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Original Research Article

Determine the Correlation of Clinicopathologic and Radiologic Characteristic Predicting the Outcome of Meningioma

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Abstract

Introduction: Meningiomas of WHO grade I can, display invasive growth [2], even though there is no histopathologic difference between invasive and non-invasive tumors. Lack of homogeneity in the WHO grade I meningioma group itself, which is histologically divided into different subtypes with variable biological behaviour [3], Intra-tumoral heterogeneity, which might be spatial (due to the genetic aberrations in the different geographical regions of the same tumor) or temporal (between the primary tumor and the local recurrence), has not been studied adequately in meningiomas [4]. It is necessary to develop a comprehensive scoring system which can predict outcome in meningioma patients based on CLASS Algorithm, Histopathology, Simpson Grading and Radiology characteristics

Objective: To develop a comprehensive scheme to prognosticate and to predict recurrence for meningioma based on pre-operative CLASS algorithm assessment with Preoperative imaging, Intraoperative completeness of resection-Simpson grading- WHO Classification 2016.

Materials and Methods

1. A retrospective study based on hospital records and patient follow up who were treated surgically in Institute of Neurosurgery Madras Medical College.
2. Fifty cases of meningioma that were treated surgically in our hospital between June 2017 and February 2018 were included in the study.
3. Computed tomography (CT) was performed before and after contrast administration in all cases.
4. Magnetic resonance imaging (MRI) including pre- and post-contrast T1- weighted imaging using spin-echo (SE) sequences and T2-weighted imaging using fast spin-echo (FSE) sequences was performed in all cases.
5. Early outcome at 6 weeks and late outcome at 12 months was assessed using the Glasgow outcome scale (GOS), and postoperative neurologic and medical complications were recorded.
6. Chi-square and Fisher's exact test were used for the comparison of the groups.
7. A logistic regression model was built to compare each group in terms of the odds of having "bad" GOS (GOS 1–3) and neurologic/medical complications.
8. A p-value of 0.05 and below was accepted as statistically significant.

Results: Out of 50 patients 27 (54%) were male, 23 (46%) female. Youngest patient age was 10 years and oldest was 75 years. Mean age presentation was 47.62 years; median age was around 48 years. Most common location being convexity followed by parasagittal and skull base regions. GROUP III patients of CLASS algorithm had the worst outcome The completeness of resection was a major predictor of outcome with better outcomes seen with greater extent of resection. Higher Grade according to WHO classification was associated with a worse outcome. However, it was not a predictor of recurrence. High Risk' imaging characteristics had a significantly worse outcomes

Conclusion: Our study was able to concur that these indicators when factored together can predict the outcome and disease-free survival. The WHO Grading and Simpson's Grading while important predictors of outcome, by themselves fail to predict the chances of recurrence. CLASS HSR is a useful predictor of Recurrence and Outcome of patients with Meningioma.With the individual components all having significant correlation with outcome, the combination offers an advantage in predicting disease free survival period.

Keywords: Meningioma; Who Classification 2016; Simpson Grading Class Algorithm.

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Introduction

Meningiomas of WHO grade I can, display invasive growth [2], even though there is no histopathologic difference between invasive and non-invasive tumors. They are routinely diagnosed using MRI and CT, but the tumors with atypical locations and misleading morphological features often leads to clinical dilemmas1.Problems with Meningiomas is that theycannot be entirely resected due to their anatomical location. Moreover, Postoperative remaining tumor cells may develop an aggressive and bone invasive growth behavior. so they lead to Increased risk of recurrence and worsening prognosis leading to Invasiveness of tumor which cannot be foreseen and makes treatment plans challenging Recurrence decreases with adjuvant radiotherapy after subtotal resection.

But the lacunae are Lack of homogeneity in the WHO grade I meningioma group itself, which is histologically divided into different subtypes with variable biological behaviour [3], Intra-tumoral heterogeneity, which might be spatial (due to the genetic aberrations in the different geographical regions of the same tumor) or temporal (between the primary tumor and the local recurrence), has not been studied adequately in meningiomas [4].

Debate in administering radiotherapy is that the local control rate at 5 years for grade I meningiomas post radiotherapy is only 41% [8]. So delaying the use of radiotherapy until signs of progressive disease is Imperative, and it is necessary to develop a comprehensive scoring system which can predict outcome in meningioma patients based on CLASS Algorithm, Histopathology, Simpson Grading and Radiology characteristics.

Objective

To develop a comprehensive scheme to prognosticate and to predict recurrence for meningioma based on pre-operative

1. CLASS algorithm assessment with
2. Preoperative imaging,
3. Intraoperative completeness of resection-Simpson grading
4. HPE- WHO Classification 2016

Materials and Methods

1. A retrospective study based on hospital records and patient follow up who were treated surgically in Institute of Neurosurgery, Madras Medical College.
2. Fifty cases of meningioma that were treated surgically in our hospital between June 2017 and February 2018 were included in the study.
3. Computed tomography (CT) was performed before and after contrast administration in all cases.
4. Magnetic resonance imaging (MRI) including pre- and post-contrast T1- weighted imaging using spin-echo (SE) sequences and T2-weighted imaging using fast spin-echo (FSE) sequences was performed in all cases.
5. Preoperative evaluation done based on CLASS algorithm and intraoperative resection based on Simpson grading.
6. Surgically resected specimen was qualified based on histopathology characteristics and grading was done based on WHO Cassification of CNS Tumors 2016.
7. Early outcome at 6 weeks and late outcome at 12 months was assessed using the Glasgow outcome scale (GOS), and postoperative neurologic and medical complications were recorded.
8. Chi-square and Fisher's exact test were used

for the comparison of the groups.

9. A logistic regression model was built to compare each group in terms of the odds of having "bad" GOS (GOS 1–3) and neurologic/ medical complications.
10. A p-value of 0.05 and below was accepted as statistically significant.
11. Class Algorithm

Table 1:

Parameters of Class Algorithm					
Factors	Score				
	-2	-1	0	1	2
Co-Morbidity	ASA 3	ASA 2	ASA 1		
Location	Complex	Moderate	Simple		
AGE	> 71	61 -70	<60		
Size (cm)			< 2	2.1 - 4	> 4
Signs And Symptoms			Asymptomatic	+	++
Other		Prior Rt / Sx		Progress	

12. HSR Algorithm

Table 2:

Parameters	Score				
	-2	-1	0	1	2
Histopathology	Grade 3	Grade 2	Grade 1		
Simpson Grade Exicision	5	4	3	2	1
Radiology					
CT	Hyper	Hypo			
MRI					
Shape	Irregular	Smooth			
T1	Hyper	Iso	Hypo		
T2	Hyper	Iso	Hypo		
Flair	Hyper	Iso	Hypo		
Contrast	Hetero	Homo			
Dural Invasion	Present	Absent			
Pial Invasion	Present	Absent			

13. Based on the CLASS HSR scoring, patients were divided into three groups

Group I with scores of more than 15

Group II with scores between 10 and 14 and

Group III with scores less than 10

14. Outcomes were statistically assessed using Python and disease-free survival was plotted on Kaplan- Meier curves

Results

Fifty cases of meningioma were treated surgically in our hospital between June 2017 and February 2018.

Age And Sex

Out of 50 patients 27 (54%) were male, 23 (46%) female. Youngest patient age was 10 years and oldest was 75 years. Mean age presentation was 47.62 years; median age was around 48 years

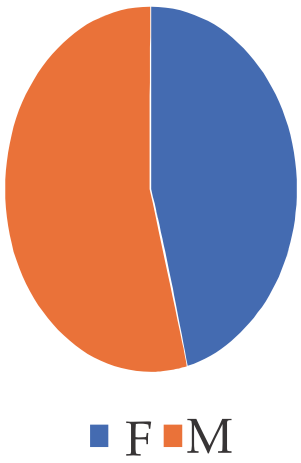

Fig. 1: Sex

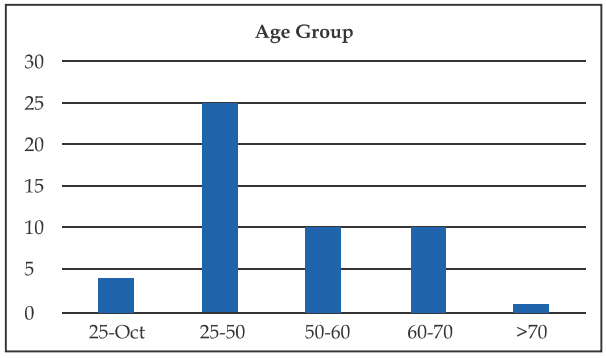

Fig. 2:

Location

Most common location being convexity followed by parasagittal and skull base regions

Table 1:

Location	No	%
Convexity	21	42
Falx/Parasaggital	8	16
Intraventricular	1	2
Posterior Fossa	6	12
Skull Base	8	16
Spine	6	12
Total	50	100

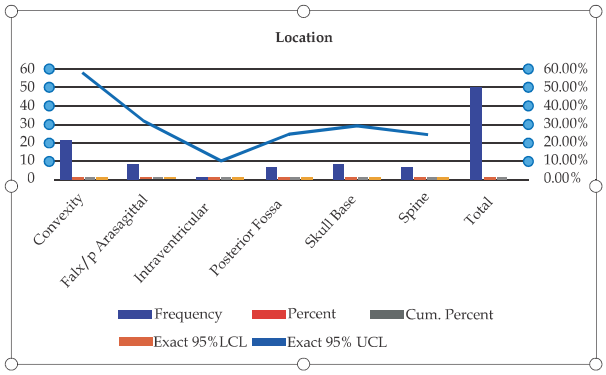

Fig. 3:

Clinical Features

Neurological symptoms such as headache, seizure, cranial nerve deficit, swelling, loss of consciousness, weakness numbness of the extremities was reported. Duration of symptoms ranged from 2 days to 1 year

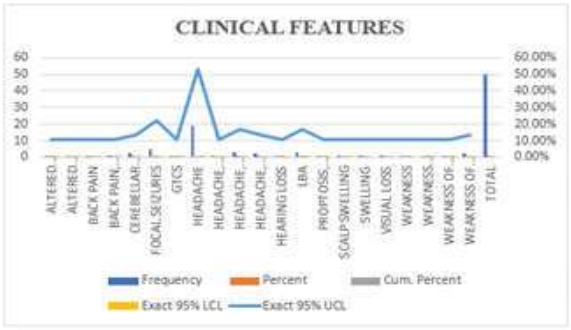

Fig. 4:

Brain Edema

45 patients presented with brain edema both radiological and clinical aspect

Table 2:

Brain Edema	No	%
Present	45	90
Absent	5	10
Total	50	100

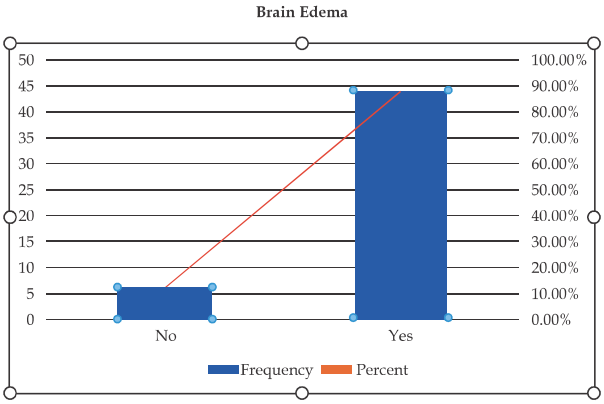

Fig. 5:

Vascularity

44 patients had moderate vascularity while only 2 patients had high vascularity

Table 3:

Vascularity	Numbers	Percentage
High	2	4
Mild	4	8
Moderate	44	88
Total	50	100

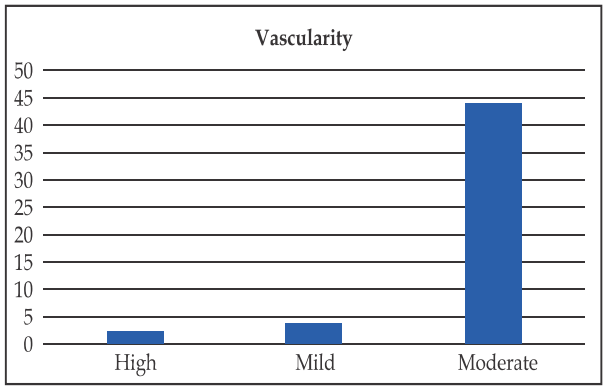

Fig. 6:

Dural Infiltration

45 Patients presented with Dural infiltration

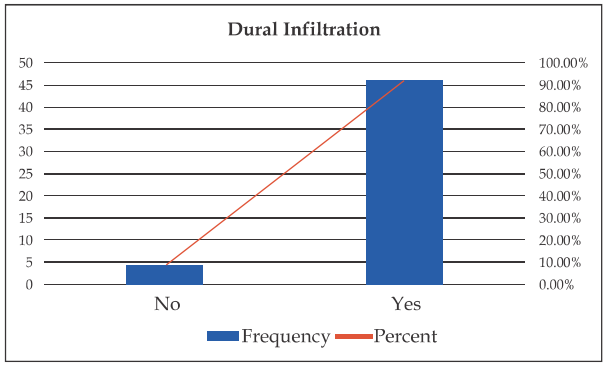

Fig. 7:

Skull Infiltration

45 patients presented with skull infiltration

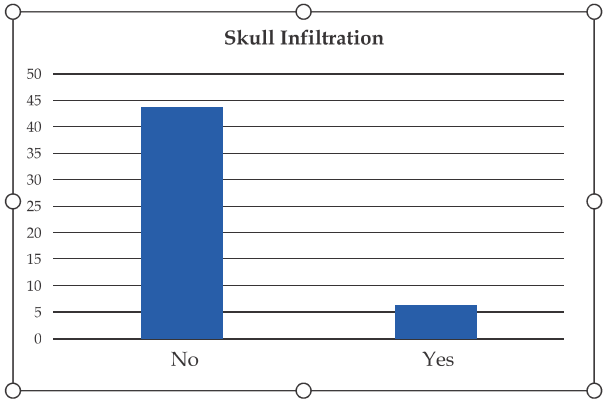

Fig. 8:

Simpson Grade

35 patients underwent Simpson Grade 1 excision

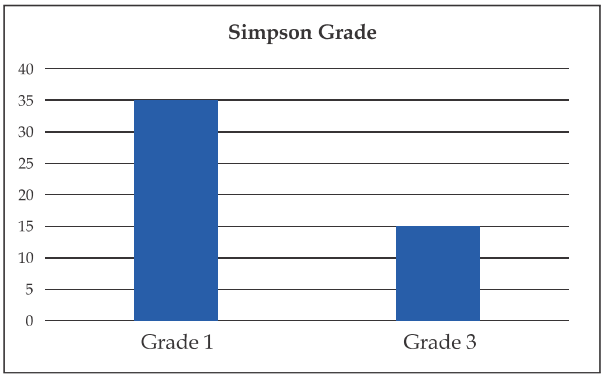

Fig. 9:

Histopathology

24 Cases Were Meningothelial Meningioma 4 Cases Were Psommomatous 1 Microcystic and Papillary type. 3 Cases Represented Recurrent Disease Subsequent to Resection Of Two Atypical Meningiomas And One Anaplastic meningiomas.

Table 4:

Hpe	Numbers	Percentage
Grade I	38	76
Grade Ii	9	18
Grade Iii	3	6
Total	50	100

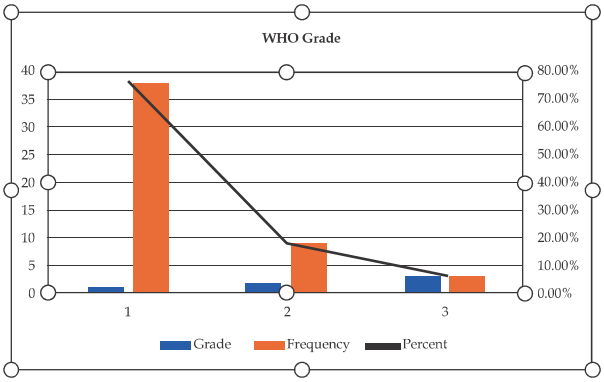

Fig. 10:

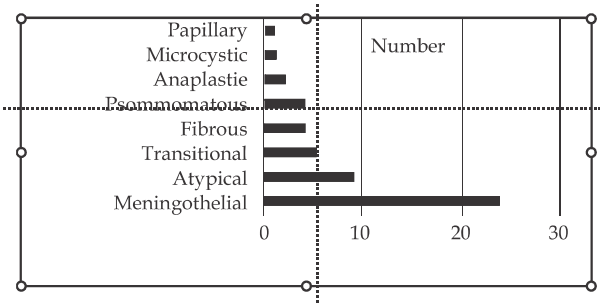

Fig. 11:

Class Algorithm and Outcome

Based on the Class Algorithm, patients were divided into three groups. Poor outcome defined by GOS of 3 or worse was found to be associated with a lower score in CLASS (Group 3)

Table 5:

Class Group	Score	No	%
Group I	>15	17	34
Group Ii	< 14	23	46
Group Iii	<10	10	20
Total		50	100

Scatter diagram showing CLASS scoreand GOS correlation

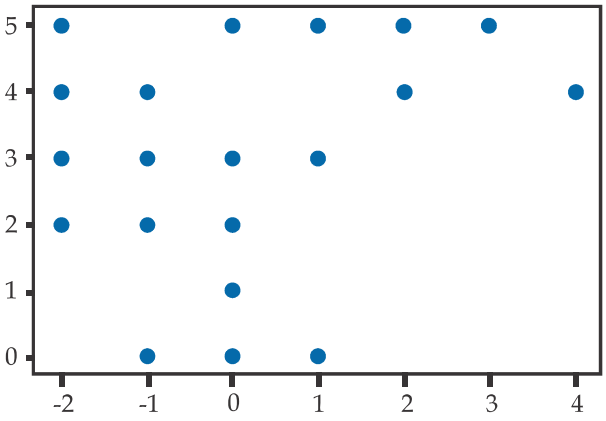

Fig. 12:

p value was found to be 0.0162

Class-HSR Scores and Outcome

Table 6:

Class HSR Group	% With Poor Outcome
Group I	11
Group Ii	43
Group Iii	100

Scatter diagram depicting correlation between CLASS-HSR and Outcome

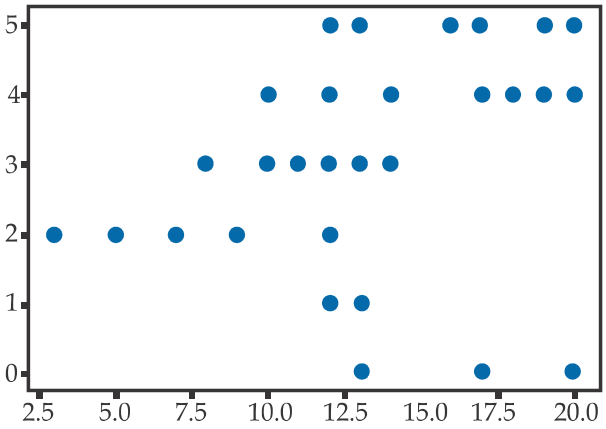

Fig. 13:

the p value was found to be 0.0351

Histopathology, Radiological Score and Simpson's Grading and Outcome

Simpson's Grade

As expected, the completeness of resection was a major predictor of outcome with better outcomes seen with greater extent of resection. P value was 0.005.

Hpe- Who Grade

Higher Grade according to WHO classification was associated with a worse outcome (p value was 0.013). however, it was not a predictor of recurrence.

Radiological Score

'High Risk' imaging characteristics had a significantly worse outcomes. P value was 0.024.

The risk of recurrence- disease free survival

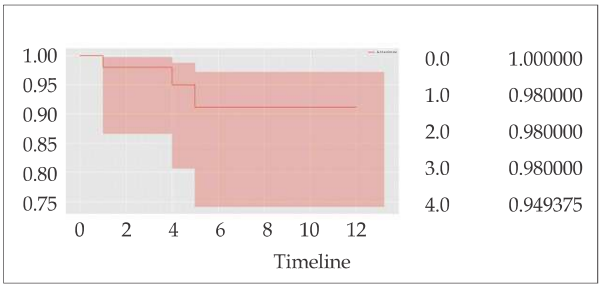

Fig. 14:

CLASS HSR and Recurrence

Of the three patients that presented with recurrence, two belonged to Group III and one belonged to Group II.There were no recurrences in Group I and accounted for a 20% recurrence in Group III and a 4% recurrence in Group II.All three cases of recurrence had WHO Grade I HPE.

The risk of recurrence- disease free survival for Grade I 14

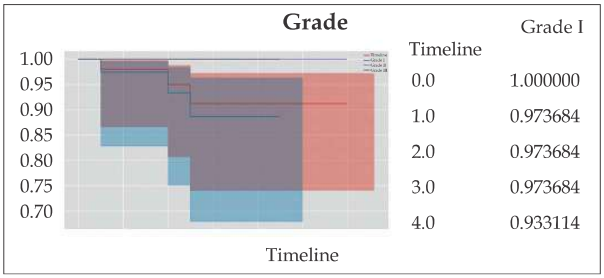

Fig. 15:

Discussion

A practical protocol for risk assessment will have tremendous benefits for the surgeon and patient because it will allow rational decision making about the treatment that is most likely to minimize the risk of complications. Other grading systems have been proposed to predict the extent of tumor removal and outcome for meningioma surgery, the method we describe in this paper specifically predicts the extent of tumor removal and postoperative neurological changes. Moreover, the previously proposed grading systems are not widely used.Individual studies have predicted that CLASS score, Histopathology, radiological features and completeness of resection are major indicators of outcome. In our study concurrent investigation and scrutinizing the CLASS HSR algorithm evidently proves by the fact that all the patients who had recurrence are Group II and GroupIII which is proven by the Kaplan meir curve for recurrence free survival. But the interesting finding in our study is the all the three cases were WHO Grade I Meningioma which tells us the lacunae behind the understanding and classification of meningiomas. Scatter diagram plotted for CLASS HSR and Outcome also show us the significance in association of poor outcome with Group III patients.The varying and heterogeneous nature of presentation of the various types of meningiomas and the commonality of occurrence has sparked efforts to primarily predict the success of surgical outcomes in meningioma surgery [11]. Sughrue et al. found no statistically significant difference in recurrence-free survival between patients following a Simpson Grade I, II, III, or IV resection for benign meningiomas [13]. The degree of resection was not an independent predictor of the patients' functional outcome in the multivariate analysis [12]. The most convincing argument in favor of conservative meningioma surgery appears to be the presumed association between substantially increased surgical morbidity and extensive operations [14].

Review of Literature

CLASS Algorithm was put forward by Jong Lee and Burak Sade as an attempt to 'balance the risks against the benefits of surgery' in patients with meningioma [6]. The study concluded that people belonging to Group 3 with a score of -2 or lesser had a poor outcome (odds ratio was 9.36) and suffered more medical and neurological complications compared to patients in Group 1 and 2, which was consistent with our study. Commins, Atkinson and Burnett in their study on Histopathology of meningioma concluded that "the ability to identify meningiomas that will behave aggressively is limited"[7]. Histological grade by itself serves as a poor marker to predict outcomes although it was among the most important characteristic to be assessed. But in our study higher the grade of WHO classification associated with poor outcome though it was predictor of recurrence, this may be because the pitfall not correlating with immunohistochemistry markers. Kira Marie Voß, Cicillia Spille et al investigated the prognostic value of Simpson's Grading involving 1079 histologically proven meningiomas over a 25-year period [8]. 'Simpson's Grading was not equally prognostic in all tumourlocation 'Subtotal resections lead to a higher recurrence in convexity meningiomas while falx and posterior fossa lesions didn't have a correlation and in our the completeness of resection was a major predictor of outcome with better outcomes seen with greater extent of resection which was statistically significant. Liu and Cheng in their study attempted to predict aggressive behavior and poor outcome in meningioma patients based on preoperative imaging [9]. Based on five radiological features, the patients were classified into three groups. Patients belonging to group 3 were found to have tumors with aggressive behavior and a significantly poorer outcome compared to the other groups which was similar to our study findings that High Risk' imaging characteristics had a significantly worse outcomes.in study done by Susan and Mc Govern et al patients with non–skull base tumors who experienced a recurrence (8 of 22 [36%]) were more likely than patients with skull base tumors (1 of 19 [5%]) to have a higher grade tumor at recurrence (p = 0.024)10 which is strikingly similar tor our study

Conclusion

Our study was able to concur that these indicators when factored together can predict the outcome and disease-freesurvival. The WHO Grading and Simpson's Grading while important predictors of outcome, by themselves fail to predict the chances of recurrence. CLASS HSR is a useful predictor of Recurrence and Outcome of patients with Meningioma.With the individual components all having significant correlation with outcome, the combination offers an advantage in predicting disease free survival period.

Limitations

Our study suffers the usual and expected limitations of retrospective reviews. There is inherent bias as treatment decision post-surgery was left to the discretion of the treating physician and not in a prospective, randomized manner. Routine follow-up imaging studies were not prospectively established, and most imaging studies were performed with 3–5 mm slice thickness, which may lead to uncertainty associated with tumor volume and planar computations. Segmenting recurrent tumor volume from adjacent normally enhancing structures, such as venous sinuses, may pose further difficulty in accurately establishing disease progression. Despite these shortcomings, we believe that the information contained may serve as a guide to practicing professionals in the field of neurological sciences.

References

1. Sharma S, Ray S, Moiyadi A, Sridhar E, Srivastava S. Quantitative proteomic analysis of meningiomas for the identification of surrogate protein markers. Sci Rep. 2014 Nov 21;4:7140. doi: 10.1038/srep07140.
2. Fogh SE, Johnson DR, Barker FG, Brastianos PK, Clarke JL, Kaufmann TJ et al. Case-based review: Meningiomaa. Neuro-Oncology Practice. 2016 Jun 13;3(2):120-34. npv063. https://doi.org/10.1093/nop/npv063.
3. Louis DN, Perry A, Reifenberger G, von Deimling A, Figarella-Branger D, Cavenee WK, Ohgaki H, Wiestler OD, Kleihues P, Ellison DW. The 2016 World Health Organization Classification of Tumors of the Central Nervous System: a summary. Acta Neuropathol. 2016 Jun;131(6):803-20. doi: 10.1007/s00401-016-1545-1. Epub 2016 May 9.
4. Samridhi Sharma, Sandipan Ray, Aliasgar Moiyadi, Epari Sridhar, and Sanjeeva Srivastavaa. Quantitative Proteomic Analysis of Meningiomas for the Identification of Surrogate Protein Markers. Sci Rep. 2014;4:7140.
5. Masaki Kokubo, Yuta Shibamoto, Jun A Takahashi, Keisuke Sasai, Natsuo Oya, Nobuo Hashimoto, Masahiro Hiraoka. Efficacy of Conventional Radiotherapy for Recurrent Meningioma Journal of Neurooncology. 2000 May;48(1):51–55.
6. Lee J.H., Sade B. The Novel "CLASS" Algorithmic Scale for Patient Selection in Meningioma Surgery. In: Lee J.H. (eds) Meningiomas. Springer, London. 2009.
7. Review of meningioma histopathology. Commins DL, Atkinson RD, Burnett ME. Neurosurg Focus. 2007;23(4):E3.
8. Liu Y, Chotai S, Chen M, Jin S, Qi S-t, Pan J. Preoperative Radiologic Classification of Convexity Meningioma to Predict the Survival and Aggressive Meningioma Behavior. PLoS ONE 2015;10(3): e0118908.
9. Susan L. McGovern, Kenneth D. Aldape, Mark F. Munsell, Anita Mahajan, Franco DeMonte, Shiao Y. Woo. Comparison of World Health Organization tumor grades at recurrence in patients with non–skull base and skull base meningioma. Journal of Neurosurgery, 2010 May;112(5):925-33.
10. Niban GM, Kannan MGV, Sudhakar K, Mohanraj G. Evaluation of Risk Factors Influencing Surgical Outcome in Meningiomas with CLASS Algorithm. Int J Sci Stud. 2017;4(12):94-98.
11. Gousias K, Schramm J, Simon M. The Simpson grading revisited: aggressive surgery and its place in modern meningioma management. J Neurosurg. 2016 Sep;125(3):551-60. doi: 10.3171/2015.9.JNS15754. Epub 2016 Jan 29.
12. Sughrue ME, Kane AJ, Shangari G, Rutkowski MJ, McDermott MW, Berger MS, et al. The relevance of Simpson Grade I and II resection in modern neurosurgical treatment of World Health Organization Grade I meningiomas. J Neurosurg 2010;113:1029–35.
13. Zentner J, Meyer B, Vieweg U, Herberhold C, Schramm J. Petroclival meningiomas: is radical resection always the best option? J Neurol Neurosurg Psychiatry 1997;62:341–45.