Descriptive Epidemiology of Intracranial Meningiomas for a Hispanic Population in Puerto Rico

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Objective: The epidemiology of meningiomas for patients with Hispanic ethnicity is mainly unknown beyond a few studies. Evidence supporting the ethnic influence over meningioma World Health Organization (WHO) grade is limited. This study aimed to investigate a Hispanic population in Puerto Rico with intracranial meningiomas regarding the WHO grade.

Methods: This study retrospectively reviewed 173 Hispanic patients who underwent pathology-proven intracranial meningioma resection by a single surgeon at a tertiary care facility during 25 years. Descriptive statistics were used to investigate clinical and histopathological differences among the patients.

Results: The cohort had 71.1% female patients, with a female-to-male ratio of 2.6:1. The median age of the patients was 53 years, ranging between 19 and 87 years. Analysis showed that 159 patients had a WHO grade 1 meningioma (91.9%), 13 patients had a WHO grade 2 meningioma (7.5%), and one patient had a WHO grade 3 meningioma (0.6%). Recurrence occurred in ten patients (5.8%).

Conclusion: This study reveals a higher percentage of Hispanic patients with WHO grade 1 meningiomas in Puerto Rico than for Hispanic patients living in the United States.

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Key words: Demographics, Ethnicity, Epidemiology, Hispanic, Intracranial, Meningioma, Race

Meningioma is the most common benign brain tumor, accounting for approximately 40.8% of all primary brain tumors and 56.2% of all non-malignant tumors (1). Most meningiomas are benign, but some have atypical features and can demonstrate aggressive behavior. Meningiomas are classified by the World Health Organization (WHO) into benign (WHO grade 1), atypical (WHO grade 2), and anaplastic or malignant (WHO grade 3) types (2). Epidemiological and pathogenetic differences between ethnic groups have been demonstrated in patients with brain tumors (3). These differences between ethnic groups could result from genetic, nutritional, or environmental factors. Epidemiological differences in brain tumor incidences between ethnic groups could emerge from greater access to health care by some ethnic groups (3-7). Minority patients are more prone to present with severe symptoms, be admitted through the emergency department, require more extended perioperative hospitalization, and generate higher hospitalization costs (4).

Evidence supporting the ethnic influence over meningioma WHO grade is limited, and the epidemiology of Hispanic ethnicity for intracranial meningiomas is mainly unknown beyond a few studies (1,4,5,8). Three prior studies have analyzed the WHO grade of intracranial meningiomas between different ethnic groups (4,8,9). This study aimed to investigate a Hispanic population in Puerto Rico with pathology-proven intracranial meningiomas regarding the WHO grade. In accordance with the 2021 WHO classification of tumors of the central nervous system, Arabic numbers were used to assign the WHO grades (2).

Materials and Methods

This study retrospectively reviewed 173 Hispanic patients who underwent pathology-proven intracranial meningioma resection by a single surgeon at a tertiary care facility during 25 years. Inclusion criteria for the study included all Hispanic patients older than 18 years of age who underwent a surgical procedure for resection of an intracranial meningioma. Exclusion criteria were non-Hispanic ethnicity and age under 18 years. All included patients underwent resection of an intracranial meningioma between 1995 and 2020. Descriptive statistics were used to report frequency, percentage, and median values. Continuous variables with non-normal distribution were reported as median. Categorical, non-continuous variables were presented as numbers with percentages. The clinical and histopathological data from this study were compared to the evidence available in the literature to determine if there was a difference among the Hispanic population of Puerto Rico. The study was approved by the Institutional Review Board of the University of Puerto Rico Medical Sciences Campus (protocol number B0940116).

Results

The study included 173 Hispanic patients with pathology-proven intracranial meningioma. The cohort had 71.1% female patients, with a female-to-male ratio of 2.6:1. The median age of the patients was 53 years (range: 19 - 87 years). The tumor location within the brain varied significantly, with the majority

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located at the convexity, sphenoid wing, sellar/tuberculum, olfactory groove, and falx/sagittal (Table 1).

Table 1. Distribution of 173 meningiomas by location

Location	n (%)
Convexity	71 (41.0)
Sphenoid wing	27 (15.6)
Sellar/Tuberculum/Planum	14 (8.1)
Olfactory groove	12 (6.9)
Falx/Sagittal	11 (6.4)
Petroclival	8 (4.6)
Tentorium	8 (4.6)
Parasagittal	4 (2.3)
Clinoid	4 (2.3)
Cerebellopontine angle	3 (1.7)
Orbit	3 (1.7)
Ventricle	2 (1.2)
Cavernous sinus	2 (1.2)
Foramen magnum	2 (1.2)
Optic nerve	1 (0.6)
Jugular foramen	1 (0.6)

Analysis showed that 159 patients had a WHO grade 1 meningioma (91.9%), 13 patients had a WHO grade 2 meningioma (7.5%), and one patient had a WHO grade 3 meningioma (0.6%) (Table 2). Recurrence after a macroscopically complete removal of the tumor, dura, and abnormal bone occurred in ten patients (5.8%) (Table 3). Eight recurrences occurred in patients with a WHO grade 1 meningioma, for a recurrence rate of 5.0% among WHO grade 1 meningiomas. One patient with a WHO grade 2 meningioma had a recurrence for a 7.7% recurrence rate among WHO grade 2 meningiomas. The only patient in the cohort with a WHO grade 3 meningioma had multiple recurrences for a recurrence rate of 100% among WHO grade 3 meningiomas. One of the patients with a WHO grade 1 meningioma who recurred developed a radiation-induced meningioma after receiving whole brain radiotherapy 26 years before for a medulloblastoma. Nine of the ten patients with a recurrence were managed with a reoperation, while one was treated only with whole-brain radiotherapy due to the presence of numerous meningiomas. For patients with recurrent meningiomas WHO grades 2 and 3, whole-brain radiotherapy was given in addition to the reoperation. None of the reoperated patients had a change in the WHO grade of the meningioma. There was no association between the tumor location and the WHO grade or the chances of recurrence.

Table 2. Distribution of 173 meningiomas corresponding to the World Health Organization (WHO) grade

WHO Grade	n (%)
1	159 (91.9)
2	13 (7.5)
3	1 (0.6)

Table 3. Recurrence rate among ten patients who develop disease recurrence

WHO Grade	n (%)
1	8 (5.0)
2	1 (7.7)
3	1 (100)

Discussion

This study provided an extensive analysis of Hispanic patients' meningioma histopathological variables. The study investigated the WHO grade for a Hispanic population of patients operated for intracranial meningioma in Puerto Rico. The patients were operated on by a single surgeon during 25 years. The cohort did not include all meningioma patients operated on in Puerto Rico during the study period; however, the sample most likely represents a Hispanic population in Puerto Rico. The patients' demographics for age and sex are comparable to the intracranial meningioma population in the United States, presented by Connolly et at. who analyzed meningioma data using the MarketScan Commercial Claims and Encounters and Medicare Supplemental and Coordination of Benefits databases (10).

The true incidence of intracranial meningiomas can differ from the reported estimates because a substantial number of them are diagnosed by radiological imaging alone and sometimes are not registered in cancer registries. Some databases include only pathology-proven meningiomas, while others also include meningiomas diagnosed using only radiological imaging. Other databases include only patients with qualifying employer-provided healthcare plans but not those covered by Medicare supplemental plans (10). Some databases include only hospitalized patients and patients evaluated at outpatient offices associated with a hospital setting. In the study by Bhala et al., where the US Surveillance, Epidemiology, and End Results (SEER) cancer registry from 2004-2015 was used, 53.2% of the meningioma cases were identified by radiological imaging alone without microscopic confirmation (11). The data for many brain tumor epidemiological studies in the literature is usually obtained from the Central Brain Tumor Registry of the United States (CBTRUS), the SEER database, the MarketScan database, the Medicare Supplemental and Coordination of Benefits database, the National Program of Cancer Registries, the North American Association of Central Cancer Registries, and the National Cancer Data Base of the American Cancer Society and the American College of Surgeons Commission on Cancer. Most studies usually utilize one or two databases and only contain a portion of the population under consideration. The last two decades have noted an increasing trend in the reported meningioma incidence (7,11). This upward trend is explained by the increased use of head computed tomographic scans and brain magnetic resonance imaging for diagnostic purposes after minor neurological or unrelated symptoms (11). The increasing trend could also be attributed to better insurance coverage and improved healthcare access.

The incidence rates for most brain tumors in the CBTRUS are higher for whites than for other ethnic groups; however, for intracranial meningiomas and tumors of the pituitary, incidence rates for blacks significantly exceed those observed for whites (1). Bhala et al. found that age-standardized rates for benign intracranial meningiomas in the United States were highest in non-Hispanic blacks, followed by non-Hispanic whites, Hispanics, and Asian/Pacific Islanders, irrespective of their sex (11). In contrast, using the National (Nationwide) Inpatient Sample, which surveys 20% of United States discharges, Ghaffari-Rafi et al. found that incidences of benign intracranial meningiomas were highest in non-Hispanic whites, followed by non-Hispanic blacks, with a substantially higher incidence for patients who were female, 65 years and older, and with a middle/high income (7). Their study also showed that Hispanics carry a significantly lower incidence rate of benign intracranial meningiomas than non-Hispanic whites, non-Hispanic blacks, and Asian/Pacific Islanders (7). In the study by Anzalone et al., which included operated and non-operated patients with intracranial meningiomas in the United States, the incidence was lowest among blacks compared to whites (5). They also demonstrated that Hispanics had an incidence rate lower than non-Hispanic whites but higher than non-Hispanic blacks (5). However, Ostrom et al. showed that the overall incidence rate for intracranial non-malignant meningiomas in whites was comparable to Hispanics but was higher for black Hispanics (1). Anzalone et al. found that Hispanic patients with intracranial meningiomas were diagnosed at the youngest age and underwent surgery more frequently (5).

There is a lack of literature examining the prevalence and incidence of meningiomas within primarily Hispanic populations, often incompletely informing our understanding of the disease burden in this population. Few studies have investigated the influence of the Hispanic ethnicity on the WHO grade for intracranial meningiomas (4,8,9). Jackson et al. analyzed several ethnic and socioeconomic factors influencing meningioma patients in the United States at a single tertiary care hospital (4). They found that Hispanics have a lower percentage of WHO grade 1 meningiomas but a higher percentage of WHO grade 2 and 3 meningiomas compared to non-Hispanic whites; however, it did not reach statistical significance. In their study, the number of patients with a WHO grade 3 meningioma was minimal to establish a significant difference. They also found that Hispanics and blacks showed a similar percentage of WHO grade 2 meningiomas (4). No statistical difference in WHO grades was identified between any ethnic group evaluated (4). Rydzewski et al. showed that Hispanics have a similar percentage of WHO grade 1-3 meningiomas compared to whites, but blacks have a higher percentage of WHO grade 2 and 3 meningiomas (9). In the study by Kshettry et al., which used data from the CBTRUS, Hispanic ethnicity was not associated with any significant difference in the incidence of any WHO grade (8). They reported that blacks and Asian Pacific Islanders present a higher proportion of aggressive (WHO grade 2 and 3) meningiomas (8). Achey et al. found that in older adults (65+ years), Hispanics have a significantly higher incidence of non-malignant meningioma (WHO grade 1 and 2) than the non-Hispanic population, except for the 65-69-year-old group (12). Hispanics also showed a trend toward higher WHO grade 3 meningiomas incidence (12).

In the study by Rydzewski et al., which included data for patients between the years of 2004 and 2014, 86.8% of the Hispanic patients presented WHO grade 1 meningiomas, WHO grade 2 meningiomas in 10.4%, and WHO grade 3 meningiomas in 2.8% (9). The study by Jackson et al., which included patients operated on between the years of 2009 and 2020, showed that among the Hispanic patients, WHO grade 1 meningiomas occurred in 83% of them, WHO grade 2 meningiomas in 15%, and WHO grade 3 meningiomas in 2% (4). The analysis from the patients operated in Puerto Rico by a single surgeon at a tertiary care facility between the years of 1995 and 2020 showed that among the Hispanic patients, WHO grade 1 meningiomas occurred in 91.9%, WHO grade 2 meningiomas in 7.5%, and WHO grade 3 meningiomas in 0.6%. The data in Puerto Rico showed a higher percentage of Hispanic patients with WHO grade 1 meningiomas than those from Hispanic patients in the United States (Table 4). However, the data from Puerto Rico included patients operated on during a 25-year period. In some patients operated on in the earlier years of the series, the WHO grade may need to be modified if revised according to the most recent WHO classification of tumors of the central nervous system. A review of the pathological tissue was not possible as the institution did not have all the tissue samples available, and reexamination of the available older ones was not recommended due to their degraded condition. Roehrkasse et al. documented that in up to 29% of WHO grade 1 meningiomas, chromosomal analysis of tissue samples demonstrated copy number profiles consistent with higher grade meningioma, and 25% of WHO grade 2 meningiomas had copy number profiles compatible with less aggressive meningiomas (13). In the future, it would be interesting to analyze genomic alterations and mutations among different ethnic groups.

Table 4. Studies examining meningioma World Health Organization (WHO) grade among Hispanics

Study	WHO Grade 1	WHO Grade 2	WHO Grade 3
Jackson et al.[4]	83.0%	15.0%	2.0%
Rydzewski et al.[9]	86.8%	10.4%	2.8%
Current (Puerto Rico)	91.9%	7.5%	0.6%

Limitations

The study had several limitations, including its retrospective nature. All the patients were operated on by a single surgeon and did not include the entire population of intracranial meningioma patients operated in Puerto Rico. The histopathological tissue sample slides could not be reviewed to determine if the original WHO grade must be modified according to the 2021 WHO classification of tumors of the central nervous system. The tissue samples were not analyzed for chromosomal mutations or the molecular profile of the meningioma. The study did not evaluate patient outcomes as this demographic information was unavailable in the database. This analysis is confined to the population of Puerto Rico, which limits the ability to generalize the results to other countries with a Hispanic population, as the inhabitants of Puerto Rico possess significantly different genetic diversity than Hispanics from other countries (14-16).

Conclusions

This study presented a comprehensive analysis with descriptive epidemiology of Hispanic patients in Puerto Rico who were operated on for intracranial meningioma by a single surgeon. During the 25-year study period, on an island with practically an entire Hispanic population, the study revealed that the percentage of benign (WHO grade 1) intracranial meningiomas is slightly higher than in the United States. This observation could emerge from health care inequalities and delays in diagnosis among Hispanics in the United States, which can potentially cause aggressive meningiomas to be diagnosed more frequently among this population.

Resumen

Objetivo: La epidemiología de los meningiomas en pacientes Hispánicos es mayormente desconocida más allá de unos pocos estudios. La evidencia que apoya la influencia étnica sobre el grado de meningioma de la Organización Mundial de la Salud (OMS) es limitada. Este estudio tuvo como objetivo investigar más a fondo una población hispana en Puerto Rico con meningiomas intracraneales teniendo en cuenta el grado del tumor de la OMS. Métodos: Este estudio revisó retrospectivamente a 173 pacientes hispanos que se sometieron a una resección de meningioma intracraneal con patología confirmada y operados por un solo cirujano en un centro terciario durante 25 años. Se utilizaron estadísticas descriptivas para investigar las diferencias clínicas e histopatológicas entre los pacientes. Resultados: El cohorte tenía 71.1% de mujeres con una relación mujer-hombre de 2.6:1. La mediana de edad de los pacientes fue de 53 años, con un rango entre 19 a 87 años. El análisis mostró que 159 pacientes tenían un meningioma de grado 1 de la OMS (91.9 %), 13 pacientes tenían un meningioma de grado 2 de la OMS (7.5 %) y un paciente tenía un meningioma de grado 3 de la OMS (0.6 %). Recurrencia del tumor ocurrió en diez pacientes (5.8%). Conclusión: Este estudio revela un mayor porcentaje de pacientes hispanos en Puerto Rico con meningiomas grado 1 de la OMS comparado con pacientes hispanos viviendo en los Estados Unidos.

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