Treatment Outcome and Survival of Meningioma:
A Retrospective Single Institutional Study

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ABSTRACT
Background: Meningiomas are extra-axial primary neoplasms that frequently arise from arachnoid cap cells. Meningiomas account for around 33% of all primary brain tumours.
Objective: The aim of the present study was to compare relationship between different grades of meningiomas and clinicopathological character, treatment and its outcome.
Patients and methods: This is a retrospective study included 52 adult meningioma patients treated at Clinical Oncology Department of Zagazig University Hospitals. The study included data of clinicopathological characters, grades of meningioma treatment and its outcome.
Results: Among the studied patients, grade I meningioma was more common than grade II and III. The most common site of meningioma was convexity and sphenoid ring. Spinal meningioma accounted for 1.9%. The most common pathological type of meningioma was meningothelial meningioma, transitional and anaplastic. Size of tumor at initial diagnosis was less than 5 cm in 59.5%. Surgical resection was done in all grades of meningioma in 47 patients (90.4%). 33 patients received postoperative radiotherapy (63.5%) and 13 patients were on follow up after surgery (25%). Dose of radiotherapy differed according to grade of meningioma whereas in grade I radiotherapy dose used was (54-55Gy) in 40.5% of patients and dose of 60 Gy was used in patients of grade II and III (42.9% and 75% respectively).
Conclusion: Tumor grade was the most important prognostic factor in meningioma patients who received radiation therapy. In patients with grade II and III tumors the extent of surgical resection was significantly associated with over all survive.
Keywords: Meningiomas, Treatment, Outcome, Overall Survival.

INTRODUCTION

Arachnoid cap cells give rise to the extra-axial primary neoplasia known as meningiomas [1]. 33% of all initial brain tumours are meningiomas [2]. In the United States, there are 97.5 incidences of meningiomas for every 100,000 people, with females seeing a two-fold increase in incidence compared to males (8.36 vs. 3.61 per 100.000 person-year) [3,4].

The benchmark for classifying meningiomas is the WHO tumour grading system. Grade I meningiomas comprise 80% of all meningiomas and are characterised by benign nature and passive behaviour, whereas grade II and grade III meningiomas account for 17.7% and 1.7%, respectively [5,6].

Less than 70% of meningiomas survive for at least 5 years, and for fully benign meningiomas, the 5-year tumour recurrence rate is under 20% [7-8]. Spinal meningiomas make for 25–45% of intradural spinal tumours and 1.2–12% of all meningiomas [9].

Therefore, this study aimed to compare relationship between different grades of meningiomas and clinicopathological character, treatment and its outcome.

PATIENTS AND METHODS

The current study is a retrospective analysis of adult meningioma patients treated at Clinical Oncology Department of Zagazig University in the period between January 2013 and December 2021. The inclusion criteria included age >18 years old and complete medical records for adult meningioma patients

The data collected were that of clinicopathological characters, grades of meningioma treatment and its outcome. During the determined time period, 46 patients were treated for meningioma at our hospital. The final analysis included 52 (13.6%) patients, six of them were missed after initial diagnosis and did not receive treatment.

Ethical Consideration:
The Academic and Ethical Committee of Zagazig University approved the project. All of the subjects' written informed permission was acquired. The Zagazig University Institutional Review Board (IRB) Committee gave its approval to the current study (ZU-IRB # 6761/12-7-2021). The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans, guided the conduct of this work.

Statistical analysis
The mean, standard deviation, and median (range) were used to convey continuous data, while numbers were used to indicate categorical variables (percentage). The Kruskal Wallis H test was used to compare quantitative data. The Pearson Chi-square test was used to compare percentages of category variables. The period from the date of surgery to the date of recurrence or the most recent follow-up contact at which the patient was known to be recurrence free was used to determine disease free survival (DFS). Using Microsoft Office Excel 2010 for Windows (Microsoft

Corporation, Redmond, WA, USA), SPSS 22.0 for Windows (IBM Inc., Chicago, IL, USA), and MedCalc 13 for Windows, all data were gathered, tabulated, and statistically evaluated (MedCalc Software bvba, Ostend, Belgium). P value < 0.05 was considered significant.

RESULTS

The median ages of patients according to grade I, II and III of meningiomas were 46,61 and 48 respectively. Grade I was the most common between age from (40-60 years) and represented by 75.7%. Grade II and III were common in patients more than 60 years by 57.1% and 37.5% respectively.

Meningioma was more common in females than males. Headache was the most common symptoms of meningioma but motor dysfunction was common in grade I and III. Visual deficits were common in grade II **(Tables 1 and 2)**.

Table (1): Clinicopathological, treatment and outcome of the studied meningioma patients

Parameters	All patient (N=52)		Parameters	All patient (N=52)	
	No.	%		No.	%
Sex			**Surgical resection**		
Male	11	21.2%	No	2	3.8%
Female	41	78.8%	Yes	47	90.4%
			Missed	3	5.8%
Age (years)			**Size of residual tumor**		
Mean±SD	47.28±12.45		No residual	10	19.2%
Median (Range)	48 (22 – 72)		<3 cm	6	11.5%
≤40 years	11	21.2%	3-5 cm	21	40.4%
>40-60 years	34	65.4%	Missed	13	25%
>60 years	7	13.5%	N/A	2	3.8%
Clinical presentation			**Radiotherapy**		
Headache	42	80.8%	No	13	25%
Seizures	1	1.9%	Yes	33	63.5%
Motor dysfunction	19	36.5%	Missed	6	11.5%
Visual deficits	4	7.7%			
Sensory dysfunction	6	11.5%			
Size of tumor			**Radiotherapy dose**		
≤5 cm	31	59.5%	No	13	25%
>5 cm	21	40.4%	50Gy	6	11.5%
Site			54-55Gy	18	34.6%
Convexity	24	46.2%	60Gy	9	17.3%
Falcine and parasagittal	11	21.2%	Missed	6	11.5%
Intraventricular	1	1.9%	**Response to treatment**		
Olfactory groove	2	3.8%	CR	5	9.6%
Sphenoid wing	12	23.1%	PR	21	40.4%
Suprasellar	1	1.9%	SD	10	19.2%
Spinal	1	1.9%	Missed	6	11.5%
			N/A	10	19.2%
Grade			**Follow-up duration (months)**		
Grade 1	37	71.2%	Mean±SD	56.32±38.84	
Grade 2	7	13.5%	Median (Range)	48 (6 – 168)	
Grade 3	8	15.4%			
Type (WHO classification)			**Recurrence**	**(N=15)**	
Meningothelial meningioma	26	50%	Absent	14	93.3%
Fibrous meningioma	2	3.8%	Present	1	6.7%
Transitional meningioma	8	15.4%	**Progression**	**(N=31)**	
Angiomatous meningioma	1	1.9%	Absent	27	87.1%
Chordoid meningioma	2	3.8%	Present	4	12.9%
Atypical meningioma	5	9.6%	**Mortality**	**(N=46)**	
Papillary meningioma	1	1.9%	Alive	41	89.1%
Anaplastic meningioma	7	13.5%	Died	5	10.9%

Categorical variables were expressed as number (percentage), Continuous variables were expressed as mean ± SD and median (range).

In our study grade I meningioma was more common than grade II and III and accounted for 71.2 %. The most common site of meningioma were convexity and sphenoid ring.

Falcine and parasagittal sites were common in grade II and III. Spinal meningioma accounted for 1.9 % of our population. The most common pathological types of meningioma were meningothelial meningioma, transitional and anaplastic meningioma. Size of tumor at initial diagnosis was less than 5 cm in 59.5%. Surgical resection was done in all grades of meningioma in 47 patients (90.4%). 33 patients received postoperative radiotherapy and 13 were on follow up after surgery. Dose of radiotherapy differed according to grade of meningioma whereas in grade I radiotherapy dose used was (54-55Gy) in 40.5% of patients and dose of 60 Gy was used in patients of grade II and III by (42.9% and 75% respectively) **(Tables 1 and 2)**.

Table (2): Comparison between different grades of meningiomas regarding clinicopathological characteristics and treatment

Clinicopathological characteristics		Grade 1 (N=37)		Grade 2 (N=7)		Grade 3 (N=8)		p-value
		No.	%	No.	%	No.	%	
Sex	Male	5	13.50%	2	28.60%	4	50%	0.063[a]
	Female	32	86.50%	5	71.40%	4	50%	
Age (years)	Mean±SD	44.56±10.24		60±9.52		48.75±17.59		0.009[b]
	Median (Range)	46 (22 – 60)		61 (48 – 72)		48 (25 – 72)		
	≤40 years	9	24.30%	0	0%	2	25%	0.014[c]
	>40-60 years	28	75.70%	3	42.90%	3	37.50%	
	>60 years	0	0%	4	57.10%	3	37.50%	
Clinical presentation	Headache	29	78.40%	7	100%	6	75%	0.395[a]
	Seizures	1	2.70%	0	0%	0	0%	0.599[a]
	Motor dysfunction	16	43.20%	0	0%	3	37.50%	0.067[a]
	Visual deficits	2	5.40%	2	28.60%	0	0%	0.132[a]
	Sensory dysfunction	4	10.80%	0	0%	2	25%	0.248[a]
Size of tumor	≥5cm	25	67.60%	2	28.60%	4	50%	0.163[c]
	>5cm	12	32.40%	5	71.40%	4	50%	
Site	Convexity	17	45.90%	3	42.90%	4	50%	0.978[a]
	Falcine and parasagittal	7	18.90%	2	28.60%	2	25%	
	Intraventricular	1	2.70%	0	0%	0	0%	
	Olfactory groove	1	2.70%	1	14.30%	0	0%	
	Sphenoid wing	9	24.30%	1	14.30%	2	25%	
	Suprasellar	1	2.70%	0	0%	0	0%	
	Spinal	1	2.70%	0	0%	0	0%	
Surgical resection	No	2	5.40%	0	0%	0	0%	0.747[a]
	Yes	33	89.20%	7	100%	7	87.50%	
	Missed	2	5.40%	0	0%	1	12.50%	
Size of residual tumor	No residual	10	27%	0	0%	0	0%	0.079[a]
	<3 cm	5	13.50%	0	0%	1	12.50%	
	3-5 cm	15	40.50%	4	57.10%	2	25%	
	Missed	5	13.50%	3	42.90%	5	62.50%	
	N/A	2	5.40%	0	0%	0	0%	
Radiotherapy	No	13	35.10%	0	0%	0	0%	<0.050[a]
	Yes	20	54.10%	7	100%	6	75%	
	Missed	4	10.80%	0	0%	2	25%	
Radiotherapy dose	No	13	35.10%	0	0%	0	0%	<0.001[a]
	50 Gy	5	13.50%	1	14.30%	0	0%	
	54-55 Gy	15	40.50%	3	42.90%	0	0%	
	60 Gy	0	0%	3	42.90%	6	75%	
	Missed	4	10.80%	0	0%	2	25%	

Categorical variables were expressed as number (percentage); Continuous variables were expressed as mean ± SD and median (range); a: Chi-square test; b: Kruskal Wallis H test; c: Chi-square test for trend.

Complete response (CR) occurred in 5 patients, three of them were grade III. Partial response was the most common response to treatment of grade I meningioma in 48.6% of our population but grade II was with stationary response to treatment (SD) in 71.4%. Recurrence occurred only in one patient; this may be due to small size of tumor at initial diagnosis and good resection of tumor and postoperative radiotherapy, which decreased incidence of recurrence in our population. Different grades of meningioma were significantly affected according to age, radiotherapy, dose of radiotherapy and response to treatment. 5-year DFS and 7-year DFS were 100% and 66.7% respectively.

5-year progression free survival (PFS) and 7-year PFS were 78.4%. However, 5-year OS and 7-year OS were 93.1% and 86.9% respectively **(Tables 2 and 3)**. Disease free survival, progression free survival and overall survival were estimated using Kaplan Meier **(Figure 1-3)**.

Table (3): Comparison between different grades of meningiomas regarding outcome of treatment

Outcome	Grade 1		Grade 2		Grade 3		p-value
	No.	%	No.	%	No.	%	
Response to treatment	(N=37)		(N=7)		(N=8)		
CR	1	2.7%	1	14.3%	3	37.5%	<0.001
PR	18	48.6%	1	14.3%	2	25%	
SD	4	10.8%	5	71.4%	1	12.5%	
Missed	4	10.8%	0	0%	2	25%	
N/A	10	27%	0	0%	0	0%	
Recurrence	(N=11)		(N=1)		(N=3)		
Absent	10	90.9%	1	100%	3	100%	0.823
Present	1	9.1%	0	0%	0	0%	
Progression	(N=22)		(N=6)		(N=3)		
Absent	21	95.5%	3	50%	3	100%	0.010
Present	1	4.5%	3	50%	0	0%	
Mortality	(N=37)		(N=7)		(N=8)		
Alive	30	90.9%	6	85.7%	5	83.3%	0.819
Died	3	9.1%	1	14.3%	1	16.7%	

Categorical variables were expressed as number (percentage) and compared by Chi-square test
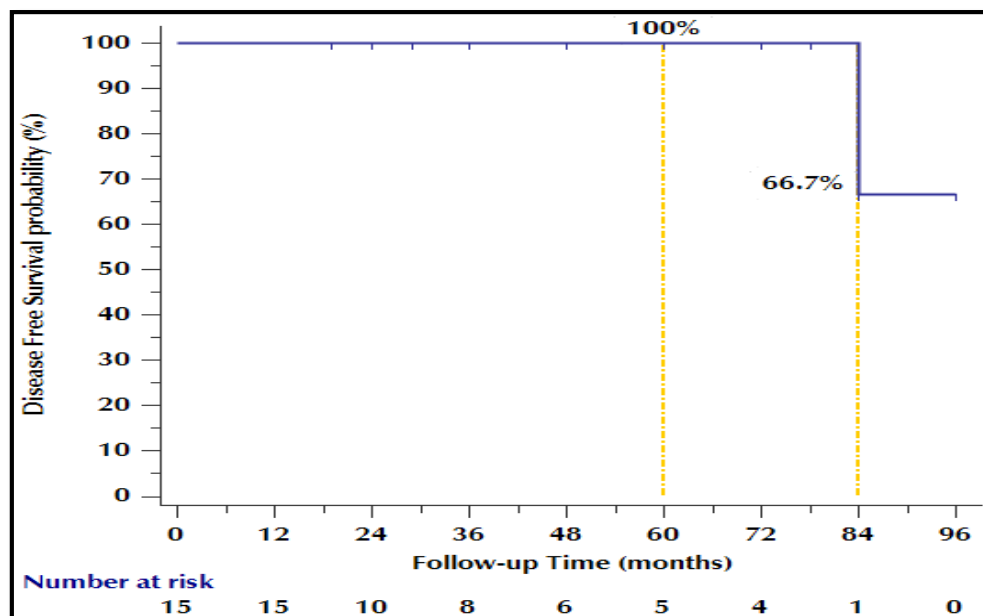

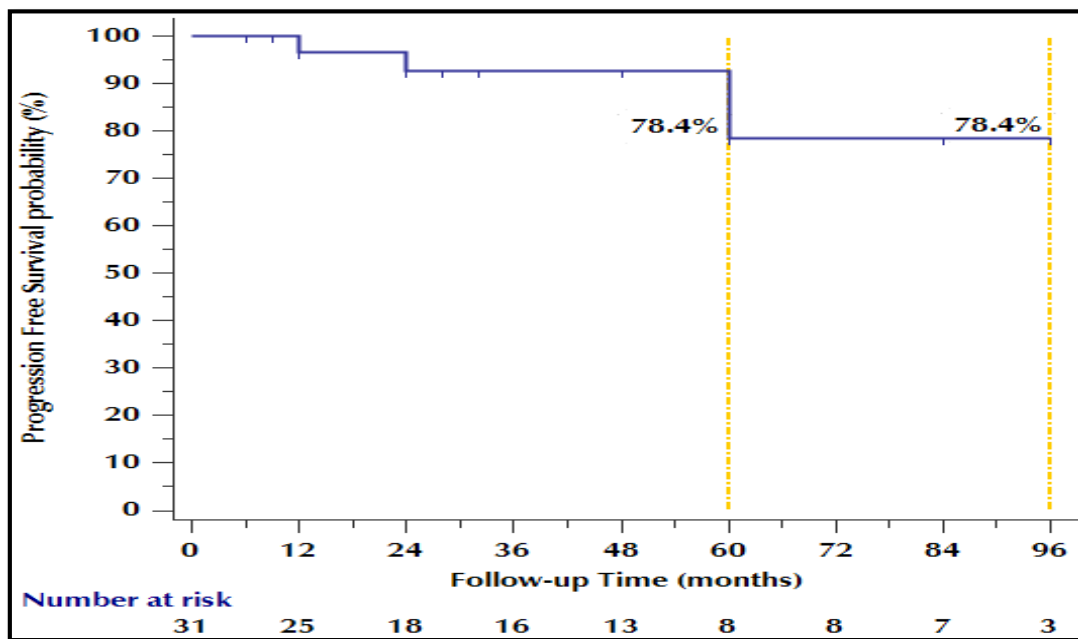**Figure (1): Kaplan Meier plot for disease free survival**

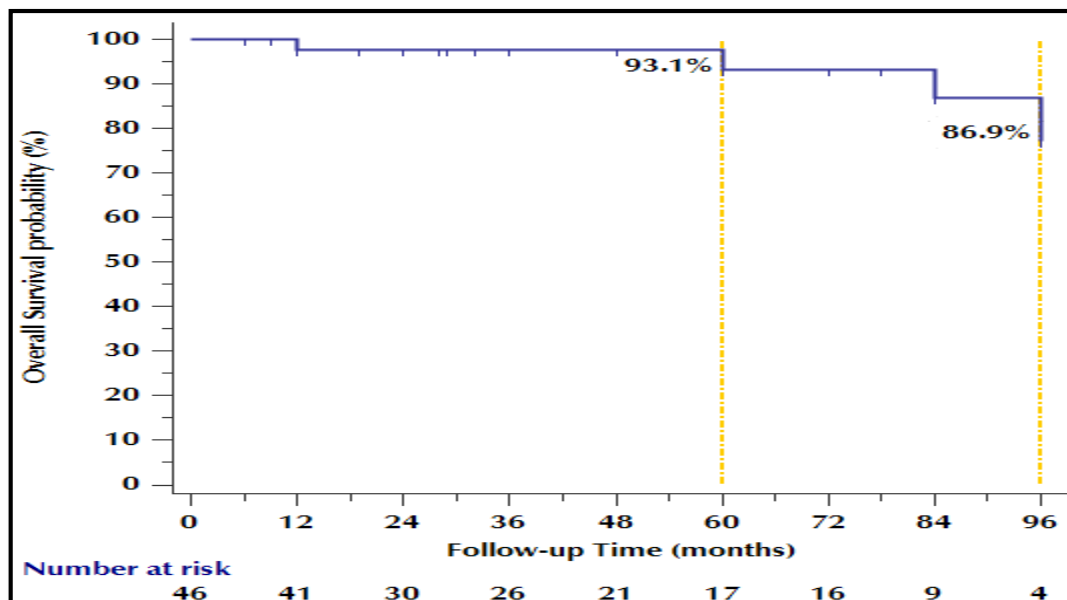**Figure (2): Kaplan Meier plot for progression free survival**

Figure (3): Kaplan Meier plot for overall survival

DISCUSSION

Meningiomas, the most common primary brain tumour, are categorised into 3 WHO classes, with 90% of cases falling into WHO grade I. The tumour must be removed during surgery to be diagnosed, however only around 50% of patients can have a complete resection. Depending on the tumor's location, degree of resection, and WHO grade, radiation treatment may be utilised [10].

In the current study the frequency of meningioma was (13.6%), this finding is lower than results from **Hewedi et al.** [11] and **Rigau et al.** [12] who reported that the frequency of meningioma was (28.8%).

In the present study, meningiomas were common in females than males and this finding is higher than results from **Ostrom et al.** [4] **and Kamenova et al.** [13].

The mean age of the studied patients at diagnosis was 47 years that was lower than results from **Holleczek et al.** [14]. Meningothelial meningioma was the most common of all meningioma (50%). This finding comes in agreement with results from **Samadi and Ahmadi** [15]. However, **Hewedi et al.** [11] revealed predominance of transitional variant (53.1%).

Meningiomas of the cranial convexity was the most common (46.2%) in our study followed by sphenoid ring (23.1%). This finding was higher than results **Champeaux et al.** [16] who reported that cranial convexity and sphenoid ring were (24.4% and 21.6%), respectively.

In the present study, spinal meningiomas accounted for (1.9%). This finding was lower than

results of **Champeaux et al.** [16] and **Huang et al.** [17] who found that spinal meningiomas represented 9.8% and 14.06% respectively.

Malignant meningiomas in our study was (15.4%) of all meningiomas and grade II meningiomas was (13.5%). This finding is higher than results of **Champeaux et al.** [16] which were (3% and 5%), respectively.

The current study revealed that the most common symptoms of meningioma was headache (80.8%), and the least common was seizures (1.9%). This comes in agreement with **Cea-Soriano et al.**[18] who found that headache and seizures represented (23.6% and 13.7%), respectively.

In our study, recurrence of meningiomas occurred in (9.1%) of grade I patients, which is lower than results in a study of **Abdelzaher et al.** [19] who found that occurrence of recurrence of meningiomas was (10.2%).

In the current study, recurrent tumors occurred in (9.1%) of grade I tumours and in (0%) of both grade II and grade III. This disagrees with results from previous study as in our study grades of meningioma were significantly affected by radiotherapy, dose of radiotherapy and overall response. Also, 5-years OS of meningiomas was 93.1 %. This finding was higher than results **Champeaux et al.** [16]. Moreover, 5 years PFS of meningiomas in our study was 78.4 %, which is higher than results from a study of **Anvari et al.**[20].

CONCLUSION
Tumor grade was the most important prognostic factor in meningioma patients who received radiation therapy. In patients with grade II and III tumors the extent of surgical resection was significantly associated with over all survive.

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