Movement Disorders
CLINICAL PRACTICE

CASE REPORT

Voluntary Inhibition of Involuntary Groaning in Progressive Supranuclear Palsy

Tina Mainka, MD,[1,2,*] Ute Hidding, MD,[2] Carsten Buhmann, MD,[2] Patrick Haggard, PhD,[3] and Christos Ganos, MD[1]

Involuntary vocalizations are a striking feature of several neurological conditions, often associated with movement disorders. They range from simple and brief sounds (e.g., throat clearing, lip smacking, or grunting) to complex and socially inappropriate obscenities such as coprolalia. Constant grunting and groaning are involuntary and uncontrollable vocalizations, typical for several types of dementia, and have also been associated with advanced progressive supranuclear palsy (PSP).[1] Here, we report the case of a 66-year-old male with PSP-Richardson syndrome (PSP-RS) who presented with constant involuntary groaning that, at times, he could voluntarily suppress. Attempts to distract attention from the active inhibitory process led to reemergence of the groaning behavior. The phenomenological classification and pathophysiological implications of the involuntary groaning behavior are discussed.

A 66-year-old male, who had been diagnosed with PSP four years earlier, presented to our department due to constant groaning, which had insidiously developed over the course of several weeks. The groaning behavior, which was constantly present and only abated during deep sleep, was distressing, particularly for the patient's family. On current examination, the patient presented with parkinsonism, vertical gaze palsy, impaired postural reflexes, and a dysexecutive syndrome, consistent with the diagnosis of PSP-RS (PSP Rating Scale score 44; Video S1, segment A). However, the most striking feature was the groaning behavior. Importantly, although the patient reported that the sound was generated involuntarily, he was able to selectively suppress the involuntary groaning; employing, for example, breathing techniques (Video S1, segment B). Distracting the patient from the effortful inhibitory process led to reemergence of the involuntary sounds. At the time of presentation, the patient was treated daily with 300/75 mg levodopa/carbidopa, 4mg rotigotine, 200 mg amantadine, 75 mg quetiapine, and 20 mg citalopram. There was no association of the involuntary groaning behavior with attempted changes in medication. For example, discontinuation of all dopaminergic medication over a period of four weeks led to deterioration of parkinsonism, without changes in groaning frequency or intensity. Similarly, discontinuation of quetiapine over several months did not lead to any changes in involuntary groaning behavior. Commencement of 7.5 mg daily dose of aripiprazole also had no effect on the involuntary vocalizations, but led to impulsive behaviors and increased fall frequency.

In the presented case, constant groaning was the most striking feature and the reason for referral to our clinic. Although the association of groaning with neurodegeneration (e.g., PSP) has been established,[1] little attention has been given to its exact phenomenological classification and pathophysiology. However, two clinical observations from the case here provide crucial insights into both of these aspects. First, the generation of voluntary speech and groaning behavior did not occur in succession, but in parallel. Importantly, the presence of involuntary groaning interfered with the production of voluntary speech. This implies that the two different types of vocalizations are generated by two different neural resources that are concurrently active, but the vocal motor apparatus cannot be driven by both generators simultaneously. Second, selective inhibition of the involuntary vocalizations did not abolish the ability to speak. This indicates that the two different types of vocalizations are associated with distinct neuromotor signals: top-down control of one type of signal (i.e., involuntary groaning) did not affect the other (i.e., speech). Thus, our case illustrates two important points regarding the neurocognitive architecture for vocal control, first, dissociation between two pathways for vocalizations. For example, functional neuroanatomic studies in squirrel monkeys and data from clinical populations have demonstrated two distinct pathways of sound production: a limbic cingulo-periaqueductal circuit involved in the generation of nonverbal utterances, such as groaning, crying, and laughing and a cortico-basal ganglia-thalamocortical circuit associated with the production of speech and singing.[2] Second, volitional inhibitory control can be selectively targeted onto just the former of these pathways without thereby inhibiting the latter. The possibility of selective inhibition confirms the dissociation between two vocal generators.

[1]*Department of Neurology, Charité University Medicine Berlin, Charitéplatz 1, 10117, Berlin, Germany;* [2]*Department of Neurology, University Medical Centre Hamburg Eppendorf, Martinistraße 52, 20246, Hamburg, Germany;* [3]*Institute of Cognitive Neuroscience, University College London, London, United Kingdom*

***Correspondence to**: Tina Mainka, MD, Department of Neurology, Charité University Medicine Berlin, Charitéplatz 1, 10117 Berlin, Germany; E-mail: tina.mainka@charite.de
Keywords: groaning, involuntary vocalization, parkinsonism, progressive supranuclear palsy.
Relevant disclosures and conflicts of interest are listed at the end of this article.
Received 5 December 2017; revised 11 January 2018; accepted 23 January 2018.
Published online 23 March 2018 in Wiley InterScience (www.interscience.wiley.com). DOI:10.1002/mdc3.12598

Hughlings Jackson proposed the distinction between voluntary vs. involuntary language as early as 1878 in his study of the aphasias.[3] Since then, and within the context of movement disorders, a wide spectrum of involuntary vocalizations has been characterized (summarized in Table S1). Among these different phenomena, constant groaning is thought to belong to a range of purposeless behaviors, such as continuous chattering and motor perseverations, as a result of reduced—prefrontal—cortical inhibitory control on subcortical structures.[4] Although the exact neuroanatomic correlates of groaning remain elusive, an imbalance between excitatory and inhibitory signals within the aforementioned limbic cingulo-periaqueductal circuit would explain the involuntary vocalizations. Neuropathological changes, characteristic for PSP-RS, further support this notion.[5] Importantly, top-down inhibitory control would temporarily alleviate symptoms. However, this effortful control would only be exerted during the brief periods of concentration.

Author Roles

1. Research Project: A. Conception, B. Organization, C. Execution; 2. Statistical Analysis: A. Design, B. Execution, C. Review and Critique; 3. Manuscript Preparation: A. Writing the First Draft, B. Review and Critique.

C.G.: 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B (clinical assessment, interpretation of the clinical data, preparation, review and approval of the manuscript.)

U.H.: 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B (clinical assessment, interpretation of the clinical data, preparation, review and approval of the manuscript.)

C.B.: 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B (clinical assessment, interpretation of the clinical data, preparation, review and approval of the manuscript.)

T.M.: 2A, 2B, 2C, 3A, 3B (interpretation of the clinical data, preparation, review, and approval of the manuscript.)

P.H.: 2A, 2B, 2C, 3A, 3B (interpretation of the clinical data, preparation, review, and approval of the manuscript.)

Acknowledgements

We are much obliged to the patient and his family for written permission to publish this case description.

Disclosures

Ethical Compliance Statement: We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this work is consistent with those guidelines. The authors confirm that the approval of an institutional review board was not required for this work.

Funding Sources and Conflicts of Interest: There are no funders to report for this submission. The authors declare that there are no conflicts of interest relevant to this work.

Financial disclosures for previous 12 months: TM, UH, and CB have nothing to disclose. PH was supported by the European Union Seventh Framework Programme (EU FP7) project VERE WP1 and by a Professorial Fellowship from ESRC and by ERC Advanced Grant HUMVOL 323943. CG holds research grants from the VolkswagenStiftung (Freigeist Fellowship) and the German Parkinson Society and was also supported by the Deutsche Forschungsgemeinschaft (DFG; GA2031/1-1 and GA2031/1-2).

References

1. Stamelou M, Rubio-Agusti I, Quinn N, Bhatia K. Characteristic constant groaning in late stage progressive supranuclear palsy: a case report. *Parkinsonism Relat Disord*. 2011;17(7):575–576.
2. Jürgens U. The neural control of vocalization in mammals: a review. *J Voice*. 2009;23(1):1–10.
3. Hughlings-Jackson J. On affections of speech from disease of the brain. *Brain*. 1878;1(3):304–330.
4. Nagaratnam N, Patel I, Whelan C. Screaming, shrieking and muttering: the noise-makers amongst dementia patients. *Arch Gerontol Geriatr*. 2003; 36(3):247–258.
5. Steele JC, Richardson JC, Olszewski J. Progressive supranuclear palsy. A heterogeneous degeneration involving the brain stem, basal ganglia and cerebellum with vertical gaze and pseudobulbar palsy, nuchal dystonia and dementia. *Arch Neurol*. 1964;10:333–359.

Supporting Information

Videos accompanying this article are available in the supporting information here.

Video S1. This video segment demonstrates the 66-year old patient at the time of presentation. **Segment A**: Examination revealed supranuclear vertical gaze palsy, particularly for downward gaze. Groaning behavior was constant throughout the examination, even when patient attempts to keep his mouth closed. There was bradykinesia. Applause sign was positive. Postural reflexes were clearly affected. **Segment B**: The patient can suppress the involuntary groaning behavior with concentration and breathing exercises. Distraction from the effortful inhibitory process leads to re-emergence of the involuntary groaning behavior, which also interferes with speech.

Table S1. Overview of involuntary vocalizations, their phenomenology and associated conditions.