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Falcine and Parafalcine Meningiomas: A Literature Review on Surgical Approaches and Possible Neurological Complications

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Abstract: ***Introduction: Meningiomas are tumors that develop in the meninges region and can be located both in the cerebral convexities, close to the venous sinuses, and in the posterior fossa. Furthermore, they account for 30% of all existing intracranial neoplasms and predominantly affect females. Among these, falcine meningiomas (MF) and parafalcine (PM) originate from the cerebral sickle, accounting for about 9% of intracranial meningiomas. Objectives: Due to the high relevance of MF and MP, further studies are needed to identify the incidence of neurological disorders associated with the surgical approach. Thus, the following issue was raised: "What are the possible neurological implications arising from different surgical approaches?" allowing for the strengthening of data that corroborate the reduction of complications. Methodology: The study consists of a retrospective literature review; aiming to anayze neurological problems resulted from different therapeutic interventions. For this purpose, the Pubmed, SciELO, Medline and medical literature databases were used. Results: Based on the studies, it was observed that the use of certain surgical approaches enables a better clinical outcome, however, the location, extension and vascularization must be taken into account, as the great challenge is to perform these procedures while minimizing neurological complications. Conclusion: In summary, this research points out the risks of neurological damage associated with different approaches. Therefore, there is a need for new tumor description schemes from a surgical perspective that facilitate the choice of a therapeutic approach, thus promoting a better prognosis for the patient.***

Keyword: Surgical approaches, Neurological disorders, Falcine meningiomas, Parafalcine meningiomas

1.Introduction

In 1614, after dissection studies, Félix Paster described a compressive mass in the adjacent brain tissues in the region of the membranes that surround the brain and spinal cord.1 With the scientific revolution and the development of new tools for neurosurgery, William W. Keen performed the first successful resection of a meningioma.2However, the term was first used in 1922 by Harvey Cushing based on clinical analyzes and attempts at innovative procedures in the early 20th century.3, 4In this context, it is known that Meningiomas are tumors that develop in the meningeal region, mainly in the nerve cells of the subarachnoid layer and can be located both in the cerebral convexities close to the venous sinuses and in the posterior fossa. Furthermore, they correspond to 30% of all existing intracranial neoplasms and predominantly affect females. intracranial.5 In view of this, further studies are needed on the incidence of neurological disorders related to surgical approaches in the resection of these tumors, with the aim of reducing complications resulting from different therapeutic approaches. In addition, the result of the procedures performed depends directly on the location, extension along the falcine insertion or areas perpendicular to it, and on the adjacent vasculature.

2.Methodology

2.1. Systematic review question

What are the possible neurological implications resulting from different surgical approaches?

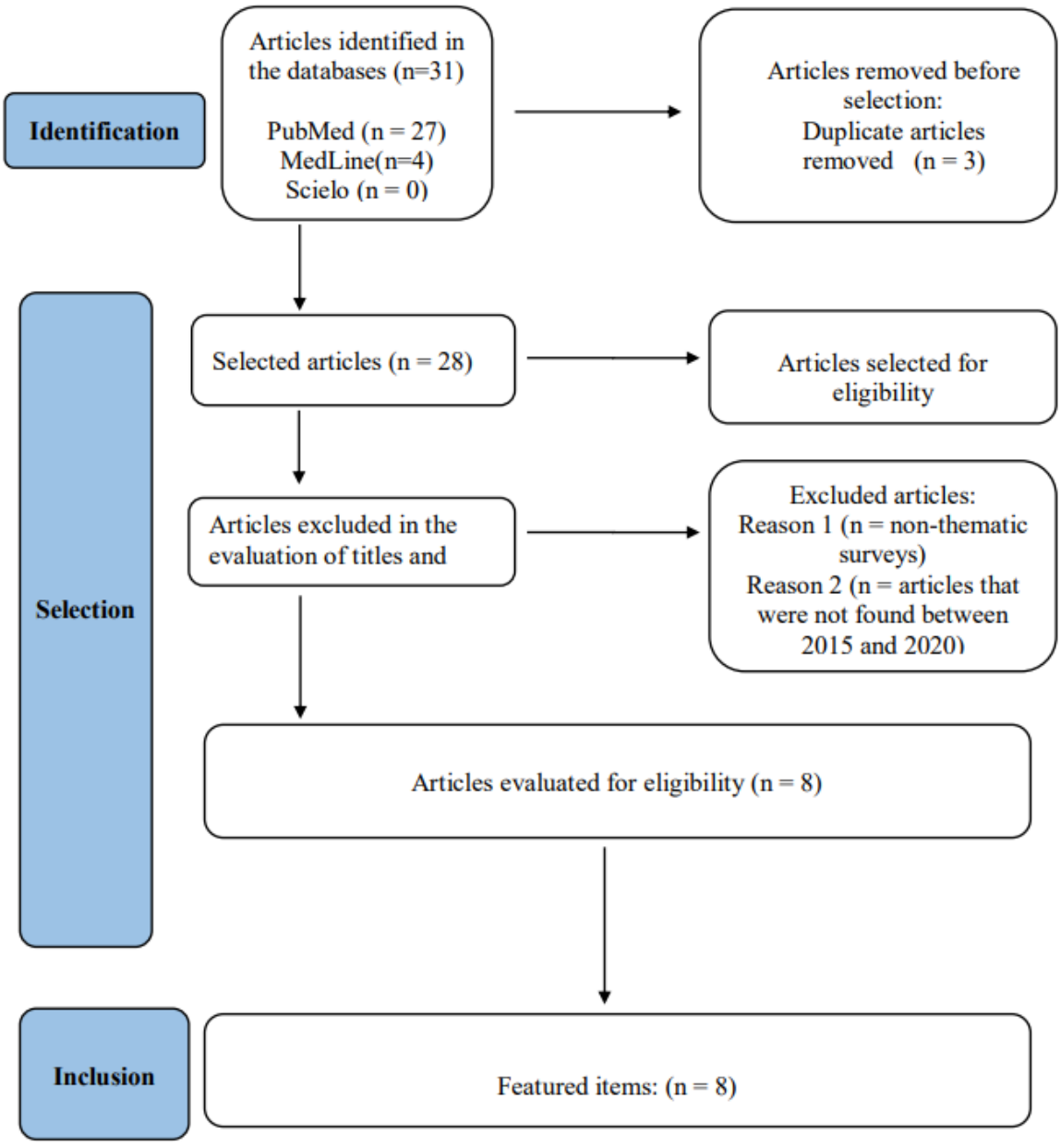
2.2. Research strategy

This work was elaborated from a retrospective literature review in the databases Pubmed, SciELO, Medline and the work Tumorsofthe Central Nervous System 14th volume. The keywords used were "Surgical approaches", "Neurological disorders", "Falcine meningiomas" and "Parafalcine meningiomas" and their corresponding in English "Surgical approaches", "Neurological disorders", "Falcine meningiomas" and "Parafalcine meningiomas". Exclusion criteria were: articles that did not correlate surgical approaches, possible neurological complications of Falcine and Parafalcine Meningiomas, as well as articles that were not found between the period 2015 to 2020. A total of 31 articles were found, adding all the databases. After reading the titles of the articles, it was noted that some of them did not meet the inclusion criteria of this study. Therefore, it was possible to select 28 articles for reading the abstract and excluded those that did not match the purpose of elucidating the surgical approaches as well as possible neurological complications of Falcine and Parafalcine meningiomas. Of these, 20 were removed based on the abstract, resulting in 8 texts complete papers included in this systematic review.

2.3. Selection criteria

The studies included in this systematic review, obligatorily, present surgical approaches as well as possible neurological complications of Falcine and Parafalcine meningiomas without time restriction, based on the following inclusion criteria:

a. The Studies published in English and Portuguese;
b. Systematic reviews, case reports and clinical studies;
c. Surgical approaches to Falcine and Parafalcine Meningiomas;
d. Risks of neurological complications in the resection of Falcine and Parafalcine Meningiomas.
e. It´s Articles published between the periods of 2015 to 2020.



3.Results

Surgical aspects, currently reviewed, with potential to improve the treatment of parafalcine meningiomas and prevent postoperative complications include their removal through unilateral exposure, early devascularization of the sickle, central decompression in large tumors, preservation of the pia mater and cortical veins, non-coagulation of small vessels in the tumor wall and excision of the sickle beyond the involved area[6]. Based on extensive clinical data, some of the most common complications were identified, such as venous infarction, edema, hemorrhages, brain injuries and neurological deficits. Although the majority of patients do not present complications or

neurological deficits, they therefore have a good recovery. Among those who present with some type of aggravation, this is usually temporary and evolves to improvement within weeks to months[6, 7]. Edema is a relevant complication and a determining factor for its formation is the relationship with venous structures of main drainage. In his study, Sheehan demonstrates that up to 38% of patients may develop edema after stereotactic radiosurgery, however, its persistence and progression occurs in a minority of cases and treatment can be performed with steroids. The need for a new approach becomes necessary only in cases where the symptoms persist[8]. In November 2016, Murrone D et al., published a study demonstrating that the preservation of the main cortical veins, the sinus and the falcine venous plexus, in addition to the non-resection of the patent cortical bridge veins involved with the tumor, allowed no mortality associated with the procedures, with gross total resection was obtained in 87.5% of the cases[9]. Roser, F. and Rigante, L. (2017) published an article on an endoscope-assisted contralateral paramedian approach for resection of falcine meningiomas. The position used during the procedure, in addition to eliminating the need for brain retraction, prevents jugular obstruction, reduces the risk of venous infarction and venous bleeding in case of sinus injury. This procedure, despite being little used, proved to be feasible to overcome hidden angles and postoperative MRIs did not show edema related to the approach[10]. For KuntalKanti Das et AL (2017), the existing classification schemes for Falcine Meningiomas did not yet consider the tumor extensions in a comprehensive way, with the need for new classification schemes that describe the MF from a surgical perspective, such characterization can facilitate the choice of a appropriate conduct, as well as preventing possible complications[11]. In 2020, Casali et al. demonstrates important factors that must be taken into account in preoperative planning for a falcine meningioma. Among them are the patient's age, patency of the sinuses, location and dimensions of the tumor, identification and understanding of the anatomy of the arteries and veins (essential to preserve pons veins and branches of the anterior cerebral artery), analysis of the relationship between the involvement of the tumor with the vessels as well as the degree of involvement with the superior sagittal sinus and use of intraoperative images to help guide and progress the surgical process. In addition, it is extremely important to choose an appropriate surgical technique, such as the ipsilateral interhemispheric approach and the contralateral transfalcin approach. All this must be evaluated for the removal of the MF in order to avoid serious complications such as venous infarction, edema, hemorrhages, brain injuries and neurological deficits[12]. For Daniel G. Eichberg et al. (2020) resections of falcine and parafalcine meningiomas are complex, due to their anatomical aspects, since they are closely related to neurovascular structures. Meningiomas involving the middle third of the superior sagittal sinus are more associated with morbidity. Therefore, a surgical strategy to avoid damage is not to cross the superior sagittal sinus during the craniotomy. In addition, the use of motor evoked potentials and preoperative embolization may contribute to a better outcome[13].

4.Discussion

From the research carried out, it was observed that the use of certain surgical approaches allows for a better clinical result, however, one must take into account the location, extension and vascularization, since the great challenge is to perform these procedures while minimizing neurological complications. Furthermore, despite these challenges, it is evident that good tumor control with acceptable morbidity rates can be achieved with a careful microsurgical technique using an alternative resection procedure, which consists of preserving the main cortical veins, sinus and plexus. falcine venous sinus since the bilaterality and the invasion of the venous sinus in the craniocaudal direction, corroborate the increase in the level of surgical difficulty, therefore, demanding specific conducts14. In this approach, residual falcine and parafalcine meningiomas can be followed closely with serial imaging and treated with stereotactic radiosurgery (SRS) in case of subsequent growth, as it offers a high degree of tumor control and is usually chosen to treat patients with meningiomas that have larger dimensions. smaller than or equal to 3 cm, which surgical resection would imply a high risk of morbidity. However, SRS needs to be evaluated in terms of benefits, as it can cause neurological damage in the postoperative period, such as: peritumoral edema, local hematomas and venous thrombosis. In addition, Falcine and Parafalcine Meningiomas have been resected using an ipsilateral approach; however, authors state that the contralateral approach can avoid ipsilateral cortical edema and offer better devascularization of the dural base. that the patients had preexisting neurological deficits that prevented a contralateral approach, due to the risk of inflicting deficits on the unaltered side. Therefore, before making a decision regarding the surgical technique, bilateral neurological deficits and potential damage to the dominant hemisphere must be taken into account. In view of the above, it is noted that another difficulty in the therapeutic conduct of resection of tumors is the invasion of the superior sagittal sinus (SSS), although rare, the tumor mass can cause compression of venous drainage, potentiating brain lesions and preventing surgical access adequate. In these cases, after removing the tumor, the medial cerebral cortical vein must be displaced, connecting the 2 ends of the venous collateral structures of the occluded segment of the SSS with the deep cerebral venous system, and finally, recanalizing the falcine sinus. Thus, for meningiomas that invade the SSS and the sickle, surgeons' attention should focus on protecting not only the superior sagittal sinus and bilateral cortical veins, but also the parafalcine veins in order to prevent the onset of cerebral edema and venous infarcts. Nowadays, small meningiomas can be removed "en bloc", internal decompression is a key initial step in actual tumor removal after adequate exposure and initial devascularization. However, a safe, minimally invasive and little used technique for large tumors is the endoscopic-assisted contralateral paramedian approach. The main advantages of this procedure consist of overcoming visual limitations, eliminating the need to retract the brain with the aid of gravity, in addition to avoiding jugular obstruction when positioning the patient, favoring venous flow and reducing the risk of venous

infarction. However, it can cause postoperative discomfort and increase the risk of cervical injury in individuals with drug-induced myoplegia. Thus, there is a need for new classification schemes that describe tumors from a surgical perspective, facilitating the choice of an appropriate management, as well as preventing possible neurological complications.

5.Conclusion

In summary, this research points out the risks of neurological disorders associated with different approaches. Therefore, there is a need for new schemes for describing tumors from a surgical perspective that facilitate the choice of a therapeutic approach, thus promoting a better prognosis for the patient. Furthermore, comprehensiveness should be proposed in relation to the criteria used, such as the inclusion of bilaterality, extension, adjacent vascularization and its position in front of the sinus venosus in the classification for resection of falcine and parafalcine meningiomas. In the present study, a survey of data associated with the incidence of neurological disorders was carried out regarding the surgical approach to meningiomas with different techniques, clinical presentations and procedures based on surgical analysis.

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