Partial epilepsy presenting as episodic dyspnea: a specific network involved in limbic seizure propagation

Case report

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The authors describe a patient who experienced stereotypical episodes of dyspnea and presyncopal sensation without loss of consciousness during a 4-month period. Further evaluation established intermittent arterial O₂ desaturations associated with this dyspnea. After an extensive cardiopulmonary workup was performed for presumptive diagnosis of pulmonary embolism, a brain magnetic resonance image revealed a right medial temporal lobe lesion. The patient’s dyspnea was then suspected to be a symptom of a seizure. His shortness of breath and O₂ desaturation resolved with administration of phenytoin. This case, to the authors’ knowledge, is the first documented example of simple partial seizures presenting with episodic autonomic cardiopulmonary symptoms in the absence of other ictal behavior. This case may also illustrate one specific limbic autonomic network.

Key Words • partial epilepsy • oxygen desaturation • hypoxemia • autonomic nervous system • limbic system

Pulmonary embolism, myocardial infarction, and pneumonia are included in the differential diagnosis of dyspnea. Therefore, patients who present with dyspnea typically undergo an extensive cardiovascular and pulmonary workup for detection of such life-threatening conditions. In the absence of a well-defined underlying medical cause, shortness of breath may be attributed to psychological factors.¹

Seizures often present with motor convulsive activity, sensory changes, or an impaired level of consciousness. They may also be accompanied by secondary autonomic dysregulations such as changes in heart rate, respiratory rate, blood pressure, sweating, and sphincter control.² We describe a patient who presented with autonomic symptoms as his sole ictal phenomenon. He was subsequently found to harbor a right medial temporal lobe lesion.

Case Report

History. This 56-year-old right-handed man presented to the emergency department with a 4-month history of episodic unprovoked shortness of breath and an associated “fainting” sensation. Each episode lasted approximately 20 seconds and occurred approximately eight times per day. The patient denied any loss of consciousness or previous convulsive experience and was quite aware of his difficulty breathing. He also denied chest pain, headache, nausea, vomiting, and incontinence. His medical history was unremarkable with respect to any epilepsy-related risk factors such as febrile seizures or head trauma. An arterial O₂ saturation level obtained during one of these episodes by using digital pulse oximetry monitoring was 82%. Arterial blood gas measurements revealed a hypoxemia level of 61 mm Hg while the patient was breathing fortified air containing 2 L O₂ during an attack.

Examination. The patient was admitted to the internal medicine service and underwent an extensive cardiopulmonary workup for search for various underlying disease processes, including pulmonary embolism. Results of all of these studies, together with high-resolution computerized tomography scans of the chest and pulmonary artery angiograms were unremarkable. Nevertheless, he continued to suffer from episodic O₂ desaturation associated with dyspnea, during which he experienced facial flushing, increased heart rate, and piloerection that lasted 5 minutes. On detailed questioning, he reported a strange smell during some of these episodes while “ants were crawling” on his neck and legs. These complaints increased the suspicion of a central nervous system process and an MR image of the brain revealed an abnormal hyperintense signal on T₂-weighted and fluid-attenuated inversion-recovery sequences in the right medial temporal lobe. A small area of enhancement was noted in this lesion on Gd administration (Fig. 1). The patient’s symptoms were then interpreted as limbic seizures. An EEG obtained during one of these episodes revealed no epileptiform discharges.

Treatments and Outcome. The patient subsequently be-
gan receiving phenytoin. After his blood phenytoin levels reached the standard therapeutic range (1–2 μg/ml), the episodes of dyspnea resolved completely. Nevertheless, he continued to report brief episodes (<5 seconds long) of sensations of “ants crawling” on his neck and down his legs, possibly representing residual auras.

An intracarotid amobarbital (Wada test) revealed left hemispherical dominance with no immediate spontaneous memory retrieval during injection of the left hemisphere (consistent with decreased right hemispheric memory support). His neuropsychological evaluation revealed right frontotemporal deficits. He later underwent resection of the abnormality observed on MR images, with no complications. Histopathological examination of the excised specimen yielded results consistent with a glioblastoma multiforme. At the 3-month follow-up examination, the patient remained free of his dyspneic episodes.

Discussion

Relief of the dyspneic episodes in our patient after administration of phenytoin indicates that his dyspnea represented a seizure. Undetected epileptiform discharges may occur on EEGs in patients with medial temporal lobe epilepsy because of the wide distribution of the surface scalp EEG electrodes from medial brain ictal events. Dyspnea presenting as simple partial seizures has not been previously reported. On the other hand, autonomic dysregulations such as cardiopulmonary distress, salivation, lacrimation, piloerection, and ciliary changes often accompany complex and (more commonly) generalized seizures. Stimulation of the limbic system that led to respiratory arrest was initially described by Jackson and Spencer, who reported prolonged apneusis (so-called uncinate fits) arising from electrical stimuli near the uncus of animals. Similar findings have been reported in humans who underwent cortical stimulation in various limbic and temporal lobe regions. Penfield and Jasper have shown transient apnea resulting from stimulation of cingulate, uncial, and rolandic gyri. These initial observations verified the role of limbic lobe structures in modulation of central ventilatory mechanisms.

Two mechanisms may account for respiratory compromise during epileptic attacks. Generalization of seizures and hence tetanic contraction of the diaphragm muscles may interfere with respiration. On the other hand, nonconvulsive complex partial and simple partial seizures may spread and induce oscillatory instability of central ventilatory and autonomic control circuits. The latter mechanism is more likely to have played a role in our patient’s case. Prolonged states of apnea have been associated with both complex and simple partial seizures with or without secondary generalization. In these studies, patients initially experienced motor symptoms followed quickly by autonomic dysfunction manifested also as tachyarrhythmia and/or neurogenic pulmonary edema. Ictal cardiopulmonary dysfunction may be a cause of sudden death among patients with epilepsy.

One may hypothesize that the epileptogenic limbic system in our patient selectively recruited networks that control the autonomic system. The selective involvement of downstream subcortical autonomic centers (more particularly in this case, the cardiopulmonary centers such as medulla or hypothalamus) may exemplify a specific network recruitment for limbic seizure propagation. Based on the animal models of epilepsy, substantia innominata and nucleus accumbens are thought to serve as relay stations between the amygdala and other modulatory networks involved in regulation of cortical motor seizure activity. In our case, the epileptic system may also involve multiple networks, none of which has “invaded” the neuronal circuits concerned with expression of motor components of limbic seizures.

Conclusions

Autonomic perturbations such as dyspnea may be the predominant presenting manifestation of partial limbic sei-
Partial epilepsy presenting as dyspnea

Oxygen saturation monitoring may provide an additional method of subclinical seizure detection. Further study of the neuronal networks involved in limbic seizure propagation may elucidate the intriguing pathways linking subcortical nuclei with limbic efferents.

References

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