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## Original Article

# The Observation at Mean Oedema Index Variations with Location and Histological subtypes in Supratentorial WHO G-I Meningiomas

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## Abstract:

***Background:*** *The term meningioma is the noncommittal, all-encompassing name coined by Harvey Cushing for this tumor of meninges which is usually benign. The severity and variety of the peritumoral brain oedema may limit operative exposure and increase the difficulties of intraoperative procedures; however, its pathogenesis is not clearly documented. Several factors, such as tumor size, location and histology, mechanical compression of draining vein by the tumor have been proposed as mechanism of peritumoral brain oedema*

***Aims:*** *The objective of this study was to determination of mean oedema index in different locations and histological subtypes in patients with supratentorial WHO G-I meningiomas*

***Methods:*** *The study was conducted in the Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from September, 2016 to March, 2018. This study was a cross sectional study. Data collection sheets were used to collect necessary information. Total 75 cases were selected consistent with inclusion and exclusion criteria. Tumor volume and localization and the presence of peritumoral brain oedema (PTBOe) were determined by MRI (Magnetic Resonance Image). All patients underwent microsurgical removal of tumor. Surgically resected meningiomas were classified histopathologically based on criteria of the new World Health Organization (WHO) classification. Regarding location and histological subtypes of tumor the study population were divided into 6 groups and 8 groups respectively.Statistical analyses were done by Statistical Packages for Social Sciences (SPSS-v.25).*

***Results:*** *A total 75 cases were selected consistent with inclusion and exclusion criteria from September, 2016 to March, 2018. Regarding location; the mean oedema index for each of the six groups was calculated and recorded. The F value was 5.97 and the P-value was 0.0001 which was less than 0.05. This result signifies that there was association between perilesional oedema in supratentorial meningioma to its location. So, Mean Oedema Index in Intracranial Supratentorial Meningiomas vary with its location. On the other hand, regarding histopathological subtypes, meningiomas*

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*were divided into eight groups-the mean oedema index of each of the eight groups was calculated and recorded. The F value was 1.62 and P-value was 0.145 which was more than 0.05. This result signifies that there was no association between perilesional oedema in supratentorial meningioma to its histological subtypes. So mean oedema index in intracranial supratentorial meningiomas does not vary with its histological subtypes.*

***Conclusion:*** *Mean Oedema Index in Intracranial Supratentorial Meningiomas vary with its location but does not vary with histological subtypes.*

***Keywords:*** *Mean Oedema Index Variations, Location, Histological subtypes, Supratentorial WHO G-I Meningiomas*

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## Introduction

Meningioma was named by Harvey Cushing in 1922 to describe a benign tumor of the meninges of the central nervous system. Derived from neuroectoderm and arising from arachnoid cap cell, it is responsible for 10-15% of all brain neoplasm[1].

Approximately 60% of meningiomas are associated with a perifocal edema[2]. Considering the extra-axial origin of meningiomas, the formation of peritumoral brain edema is difficult to understand. In contrast to intra-axial tumors, causing a functional disorder of the blood-brain-barrier, the pathogenesis of edema in meningiomas remain obscure[3].

There have been several hypotheses to explain the pathophysiology of PTBOe associated with meningiomas. Four hypotheses found in the literature are discussed4:

1. Ischemia caused by mechanical compression
2. Venous stasis caused by compression on veins
3. Excretory-secretory phenomenon
4. Hydro-dynamic process whereby extravasates from meningiomas appear in the surrounding brain.

With regard to tumor location the edema indices, temporobasal and frontobasal meningiomas are associated with the highest edema incidence. Compare to falcine and convexity meningiomas, this tumor showed a significantly higher edema incidence. Furthermore, temporobasal and frontobasal meningiomas showed a significantly higher edema incidence than sphenoid wing meningiomas[3].

Meningotheliomatous meningiomas were frequently associated with significant brain edema5. Meningotheliomatous and transitional meningiomas tended to be associated with larger PTBOe than fibroblastic meningiomas[6].

## Methodology

This cross-sectional observational study was carried out on 75 patients diagnosed with Meningioma in Department of Neurosurgery of BSMMU, NINS&H and Dhaka Medical College , Bangladesh, during September 2016 to March 2018. Ethical clearance for the study was taken from the Department of Neurosurgery and IRB, BSMMU and informed written consent was taken from each patient. Preoperatively thorough neurological examination

was done. Findings of MRI were recorded and analyzed and operative findings were noted carefully.

Tissues were sent for histopathology in every cases. Histopathological reports were collected and recorded. The diagnosis was confirmed by histopathological examinations. WHO Grade I Meningiomas were included in this study.

### Imaging criteria:

After detailed history and clinical examination, MRI of brain was carefully studied in all patients with intracranial meningiomas. Tumor volume was estimated on T1W scans with or without contrast. Peritumoral brain edema was evaluated on T2W and/or FLAIR scans. PTBOe was identified by high signal intensity region on T2W/FLAIR scans that was clearly distinguished from normal tissues, including the tumor.

### Formula for measurement of tumor volume:

The tumor and PTBOe volumes were approximated from axial, coronal, and sagittal images as follows. The maximum perpendicular diameters (a, b) of the tumor and the PTBOe were measured on axial scans, and the coronal direction (c) was measured on coronal or sagittal scans. The total volumes of tumor and the PTBOe was then approximated by using the formula for a spheroid:

**Formula for measurement of Oedema index:**

The relation of PTBOe and tumor volume (edema index, OeI) was defined as3,6,7:

$$\text{OeI} = \frac{V\ Tumor + Edema}{V\ Tumor}$$

**Statistical analysis**

Statistical significance was set at P value <0.05. One way F test (ANOVA) was applied to test the significant difference in six different groups of locations. A similar test was used regarding histological subtypes.

Observations and results:

**Table-I**

*Distribution of respondents by age:*

| Age in years | Frequency (N) | Percentage(%) |
|---|---|---|
| 11-20 | 3 | 4.00 |
| 21-30 | 9 | 12.00 |
| 31-40 | 27 | 36.00 |
| 41-50 | 15 | 20.00 |
| 51-60 | 18 | 24.00 |
| >60 | 3 | 4.00 |
| Total | 75 | 100.00 |

**Table-II**

*Distribution of respondents by sex*

| Sex | Number of patients | Percentage (%) |
|---|---|---|
| Male | 21 | 28.00 |
| Female | 54 | 72.00 |
| Total | 75 | 100.00 |

**Table-III**

*Mean Oedema Index in various locations:*

| Tumor | Frequency location | Mean Oedema | Standard deviation |
|---|---|---|---|
| Frontobasal | 8 | 2.89 | 0.80 |
| Temporobasal | 4 | 5.36 | 0.05 |
| Convexity (frontal, parietal, temporal, occipital) | 20 | 2.73 | 1.64 |
| Falcine andParasagittal | 23 | 2.52 | 1.28 |
| Sphenoid wing | 16 | 2.01 | 0.83 |
| Suprasellar andParasellar | 4 | 1.26 | 0.36 |
| Total | 75 | 2.59 | 1.41 |

*Mean Oedema Index-Expressed as ratio.

**Table-IV**

*Mean Oedema Index in various histological subtypes:*

| Histological Subtypes | Frequency | Mean Oedema Index | Standard deviation |
|---|---|---|---|
| Meningothelial | 37 | 2.55 | 1.40 |
| Fibrous | 11 | 2.00 | 0.63 |
| Psammomatus | 10 | 2.48 | 1.48 |
| Angiomatus | 5 | 4.10 | 2.19 |
| Transitional | 8 | 2.79 | 1.27 |
| Microcystic | 2 | 1.99 | 1.25 |
| Secretory | 1 | 1.90 | 0.00 |
| Lymphoplasmacyte -rich | 1 | 4.67 | 0.00 |
| Total | 75 | 2.59 | 1.41 |

**Table-V**

*ANOVA table A (Determine relationship between location and Mean Oedema Index in 6 different Locations)*

| Source of variance | Sum of squares | Degree of freedom | Mean square | F | P (Significance) |
|---|---|---|---|---|---|
| Betweenlocations | 44.44 | 5 | 8.89 | | 0.0001 |
| Withinlocation | 102.82 | 69 | 1.49 | 5.97 | |
| Total | 147.26 | 74 | | | |

**Table-VI**

*ANOVA Table B (Determination of relationship between histological subtypes of meningioma and Mean Oedema Index in 8 different subtypes )*

| Source of variance | Sum of squares | Degree of freedom | Mean square | F | P (Significance) |
|---|---|---|---|---|---|
| Between Histological subtypes | 21.32 | 7 | 3.05 | | 0.145 |
| WithinHistologic al subtypes | 125.94 | 67 | 1.88 | 1.62 | |
| Total | 147.26 | 74 | | | |

**Discussion:**

In this study, the mean age was 42.52 years with an age range between 12 to 67 years. Peak incidence of age in this subcontinent is in the 4th and 5th decade varies from western literature and this study is consistent with subcontinent8. Meningiomas are tumours of adults with a peak incidence between 50 and 60 years. They can also occur in children and the elderly9.

Sex distribution of the study patients were 28 % (21) being male and 72 % (54) female. Female: male ratio was 2.57:1. Another study found that female: male 2.5: 1 ratio to be out of 175 cases where there were 53 males and 122 females3.

Regarding location, the mean oedema index for each of the six groups was calculated and recorded. The mean oedema index among the six groups was compared with ANOVA test (F-test). The F value was

5.97 and the P-value was 0.0001 which is less than

0.05. This result signifies that there is association between perilesional oedema in supratentorial meningioma to its location. So, Mean Oedema Index in Intracranial Supratentorial Meningiomas vary with its location.

Meningioma is classified into convexity, falx, frontobasal, temporobasal, sphenoid wing, suprasellar and parasellar, and tentorial meningiomas and there is significant correlation between Mean

Oedema Index and the locations of the tumor. Temporobasal and frontobasal meningiomas were associated with the highest oedema incidence and the highest Mean Oedema Index. Compared to Convexity and Falcine meningiomas these tumors showed a significantly higher oedema incidence (95.2% vs 73.7%; P<0.04) and mean oedema index (OeI=5.6 vs OeI=2.2 P<0.0001)3.

This study also shows the similar finding, Frontobasal and Temporobasal meningiomas had the highest oedema incidence and mean oedema index 2.89 and

5.36 respectively.

On the other hand, regarding histopathological subtypes, meningiomas were divided to eight groups- the Mean Oedema Index of each of the eight groups was calculated and recorded. The Mean Oedema Index among the eight groups was compared with ANOVA test (F-test). The F value was 1.62 and P- value was 0.145. This result signifies that there is no association between perilesional oedema in supratentorial meningioma to its histological subtypes. So Mean Oedema Index in intracranial supratentorial meningiomas does not vary with its histological subtypes which is consistant with previous study3,6.

In another study, there were 55 cases of meningiomas and were divided into 10 groups by histological subtypes. There was no significant correlation between histological subtypes and PTBOe, P= 0.379.

**Conclusion:**

Mean Oedema Index in Intracranial Supratentorial Meningiomas vary with its location but does not vary with histological subtypes.

**Limitations:**

The study population was selected from three selected hospital in Dhaka city, so that the results of the study may not be reflect the exact picture of the country. The present study was conducted at a very short period of time. Small sample size was also a limitation of the present study. Therefore, in future further study may be under taken with large sample size.

**Recommendations:**

Further studies can be undertaken by including large number of patients in different hospitals.

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