring, but no other features indicative of obstructive sleep apnea syndrome. There was no history of gastrointestinal, psychiatric or neurological disorders. The patient suffered a blow to the anterior neck in childhood which was without residual sequelae.Otolaryngological examination revealed no abnormalies. An allnight polysomnogram demonstrated mild obstructive sleep apnea with an apnea/hypopnea index of 6, and the lowest oxygen saturation was 84%. No choking episodes occurred during the recording.

Case 6. A 54-year-old male presented because of three episodes of choking during the latter third of the sleep period. Each episode occurred on a separate night and was characterised by intense stridor, panic and tachycardia. The episodes lasted less than 60 seconds and spontaneously resolved. They would awaken his wife. There was no history of obstructive sleep apnea syndrome, gastrointestinal, neurological or psychiatric disorders, although the patient was tense and a little anxious during the interview. Polysomnography was not performed. Following the initial evaluation no further episodes had occurred at follow-up 12 months later.

Case 7. A 33-year-old female had one or two episodes of choking during sleep each year over the previous eight years. The episodes were characterised by panic, tachycardia and stridor that would awaken her husband. Hoarseness of her voice would follow the episodes. She had one episode that occurred during the daytime while swallowing food. There was no history of obstructive sleep apnea syndrome, gastrointestinal, or neurological disorders. She was described as slightly anxious woman who had been prescribed minor tranquilizers in the past but did not meet criteria for a diagnosis of anxiety disorder. The general physical examination was normal. Two nights of polysomnography were performed and demonstrated normal cardiorespiratory function during sleep. No choking episodes were reported during the recording.

COMMENTS

Our seven patients had choking episodes during sleep that were characterised by an abrupt awakening, often leading to a sudden leap from the bed, intense autonomic activity with tachycardia, diaphoresis and a sensation of panic or impending death. The strong effort to re-establish breathing produced an intense and short-lived stridorous sound that was disturbing to bedpartners causing

them to be awoken. Temporary hoarseness of the voice occasionally resulted. In three patients, relief was obtained by drinking water. The stridor suggested sudden tonic vocal cord spasm in adduction, i.e., glottic closure laryngospasm, as the underlying pathophysiological mechanism which occasionally resulted in residual hoarseness.

Vocal cord spasm characterized by stridor and panic has been reported to occur due to psychogenic factors[5,11-13,15,26,38,40,42-44]. A variety of terms have been applied to this condition such as Münchausens's stridor, factitous asthma, psychogenic stridor, non-organic or functional upper airway obstruction, emotional laryngospasm, paradoxic vocal cord movement, vocal cord dysfunction, laryngeal dyskinesia, functional inspiratory stridor and respiratory glottic spasm. However, these laryngospasm episodes were reported to occur only during wakefulness and not during sleep. Endoscopy during episodes has demonstrated paradoxical vocal cord movement[11,26,40,43]. Voluntary adduction of the vocal cords upon inspiration has also been reported in such patients[26]. The mechanism of the paradoxical movement of the vocal cords is believed by Collett et al. to be an all-or-none event linked to phase reversal of the inspiratory neuron output and the glottic constrictors as a result of psychogenic factors[11].

None of our patients had a psychiatric disorder but the episodes had features, such as feeling of impending death, dyspnea and tachycardia, similar to those seen in panic disorder or sleep terror disorder[2,3,24]. Other features of panic disorder such as daytime panic attacks, anxiety, agoraphobia, and depression were not present. Stridor and the presence of observed respiratory difficulty have not been described with panic attacks. In addition, mild to moderate complaints of insomnia and early morning arousal[33] that are usually seen in patients with panic disorder[20,21,30,32] were absent in our patients nor were the typical sleep architecture changes seen[20,32-34]. Nocturnal panic attack patients tend to display less agoraphobia, but they represent only 4% of the panic disorder population[33,34]. There is only one report of panic attacks that occurred solely during sleep[21]. A 28-year-old woman experienced panic attacks after the onset of syncopal spells associated with major depression. Panic attacks typically occurred 40 minutes into sleep, out of "deep sleep" and occurred almost nightly in the beginning. No polysomnographic documentation was obtained.

Polysomnographically, panic attacks have been documented to occur in the transition phase between stage 2 and early stage 3 sleep[20,32-34] or emerging from delta sleep[30]. No specific characteristic EEG signs preceed the attacks in these patients[20]. Panic disorder patients typically experienced difficulty in going back to sleep after the episode[20,30,32-34]. None of our patients experienced trouble falling back asleep after their intense laryngospasm.

Laryngospasm has features in common with sleep terror episodes which are characterized by a sudden arousal from slow wave sleep with a piercing scream or cry, accompanied by autonomic and behavioural manifestations of intense fear[3,24]. The patient is unresponsive to external stimuli and amnestic for the episode[3]. Sleep utterances in the form of gasps, moans, groans, and cursing may occur in sleep terror disorder but a blood-curdling piercing scream is a typical feature[3,16,24]. Polysomnographic studies have shown that sleep terror episodes typically occur out of stage 4 sleep[3,16]. Sleep terrors most commonly occur in children, but episodes can occur in the adult population in association with anxiety, depression, obsessive-compulsive and phobicness[24]. However, it is unusual for sleep terrors to begin in middle or older age[24] and the presence of both stridor and observed respiratory difficulty has not been reported in sleep terror disorder. The above features of panic attacks in sleep and sleep terror disorder tend to distinguish these events from the descriptions of choking given by our patients, however, an atypical form of panic attack or sleep terror disorder can not be ruled out.

That the episode of laryngospasm occurred out of slow-wave sleep suggests a mechanism similar to that of sleep terrors. However, the stridor of laryngospasm and the vocalization (scream) of a sleep terror are pathophysiologically different phenomema. Stridor involves the involuntary CNS motor control of the vocal cords which produces a reversible paradoxical adduction of the

vocal cords during the inspiratory portion of the respiratory cycle[11] whereas the scream of sleep terror is a behavioral phenomena involving higher cerebral control that produces normal vocal cord movement in expiration.

Patients with sleep-related laryngospasm must be distinguished from those with known organic causes of vocal cord spasm.

Patients with suspected sleep-related laryngospasm should undergo appropriate investigations to determine an organic etiology. However, in an otherwise asymptomatic healthy patient, investigation of occult causes is not likely to be productive. Polysomnography performed at the time of the laryngospasm episode failed to demonstrate any precipitating cardio-respiratory event in our patients. The demonstration of laryngospasm during sleep without precipitating physiological events is also supportive of a psychogenic etiology, however none of our patients had any significant psychopathology.

Gastroesophageal reflux with aspiration is a possible explanation for laryngospasm. Even in the presence of a history of gastroesophageal reflux, caution should be exhibited before attributing laryngospasm to the gastroesophageal reflux. Adult patients with gastroesophageal reflux and associated respiratory symptoms typically have choking and wheezing episodes, but have not been reported to have stridor or laryngospasm either during wakefulness or during sleep. Pellegrini et al. presented 100 patients with gastroesophageal reflux documented by 24-hour esophageal monitoring, but associated laryngospasm was not reported[39]. Although 48 patients had respiratory and gastroesophageal symptoms indicative of aspiration, the presence of aspiration could only be documented in five. An additional five patients had reflux that was secondary to a primary respiratory disorder with its associated coughing and wheezing. In addition, 90% of the patients with suspected aspiration reported a history of cough with an acid taste in the mouth, symptoms that were not reported by any of our patients[39]. Laryngospasm due to subclinical gastroesophageal reflux is possible, however the association of laryngospasm and subclinical episodes of gastroesophageal reflux has never been reported. Rare cases of gastroesophageal reflux inducing laryngospasm and stridor have been reported in infants[36,37]. Guilleminault and Miles have reported the exceptional development of laryngospasm in adult patients with obstructive sleep apnea (OSAS). However, unlike our patients, these patients had frequent symptoms of esophageal reflux during sleep[18]. Orenstein et al suggested that laryngospasm is more likely to occur in infants because of a hyperactive adduction reflex of the vocal cords due to an immature nervous system[37].

Gastroesophageal reflux may be documented by 24-hour esophageal pH monitoring, but the rarity of the laryngospasm episodes makes the likelihood of detecting concomitant gastroesophageal reflux and laryngospasm most unlikely. The presence of gastroesophageal reflux in the absence of an episode of laryngospasm would not necessarily be evidence that the two are related. In slow wave sleep, ventilation, cardiac rhythm and other autonomic functions are clinically at their quietest, muscle activity most stable, and sleep at its deepest. It is therefore unlikely that an episode of intense gastric muscle activity producing gastroesophageal reflux would be associated with laryngospasm in slow wave sleep. Sympathetic nervous system activity may occur during NREM sleep in normal subjects as reflected by paroxysmal periods of electrodermal activity (EDA) called "storming"[10,23,31,45]. EDA is maximal during delta sleep and minimal during REM sleep[17,31]. Ware et al. suggest that this physiologic arousal activity is part of a mechanism to regulate depth of sleep[45]. Whether this intense "storming" sympathetic nervous activity during delta sleep and laryngospasm are related is unclear.

Other possible causes of laryngospasm need to be considered. Otolaryngological examination in five patients failed to reveal upper airway abnormalities that could explain the laryngospasm. Four patients gave a history of postnasal drip that conceptualy could be implicated in the production of an irritant to the vocal cords. Kavey et al. documented pooling of secretions in two of three patients with MSA-AF, raising the possibility that the secretions could have induced the laryngospasm[25]. However, laryngospasm due to postnasal drip has never been reported or documented.

It is possible that the combination of an irritant and heightened sympathetic nervous system activity i.e. "storming" during delta sleep (EDA) could be responsible for the emergence of appropriate conditions to allow the infrequent laryngospasm attacks as seen in our patients. Epilepsy as a cause of sleep-related laryngospasm has been reported[4]. Amir et al. reported a six year old child with attacks of suspected laryngospasm that occurred during both sleep and wakefulness, however, stridor did not occur with any of the episodes[4]. Spike and wave activity indicative of an epileptic etiology was seen on polysomnography. None of our patients had a history of epilepsy and the seven patients who had polysomnographic evaluation did not demonstrate any ictal or interictal features of epilepsy.

Because of the infrequency of the laryngospasm episodes the pathophysiology of the events will be difficult to document and explore, therefore the understanding of the disorder rests largely upon the clinical course and response to treatment.

Treatment of sleep-related laryngospasm should be directed to treatment of the the underlying organic cause, if one is established. If gastroesophageal reflux is suspected as a cause, documentation of the gastroesophageal reflux and the associated respiratory symptoms, by 24-hour pH monitoring is necessary[39]. In addition, investigation of a psychogenic etiology of the laryngospasm is also recommended. Patients number 2, 3, 4, 6 thought that the choking episodes were more frequent during times of mental stress. One patient responded beneficially to a nocturnal dose of amitriptyline that had been prescribed both to allay anxiety about the episodes and to improve sleep quality. The resolution with amitriptyline and reassurance suggests a psychogenic factor in the etiology of this disorder.

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