PREVALENCE OF CNS TUMORS AND HISTOLOGICAL RECOGNITION IN THE OPERATED PATIENTS: 10 YEARS EXPERIENCE IN YEMEN

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ABSTRACT

Background: Tumors of the central nervous system consist of a heterogeneous grouping of neoplasms of enormous histological variety. In spite of the increasing prevalence of CNS tumors in developing countries, certain places alike Yemen do not have representative studies showing the true impact of these tumors on the population.

Aims: Description of the distinctiveness of primary and secondary tumors of the CNS in the past ten years in one Yemeni institute.

Materials and methods: A descriptive-observational study was performed on patients with tumors of the CNS who were selectively treated by surgical excision with subsequent diagnosis through a study of pathological tissues at the Saudi German Hospital SGH- Sana’a, over a period of 10 years from January 1, 2009 to December 31, 2019. The variables of the study were qualitative (histological type, gender, affected anatomical position) and quantitative (age). Both group and histopathological diagnoses were formed in line with the 2006 WHO classification of CNS tumors.

Results: There were a total of 359 central nervous system tumors. Of these, 200 were females and 159 were males, with a ratio of 1.3: 1 and a mean age of 49.3 years. The most common tumors were the neuroepitheliurn (28.4%), meningiomas (26.55%), followed by mesenchymal tumors (13.4%), sellar region tumors (11.14%) and the nerve sheets (8.6%). Class II meningiomas (7.24%) and Schwannoma (6.7%) had the highest prevalence in female patients (20.33%), while it was in male neuroepithelial tumors (15.32%). Single entity repeat point form, Grade I meningioma was the most common (18.11%) followed by pituitary adenomas (9.2%), Glioblastoma multiform (8.6%), Class II meningiomas (7.24%) and Schwannoma (6.7%).

Conclusion: This is the firstly study of a sequence of cases in Yemen to be conducted on both benign and malignant tumors of the CNS, with all age groups patients with a extent of 10 years. Whilst this work represents no more than a retrospective analysis of a single institute, it can be a strong indicator of the epidemiology of the CNS tumors in Yemen.

Keywords: Central nervous system tumors, Histology, Pathology, Prevalence, Yemen.

INTRODUCTION

The tumors of central nervous system are a heterogeneous grouping of tumors of enormous histological variety and are restricted to the spinal cord, brain, meninges; and paraspinal and cranial nerves. A large series was conducted by diverse groups all around the world in order to verify the epidemiological and clinical features. It can be noticed in these studies that there has been a significant rise in latest decades, particularly in non-industrialized countries such as Yemen.

In some study series, these tumors are the leading cause of cancer-related death in children and draw attention to that more than 50% of children survivors of brain tumors have impaired cognitive function linked to the tumor or its treatment. For that reason it is important to determine the recent features of these tumors in the environment. Nevertheless, in Yemen as in the majority of Arab countries, there are few specialized epidemiological records dedicated to this field, and for that reason it is important to encourage, update, build up and continue to offer studies on the manners of CNS tumors with the purpose of achieve a greater extent and influence on public health, with early diagnosis and suitable treatment with the purpose of enhance survival and reduce possible subsequent consequences.
The 6-year-old Saudi-Emirati aggression on Yemen has transformed this already weak country into the largest man-made humanitarian crisis in the world, taking away what its people need most, including basic needs, such as health care6. The United Nations report stated that in the year 2020-2021, more than 19.7 million people need health care services in Yemen, while only less than half of health facilities are still functioning. There are also about 1.5 million IDPs currently suffering from existing vulnerabilities including increased exposure to carcinogens6. According to the Limited Yemen Cancer Studies, the most common cancer among Yemeni children and adults were leukemia (33.1%), lymphoma (31.5%), central nervous system tumors (7.2%) and bone tumors (5.2%)6-8. This study was performed to give base line description of histopathological pattern of CNS tumors recorded in regional hospital SGH-Sana'a. These registers are not population-based cancer registration but is the only available source. Current study served to prove the basic demographic and histological data which can be competed with available studies on literatures. On other hand to provide primary base line tool to work-up for future population studies on CNS tumors.

PATIENTS AND METHOD

A descriptive observational study was performed in patients with CNS tumors that were treated selectively by surgical excision with succeeding diagnosis by studying pathological tissues at the Saudi German Hospital SGH - Sana'a, in excess of an interval of 10 years from first of January, 2009 to December 31, 2019. The study variables were qualitative (histological group, gender, affected anatomical site) and quantitative (age). Both group and histopathological diagnoses were formed in line with the 2007 WHO classification of nervous system tumors9. According to WHO classification, the patients were divided into 7 groups: neuroepithelial neoplasms, cranial nerve tumors, paraspinal tumors, tumors arising in the meninges, lymphomas, hematopoietic tumors, germinal cell tumors, sellar region, and metastatic tumors. We then classified subgroups according to morphological diversity.

Inclusion criteria: Inclusion criteria included the histopathological diagnosis of primary brain tumor of any age and gender, availability of clinical data, and histological slides to confirm the diagnosis.

Exclusion criteria: Exclusion criteria included no histopathological slides and insufficient clinical data.

Statistical analysis
Data were reported using appropriate descriptive statistics (including frequency, mean, standard deviation, and P-value). All statistical analyzes of the data were performed using the Statistical Package for Social Sciences (SPSS) version 24 and Excel 2007.

Ethical approval
The ethical approval was obtained from the Medical Research and Ethics Committee at the Faculty of Medicine and Health Sciences at Sana'a University with a reference number (202) dated 12-01-2021. Also, all data, including patient identification, have been kept confidential.

RESULTS

For age and gender distribution: This study included 359 CNS tumors patients, 200 (55.7%) females with a mean age of 36.7 years, while 159 (44.3%) were male patients with a mean age of 39.5 years (Figure 1).

![Sex distribution of CNS tumors.](image_url)

**Figure 1: Sex distribution of CNS tumors.** Total 295 (82.2%) were adult patients aged 19-70 years with a mean age of 44 years (Figure 2).

![Age distribution of CNS tumors.](image_url)

**Figure 2: Age distribution of CNS tumors.** Total 164 patients (55.6%) were female with a mean age of 42.5 years, and 131 patients (44.4%) were male with a mean age of 45.9 years (Figure 4). 64 (17.8%) were pediatric patients aged 1-18 years, with a mean age of 9.8 years. 36 patients (56.25%) were female with a mean age of 10 years, and 28 patients (43.8%) were male with a mean age of 9.4 years (Figure 3).

![Paediatric age distribution in relation to sex, n= 64 patients.](image_url)

**Figure 3: Paediatric age distribution in relation to sex, n= 64 patients.**

Frequency of CNS tumors: Of all CNS tumors 359 cases, neuroepithelial neoplasms showed the most common tumor (28.4%) followed by meningiomas (26.5%) then mesenchymal tumors (13.4%) and equal presence of NST with sellar tumors (11.4%) for each (Figure 5). In single entity repeat point form, grade I
meningioma was the most common 65 cases (18.11%) followed by pituitary adenomas 33 cases (9.2%), GBM 31 cases (8.6%), grade II meningiomas 26 cases (7.24%) and schwannoma 24 cases (6.7%).

Figure 4: Adult age distribution in relation to sex, n= 295 patients.

Frequency of CNS tumors with respect to gender: Male patients showed a predominance in neuroepithelial tumors (15.3%) and sellar tumors (7.2%) while females showed a predominance over males in the other tumors except for NSTs were evenly distributed in both sexes (0.56%) (Figure 6).

Frequency of CNS tumours in relation adult age: Meningiomas were the first common adult group tumours (31.5%) with predominance of grade-I meningioma 64cases (68.8% of all meningiomas), grade-II 26 cases (28%) and grade-III 3 cases (3.2%). Gliomas were the second common tumours (25.4%) with predominance of astrocytomas 55 cases (73.3% of all Gliomas). GBM was the commonest type of astrocytoma 29 cases (52.7% of all astrocytomas). The third tumours category was NSTs (12.9%), equally in both male and female. Schwanomma was commonest type 24 cases (63.2% of all NSTs) affected more male patients (70%). Mesenchymal tumours (MTs) category were (12.2%), lymphoma was the commonest single entity 8 cases (22.2% of all MTs) followed by hamiangioblastoma 6 cases (16.7% of all MTs) both showed male predominance (31.8%) and (18.2%) respectively. Sellar tumours category were (11.9%) with male predominance (16.4%), pituitary adenomas were 32 cases (91.4% of all sellar tumours) (Figure 7, Table 1).

Frequency of CNS tumours in relation pediatric age (Figure 8, Table 3): Gliomas were the first common tumours (42.2%) with predominance of astrocytomas 20 cases (74.1% of all Gliomas). Pilocytic astrocytoma was the commonest type of astrocytoma 14 cases (70% of all astrocytomas).

Table 1: The frequency of CNS tumors in relation to WHO grading in total, adult, and pediatric cases.

<table>
<thead>
<tr>
<th>Tumors</th>
<th>Total cases</th>
<th>Adults cases</th>
<th>Pediatric cases</th>
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<tr>
<td>Grade 1</td>
<td>53.3</td>
<td>55</td>
<td>46.2</td>
</tr>
<tr>
<td>Gliomas</td>
<td>8.1</td>
<td>3.6</td>
<td>26.9</td>
</tr>
<tr>
<td>Mesen TO</td>
<td>2.2</td>
<td>2.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Sellar</td>
<td>2.6</td>
<td>1.4</td>
<td>7.7</td>
</tr>
<tr>
<td>NST</td>
<td>14</td>
<td>16.4</td>
<td>3.8</td>
</tr>
<tr>
<td>Meninges</td>
<td>24.6</td>
<td>29.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Mixed</td>
<td>1.1</td>
<td>0.9</td>
<td>1.9</td>
</tr>
<tr>
<td>Ch plexus</td>
<td>0.4</td>
<td>0.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Embryo TO</td>
<td>0.4</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Grade 2</td>
<td>23.2</td>
<td>24</td>
<td>19.2</td>
</tr>
<tr>
<td>Gliomas</td>
<td>13.2</td>
<td>12.3</td>
<td>17.3</td>
</tr>
<tr>
<td>Meninges</td>
<td>9.6</td>
<td>11.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Mesen TO</td>
<td>0.4</td>
<td>0.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Grade 3</td>
<td>17.6</td>
<td>5.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Gliomas</td>
<td>13.2</td>
<td>5</td>
<td>3.8</td>
</tr>
<tr>
<td>Meninges</td>
<td>9.6</td>
<td>0.9</td>
<td>1.9</td>
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<tr>
<td>Mixed</td>
<td>0.4</td>
<td>0.0</td>
<td>28.8</td>
</tr>
<tr>
<td>Grade 4</td>
<td>5.9</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Embryo TO</td>
<td>6.3</td>
<td>1.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Gliomas</td>
<td>11.4</td>
<td>13.2</td>
<td>3.8</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>82.2</td>
<td>17.8</td>
</tr>
</tbody>
</table>
More common in male (34.6%). Embryonal tumours were the second common tumours (20.31%) with predominance of medulloblastoma 10 cases (76.9% of all ETs). The third tumours category was Mesenchymal tumours (MTs) (18.75%), lymphoma was the commonest single entity 5 cases (41.67% of all MTs) followed by cavernous angioma and chondroma 2 cases (16.67% of all MTs) for each.

DISCUSSION

Tumors of the CNS are one of the primary tumors in children and one of the most common causes for consulting neurosurgery services for adults. The endurance rate can be as deprived as 26% at 5 years for posterior fossa tumors and 7% when the brainstem is affected\textsuperscript{10,12}. Neurocognitive sequelae are another major concern, primarily because of the managing of neurosurgery and the neurotoxicity of chemotherapy and radiation\textsuperscript{13,14}. The tumor series reported in Yemen either specifically focus on cancer in general, with no publications on CNS cancers\textsuperscript{4,7,8}. Studies of different groups containing large numbers of adults indicate that there are differences in terms of histological group and the most prevalent tumors; in the neighboring and world series, meningiomas are more common, at about 35\%\textsuperscript{3,15,16}. 

Prevalence rate of CNS tumours with site (Figure 8): 81.64% of all tumours located intracranial while (18.36%) were intraspinal which was the main site for metastasis 6/11 cases and NSTs 28/40 cases.

Distribution of CNS tumours by grading in adult (Table 1): 79.1% were non malignant tumours (WHO grade I/II), included meningiomas (41.3%), NSTs (16.4%), Gliomas (15.9%), 20.5% were malignant included gliomas (18.2%), embryonal tumours 1.8% and MPNST 0.5% (Figure 9, and Figure 10).

Distribution of CNS tumours by grading in pediatric (Figure 9, Table 1): 65.4% were non malignant tumours (WHO grade I/II), included gliomas (44.2%) sellar tumours (7.7%), meningiomas, NSTs (3.8%) for each. 34.6% were malignant included embryonal tumours 25%, gliomas 7.6% and MPNST 0.5%.
In the current study, Gliomas were the most common central nervous system tumors with 28.4% (Figure 5). In the European series, neuroepithelial tumours are more prevalent with 33.3% in Greece and 53.9% in France. In the series from China, neuroepithelial neoplasms reported for 38% and meningiomas 36.5%. In Japan, Nakamura, et al. reported a comprehensible prevalence of meningiomas of 38.2% and 38.2%. From Latin America the only report was the study by Ramos Clason et al. This study performed in Colombia, and reviewed a total of 390 cases, meningiomas were the most common 50%. The difference in proportions in CNS tumors may be caused by that there are dissimilarities in the methodology employed in each of the different reports, that a few series reported primary and secondary tumors and that the study period is an additional important variable, as the number of centers contributing in each study and the sample size of the patients in each study. In the current study, in the adult group, meningiomas were the most common tumor with a rate of 25.9% with a Grade I-I of 17.8%, and these results are consistent with many studies in both developing and developed countries; for example, in Saudi Arabia about 26% as well as the study reported by Adalberto Miranda-filo et al., and it may be related to the high incidence of breast cancer among Yemeni patients, confirming the hormonal effects that make females more susceptible to meningioma. Astrocytomas was the second entity of individual neoplasms in adults after meningiomas in the current study, which represented 18.43% of all adult central nervous system tumors and 72.9% of glioma subtype tumor roughly close to the findings from Zalata et al. who reported that astrocytomas was the common one with predominant of glioma subtype (79.4%), but our results were lower than Mohammad et al., (29%) of all CNS tumors ; and are higher than Suh et al., in Korea. Although GBM was the most common glial tumor (39.2%) in this study, this is roughly close to Zalata et al. (38.3%), and higher than the Jordanian study of 18.9% but still lower than other studies by Mohammad et al., (65.2%) and Cibtrus 2006 (50.7%). It has been noticed that a third of the current study GBM cases appeared after the war on Yemen, and many of these cases came...
from areas that were subjected to the air attacks. Pituitary adenoma was frequent in this study with 31 cases (10.9%) of adult CNS tumors with male dominant and was the second adenoma after grade I meningioma which is similar to Bary et al., 34 (10%) but slightly lower than Zalata et al., 30 (11.6%) but higher than Mohammed et al., 31 (6.2%) and Cbtrus 33 (6.3%).

In the pediatric group in this study, pilocytic astrocytoma was the first single entity tumor of 22.7% followed by medulloblastoma at 15.15%, and these results are consistent with Gaidi et al., 35 and Cbtrus 2015 33 who stated that pilocytic astrocytoma is the leading histological type in infants and children. Contrary to the current study findings, previous studies conducted in Yemen and Saudi Arabia showed that medulloblastoma was the most common childhood tumor followed by astrocytomas 7, 8, 23, 24.

Also, this study found that the rate of medulloblastoma was 15.15% which is still lower than that reported in several studies such as Govindan et al., (30.9%) 36 and Catch et al., (25.7%) 37. The Yemen Cancer Center stated 38 that lymphoma is one of the most common tumors among Yemeni children, which may be in line with our conclusion that lymphoma is the third most common type of tumor in the children’s group (7.75%). Primary intracranial tumors accounted for 82.8%, which is less than that reported by Suh et al., (93.4%) 32 and Cbtrus (2006) (94.3%) 33, but close to Zalata et al., (86.7%) 30. Almost all astrocytomas and all gliomas and embryonal were intracranial as is the case with Komot and Mills 39. In the current study, primary spinal tumors accounted for 17.2% which is higher than that reported by Zalata et al., (10.9%) and Schilling et al., (4-8%) 38. In this study, 47% of intraspinal tumors were nerve sheath tumors followed by mesenchymal tumors which differed from those reported by Jalali et al., who reported that nerve sheath is more common followed by meningioma 40. In the current study, ependymoma accounted for 71.4% of all spinal gliomas and are higher than those reported by Razi et al., 41 (30-60%) and Zalata et al., 30 (54%). Metastasis were also recorded at 3.1% in this study, which appeared to be lower than many studies conducted by Zalata et al., 30 (5.8%) and Suh et al., 35 (6%). In the current study, most of the metastatic lesions were in females (63.63%) with intraspinal peridilation (54.54%).

CONCLUSION

This is the firstly study of a sequence in Yemen looking at CNS tumors, which includes patients of all age groups over a period of 10 years. Even though this study is no more than a retrospective analysis of a single institution, it can be a strong indicator of the epidemiology of CNS tumors in Yemen. In addition, the current study recorded data matches with those in the global literature and neighboring country studies, with some differences.

AUTHOR’S CONTRIBUTION

This study was completed by Monya Abdullah Y El-Zine, Professor of Histopathology at Sana’a University, the Histopathologist at the Saudi German Hospital SGH- Sana’a City, Professor Maged Ali Amer Ali the neurosurgeon at the Saudi German Hospital SGH - Sana'a City, and professor of neurosurgery in Sana’a University; and Prof. Dr. Hassan Abdul-Wahab Al-Shamahy, Faculty of Medicine, Sana'a University. All authors analyzed the data, wrote the manuscript, and reviewed it.

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CONFLICT OF INTEREST

No conflict of interest associated with this work.
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