Comparison of Intraoperative Findings and Pathological Grading of Cerebral Meningioma

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Abstract

Introduction: Meningioma is one of the most common cerebral tumors. In some cases, pathologic findings, imaging findings, and intraoperative findings among the meningioma are incongruous. A better understanding of these can help improve the prognosis of patients. The purpose of this study was to compare the intraoperative findings and pathologic grading of brain meningioma. **Material & methods:** This cross-sectional descriptive-analytical study was performed on patients with surgical indication of meningioma for 2 years. Epidemiological, demographic, baseline clinical checklist, intraoperative macroscopic findings, imaging and pathologic findings were completed for patients. Data were analyzed by SPSS 18 software. **Results**: 40 patients with meningioma were included in the study. The mean age of the patients was 51.23±1.8 years. Calcification was seen in 24 patients (60%). Tumor necrosis was seen in 3 patients (7.5%) and cysts in 2 patients (5%). Osteogenesis (bone formation) and bone erosion were seen in 13 (32.5%) and 8 (20%) of patients, respectively. The mean number of vessels in tumors was 4.8±2.1. There was a significant correlation between the number of vessels with pathological grading and positive correlation coefficient (CC = 0.98). (P = 0.001). **Conclusion:** The number of vessels was significantly correlated with meningioma and in other words, the number of veins could be a predictor of pathologic grade. Half of the meningioma cases were Grade I and the incidence of calcification and bone changes in the meningioma was significant. Considering the lack of studies in this field, further studies in the future, with consideration of macroscopic, imaging and pathologic variables, are recommended in order to investigate the relationship and determine the ways to improve patient prognosis.

Key Words: Pathological Grading, Meningioma.

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Introduction

With technological advances in the field of diagnostic tools as well as new advances in the field of microsurgery in neurosurgery and other auxiliary therapies, the number of patients who are successfully undergoing brain tumor surgery is increasing day by day (1). Meningioma is a tumor that originates from the membranous coverings the brain (meninges). It is the most common primary brain tumor and accounts for 33.8% of primary brain tumors and the central nervous system (2). Meningioma is often seen in one area of the brain, but can sometimes be seen in multiple areas of the brain. Meningioma is most commonly seen in women and in men in their fourth and fifth decades (1). Meningioma is one of the most common benign brain tumors (3), which can have various symptoms such as visual disturbances, seizures, headaches, weakness, organ and brain nerve disorders depending on the location of the tumor and are one of the many tumors that have been successfully diagnosed and treated in recent decades (1, 2).

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The only definitive cure for this tumor is extensive surgical resection, and some patients may require adjunctive treatment such as radiotherapy (1, 4). According to Baldi I et al advice (5), although much progress has been made so far in the diagnosis and treatment of brain meningioma, however, due to the increasing prevalence of this tumor in recent decades in the general population and increasing incidence of Undesirable prognosis of this brain tumor, studies are needed to identify the factors associated with this tumor (especially those associated with increased prevalence and predictors of its poor prognosis) to improve the outcome of patients. Given the high prevalence of this brain tumor and its associated morbidity and mortality (5, 6), timely diagnosis and recognition of factors that can be used in the diagnosis, treatment and prognosis of patients are of high importance. This is because it can improve health by reducing people's mortality. One of the high-potential cases that can be used to predict the prognosis of patients with a variety of tumors (including brain tumors and meningioma) is tumor grading or classification. (8) Grading of meningioma can be performed based on preoperative imaging studies, intraoperative resection, or tumor pathology. Grading is very important for neurosurgeries. This case can predict the resectability of the tumor, the length of hospital stay, and the cost of patients, the outcome after surgery, and how to plan treatment (8).

For example, when Grading is determined to be a non-resectable tumor or has multiple problems, partial resection and radiotherapy, or non-surgical treatment in general, may be recommended, or radiotherapy may be offered or chemotherapy is preferred for the treatment of meningioma. (2,7) The World Health Organization (WHO) has divided the meningioma into three grades: typical, atypical, and anaplastic. Although studies of this classification correlate favorably with patients' outcome (especially tumor recurrence rate), however, according to the authors opinion (2, 7), future classifications of meningioma will mostly be based on mitosis rate, Ki-67 ratio, karyotypes and advanced imaging techniques. In addition to the microscopic findings reported by the pathologist in meningioma (which is an important factor in determining the prognosis of patients), consideration of macroscopic factors (intraoperative meningioma factors), such as tumor size and shape, and in some cases the rate of local invasion of this tumor, like bone invasion, can also be useful in determining the prognosis of patients because of differences in brain meningioma in different parts of the brain (2, 6, 7). Given the differences in pathologic findings, imaging findings, and intraoperative findings among brain meningioma, and the application of these findings in the determination of patients' prognosis, further understanding of these can be helpful in improving the prognosis of patients. The aim of this study was to compare the findings of intraoperative and pathologic grading of cerebral meningioma.

Material & Methods

The study was a cross-sectional and descriptive-analytical study for two years from August 2015 until the end of august 2016. The study population consisted of patients 18 years and over of both sexes admitted to the Neurosurgery Department of Valiasr Hospital in Arak who had cerebral meningioma based on the diagnosis of neurosurgeon (according to the patient's clinical conditions, imaging, and laboratory findings) with indications for interventional therapy (surgery alone or surgery with radiotherapy or chemotherapy). The method of selecting the patients was one-step, and non-probable, based on the inclusion and exclusion criteria. Inclusion criteria include patients 18 years and over, men and women with cerebral meningioma with indication of interventional therapy (surgery or surgery with radiotherapy), informed consent to participate in the study. Exclusion criteria included dissatisfaction with the study. After selecting the patients and obtaining informed consent to participate in the study,

the baseline demographic and epidemiological information (age, sex and place of residence) for all patients was completed.

Based on imaging studies, pathologic findings and intraoperative findings, information on the following variables was completed in each patient's checklist: Tumor consistency, Bone changes adjacent to the tumor, number of vessels, rate of calcification, cyst, necrosis, tumor histology (Grading of pathology). Tumor consistency was defined as 3 states: loose (suctionable), soft but non-suctionable, and rigid. Bone changes were considered as hyperosteotic, osteolytic or bone erosion without bone changes (1, 3, 8). The rate of calcification was defined presence or absence (low, medium and high), cysts and necrosis were defined as their presence or absence. The pathologic grade of the tumor was generally divided into 3 grades (I, II and III). The data were analyzed by SPSS 18 software and mean, standard deviation, standard error, frequency percentage were used to analyze the results. Spearman statistical test was used to examine the correlation between study variables. P-value <0.05 was considered as the significant level.

Results

During a 2-year period, 40 patients with meningioma who had indication for interventional (surgical) treatment were enrolled after studying inclusion and exclusion criteria. The mean age of the patients was 51.23±1.8 years. Table 1 summarizes the baseline demographic, epidemiological. 24 patients (60%) were female and 16 patients (40%) were male. The majority of patients (27.5%) were in Arak city and 13 (32.5%) were rural residents. Calcification was seen in 24 patients (60%). Of these, calcification rates were low, moderate and high in 5 (12.5%), 13 (32.5%) and 6 (15%) cases, respectively. Tumor necrosis was seen in 3 patients (7.5%) and cysts in 2 patients (5%) (Figure 1). Osteogenesis (bone formation) and bone erosion were seen in 13 (32.5%) and 8 (20%) patients, respectively. 19 tumors (47.5%) did not cause bone changes (Figure 2). 24 tumors (22.5%) had firm consistency and 7 tumors (17.5%) had soft (suctionable) consistency (Figure 3). The mean number of vessels in tumors was 4.8±2.1. The majority of patients, 11 cases (27.5%) had 3 vessels in the tumor. The minimum number of veins in patients was 2 and maximum was 8. Pathologic findings revealed that there were 23 tumors in Grade I (57.5%), 12 tumors in Grade II (30%) and 5 tumors (12.5%) in Grade III.

Table 1. Demographic and Epidemiological Factors Baseline Data for 40 Meningioma Patients

Variables	Patients with meningioma
Age (mean ± SD)	23.51±8.1
Gender (male / female) Number (%)	16(40) / 24(60)
Location (city / village) Number (%)	27(5/67) / 13(5/32)

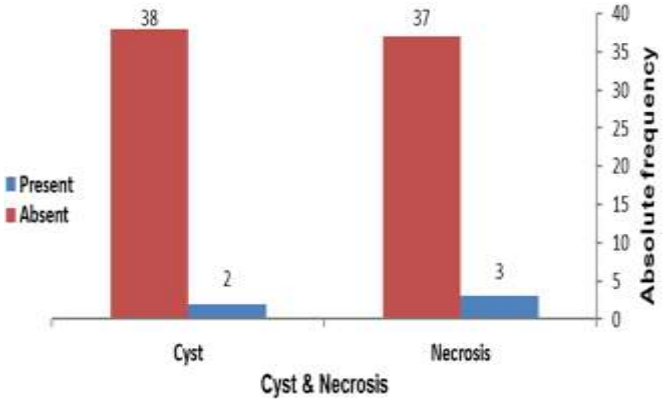

Figure 1. Absolute frequency of meningioma cases with necrosis and cysts

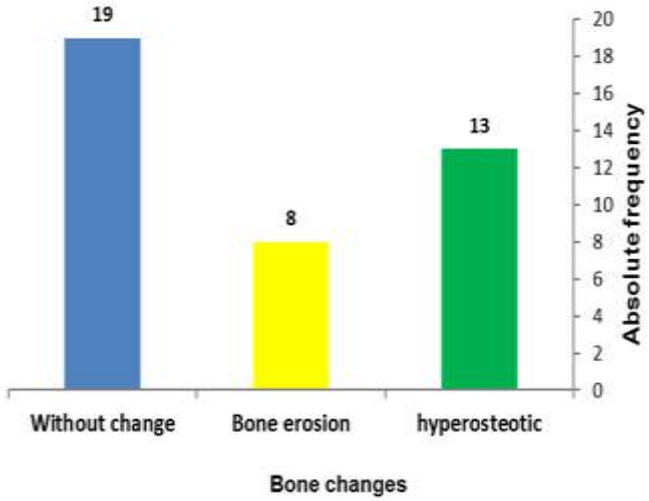

Figure 2. Absolute frequency of bone changes adjacent to the meningioma tumor

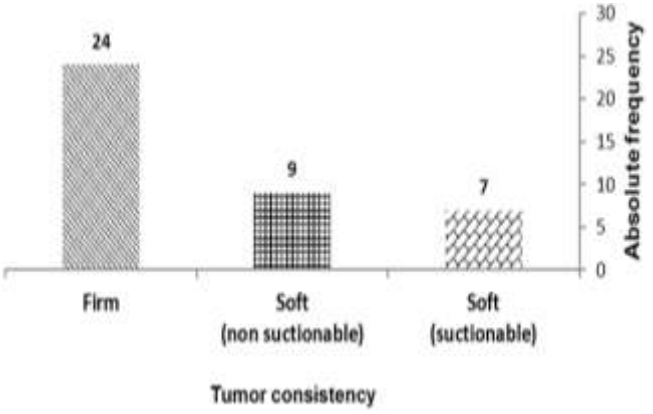

Figure 3. Absolute frequency of tumor consistency among 40 meningioma tumors

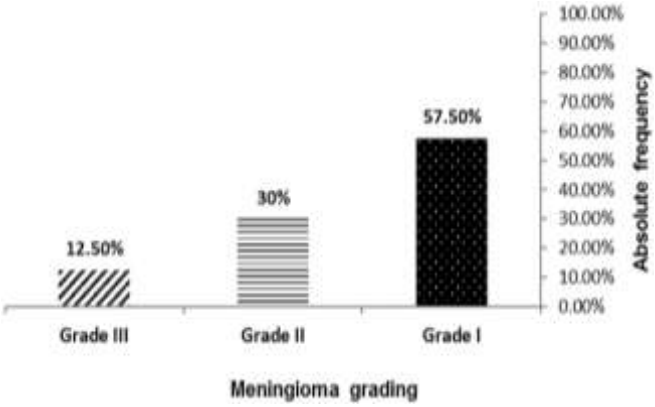

Figure 4. Grading absolute frequency of meningioma tumors

The results of examining the relationship between macroscopic, imaging, and clinical factors of meningioma with pathological grading are presented in Table 2. According to the results, there was a significant correlation between the number of vessels with pathological grading with positive correlation coefficient (CC = 0.98), (P = 0.001). There was no significant correlation between the remaining variables with pathological grading.

Table 2. Relationship between imaging, macroscopic and clinical variables of meningioma with pathologic grading among 40 patients with meningioma

Pathologic grading		Variables
CC	p-value	
2.0	082.0	Calcification
1.0	711.0	Necrosis
31.0	62.0	Cyst
8.0	211.0	Bone change (osteogenesis & bone erosion)
4.0	2.0	Tumor consistency
98.0	001.0	Number of vessels

CC: Correlation Coefficient

Discussion

The present study investigated the epidemiological, demographic and clinical factors of patients with surgical meningioma. The study also compared the association between macroscopic findings during surgery, imaging findings, and pathologic findings of the tumor. According to our results, half of the meningioma was Grade I. There was a significant correlation between the number of vessels with pathological grading. In other words, the number of vessels was directly correlated with the rate of meningioma malignancy and, in other words, only the number of vessels could predict the pathologic grade. Our study also showed that, most patients with meningioma was female, most meningioma lead to calcification. Necrosis and cysts were seen in a limited number of meningioma. Approximately half of the meningioma results in bone changes (bone formation and bone erosion). The consistency of most meningioma was firm (rigid). Meningioma is one of the most common brain tumors (3). According to Baldi I et al opinion (5), although much progress has been made so far in the diagnosis and treatment of brain meningioma, however, due to the increasing prevalence of this tumor in recent decades in the general population and increasing incidence of undesirable prognosis of this brain tumor, studies are needed to identify the factors associated with this tumor (especially those associated with increased prevalence and predictors of its poor prognosis) to improve the outcome of patients, given the high prevalence of this brain tumor and its associated morbidity and mortality (5, 6). On time diagnosis and understanding of the factors that can be used to diagnose, treat and predict the prognosis of patients is of great importance, as this can improve health by reducing mortality. (1, 5-7) In addition to the microscopic findings reported by the pathologist in meningioma (which is an important factor in determining the prognosis of patients), consideration of macroscopic factors (intraoperative meningioma factors), such as bone invasion, Also, because of

differences in brain meningioma in different parts of the brain, it can be useful in determining the prognosis of patients (2, 6, 7). So far, based on available sources, few studies have been performed to investigate and correlate between macroscopic (intraoperative findings), imaging and pathological variables of meningioma. Farokhi M et al (1) conducted a study aimed at investigating the causes and factors affecting recurrence of meningioma over a period of 20 years in Shiraz. In this case-series and descriptive-analytical study, all patients who underwent surgical meningioma in Shiraz University of Medical Sciences between the years 1983 to 2003 were studied. Information including number of recurrences, age, sex, location and shape and size of primary tumor based on CT and MRI, presence or absence of edema and bone changes, surgical resection rate, type of tumor histology and time to recurrence, use or non-use Radiotherapy was recorded. The results of this study showed that the recurrence rate of cerebral meningioma is 9.6%. There was also a higher chance of recurrence in tumors that had edema around the tumor and bone changes; fungal shape, large size, and non-benign histological type were also associated with an increased chance of recurrence. The chance of tumor recurrence decreased with increasing surgical resection. Malignant and atypical meningioma recurred earlier than benign types. The radiotherapy group had less recurrence. The purpose of this study, which examined recurrence and some factors associated with meningitis recurrence, was slightly different from our study goals, in our study, we did not investigate the tumor size and shape and edema around the tumor while their study did not include the tumor consistency and the number of vessels. In their study, cases such as the fungal form of the tumor, its large size, and bone changes were associated with poor prognosis (associated with greater recurrence). In our study, however, only the number of vessels was significantly correlated with pathological grading. The mean age of meningioma patients in our study was 51.23 years. The majority of patients were women (60%). Based on past evidence, meningioma is more common in women and in men in the fourth and fifth decades of life (1-3). Our results show that most meningioma lead to calcification and necrosis and cysts are rare in meningioma. Our study also showed that bone changes were seen in at least half of meningioma. The results of clinical features and meningioma imaging in our study are consistent with past evidence in this area (9-12). One limitation of our study was the lower sample size than similar studies, as well as the lack of consideration of clinical factors such as recurrence rate and the association between recurrence and study variables, it is recommended that future studies be conducted with a larger sample size and taking into account multiple clinical factors for a more comprehensive conclusion.

Conclusion

The number of vessels was significantly correlated with the rate of meningioma malignancy, in other words, the number of vessels could be a predictor of pathologic grading. Half of the meningioma was grade I and the incidence of calcification and bone changes in the meningioma was significant. Given the scarcity of studies in this area, further studies are recommended in the future, considering more macroscopic, imaging, and pathologic variables to evaluate the association and determine strategies for improving the prognosis of patients.

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