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Preoperative Embolization as a Strategy to Mitigate Hemorrhage Risk in Surgical Resection of Spinal Hemangioblastomas

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ABSTRACT

Objectives: This study aims to explore the interest and indications of preoperative embolization as an adjunctive technique to mitigate hemorrhage risk during surgical resection of spinal hemangioblastomas.

Background: Spinal hemangioblastomas are benign vascular tumors that pose a surgical challenge due to the risk of intraoperative hemorrhage. The standard treatment for these tumors is surgical resection, but the potential for significant bleeding necessitates additional strategies to enhance safety.

Methods: A comprehensive literature review was conducted using reputable databases, including PubMed and Medline in May 2023. Studies focusing on the surgical management of spinal hemangioblastomas and the use of preoperative embolization were reviewed. The emphasis was placed on evaluating the benefits and indications of preoperative embolization in reducing hemorrhage risk during surgical resection. The search terms used were "Hemangioblastoma," "haemangioblastoma," "spinal cord," and "embolization".

Results: In our review, a total of 17 studies met our criteria, encompassing 69 patients. The age range varied from 16 to 71 years. Common symptoms at the time of diagnosis included progressive back pain with radiculalgia, motor deficits, urinary disturbances, and hyperreflexia. The cervical region was the most frequent site of involvement (66.7%), followed by the thoracic region (15.9%). The majority of cases had tumors larger than 3 centimeters. The time interval between embolization and surgery ranged up to four months. Total tumor resection was achieved in most patients, except for one case. Among the 69 patients, 61 patients (88.4%) experienced less bleeding than expected.

Conclusion: Preoperative embolization of hemangioblastomas is a useful technique that can make surgical resection safer and more effective. We recommend considering it after multidisciplinary consultation involving neurosurgeons and interventional neuroradiologists.

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Introduction

Hémangioblastoma is a benign vascular tumor WHO Grade 1. It is a rare tumor that originates in the central nervous system. It is the third most common intra-medullary tumor (2-6%). Medullary hemangioblastoma most often affects young individuals in their forties. In 20 to 40% of cases, it may be associated with Von Hippel Lindau syndrome [1]. The treatment is surgical excision and poses a real challenge due to the significant risk of hemorrhage. Today, advances in interventional neuroradiology allow us to specify the characteristics of the tumor and understand its vascularization. Preoperative embolization could reduce the risk of bleeding during surgery. Based on the literature, we will try to determine the interest and indications of preoperative embolization in the management of medullary hemangioblastomas.

Materials and Methods

We conducted a selective literature review on May 15, 2023 (PubMed, Medline) regarding medullary hemangioblastomas. The search terms included: "Hemangioblastoma", "haemangioblastoma", "spinal cord", "embolization". We included in the study the patients who underwent preoperative embolization for medullary hemangioblastomas. And we excluded the case studies of patients who underwent surgery alone and case studies of patients who underwent preoperative embolization for hemangioblastomas located in the brain. Epidemiological data, tumor characteristics (location, size, presence or absence of syrinx, embolization material, intraoperative bleeding, degree of tumor resection, presence or absence of postoperative complications), preoperative embolization data, and management outcomes were reviewed. Special emphasis was placed on preoperative embolization, its modalities, and indications. Statistical analysis of the data was performed. Proportions were expressed as percentages.

Results

In our review, we were able to collect 17 studies meeting our criteria, totaling 69 patients. Table 1 summarizes the epidemiological data, tumor characteristics, and management modalities of the different series.

Table 1

Studies Case	Number	Localization	Size (cm)	Syrinx	Emboizing Material	intraoperative Bleeding	Degree of Tumor Resection	Postoperative Complications
Vicki M et al, [1]	6	Cervical: 1 Thoracic: 2 Sacrum: 3	ND	ND	ND	ND	Total	No
Saliou G [2]	7	Cervical: 4 Dorsal: 3	ND	Yes: 4	Yes: 4	< 150 ml	Total: 6 Sub- total: 1	Yes: 2
Luxin et al, [3]	16	Cervical	12: ≥3 4: ≥5	ND	ND	<150 ml	Total	Yes: 2 deaths
Pengfei et al, [4]	11	Cervical	1: ≥2 4: ≥4 6: ≥4	ND	Onyx or N-BCA	9 :<150ml 2: 150 -250ml	Total	No: 10 Yes: 1 death
Thiex [5]	2	ND	ND	ND	N-BCA	< 150 ml	Total	Yes: Sensory and motor deficit
Nishimura et al, [6]	1	Terminal filum	ND	No	Avitene	< 150 ml	Total	Yes: Transient sensory deficit
Gore et al, [7]	1	Thoracic	ND	ND	Onyx	ND	ND	No
Rodesh et al, [8]	4	Cervical	ND	ND	PVA: 1 N-BCA: 3	< 150 ml	Total	Yes: 2 deaths
Cornelius et al, [9]	4	Cervical: 3 Thoracic: 1	ND	ND	Embosphere	< 150 ml	Total	No
Nadkarni et al, [10]	1	Terminal filum	ND	NO	Embosphere	< 150 ml	Total	No
Biondi et al, [11]	4	Spinal cord: 2 Terminal filum: 1 Cauda equina: 1	ND	ND	Microspheres: 3 APV: 1	< 150 ml		No: 3 patients Yes: 1 meningomyeloc ele
Lee Kyu et al, [12]	4	Cervical: 3 Thoracic: 1	≥2 ≥4	Yes (3)	APV	< 150 ml	Total	NO
Pluta et al, [13]	1	Sacrum	≥4	ND	Embosphere	< 150 ml	Total	No
Oktakara et al, [14]	1	Cervical	≥3	Yes	APV	< 150 ml	Total	No
Eskridge et al, [15]	4	Cervical: 2 Thoracic: 2	ND	No	APV	< 150 ml	Total	No
Tampieri et al, [16]	1	Thoracic	≥4	ND	APV	< 150 ml	Total	No
Friedrich et al, [17]	1	Cervical	ND	ND	APV	>250 ml	Total	No

ND: Not defined, APV: Polyvinyl alcohol, NBCA: N-Butyl cyanoacrylate

Among the 69 patients, gender was reported 37 times with 28 % for males and 26 % for females (Figure 1). The age range varied between 16 and 71 years. Tumor size was reported only 34 times and ranged between 2-6 cm in maximum diameter [3,4,12,13,16]. Four patients, 5%, presented with Von Hippel Lindau Syndrome [6,11,13,16]. Symptoms at the time of diagnosis included progressive back pain with radiculopathy, motor deficits, urinary disturbances, and hyperreflexia [8,11,14]. Tumor localization was specified in 67 cases and was not mentioned in 2 cases (Figure 2). The cervical region is the most frequent localization at 66.7%, followed by the thoracic region in 15.9% of cases. The presence of syrinx was reported in three studies with a total of eight patients [2,12,14].

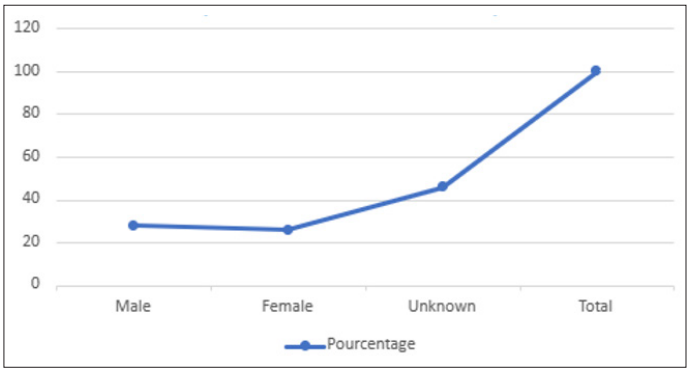

Figure 1: Sex Percentage

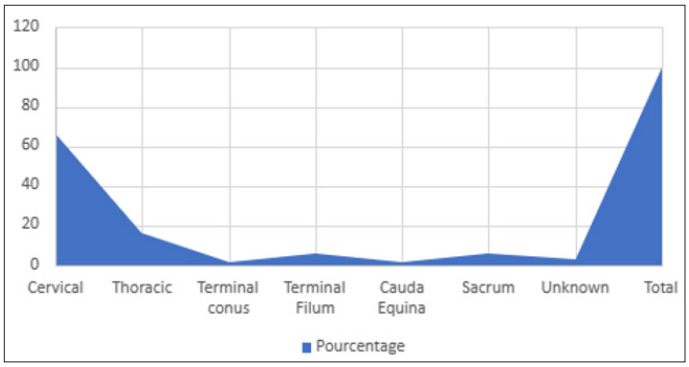

Figure 2: Spinal Location of Hemangioblastoma

Preoperative embolization Polyvinyl alcohol (PVA) was used in fifteen (15) patients, 21.7% [5,8,11,12,14-18]. The use of Trisacryl gelatin microspheres was mentioned in three patients (4.34%). N-Butyl cyanoacrylate was used in five patients, 7.24% [2,4,8]. More rarely, the use of Avitene and Onyx was mentioned [18]. The interval between embolization and surgery could be up to four months [2]. In most studies, surgery was performed early except in cases of contraindication, particularly abnormal prothrombin levels warranting a delay of surgery for up to one month [4].

Tumor resection was total for the majority of patients except for one subject [2]. Out of 69 patients, 61 patients (88.4%) bled less than150 ml, and one patient (1.5%) bled more than 250 ml (Figure 3) [17]. Data were not available for 7 patients (10.1%) [1,7]. Post-embolization complications were transient. These included swallowing difficulties, proprioception disorders, and spasticity [8,12,18].

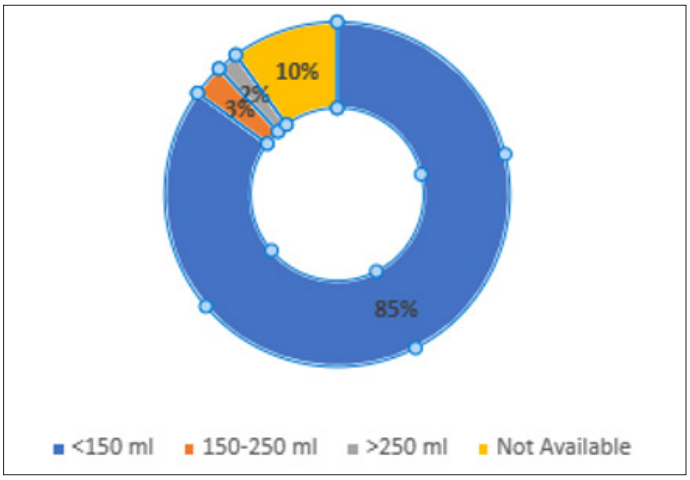

Figure 3: Per Operative Bleeding

After surgery, there was one case of transient sensory deficit (1.4%), one case of treated meningocoele (1.4%), three deaths, 4.3%, and no details for seven patients (10.1%) [1-4,6,11].

Discussion

The resection of hemangioblastomas is a hemorrhagic surgery. Intraoperative blood loss can significantly impact the patient's functional and vital prognosis [18]. The operative risks and postoperative morbidity depend on the localization and size of the tumor. The use of preoperative embolization has been frequently reported for meningiomas and arteriovenous malformations [19,20]. The goal is to reduce tumor blood flow and thus secure tumor resection. The interest of embolization is to improve the visibility of the surgical field, reduce operative time, and enhance tumor resection [18].

The interval between embolization and surgery varies in the literature. A significant delay could allow for adequate thrombosis and subsequent tumor necrosis induced by reduced blood flow. Several authors recommend a waiting period ranging from 1 to 8 days to achieve optimal therapeutic effect [21]. Some authors believe that delaying tumor resection could expose to the risk of significant peritumoral edema [22]. In our review, we notice that the timing for surgery has no correlation with the risk of intraoperative bleeding.

The surgery of intraspinal hemangioblastomas without preoperative embolization is a procedure that some authors do not seem to associate with increased morbidity. Through their work, Deng et al and Sun et al reported that safe and effective treatment of intraspinal hemangioblastomas can be achieved for most patients, even without preoperative embolization [23,24].

Nevertheless, our study shows that intraoperative bleeding is considerably reduced thanks to preoperative embolization. In oncological surgery, controlling intraoperative hemorrhage contributes to better resection quality. Furthermore, our literature review highlights that, characteristics of medullary hemangioblastoma, particularly a large diameter (>3 cm), cervical location (proximity to a highly functional area like the brainstem), and intensity of vascular blush on arteriography, constitute complicating factors for surgery. In these cases, embolization of the tumor lesion would optimize the quality of surgical resection. Moreover, preoperative embolization also presents potential risks, including damage to surrounding tissues, strokes, and the possibility of incomplete embolization, which can lead to increased bleeding risk during surgical intervention. Therefore, the decision to perform preoperative embolization should be made on a case-by-case basis, after careful consideration of potential risks and benefits.

Our study has limitations due to its retrospective nature and lack of data for some patients. A prospective study would be needed to objectively assess the real impact of preoperative embolization over time in order to establish guidelines for the management of medullary hemangioblastomas.

Conclusion

Preoperative embolization of hemangioblastomas does not significantly increase morbidity. It can be a useful technique to reduce blood supply to medullary hemangioblastomas, which can make surgical resection safer and more effective. Its indication should be considered based on tumor size (>3cm), cervical location, and intensity of vascular blush on arteriography. Also,

the decision to perform this procedure should be made on a case-by-case basis, after careful consideration between neurosurgeons and interventional neuroradiologists regarding potential risks and benefits.

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