**ABSTRACT**

**Background:** Parkinson’s disease is the main primary cause of Parkinsonian syndrome, otherwise, other etiologies should be investigated when these symptoms appear. Secondary parkinsonism can be caused by intoxication, cerebrovascular and metabolic disorders, head trauma, infections, and others, including intracranial tumors, which are responsible for only 0.3% of these cases. Meningiomas are the most common asymptomatic and extra-axial intracranial tumors and associated with the appearance of extrapyramidal symptoms in secondary parkinsonism. A case is reported along with a literature review with all the cases described in which meningiomas were the primary cause of a parkinsonian syndrome.

**Case Presentation:** Male patient, 58 years-old, with history of mood and behavior oscillations, affective dullness, anhedonia, lack of volition, binge eating and social isolation. He also developed left hemiparesis associated with high amplitude and low frequency resting tremor. The symptoms were associated with a right parafalcine parasagittal meningioma, which mass effect get over the frontal lobe and ipsilateral basal ganglia. The surgical resection was performed, resulting in complete resolution of parkinsonian symptoms and behavior.

**Conclusions:** Parkinsonian symptoms due to meningiomas are rare and their clinical presentation can appear as idiopathic PD. Because of that, it is important to always to perform investigation of differential diagnosis. Clinicians must pay attention to this secondary cause of PD since the treatment, prognosis and quality of life are completely different from those patients with primary PD.

**Keywords:** Parkinsonian Syndrome; Meningioma; Secondary Parkinsonism; Resting tremor; Parasagittal meningioma
de 58 anos com histórico de oscilações de humor e comportamento, embotamento afetivo, anhedonia, falta de vontade, compulsão alimentar e isolamento social. Ele também desenvolveu hemiparesia esquerda, associada a tremor de repouso de alta amplitude e baixa frequência. Os sintomas foram associados a um meningioma parassagital parafalcino direito, cujo efeito de massa atinge o lobo frontal e os gânglios da base ipsilaterais. A reseccão cirúrgica foi realizada, resultando na resolução completa dos sintomas parkinsonianos e também do comportamento. **Conclusões:** Os sintomas parkinsonianos decorrentes de meningiomas são raros e sua apresentação clínica pode se apresentar como DP idiopática. Por isso, é importante sempre investigar o diagnóstico diferencial. Os médicos devem estar atentos a esta causa secundária de DP, uma vez que o tratamento, prognóstico e qualidade de vida são completamente diferentes daqueles pacientes com DP primária.

**Palavras-Chave:** Síndrome Parkinsoniana; Meningioma; Parkinsonismo secundário; Tremor de repouso; Meningioma parassagital

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**INTRODUCTION**

Parkinsonian syndrome is characterized by bradykinesia, resting tremor, rigidity, and postural and gait impairment. Although Parkinson's disease (PD) is the main primary cause of this syndrome, other etiologies should be studied when these symptoms appear\(^1\). Intoxication, cerebrovascular and metabolic disorders, head trauma, infections, electrolyte disturbances and intracranial tumors should be investigated as a secondary cause of parkinsonism\(^2\). Low-grade astrocytomas, glioblastomas, oligodendrogliomas, lymphomas, meningiomas and other tumors have been associated in the literature with parkinsonism on a few occasions\(^3\). According to a study by Krauss et al., these symptoms caused by brain tumors are quite rare, with an incidence of 0.3%. Among them meningioma is more associated with the appearance of extrapyramidal symptoms, especially when it is located in the sphenoid crest, frontal or parietal area\(^4\).

Meningiomas are tumors of the central nervous system that arise from the meningotheial cells of the arachnoid villi from their outermost part\(^5\). They are the most common asymptomatic and extra-axial intracranial tumors, representing about 30% of central nervous system tumors in adults\(^6,8\). Compared to males, a higher prevalence in females can be seen, in a 2:1 ratio\(^7\), affecting more often individuals between the 3rd and 6th decade of life\(^8\). Mostly commonly found isolated in the skull base, parasellar regions, cerebral convexities and parasagittal regions\(^5,7,8\), it is mainly supplied by blood flow originating from the external carotid artery system\(^9\). Although not yet completely elucidated in pathophysiology, it is known that there is a genetic factor involved in their emergence, as well as exposure to ionizing radiation and hormones seem to have a strong relationship with their development\(^6,8\). Despite being classified histologically as benign lesions, meningiomas can present disabling clinical symptoms related to their adjacent structures, such as loss of vision, seizures, hemiparesis, neuropathies, difficulty in reading, writing, driving and even thinking\(^6\). Although less commonly, as already mentioned, another symptom that can be strongly related to the development of meningioma is the onset of parkinsonism syndrome, resulting from the mechanical compression of the basal ganglia and the nigrostriatal pathway\(^10\).

Therefore, despite the rarity of meningioma's secondary parkinsonism, the study about this condition is of utmost importance, since the diagnosis by exams makes the treatment different between these patients and those with other causes of parkinsonism which greatly impact these people's lives. Based on this, our aim is to report a case and review the literature related to the presence of meningioma and secondary parkinsonian symptoms, evaluating the importance of imaging tests and surgical treatment for clinical improvement.

**CASE PRESENTATION**

A 58-year-old male patient with a past medical history of diabetes, hypertension and morbid obesity presented with a 2-year history of mood and behavior oscillations, affective dullness, anhedonia, lack of volition, binge eating and social isolation. Subsequently, he developed left hemiparesis associated with high amplitude and low frequency resting tremor. On neurological examination, the patient had disproportionate incomplete hemiparesis, predominately in the left upper limb, associated with hyperreflexia and spasticity with cogwheel rigidity, predominantly in the left wrist. Hoffmann and Trommer signs were also present. Fundoscopic examination revealed bilateral papilledema. Further
assessment with Magnetic Resonance Imaging (MRI) revealed a right parafalcine parasagittal meningioma causing mass effect over the frontal lobe and ipsilateral basal ganglia.

The patient underwent surgical resection with microscope (Simpson I). Figure 1 shows the pre and postoperative MRI images. The early follow-up demonstrated a remarkable improvement with complete resolution of the parkinsonian symptoms and also behavior.

**METHODS**

A search was performed in articles using “meningioma” and “parkinsonism” in the PubMed® database as keywords resulting in 112 articles. The inclusion criteria for the studies were articles addressed to parkinsonism symptoms in patients with meningioma, written in English, Spanish or Portuguese. The exclusion criteria were articles unrelated to the topic, which described surgical techniques and equipment, whose patients developed parkinsonism after removal of the tumor or by surgical complications, which reported tumors other than meningioma or extracranial tumors, which did not describe the postsurgical outcome and when the complete file was unavailable. Figure 2 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram performed. Two articles that were duplicates were eliminated. Sixty-nine articles were eliminated based on the reading of titles and abstracts, remaining 41 articles. After reading them completely, another 17 were disregarded. Thus, this review consisted of 24 articles (17 case reports, three case series and four letters to the editor with a report). This analysis of the articles was initially carried out by one author, but the final election also included two other authors. There are few studies related to this subject, so several variations of study designs have been included. Information about year of the case, number of patients, age, sex, main symptoms, duration of symptoms, neurological exams, medications, laboratory results, imaging exams, compressed structures, and symptoms after surgery were included in this study for analysis. To standardize the location of the tumor, the classification of the most common locations according to Yamashita et al. was used. The authors evaluated the tumor images in each article for this purpose.
Cobucci FLR, Almeida JFM, Rigueiral MEG, Gonzaga RVV, Medeiros RTR, Franceschini PR, Aguiar PHP - Unusual Case of Parkinsonian Syndrome Induced by a Parasagittal Meningioma: a systematic review

RESULTS

The articles included in this review are mainly case reports and case series published between 1964 and 2019. Tables 1 and 2 show the data for each of them. Twenty-four articles with 30 patients in total were analyzed. Of the patients analyzed, 76.7% were women and 23.3% men. The age of the patients ranged between 41 and 70 years, with 57.5 as the mean found. Only two patients (6.6%) had a family history of Parkinson’s disease or parkinsonism.

The main signs and symptoms observed in this review were tremor at rest, bradykinesia and rigidity. In addition, gait changes, limb weakness, seizures, memory loss, urinary incontinence, headache, vomiting and psychiatric disorders such as binge eating, disinhibition, inappropriate behavior, depression and anxiety were also mentioned. These behavioral changes were present in 23.3% of patients. The duration of symptoms ranged from one day to 18 years.

Regarding drug treatment before surgery, 53.3% of patients received medication with minimal or no improvement in symptoms. Only one had subjective improvement but discontinued treatment.

Laboratory tests performed preoperatively had mostly normal or unspecified results, except in three cases (9.6%) that had hyperproteinorrachia. In 46.7% of the patients, the identification of the tumor was made using magnetic resonance imaging (MRI), and 43.3% with computed tomography (CT scan). Angiography was used for diagnosis in only 20.0% of cases and other imaging exams in 23.3%.

The main structures that were mentioned in the articles for being compressed by the tumor and edema, directly or indirectly, were, in 53.3% of the cases, the basal ganglia. Damages were also found in the following areas: cavernous sinus, cerebellum, brainstem, thalamus, superior sagittal sinus, and corpus callosum. In addition, changes in the ventricles, such as dilations and compressions, in cerebral arteries (basilar artery), and midline deviations were identified.

Tumors were mostly located in the convexity (10/33; 33.3%)\(^{10,13,14,17,19,22,25,29}\), sphenoidal ridge (5/30; 16.7%)\(^{2,18,21,26,28}\), falx (3/30; 10.0%)\(^{23,24}\) and parasagittal region (3/30; 10.0%)\(^{15,24,30}\).

They were also found in other locations as middle fossa (2/30; 6.7%)\(^{10,19}\), posterior fossa (1/30; 3.3%)\(^{31}\), third ventricle (1/30; 3.3%)\(^{31}\), tuberculum sellae (1/30; 3.3%)\(^{13}\), clivus (1/30; 3.3%)\(^{20}\), planum sphenoidale (2/30; 6.7%)\(^{16,19}\), and cerebellar pons angle (1/30; 3.3%)\(^{32}\).

Most patients (93.3%) evolved with total or partial improvement of parkinsonian symptoms in the postoperative period after tumor removal. In 16.6% of cases, persistent complications were found: seizures\(^{10}\), hemiparesis, urinary incontinence, disorientation and memory disorders\(^{31}\), slowing of the hand\(^{22}\), headache and tremor due to complications in the shunt\(^{26}\), and death after anesthetic induction for the second part of the surgery\(^{24}\). One patient improved after surgery, but parkinsonism symptoms returned within a few years and were successfully treated with medications\(^{29}\). Only one patient had tumor recurrence 2 years after the first surgical approach. He presented with symptoms such as headache, visual loss and progressive weakness, and underwent resection of the new tumor again\(^{26}\).

This review has some limitations. Many articles could not be included as their full text was unavailable. The older articles used X-ray exams or non-high definition CT imagens, which complicated the tumor localization analysis. Not all studies described all the parameters we evaluated, reducing our sample. Furthermore, neurological examinations were not performed systematically and equally in all articles. Finally, regarding the standardization of tumor location, some articles presented only axial CT/MRI images of the tumor before surgery, making it difficult to accurately differentiate between parasagittal and convexity meningiomas.
### Table 1. General data of the articles included in this systematic review about parkinsonism secondary to meningioma – Part 1.

| Paper | Year | N  | Sex | Age | Main symptoms | Duration of symptoms | Neurological exam | Medications |
|-------|------|----|-----|-----|--------------|---------------------|------------------|-------------|
| Adhiyaman and Meara\(^{10}\) | 2003 | 1  | F   | 63  | 1. Rest tremor on L hand | 1. 18 years | Bilateral upper limb tremors, rigidity and akinesia, more marked on the L side | Orphenadrine hydrochloride, amantidine, levodopa or pergolide without improvement |
|       |      |    |     |     | 2. Worsened tremor           | 2. 5 years |                       |             |
|       |      |    |     |     | 3. Sudden weakness of the L arm and leg and collapsed | 3. few months |                       |             |
| Al-Janabi et al.\(^{12}\) | 2019 | 1  | F   | 65  | Progressive resting tremor on the R hand | 3 months | Mild features of early PD, including bradykinesia and slight cogwheel rigidity at the elbows | * |
| Barbosa et al.\(^{13}\) | 1987 | 1  | F   | 50  | 1. Holocranial headache | 1. 5 months | Complete, discrete R hemiparesis, with facial predominance; oligokinesia, rigidity, and resting tremor involving the R hemibody, especially the upper limb; bilateral papilledema; fixation memory deficit, nominative dysphasia and direct-L disorientation | Dexamethasone levodopa and benzerazide with slight improvement in tremor |
|       |      |    |     |     | 2. Tremor and difficulty in moving the R upper limb | 2. 1 month |                       |             |
| Benincasa et al.\(^{14}\) | 2005 | 1  | F   | 61  | December 2004: rest tremor and slowness of movements in the R upper limb | December 2004: 4 months | December 2004: initial R hemiparkinsonism, with rest tremor, bradykinesia and slight rigidity | Poor response to antiparkinsonian drugs |
|       |      |    |     |     | October 2005: frequent vomiting, L ear tinnitus, slowness of thinking, and repeated, transient episodes of R palpebral ptosis | October 2005: hemiparkinsonian syndrome with rest tremor, rigidity, and bradykinesia of the R limbs (more pronounced in the upper limb); asymmetrical deep tendon reflexes (slightly brisk in the R limbs), and the R plantar reflex was equivocal |             |
| Bostantjopoulou et al.\(^{15}\) | 2007 | 1  | M   | 49  | 1. Mild slowness of movement on the L side and loss of dexterity of the L hand, slight rest tremor on L hand | 1. 2 months | Slight rest tremor of the L hand, moderate bradykinesia and rigidity on the L side, reduced L arm swing and brisk tendon reflexes on the L side with equivocal L plantar reflex | * |
|       |      |    |     |     | 2. 7 years later: slowness of movement of the L hand | 2. 7 years later: 1 month | 7 years later: L hemifacial hypomimia, bilateral postural mild bradykinesia and rigidity of his L arm and leg, broad-based gait with reduced L arm swing and brisk tendon reflexes on the L | Mood stabilisers (Depakin) without improvement |
| D’Elia et al.\(^{16}\) | 2014 | 1  | F   | 57  | 1. Disinhibition and inappropriate conduct | 1. 10 years | Resting tremor, arm swing decreased on walking, mild bradykinesia, hypomimia and marked rigidity in all four limbs, with cogwheel rigidity at the elbows |             |
|       |      |    |     |     | 2. Anosmia and a marked bilateral and symmetrical resting tremor localized to the jaw and all four limbs, bradykinesia and difficulty walking | 2. 3 months |                       |             |
| Fong et al.\(^{17}\) | 2015 | 1  | F   | 58  | Progressive asymmetrical extrapyramidal symptoms and signs suggestive of idiopathic PD | 2 months | Moderate hypomorphic facies with hypophonic speech, reduced R arm swing and a slow gait. Resting pill rolling tremor in the distal R upper limb and tremor of her jaw. Cogwheel rigidity of the wrist, and bradykinesia on the R | * |

*Not cited by the article; N: number of patients F: female; M: male; PD: Parkinson’s disease; R: right; L: left; cm: centimetre; mm: millimetre; DAT-SPECT scan: Single-Photon-Emission-Computed-Tomography Dopamine Transporter scan; MRA: Magnetic Resonance Angiography; PET scan: Positron-Emission-Tomography scan; CMRglu: Cerebral Metabolic Rate of glucose; [18F]Dopa: Fluorodeoxyphenylalanine 18-Dopamine; ICU: Intensive Care Unit; CSF: cerebrospinal fluid.
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Table 1. Continued...

| Paper          | Year | N  | Sex | Age | Main symptoms                                                                 | Duration of symptoms | Neurological exam                                                                 | Medications                  |
|----------------|------|----|-----|-----|-------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------|------------------------------|
| Kim et al.     | 2014 | 1 F 58 | Bilateral resting tremor, more prominent on the R | 2 months            | Asymmetric parkinsonism without pyramidal signs. Hand tremor (more prominent in the R hand), mild bradykinesia in finger and foot, cogwheel rigidity in both arms (prominence in the R), and reduced arm swing on the R side |                         | *                                                                                 |
| Kleib et al.   | 2016 | 1 F 41 | Slight slowness of movement on the R side | 4 months            | Slight rest tremor of the R hand, moderate bradykinesia and rigidity            | Levodopa for 4 months        | without improvement Propanolone without improvement |
| Krauss et al.  | 1989-1993 | 4 M 67 | L tremor, akinesia and postural instability | 1 year              | L tremor, akinesia and postural instability                                     |                         | *                                                                                 |
| F 55           |      | 1. L tremor, rigidity, akinesia and postural instability | 1. 3 years       | Pyramidal signs, L tremor, rigidity, akinesia and postural instability          |                         | *                                                                                 |
| F 70           |      | 1. R tremor, rigidity and akinesia | 1. 2 years       | Pyramidal signs, R tremor, rigidity and akinesia                              |                         | *                                                                                 |
| F 51           |      | 2. Psychological alterations and pyramidal signs | 2. 1 year       |                                                                                 |                         | *                                                                                 |
| Labate et al.  | 2018 | 1 F 67 | Progressive ataxia, slight orthostatic hypotension and urinary incontinence at onset | 4 months            | Hyperreflexia, gait ataxia, bradykinesia, rigidity, and mixed postural and resting tremor in both arms | Poor response to levodopa    | *                                                                                 |
| Lesoin et al.  | 1981 | 1 M 52 | 1. Tremor, rigidity, and akinesia | 1. 3 months | Tremor, rigidity and akinesia                                                                                 | At no time he has received medical treatment for PD |
| Lieberman et al.| 2013 | 1 M 69 | Fall without loss of consciousness, mild gait difficulty | 2. 2 days       | *                                                                            | Mild gait difficulty         | *                                                                                 |
| Miyagi et al.  | 1993 | 1 F 48 | 1. Tremor and cogwheel rigidity in her L limbs | 1. 3 years       | Resting tremor in the L arm associated with cogwheel rigidity, tremor less intense in the L leg, and mild L-sided hemiparesis with hyperreflexia and positive Babinski’s sign | Clonazepam, trihexyphenidyl HCl, and levodopa without improvement on tremor |
|                |      | 2. Urinary incontinence followed by weakness of the L limbs | 2. 3 months |                                                                                 |                         | *                                                                                 |

*Not cited by the article; N: number of patients; F: female; M: male; PD: Parkinson's disease; R: right; L: left; cm: centimetre; mm: millimetre; DAT-SPECT scan: Single-Photon-Emission-Computed-Tomography Dopamine Transporter scan; MRA: Magnetic Resonance Angiography; PET scan: Positron-Emission-Tomography scan; CMRglu: Cerebral Metabolic Rate of glucose; [18F]Dopa: Fluorodeoxyphenylalanine 18-Dopamine; ICU: Intensive Care Unit; CSF: cerebrospinal fluid.
Table 1. Continued...

| Paper                      | Year  | N  | Sex | Age | Main symptoms                                                                 | Duration of symptoms | Neurological exam                                                                                   | Medications                  |
|---------------------------|-------|----|-----|-----|-------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------|-------------------------------|
| Nicholson and Turner      | 1963  | 3  | M   | 61  | 1. Loss of concentration and memory                                            | 1. 1 year            | Marked retardation of the mental processes, tremor in all limbs with increased tone and rigidity on the R side, tremor of the tongue and loss of facial expression | Medication for PD            |
|                           |       |    |     |     | 2. Festination of speech and gait, intermittent urinary incontinence and a possible episode of unconsciousness | 2. 3 months          |                                                                                                   |                               |
|                           | F 51  | 1  |     |     | 1. History of parkinsonism                                                     | 1. 4,5 years         | Tremor and increase in tone on the R side with cogwheel rigidity, loss of facial expression and slowness in communication, urinary incontinence, bilateral papilledema |                               |
|                           |       |    |     |     | 2. Increasing dysphasia and marked slowing of mental performance and responsiveness | 2. 1 year            |                                                                                                   |                               |
|                           | F 61  | 1  |     |     | History of parkinsonism and deterioration of memory and concentration, feeling of heaviness in the limbs (particularly of the L arm), and frequent falls to the L side | 9 months             | The patient was unco-operative, disorientated and incontinent, speech was slurred and there was a mild spastic paresis of all limbs (particularly of the L side), accompanied by an increase in tone and cogwheel rigidity |                               |
| Okada et al.              | 1982  | 1  | F   | 70  | 1978: Bilateral tremor of her upper limbs, antero-pulsion and a paralytic gait  | 4 years              | 1982: Bilateral postural tremor, hemiparesis, muscle rigidity of the L extremities and hyperreflexia of the L upper limb. She moved slowly and had a slight masked face | 1978: The initial diagnosis was cerebral infarction and she was treated for 3 years |
|                           |       |    |     |     | 1982: Her symptoms became progressively worse, she had lost her ability to initiate movement and complained of headaches |                      |                                                                                                   |                               |
| Polyzoidis et al.         | 1959- 2 | 1  | M   | 63  | 1959: Severe depression                                                        | *                    | 1960: resting tremor, cogwheel rigidity, masking of her face, and hyperreflexia of the L side         | 1959: Imipramine              |
|                           | 1960  |    |     |     | 1960: Tremor of the L hand                                                     |                      | Later 1960: progressive extrapyramidal and pyramidal signs                                     | 1960: Benzotropine mesylate and perphenazine were added |
|                           |       |    |     |     |                                                                                           |                      | Later 1960: Progressive extrapyramidal and pyramidal signs, mental deterioration and blurring of vision |                               |
|                           | 1979  | 1  | F   | 51  | 1. Convulsive seizures                                                         | 1. 12 years          | Brief attention span, L homonymous hemianopsia, minimal weakness of the L arm and leg with slight hyperreflexia, constant tremor in the L arm and head, and unexpressive face | Haloperidol                   |
|                           |       |    |     |     | 2. Memory loss and personality changes                                          | 2. 3-5 years         |                                                                                                   |                               |
|                           |       |    |     |     | 3. Increased appetite and she gained 7.5kg                                     | 3. 1 year            |                                                                                                   |                               |
|                           |       |    |     |     | 4. Tremor involving the L arm and the head                                      | 4. 3 years           |                                                                                                   |                               |
|                           |       |    |     |     | 5. Clear nasal discharge and R parietal headaches                               | 5. Several months    |                                                                                                   |                               |
|                           |       |    |     |     | 6. Weakness of the L arm and leg                                                | 6. 3 days            |                                                                                                   |                               |

*Not cited by the article; N: number of patients; F: female; M: male; PD: Parkinson’s disease; R: right; L: left; cm: centimetre; mm: millimetre; DAT-SPECT scan: Single-Photon-Emission-Computed-Tomography Dopamine Transporter scan; MRA: Magnetic Resonance Angiography; PET scan: Positron-Emission-Tomography scan; CMRglu: Cerebral Metabolic Rate of glucose; [18F]Dopa: Fluorodeoxyphenylalanine 18-Dopamine; ICU: Intensive Care Unit; CSF: cerebrospinal fluid.
### Table 1. Continued…

| Paper            | Year | N  | Sex | Age | Main symptoms                                                                 | Duration of symptoms | Neurological exam                                                                                      | Medications                                      |
|------------------|------|----|-----|-----|--------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Reyes et al.[^27] | 2019 | 1  | F   | 56  | 1. Bradykinesia, rigidity, bilateral upper tremor (more prominent in the R), and wrists cogwheel rigidity  
2. Paroxysmal vertigo, tinnitus, mild subjective hearing loss, and worsening gait disturbances  
3. Acute onset spastic quadriplegia  
4. Decreased responsiveness                                                                 | 1. 2 years          | Glasgow Coma Scale of 10/15 with orientation to time and place but not to person, Parkinson’s facies, R VI nerve palsy and global weakness, hyperreflexia in all limbs, and horizontal gaze nystagmus to the L | Poor response to carbidopa-levodopa and trihexyphenidyl HCL (resistance for 2 years) |
| Salvati et al.[^4] | 2000 | 1  | M   | 61  | Weakness, rigidity, bradykinesia, resting tremors in the L upper limb and postural tremors  
2. Paroxysmal vertigo, tinnitus, mild subjective hearing loss, and worsening gait disturbances  
3. Acute onset spastic quadriplegia  
4. Decreased responsiveness                                                                 | 10 years            | Weakness, rigidity, bradykinesia combined with resting tremors in the L upper limb and with postural tremors in the L hand, postural tremor, cogwheel rigidity at the L wrist and elbow, loss of dexterity due to bradykinesia, bilateral papilledema, and slow gait with L arm swing diminished | Levodopa-carbidopa and bromocrypbine for 5 years without improvement |
| Shah and Rajshekhar[^30] | 2004 | 1  | F   | 54  | Tremor, particularly at rest, in the L upper limb and 2 episodes of generalized seizures | 2 months            | Masked facies, rest tremor in the L hand, postural tremor, cogwheel rigidity at the L wrist and elbow, loss of dexterity due to bradykinesia, bilateral papilledema, and slow gait with L arm swing diminished | Levodopa-carbidopa and bromocrypbine for 5 years without improvement |
| Tan et al.[^29]   | 2007 | 1  | M   | *   | Gradual onset of L sided resting tremor, bradykinesia, and rigidity, which progressed to involve the R-sided limbs over a few months, associated with symptoms of generalized anxiety disorder | Few months           | No evidence of impaired cognition, and his limb power, sensory modalities, and reflexes were normal. There were no atypical features such as gaze abnormalities or orthostatic hypotension to suggest secondary causes for his parkinsonism | Selegline for 2 months but discontinued receiving the medication despite subjective improvement |
| Vijiaratnam et al.[^30] | 2018 | 1  | F   | 44  | Sudden-onset R leg weakness and small handwriting | 4 months            | Power in her R leg was mildly reduced proximally and she was unable to perform ankle dorsiflexion. Hoover’s sign was positive. She had slight impairment of dexterity in the R arm. On pen-and-paper tasks, she had R-sided small script but there was no size decrement, and the Archimedes spiral was small in size with consistent spiral turn spacing | Dopamine agonist without improvement |
| Wakai et al.[^31] | 1984 | 1  | F   | 58  | 1. Disturbance of gait with festination  
2. Lost consciousness but regained it in a few minutes  
3. Urinary incontinence and a high fever of 2 days duration. After that she became bradykinesic  
4. Unable to stand                                                                                       | 1. 6 years          | Mask face, positive Myerson’s sign, lead-pipe rigidity in all extremities, bradykinesia, astasia-abasia, loss of salivation on the body and increased salivation. Two days after admission, she showed marked improvement of these symptoms despite no particular therapy | Slightly reduced R-arm swing, bradydysdiadochokinesia of the R arm, minor action tremor especially when writing and drawing, postural instability when tandem walking and a slight upbeat nystagmus induced by upward gaze and mildly increased tendon reflexes on the R |
| Wojciech et al.[^32] | 2012 | 1  | F   | 56  | Bradykinesia, tremor in the R hand, micrographia and postural instability | 9 months            | Slightly reduced R-arm swing, bradydysdiadochokinesia of the R arm, minor action tremor especially when writing and drawing, postural instability when tandem walking and a slight upbeat nystagmus induced by upward gaze and mildly increased tendon reflexes on the R | Dopamine agonist without improvement |

[^Not cited by the article; N: number of patients F: female; M: male; PD: Parkinson’s disease; R: right; L: left; cm: centimetre; mm: millimetre; DAT-SPECT scan: Single-Photon-Emission-Computed-Tomography Dopamine Transporter scan; MRA: Magnetic Resonance Angiography; PET scan: Positron-Emission-Tomography scan; CMRglu: Cerebral Metabolic Rate of glucose; [18F]Dopa: Fluorodeoxyphenylalanine 18-Dopamine; ICU: Intensive Care Unit; CSF: cerebrospinal fluid.]
### Table 2. General data of the articles included in this systematic review about parkinsonism secondary to meningioma – Part 2.

| Paper | Year | N  | Sex | Age | Laboratory exams | Imaging exams | Compressed structures | Tumor location | Symptoms after surgery |
|-------|------|----|-----|-----|------------------|---------------|-----------------------|---------------|------------------------|
| Adhiyaman and Meara[^10] | 2003 | 1  | F   | 63  | *                | CT scan: 4 cm densely calcified lesion with surrounding edema in the R frono-parietal region with some mass effect | Compression of the R basal ganglia by the frono-parietal meningioma and the L basal ganglia by the mass effect | R convexity | The L hemiparesis persisted and recovery was complicated by focal seizures. Tremor and akinnesia resolved completely. Near full recovery after a program of rehabilitation |
| Al-Janabi et al.[^12] | 2019 | 1  | F   | 65  | *                | MR: mass measuring 5.7×4.2×5.6 cm in the anterior cranial fossa and moderate mass effect with edema which was greater in the R than in the L lobe. The frontal horns were somewhat distorted and posteriorly displaced. The mass extended into the anterior margin of the suprasellar cistern and was abutting the anterior margin of the optic chiasm | Mass effect on the basal ganglia (caudate) | Tuberculum sellae | Gradual and continuous improvement in her tremor and cogwheel rigidity, but she continued to have stable mild R-hand resting tremor |
| Barbosa et al.[^11] | 1987 | 1  | F   | 50  | *                | CT scan: mass in the L frontotemporal region, iso-attenuating in relation to the adjacent parenchyma and showing homogeneous contrast uptake | Basal ganglia and/or nigral efferences | R convexity | Two weeks after surgery the parkinsonian signs and R hemiparesis had disappeared. The papilledema and neuropsychological dysfunctions persisted attenuated. After 1 year, the patient remained asymptomatic |
| Benincasa et al.[^14] | 2005 | 1  | F   | 61  | *                | December 2004 DAT-SPECT scan: significant reduction of tracer binding at the level of the L striatum October 2005 MRI: large L frontal tumor with surrounding edema compressing the basal ganglia and the mesencephalon | Basal ganglia and mesencephalon | L convexity | The hemiparkinsonian signs were completely resolved 7 days after surgery. On the last out-patient examination the neurological exam was normal with the exception of an equivocal R plantar reflex response |
| Bostantjopoulou et al.[^15] | 2007 | 1  | M   | 49  | Routine hematological and biochemical examination were normal | CT scan and MRI: large R parasagittal tumor with surrounding edema compressing the basal ganglia. A small tumor was also observed in the L cerebellar hemisphere. After 7 years MRI: huge R parasagittal meningioma, with surrounding edema and midline shift to the L | R basal ganglia on both times | Parasagittal on both times | Signs of parkinsonism were abolished after tumor resection. Four years later, the patient was operated again for the cerebellar tumor (fibroblastic meningioma). There were no signs of recurrence of the first meningioma at that time. Seven years later: excision of the tumor abolished parkinsonism. At repeated follow-up examinations for more than 4 years he remained free of any PD symptoms |
| D’Elia et al.[^16] | 2014 | 1  | F   | 57  | Blood test, thyroid function, and ECG results were normal | CT scan: large lesion occupying the frontal lobes and a midline shift to the L | The lesion compressed and displaced the corpus callosum posteriorly and the head of the caudate nucleus bilaterally | Sphenoidal planum | There was a marked reduction in the patient’s tremor on the first post-operative day, and a nearly complete resolution 30 days later. At the 18-month follow-up, the patient was still in good health and had no neurological symptoms. Her behavioral issues were also reduced, but her anosmia remained unchanged |

[^10]: Not cited by the article; N: number of patients F: female; M: male; PD: Parkinson's disease; R: right; L: left; CT scan: Computer Tomography scan; MRI: Magnetic Resonance Imaging; cm: centimetre; mm: millimetre; DAT-SPECT scan: Single-Photon-Emission-Computed-Tomography Dopamine Transporter scan; MRA: Magnetic Resonance Angiography; PET scan: Positron-Emission-Tomography scan; CMRglu: Cerebral Metabolic Rate of glucose; [18F]Dopa: Fluorodeoxyphenylalanine 18-Dopamine; ICU: Intensive Care Unit; CSF: cerebrospinal fluid.
### Table 2. Continued...

| Paper                          | Year | N | Sex | Age | Laboratory exams                          | Imaging exams                                                                 | Compressed structures | Tumor location | Symptoms after surgery                                                                 |
|-------------------------------|------|---|-----|-----|--------------------------------------------|-----------------------------------------------------------------------------|-----------------------|----------------|----------------------------------------------------------------------------------------|
| Fong et al.\(^{17}\)          | 2015 | 1 | F   | 58  | *                                          | MRI: very large contrast-enhancing L-sided extra-axial frontal tumor measuring 6.8×5.6×6.4 cm. The perilesional vasogenic edema with significant mass effect resulted in a 14 mm L to R midline shift, subfalcine and early uncal herniation with midbrain rotation | L basal ganglia       | L convexity     | Parkinsonism significantly improved. Review at 6 months documented resolution of all her peripheral features, although a mild intermittent jaw tremor persisted |
| Kim et al.\(^{2}\)            | 2014 | 1 | F   | 58  | Blood cell count, serum chemistry tests, and thyroid function tests were normal | PET scan: normal strength of radiolotope uptake in both striatum, but the L caudate nucleus and putamen were displaced dorsally MRI: lobulated and well-defined mass (5.67×5.01 cm) in the L sphenoid ridge | The mass compressed the L cavernous sinus, and the cerebral midline was shifted toward the R side | L sphenoidal ridge | Disappeared after 2 months                                                                 |
| Kleib et al.\(^{18}\)         | 2016 | 1 | F   | 41  | *                                          | MRT: large L sphenoid wing tumor with significant perilesional edema extending to the basal ganglionic region with midline shift | Basal ganglia         | L sphenoidal ridge | R hemiparkinsonian signs were completely resolved in 3 weeks after surgery              |
| Krauss et al.\(^{19}\)        | 1989-1993 | 4 | M   | 67  | *                                          | CT scan: R temporal meningioma surrounded by edema causing midline shift and compression of the ipsilateral basal ganglia. Signs of raised intracranial pressure. Tumor volume 22cm\(^3\) | R basal ganglia       | R middle fossa | Akinesia and postural instability disappeared and tremor was minimal 3 months later. Patient died due to metastasizing stomach cancer 6 months later |
| &nbsp;                        |      |   |     |     |                                             | F 55 * CT scan: edema, signs of raised intracranial pressure. Tumor volume: 200 cm\(^3\) | Basal ganglia         | R convexity     | Psychological, neurological and parkinsonian symptoms and signs improved after one week and resolved after a few months |
| &nbsp;                        |      |   |     |     |                                             | F 70 * CT scan: edema, signs of raised intracranial pressure. Tumor volume: 80cm\(^3\) | Basal ganglia         | L convexity     | Transient increase in R-sided hemiparesis after total resection. Paresis and parkinsonian symptoms improved over the following weeks. The patient suffered a cardiac arrest at the age of 79 when she was free of Parkinsonian symptoms |
| &nbsp;                        |      |   |     |     |                                             | F 51 * CT scan: edema, signs of raised intracranial pressure. Tumor volume: 50cm\(^3\) | Basal ganglia         | R sphenoidale planum | Symptoms improved steadily after total removal. Tremor was barely noticeable and other symptoms and signs were no longer present after a year. Parkinsonism recurred and increased during the following years, but controlled satisfactorily with levodopa, dopergine, amantadine and biperidine. A CT control showed no tumour recurrence |

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## Table 2. Continued...

| Paper                        | Year | N   | Sex | Age | Laboratory exams | Imaging exams                                         | Compressed structures                                                                 | Tumor location   | Symptoms after surgery                                                                 |
|------------------------------|------|-----|-----|-----|------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------|
| Labate et al.                | 2018 | 1   | F   | 67  | Normal           | DAT-SPECT scan: integrity of the nigrostriatal system | Compression and dislocation to the R of the pons, midbrain, basilar artery, and middle cerebellar peduncle | Clivus           | After surgery, she displayed a slight abduction nystagmus in each eye. At clinical and imaging follow-up 2 months later, her bradykinesia and tremor became very mild, the gait ataxia improved considerably, and orthostatic hypotension slightly improved |
| Lesoin et al.                | 1981 | 1   | M   | 52  | *                | CT scan and carotid angiography: well-defined mass (10 cm) with edema on the R lesser wing of the sphenoid | *                                                                                       | R sphenoidal ridge | Immediately after surgery the tremor disappeared. Muscle rigidity disappeared within 3 days after the operation, and the akinesia rapidly receded. His clinical condition, electroencephalograms and CT scans were normal after 3 years |
| Lieberman et al.             | 2013 | 1   | M   | 69  | *                | MRI: large falk meningioma, which extended on the R side of the inferior supplementary motor area and the premotor area | No evidence of distortion of the basal ganglia and midbrain by the tumor on neuroradiological examination. The possible mechanism of parkinsonism is an impairement of the basal ganglia output to the supplementary motor area | L convexity       | Following the removal of the meningioma the patient walked normally but complained of slowness of his R hand |
| Miyagi et al.                | 1993 | 1   | F   | 48  | *                | MRI: large falk meningioma, which extended on the R side of the inferior supplementary motor area and the premotor area | No evidence of distortion of the basal ganglia and midbrain by the tumor on neuroradiological examination. The possible mechanism of parkinsonism is an impairement of the basal ganglia output to the supplementary motor area | Falx             | Postoperatively, the patient developed L hemiplegia, which improved gradually. Six months after, she could walk by herself and her tremor and cogwheel rigidity were markedly improved |
| Nicholson and Turner         | 1963 | 3   | M   | 61  | Elevation of the protein content of the CSF | Angiography: large meningioma                          | *                                                                                       | Falx             | Memory improved (although the patient experienced a persistent difficulty in spelling); tremor, rigidity and incontinence were lost, and the weakness of the legs improved. Within 18 months a perfect recovery was made in all respects |
|                             |      |     | F   | 51  | Elevation of the protein content of the CSF | Angiography: L parasagittal meningioma                  | *                                                                                       | L parasagittal    | Postoperatively: the tremor, rigidity, dysphasia and mental disturbances disappeared |
|                             |      |     | F   | 61  | Elevation of the protein content of the CSF | Ventriculography and angiography: vascular midline from parietal tumour, displacing both frontal lobes from the falk | Posterior frontal lobes including the level of the striatum and posterior to that level for about 3 cm | Falx             | A few days later she became drowsy and a decompression was performed. Her condition deteriorated after a brief improvement, but she died during the induction of the anesthetic for the second stage of the operation. A coroner's postmortem examination revealed a meningioma protruding from both sides of the falk |

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### Table 2. Continued...

| Paper          | Year    | N  | Sex | Age | Laboratory exams                  | Imaging exams                                                                 | Compressed structures           | Tumor location | Symptoms after surgery                                                                 |
|----------------|---------|----|-----|-----|-----------------------------------|-------------------------------------------------------------------------------|---------------------------------|----------------|----------------------------------------------------------------------------------------|
| Okada et al.   | 1982    | 1  | F   | 70  |                                   | 1982 CT scan: broad low density area in the R frontoparietal lobes. The bilateral anterior horns of the lateral ventricle were deviated to the L. Edema had spread to the R head of the caudate, the putamen and the pallidum | Basal ganglia                   | R convexity     | Symptoms gradually improved after total removal of the tumor. The patient was discharged 4 months after the operation without any neurological deficits |
| Polyzoidis et al. | 1959-1960 | 2  | F   | 63  |                                   | R cerebral angiogram: large, R sphenoid wing meningioma                        |                                | R sphenoidal ridge | A hemiparesis of the L side was described postoperatively but disappeared rapidly. Only minimal residual tremor and mild hyperreflexia on the L side were reported. The tremor was absent 6 months later. After 2 years, she complained of headaches and visual loss in the R eye. She was found with unilateral exophthalmos and involvement of the R third, fourth, fifth, and sixth cranial nerves. A carotid arteriogram showed narrowing of the R middle cerebral artery. Recurrent tumor was removed a few months later (1964), after progressive weakness of the L side was noted. There was no return of the tremor of the L hand. The patient died at home 2 years later (1966). |
|                | 1979    | 1  | F   | 51  | X-ray of the skull: erosion of the sella turcica, osteolytic lesion in the R parietal area, and enlargement of the posterior branch of the R middle meningeal artery CT scan and angiogram: very large R parietal meningioma |                                |                                | Due to CSF rhinorrhea, a lumbo-peritoneal shunt was inserted. Her tremor was found markedly improved after 1 month. She complained of headaches later in 1980. The tremor of the L hand and head had returned. An CT scan showed a collection of air in the L frontal region, which appeared to have passed upward through a hole in the cribriform plate. The shunt was revised and resection of a small portion of protruding brain was carried out. The tremor was described as minimal in 1980, slight in 1981, and barely noticeable in 1982. |
| Reyes et al.   | 2019    | 1  | F   | 56  | Normal                            | MRI: solid, well circumscribed T2 isointense, L posterior cranial fossa extra-axial mass (3.7×3.5×4.0 cm) arising from the L cerebellopontine angle, causing cerebellar tonsillar herniation of 6 mm beyond the foramen magnum | Compression of the L cerebellar hemisphere and brainstem, and midbrain distortion | L posterior fossa | Slow progressive good postoperative recovery within 14 days of ICU. Handwriting improved 6 weeks after. She was walking without support 3 years later. After 8 years, she had only persistent tremor |

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### Table 2. Continued...

| Paper | Year | N | Sex | Age | Laboratory exams | Imaging exams | Compressed structures | Tumor location | Symptoms after surgery |
|-------|------|---|-----|-----|------------------|----------------|-----------------------|----------------|------------------------|
| Salvati et al.¹⁴ | 2000 | 1 | M | 61 | CT scan: hyperdense area with 6cm in diameter in a R frontotemporal (petroclival) localization, surrounded by an extensive area of edema | Compressing and consequently impairing perfusion of the basal ganglia region | R middle fossa | Parkinsonian symptoms improved 5 days postoperatively and completely resolved over the following 40 days. One year after surgery, the patient was in good general health and free of neurological deficits |
| Shah and Rajeshkhar²⁵ | 2004 | 1 | F | 54 | MRI: large homogenous dural-based mass along the R medial sphenoidal wing with significant perilesional edema and midline shift | Mass effect on the R basal ganglia and the thalamus with midline shift to the L | R sphenoidal ridge | Tremor and rigidity in the L upper limb disappeared completely |
| Tan et al.²⁹ | 2007 | 1 | M | * | * | MRI: large meningioma in the R frontal-temporal region with significant ventricular compression and midline shift of the brain | Vascular compression | R convexity | Resolution of his parkinsonism and anxiety symptoms after tumor resection |
| Vijiarratnam et al.³⁰ | 2018 | 1 | F | 44 | MRI: large L parafalcine meningioma with areas of acute/subacute blood internally and intense enhancement with probable infiltration of the superior sagittal sinus at which point the mass crossed the midline | Superior sagittal sinus, There was no basal ganglia distortion by the mass | L parasagittal | She was managed with a combination of surgical debulking and steroid therapy. Her writing and spiral assessments improved over the course of treatment with an initial dramatic improvement noted shortly after the initiation of steroid |
| Wakai et al.³¹ | 1984 | 1 | F | 58 | CSF was normal | CT scan: round high-density mass with spotty calcification in the anterior part of the third ventricle, which occluded the foramen of Monro bilaterally. Both lateral ventricles were moderately dilated, with periventricular hypodensity around the frontal horns | Anterior caudate and terminal veins were compressed and stretched by the tumor on both sides. The mass was found to have indented both medial thalami, where the ependymal lining seemed to be destroyed | Third ventricle | The patient developed a hemiparesis on the L side with some memory disturbance, but muscular rigidity of the limbs and Myerson's sign disappeared. On the second day after surgery she was unresponsive. A CT scan showed hemorrhage around the foramen of Monro with marked dilatation of both lateral ventricles. After ventricular drainage, she regained consciousness but had a high degree of disorientation and memory disturbance. Urinary incontinence ensued. Three weeks later a ventriculoperitoneal shunt was installed. After that, she had no muscular rigidity or Myerson's sign, but some memory disturbance and bradykinesia persisted |
| Wojtecki et al.³² | 2012 | 1 | F | 56 | MRI: R-sided infratentorial meningioma | The tumor compresses the lower midbrain, pontomedullary brainstem, the cerebellum and fourth ventricle | R cerebellar tons angle | Follow-up examination at 1 year showed only slight impairment of fine distal finger movements |

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**DISCUSSION**

Meningiomas are originated from arachnoid cap cells, that is, in the outermost layer of the membrane, in its villi⁴⁻⁸. Among its possible etiologies, there are traumatic, actinic, viral and genetic causes (deletion of chromosome 22)⁵. Exposure to ionizing radiation can also be considered a factor for increasing the risk of developing these tumors⁵. There is a correlation between the occurrence of meningiomas with hormones and breast cancer, since estrogen, progesterone and androgen receptors were found in some of these tumors, which may explain the higher incidence of this pathology in females⁶⁻⁹. Among all meningiomas, approximately 25% are located in the parasagittal region. These, by definition, invade at least one of the walls of the superior sagittal sinus⁹⁻¹⁰.

Meningiomas can be found alone or with multiple lesions, usually associated with hereditary syndromes, such as neurofibromatosis type 2 (NF-2), which tends to be more aggressive than the other subtypes, being more commonly found in parasagittal meningiomas⁵⁻⁷⁻⁹.

The diagnosis of meningioma is obtained through imaging exams. MRI is considered to be the gold standard. It is presented as hypo or isointense and homogeneous in the T1 window, and when contrasted, its outer meningeal layer becomes more evident, receiving the name of “dural tail”. In T2, a vasogenic edema often prominent is seen¹⁴. CT scan is also a method used in the diagnosis of these tumors, being isointense, multilobulated and adjacent to dural structures. When ill-defined margins, parenchyma invasion or irregular enhancement on examination are found, it is suggestive of malignant lesions⁶.

Meningiomas can be classified according to their degree of malignancy, considering the variables: cell type, mitotic activity, cellularity, necrosis and brain invasion. WHO I tumors are benign and represent about 90% of meningiomas, WHO II (5 to 7% of meningiomas) and WHO III (approximately 3% of these tumors) are the rarest classifications to be found and represent, respectively, atypical meningiomas and anaplastic meningiomas⁶.

When located in a highly irrigated area and surrounded by noble structures, its total resection becomes delicate and subject to numerous complications. Even so, its surgical resection remains the primary treatment, given the increase in patient survival despite its possible risks⁸⁻¹⁰. Surgical indications may vary according to its accessibility, and a total resection technique or a subpartial resection followed by radiotherapy in the remaining parts can be chosen⁸. There is no solid opinion on the use of radiotherapy, but it does show a positive impact on tumor progression⁹⁻¹⁰.

Technological progress in recent years has considerably improved the surgical technique, reducing possible complications, and increasing the precision for total tumor resection. These technologies include intraoperative neuronavigation and electrophysiology, both used in the case reported. The introduction of the surgical microscope in neurosurgery was an important step to improve safety with the extension of surgical removal of the tumor. In addition, removal of the bone affected by the tumor, followed by intraoperative molded cranioplasty, helps to prevent tumor recurrence⁶.

Thus, the main surgical objective is its total removal, since studies show that the partial resection of the tumor leads to high recurrence rates, being one of the main causes of poor results⁸⁻¹⁰. In benign meningiomas, the occurrence of relapse is relatively common, with an overall rate of 15 to 20% during the subsequent 20 years of surgery⁶⁻³⁴.

In an essential PD, the symptoms hardly appear isolated, and they almost always have a gradual evolutionary character. Thus, when tremor appears in a counterintuitive way, other causes must be analyzed¹.

A thorough medical history of the patient should reveal how and when the symptoms appeared, in addition to their motor characteristics and potential uses of chemical substances that may predispose to this condition, such as some antipsychotics, antiemetics, cholinomimetics, antidepressants, anti-vertigo drugs, calcium channel antagonists, antiarrhythmics and antiepileptics¹⁰⁻¹¹. In addition, a complete neurological examination evaluating the patient’s general mental state, cognition, eye movements, as well as their cerebellar and pyramidal functions must be done. Laboratory tests within the normal range exclude conditions that can lead to sluggishness and fatigue, such as anaemia, hypothyroidism, and renal failure¹.

Among the possible etiologies of a parkinsonian syndrome, meningioma is the most common tumor associated with this condition, as its mass effect can culminate in compression of the basal ganglia and nigrostriatal pathway¹⁻⁴⁻⁶⁻¹⁰, directly affecting the pre and postsynaptic dopaminergic neuron axon and the venous drainage of the region¹⁻⁴. This mass effect caused by the progressive increase of the tumor, in addition to affecting the dopaminergic areas, can also cause compression of the tonsil...
and frontal lobe areas, generating emotional components as well, such as irritability and affective dullness. In addition, there is evidence that tumor edema, caused by tumor infiltration and impaired tissue perfusion, also contributes to the appearance of these symptoms. Some studies indicate that the tumor itself has a secretory action, being responsible for triggering vasogenic phenomena that can lead to the appearance of these edemas, as they are more vasogenic than cytotoxic in nature.

Parkinsonism secondary to intracranial tumors usually manifests unilaterally and contralesionally to the underlying lesion, with bilateral symptoms less frequently reported.

The case described in this article presents clinical features and age compatible with those described in the literature. Despite this case gender, our male patient, women are more often affected. Imaging exams were necessary to exclude PD, showing the importance of investigating the cause of parkinsonian symptoms. The parasagittal location of the tumor is one of the most frequent, both in the review of this work and in other studies found in the literature. This patient presented regression of symptoms soon after surgical resection, as observed in the review, in which more than 90% of patients had this improvement, proving that parkinsonism was of secondary origin to the tumor.

CONCLUSION

Parkinsonian symptoms due to meningiomas are rare and their clinical presentation can appear as idiopathic PD. Because of that, it is important to always investigate differential diagnosis. This review and case report found that these patients rarely respond to conventional drug therapy for PD and that the vast majority of those who underwent surgical resection of the tumor had complete or partial resolution of symptoms. Clinicians must pay attention to this secondary cause of PD since the treatment, prognosis and quality of life are completely different from those patients with primary PD.

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Parasagittal Meningioma: a systematic review

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Funding: nothing to disclose
Conflicts of interest: nothing to disclose

Cobucci FLR, Almeida JFM, Rigueirat MEG, Gonza RRV, Medeiros RTR, Franceschini PR, Aguiar PHP - Unusual Case of Parkinsonian Syndrome Induced by a Parasagittal Meningioma: a systematic review