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G. Popescu,
Francesca Paslaru,
A.C. Paslaru,
M. Apostol,
M.C. Zaharia,
T. Corneliu,
M. Mitrica,
M. Popescu,
R.M. Gorgan

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G. Popescu[1,2], Francesca Paslaru[1], A.C. Paslaru[3,4], M. Apostol[1], M.C. Zaharia[1], T. Corneliu[3,5], M. Mitrica[6], M. Popescu[7], R.M. Gorgan[1,3]

[1] 4th Neurosurgical Department, "Bagdasar Arseni" Clinical Emergency Hospital, Bucharest, ROMANIA
[2] PhD Student, "Carol Davila" University of Medicine and Pharmacy, Bucharest, ROMANIA
[3] "Carol Davila" University of Medicine and Pharmacy, Bucharest, ROMANIA
[4] Department of Genetics,"Dr. Victor Gomoiu" Children's Clinical Hospital, Bucharest, ROMANIA
[5] Department of Neurosurgery, National Institute of Neurology and Neurovascular Diseases, Bucharest, ROMANIA
[6] Department of Neurosurgery, "Dr. Carol Davila" Central Military Emergency Hospital, Bucharest, ROMANIA
[7] Department of Neurosurgery, Pitesti Emergency Hospital, University of Pitesti, ROMANIA

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Corresponding author:
G. Popescu

"Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

george_popescu39@yahoo.com

ABSTRACT

Meningiomas are common neoplasms of the central nervous system, comprising between 24 and 30% of primary intracranial tumors, most commonly affecting females in their middle age or later adult life [1] [2].

Meningiomas are classified as benign, atypical or anaplastic meningiomas depending mostly on histopathological criteria known to be associated with worse prognosis in terms of tumor progression, recurrence risk after surgery and overall survival. The 2016 edition of World Health Organization (WHO) classification of Central Nervous System (CNS) tumors recognizes brain invasion as an independent criterion for diagnosing an atypical grade II meningioma [3]. Meningioma grading based on the WHO classification of CNS tumors thoroughly impacts therapeutic management and tumor prognosis.

Aggressive meningiomas, a different phenotype of tumors, characterized by rapid growth and involvement of adjacent brain tissue, blood vessels and bone, was not previously listed as an independent entity in the WHO classification of meningothelial-cell tumors.

Regarding the increasing importance of tumor grading in meningioma treatment

strategies, the authors here provide an overview of clinicopathological and radiographic features, surgical management and long-term prognosis of this novel meningothelial tumor entity, the aggressive meningioma. In particular, we aimed to describe pre-, intra- and postoperative methods for recognizing aggressive meningiomas and explore the implications of this diagnosis on both surgical strategies and adjuvant therapy.

PATIENTS AND METHODS

We performed a single-center retrospective study. We reviewed the files of all patients diagnosed with primary intracranial meningioma at the 4th Clinical Department of Neurosurgery, Bagdasar-Arseni Clinical Emergency Hospital, between January 2013 and December 2018. Inclusion criteria, primary based on preoperative imaging and confirmed by histopathological examination, consisted of either: invasion into the brain parenchima, involvement of the major blood vessels, cranial vault bone lysis without involvement of the outer table of the skull or complete bone destruction and aeshthic diformity.

RESULTS

A total of 25 patients, 16 female and 9 male patiens, with a gender female:male ratio of 1.7:1, met the required imagistic/histopathological criteria and were included in the present study. Age at diagnosis ranged from 29 to 74 year old, with a median of 53.8 years. Figure 1 shows the distribution based on the tumor location. We found 11 frontal meningioma, 6 skull base tumors, 5 parietal meningiomas and one of each: temporal, occipital and posterior fossa (comprised in Figure 1 as "others").
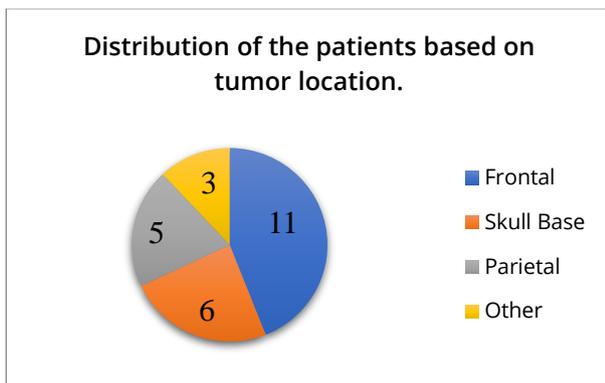

Figure 1. Distribution of the patients based on tumour location

Most frequent symptoms at diagnosis were: headache, progressive motor weakness and seizures. Regarding the tumor size, based on the

largest diameter as measured on preoperative imaging, tumors ranged from 30 mm to 80 mm diameter. Figure 2 shows the distribution based on the involvement of the neighbouring structures. Bone lysis (Image 1, IMage 2) was observed in 9 cases (36%), major blood vessels involvement in 8 cases (32%), invasion into the brain parenchima in 8 cases (32 %) and complete bone destruction with cosmetic diformity (Image 2) in 6 cases (24%).

Image 1. Contrast enhanced computed tomography scan showing a large extraaxial lesion with frontal bone involvement and peritumoral edema
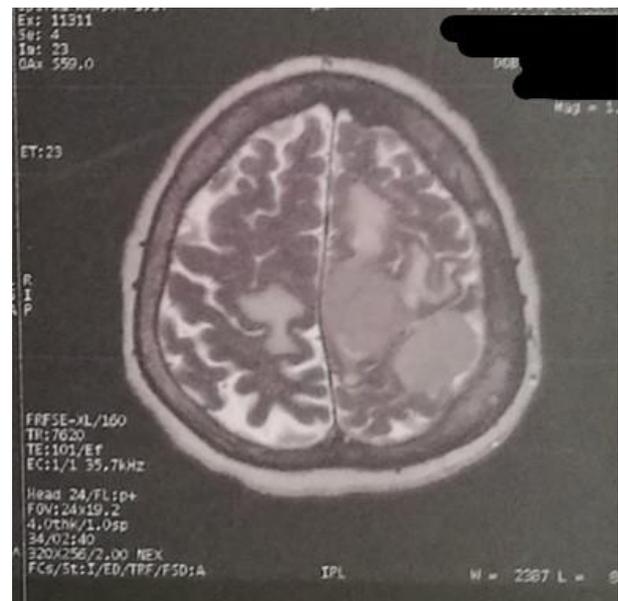

Image 2. Non-enhanced magnetic resonance imaging scan, T2 sequence, axial section, showing a left parietal tumor extending into the corpus callosum, with perilesional edema and bone invasion

Figure 3 shows the distribution of the patients based on the extent of resection. All but one patient were operated on, achieving a gross total resection in 16 cases (64%) and a subtotal resection in 8 cases (32%). In the single case where conserative management was chosen, it was because of the patient`s associated diseases.
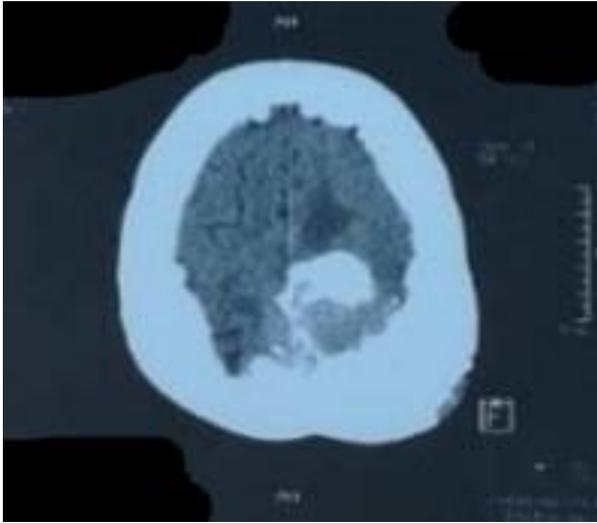

Image 3. Contrast enhanced cmputed tomography scan showing a large extraaxial lesion with complete parietal bone destruction and cosmetic diformity

FIgure 4 shows the patients distribution based on the histopathological variants, using the current WHO classification of tumors of the meninges. We found 13 atypical (WHO grade II) and 12 WHO grade I tumors: 5 transitional (mixed), 4 meningothelial, one psamomatous, one fibrous (fibroblastic) and one angiomatous meningioma.

Postoperative recurrence rate was 16% (4 cases). Perioperative mortality rate was 4% (1 case).
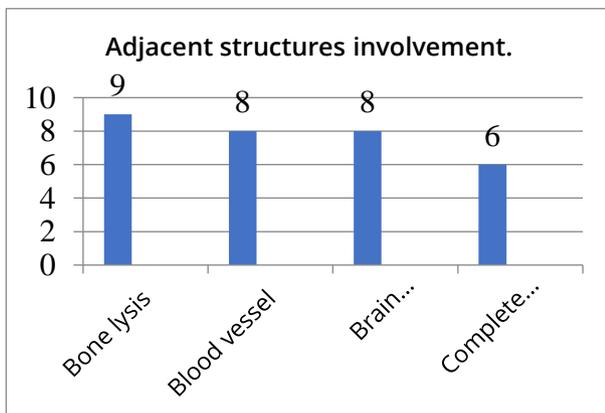

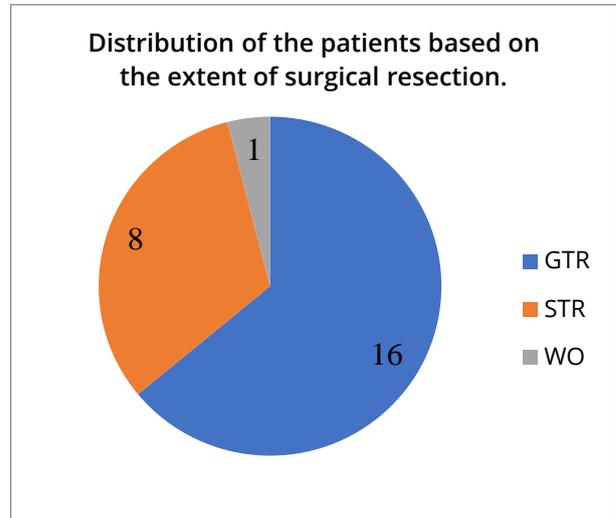**Figure 2.** Adjacent structures involvement

Figure 3. Distribution of the patients based on the extent of surgical resection
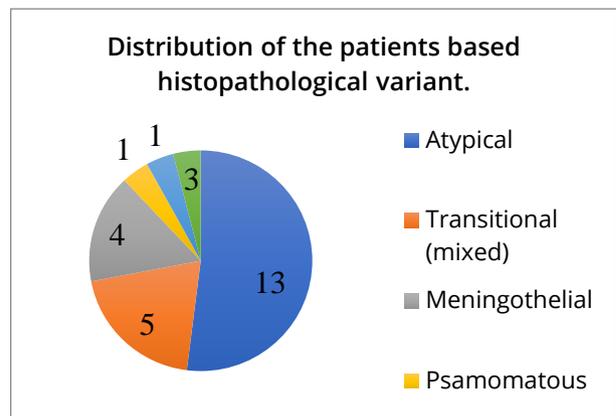

Figure 4. Distribution of the patients based histopathological variant

DISCUSSION

Intracranial tumors can be divided into primary and secondary lesions, intra-axial or extra-axial. Most common origin structures for extra-axial tumors are cranial nerves and meninges [4]. Meningiomas, tumors arising from arachnoidal cap cells, comprise between 24 and 30% of primary intracranial tumors and most commonly affect females in their middle age or later adult life [1] [2]. These tumors are a heterogenous group, commonly defined by histopathological classification based on the WHO grading scale. However, it has been reported that the clinical aggressiveness of intracranial meningioma does not always correlate with WHO grading, some tumors displaying early recurrence and invasion, despite maximal surgical resection with of without

adjuvant radiotherapy [5]. The 2016 edition of World Health Organization (WHO) classification of Central Nervous System (CNS) tumors has integrated infiltrative growth of meningioma into the adjacent brain parenchima as a stand-alone criterion for diagnosing and atypical meningioma [3]. Behling et al. studied the prognostic significance of intraoperative detection of infiltrative growth of primary meningioma and reported that the combination of intraoperative detection and histopathological assesment of central nervous system invasion is an independent prognostic factor for recurrence and gives a better risk-adapted tumor classification [6]. Brain invasion could also be predicted based on preoperative MRI scans. Ong et al. reported that large peritumoral edema was significantly higher in invasive meningioma and enlarged pial feeding arteries, a rare finding, was only seen in brain-invasive meningiomas, while a complete cerebrospinal fluid cleft was only found in non-invasive meningiomas [7]. Joo et al. published an imaging-based model that combines interface radiomics and peritumoral edema, in order to predict brain invasion by meningioma [8]. In our study, we found brain parenchima invasion in 8 out of the 25 patients with aggressive meningioma (32%). The primary treatment of intracranial meningioma remains safe maximal surgical resection, being an independent prognostic factor for tumor recurrence [9]. Diagnosis of meningioma is based on histopathological examination of the surgical or biopsy sample. However, Karabagli et al. studied the prognostic significance of histopathological features of aggressive meningioma regarding the recurrence rate and found that no feature could be used to predict the recurrence rate [10].

CONCLUSIONS

Aggressive meningiomas, characterised by rapid growth and involvement of adjacent brain tissue, blood vessels and bone, can be considered a different phenotype of tumors, not previously mentioned in the WHO classification, with a distinct pattern of evolution and postoperative recurrence. Further studies are needed to better asses the criteria for diagnosing this type of tumors.

CORRESPONDENCE

A.C. Paslaru & C. Toader (corneliu.toader@gmail.com)
Author with equal contribution: Dr. M. Popescu

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