Jacques Jean Lhermitte and the syndrome of peduncular hallucinosis

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Jacques Jean Lhermitte (1877–1959) was among the most accomplished neurologists of the 20th century. In addition to working as a clinician and instructor, he authored more than 800 papers and 16 books on neurology, neuropathology, psychiatry, and mystical phenomena. In addition to the well-known “Lhermitte’s sign,” an electrical shock–like sensation caused by spinal cord irritation in demyelinating disease, Lhermitte was a pioneer in the study of the relationship between the physical substance of the brain and the experience of the mind. A fascinating example of this is the syndrome of peduncular hallucinosis, characterized by vivid visual hallucinations occurring in fully lucid patients. This syndrome, which was initially described as the result of a midbrain insult, also may occur with injury to the thalamus or pons. It has been reported as a presenting symptom of various tumors and as a complication of neurosurgical procedures. Here, the authors review the life of Lhermitte and provide a historical review of the syndrome of peduncular hallucinosis.

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JACQUES Jean Lhermitte (Fig. 1) was among the most accomplished neurologists in modern history, yet he is often overlooked in the neurosurgical literature. Lhermitte began his career in the study of spinal cord injury, but his work gradually evolved to explore the neurological basis of the mind, laying the groundwork for the field of neuropsychiatry. He was fascinated with the pathogenesis of hallucinations and was the first to describe the syndrome of peduncular hallucinosis, or complex visual hallucinations, occurring in lucid patients as a result of midbrain injury (Fig. 2). This syndrome, which is likely underrecognized, has been reported as both a presenting symptom of several tumor types^{2,6,10,14,25,28,30,31,34} and a complication of neurosurgical procedures.^{4,16–18,25,29,36–39} In this article, we discuss the life of Jacques Jean Lhermitte and the peculiar syndrome of peduncular hallucinosis.

Jacques Jean Lhermitte (1877–1959)

Jacques Jean Lhermitte was born on January 20, 1877, in Mont-Saint-Père, to a family of artists. His father, Léon

Augustin Lhermitte, was a French realist painter, and his brother, Charles Augustin, was a photographer.¹⁵ Vincent van Gogh and Auguste Rodin were family friends. Lhermitte’s early education was at St. Etienne, followed by medical training in the Faculty of Medicine at the University of Paris.⁷ He worked under neurologist Fulgence Raymond in the Pathological Anatomy Laboratory and defended his doctoral thesis titled “Étude sur les paraplégies des vieillards” (Studies on paraplegia in the elderly) in 1907, graduating with honors. In 1908, he was appointed director of the neurological clinic at l’Hôpital de la Salpêtrière, and in 1910, he was appointed head of Pierre Marie’s laboratory where he studied neuropathology under Gustave Roussy.¹⁵ During World War I, he worked as a field doctor for 2 years. Following this, he worked with Henri Claude at the neurological center of the 8th military region in Bourges, where he studied spinal cord injury, neuroendocrine pathology, and neuropsychiatric disorders among war victims and veterans.

After World War I, Lhermitte returned to Paris and

FIG. 1. A portrait of Jacques Jean Lhermitte (1877–1959). Photographer: Studio Damrémont. Interuniversity Library of Health Bibliothèque inter-universitaire de Santé; Health Medicine Collection Ref. image: 09551. (<http://www.biusante.parisdescartes.fr/histmed/image?09551>). Permission is covered by a License Ouverte/Open License.

was appointed chief of service at Paul-Brousse Hospital in 1919. In 1923, he received the title of associate professor of psychiatry. He was also clinical director at La Salpêtrière, the premier neuropsychiatric teaching hospital at that time.³ Despite his academic accomplishments in neurology, he was never awarded the title of professor of neurology because the only existing position in Paris was filled throughout his career.³ In 1928, he became head of the Dejerine Laboratory. When World War II began, he again returned to service as a military doctor. In 1944, he was offered the position of Chair of Psychiatry after the disappearance of the previous chair, Professor Joseph Lévy-Valensi. Lhermitte honorably declined the position in the absence of information regarding the professor's whereabouts. It was later discovered that Professor Lévy-Valensi had been arrested and taken to Auschwitz where he was killed.¹² When the position again became available, Lhermitte was no longer eligible due to an age limit. At his retirement in 1947, he was given an honorary professor appointment in neurology.

Lhermitte was remarkably prolific, authoring more than 800 papers and 16 books on neurology, neuropa-

thology, psychiatry, and even mystical phenomena such as possession. He is best known for describing the symptom of an electrical shock-like sensation that runs along the spine and/or limbs following flexion of the neck, i.e., “Lhermitte’s sign,” which is due to irritation or inflammation of the spinal cord.^{19,21} Although he was not the first to describe this phenomenon, he was the first to recognize its importance as an early presenting symptom of demyelinating disease.⁵ Lhermitte also described internuclear ophthalmoplegia (also known as Lhermitte’s syndrome), a constellation of pyramidal and extrapyramidal symptoms associated with parkinsonism in the elderly (Lhermitte-McAlpine syndrome),²⁴ dysplastic cerebellar gangliocytoma (Lhermitte-Duclos disease),²² Huntington’s disease,²⁷ and the syndrome of hallucinations caused by damage to the midbrain and pons (Lhermitte’s peduncular hallucinosis),²⁰ and he contributed to the description of several other diseases of the nervous system. In his later years, he was fascinated with the organic basis of the mind and psychiatric disease, and is often considered to be one of the fathers of neuropsychiatry.^{3,5}

Lhermitte died in his sleep at the age of 81 years on January 24, 1959.⁷ He was survived by 4 children, including a son, François Lhermitte, who became a professor of neurology at La Salpêtrière in Paris. In addition to his scientific contributions, he was recognized as a passionate, engaging instructor³ and “the most sincere and generous of friends, warm-hearted and tolerant, stimulating and encouraging.”⁷

History of the Syndrome of Peduncular Hallucinosis

In 1922, Lhermitte described a 72-year-old woman who developed signs of a stroke involving the cerebral peduncle and pons.²⁰ One year prior to presentation, she suffered a transient episode of vertigo. At presentation, she complained of 2 weeks of headache, vomiting, and diplopia. Her physical examination findings were notable for left-sided cranial nerve VI palsy, right-sided hyperreflexia, pallesthesia involving the right leg, and an intention tremor involving the right arm. Findings from her lumbar puncture were unremarkable. Two months later, at a clinical visit, she was noted to have additionally developed ptosis and palsies of the left third and fourth cranial nerves with a preserved pupillary response, right-sided tongue deviation, right-sided incoordination, and weakness. She had no psychiatric symptoms or intellectual disturbance; however, she did report the onset of hallucinations:

October 30, 1922, the patient told us that during the day, especially at dusk, she sees different animals walking on the floor of the room. They are cats or strange-looking chickens with dilated pupils that shine. To test the reality of these perceptions, the patient tried to touch these animals and she tells us that their contact was quite like that of real animals. But as soon as she touched them, they slowly disappeared through the floor. Despite the concordant association of her visual and tactile sensation, the patient does not think that these are real perceptions, since, when questioned, none of her neighbors experienced them. She remains convinced that she is the toy of the illusions. These visions, which, according to the patient, return daily, are not accompanied by any abnor-

FIG. 2. Example of the vivid visual hallucinations experienced by patients with peduncular hallucinosis. These pictures were drawn by a 53-year-old woman who experienced visual hallucinations associated with compression of the quadrigeminal plate due to a pineal meningioma. These hallucinations became less frequent, but did not completely resolve, after tumor removal. Reproduced from Miyazawa T, Fukui S, Otani N, Tsuzuki N, Katoh H, Ishihara S, et al: Peduncular hallucinosis due to a pineal meningioma. Case report. *J Neurosurg* 95:500–502, 2001. ©AANS. Published with permission.

mal noise. Significantly, [the patient's] sleep seems strongly disturbed, and sleeplessness at night results in somnolence during the afternoon.... [For several days] this hallucinatory state has persisted. The visions are no longer all animals, but human beings as well who are dressed in bizarre costumes or children playing with dolls. The patient sees them in her neighbors' bed.²⁰ [translated from French]

Gradually, Lhermitte's patient began to believe that the hallucinations were real, as they seemed to be so lifelike. Lhermitte surmised the lesion was likely vascular and localized it to the region of the midbrain and pons. He emphasized that this seemingly psychiatric disturbance did not originate from the cortex, but rather from the brainstem, and hypothesized that it might somehow also be related to disturbances of sleep.

In 1927, Van Bogaert presented a similar case of a 59-year-old woman who, at autopsy, had findings of a stroke involving the pulvinar nucleus of the thalamus, cerebral peduncle, third nerve nucleus and exiting fibers, superior colliculus, red nucleus, periaqueductal gray, decussation of the superior cerebellar peduncle, and substantia nigra.⁴⁰ He was the first to use the term “l'hallucinosé pédonculaire,” often translated as “peduncular hallucinosis,” although “pédonculaire” may also refer to the midbrain, not the cerebral peduncles alone.¹¹ Following this, Lhermitte, Levy, and Trelles reported on a patient who halluci-

nated that his room was transformed into a train each evening and saw figures that spoke to him. The patient died of pneumonia, and at autopsy was found to have pigmentary degeneration of the periaqueductal gray, particularly the median raphe and the oculomotor nuclei.²³

In 1935, de Morsier provided an additional report of a 54-year-old woman who similarly presented with the acute onset of symptoms, including right-sided paralysis of the third, fourth, and sixth cranial nerves, with left-sided hemiparesis, hyperreflexia, and cerebellar signs.⁹ Two years after onset of these symptoms, she additionally described “visions”:

In the evening, when her eyes are closed but she is completely awake, she sees colorful characters and animals very clearly. These visions suddenly appear and disappear in the same way after a few seconds. They occur mainly in the evening but not exclusively. She has seen characters, even during the day, with her eyes open. These can be characters she recognizes (her brother) or objects unknown to her (fantastic animals). These are not frightening to her; rather she feels a slight pleasant emotion when the images are beautiful. The images unfold naturally, ‘as in the cinema.’... They do not come at will...[and] have nothing to do with her thoughts.... The visions do not appear right in front of her, but are always born on the left and...move from left to right until the median line where they disappear.⁹ [translated from French]

He likewise believed this to be the result of a vascular

lesion in the territory of the right midbrain, emphasizing the organic basis suggested by hallucinations constrained to one-half of the visual world.

In 1952, Rozanski presented one of the first descriptions of peduncular hallucinosis in the English-language literature.³⁸ This case involved a 34-year-old woman who underwent diagnostic cerebral angiography for episodes of transient hemianesthesia and mild hemiparesis thought to be sensory seizures. In attempting direct puncture of the cervical carotid artery, the left vertebral artery was inadvertently accessed. Immediately following the procedure, the patient reported the onset of vivid visual hallucinations. Though she was still awake, when she closed her eyes, she saw natural scenes such as a flock of storks, a garden, and a forest with snow-covered trees and falling snowflakes. The patient recognized these scenes as hallucinations but felt them to be pleasurable and amusing. On physical examination, she was noted to have developed a partial left third nerve palsy and sixth nerve palsy in addition to her baseline hemianesthesia. Three days after the incident, she began to exhibit a hypomanic state characterized by euphoria, joviality, disorientation, and indifference toward her children. Over the course of the next several weeks, both the hallucinations and hypomania gradually resolved. The authors hypothesized that vasospasm, local toxicity caused by the contrast agent, or thrombotic obliteration of terminal midbrain vessels was the cause of the patient's symptoms.

In 1987, Geller and Bellur reported the first case of MRI-confirmed peduncular hallucinosis in a patient who reported seeing images of "cats running about on the floor, flowery outdoor scenes in bright purple colors, and the faces of neighbors and friends." MRI demonstrated a stroke involving the tegmentum and cerebral peduncle in the distribution of a mesencephalic branch of the posterior cerebral or superior cerebellar artery.¹³

Pathogenesis of Peduncular Hallucinosis

Because sleep disturbances often accompanied the visual hallucinations, Lhermitte believed that peduncular hallucinosis resulted from the pathological release of subcortical regions that are active in dreaming, while consciousness remained intact.²³ In addition to lesions in the midbrain, injury to the pulvinar nucleus of the thalamus^{8,11} and lower pons¹ also has been associated with complex visual hallucinations, raising the possibility that this condition may arise from disruption of subcortical visual processing pathways or a diffuse cerebral reaction to various lesions in primitive structures. In a comprehensive review article on complex visual hallucinations, Manford and Andermann posited that peduncular hallucinosis likely results from disruption of visual processing pathways and the ascending reticular activating system, a set of interconnected nuclei involved in maintaining arousal and consciousness.²⁶ Specifically, injury to the dorsal raphe nuclei has the effect of impaired suppression of the dorsal lateral geniculate nucleus of the thalamus (involved in the visual pathway) and reduced fidelity of retinogeniculate transmission.²⁶ This structure is also involved in the regulation of sleep. Similarly, the pulvinar nucleus of the thalamus

receives input from the retina, pedunculopontine tegmental nucleus, and brainstem raphe, suggesting that injury to this structure results in similar dysregulation.²⁶

In addition to midbrain and brainstem disinhibition, a decrease in cortical visual stimulation also likely contributes to visual hallucinations in peduncular hallucinosis. Although visual loss is not necessary for hallucinations to occur, it often accompanies them,^{10,13} and hallucinations may be more pronounced when the eyes are closed.^{26,38} Indeed, visual hallucinations occur without brainstem involvement following visual loss, most commonly following macular degeneration in the elderly (i.e., Charles Bonnet syndrome) and posterior cerebral artery infarctions involving occipital cortex and visual thalamus.²⁶

Peduncular Hallucinosis in Neurosurgery

Although peduncular hallucinosis is most often caused by ischemic or hemorrhagic injury to the rostral brainstem,²⁶ it may also be the presenting symptom of several tumors. Complex visual hallucinations have been described with craniopharyngiomas,¹⁰ medulloblastomas,³¹ cerebellar juvenile pilocytic astrocytomas,^{2,30} pineal meningiomas,²⁸ metastatic disease,^{14,34} pontine cavernomas,⁶ and posterior fossa meningiomas.²⁵ The cause of the hallucinations in these cases is generally thought to be compression of the pons, midbrain, and/or diencephalon, and they resolve or improve after resection. Vivid visual hallucinations responding to induced hypertension have also been described following aneurysmal subarachnoid hemorrhage, suggesting that peduncular hallucinosis may occur as a result of brainstem ischemia from vasospasm.^{33,41}

Surgery near the midbrain or pons may also result in peduncular hallucinosis. Transient visual hallucinations following the sacrifice of the superior petrosal vein and/or tributaries to it during microvascular decompression have been reported by several groups.^{4,16,39} Cerebellar retraction injury during microvascular decompression procedures without venous sacrifice has also been associated with complex visual hallucinations.²⁹ Midbrain trauma and/or microvascular ischemia following endoscopic third ventriculostomy,¹⁷ cerebral angiography,³⁸ hypothalamic astrocytoma,¹⁷ medulloblastoma,¹⁸ petroclival meningioma,³⁷ and posterior fossa meningioma²⁵ resection; and transoral odontoidectomy have also been reported to cause transient complex visual hallucinations.³⁶ These are generally self-limited, resolving without treatment in 1 to 2 weeks. Antipsychotic agents such as olanzapine and quetiapine have demonstrated efficacy in cases in which hallucinations are persistent.^{6,32,35}

Conclusions

Jacques Jean Lhermitte made extensive contributions to the fields of neuroanatomy, pathology, neurology, and psychiatry throughout his illustrious career but has seldom been recognized in neurosurgery. His study of the biological basis of complex phenomena such as hallucinations shed light on the mysterious process by which the physical substance of the brain generates the experience of the mind. Lhermitte's syndrome of peduncular hallucinosis is one example of this, which neurosurgeons should

be aware of and understand so as to appropriately counsel their patients. Moreover, it is a reminder to all of the extraordinary nature of the organ we interface with on a daily basis.

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Disclosures

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Author Contributions

Conception and design: Kosty, Mejia-Munne. Acquisition of data: Kosty, Mejia-Munne. Drafting the article: Kosty, Dossani, Savardekar, Guthikonda. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Kosty.

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