Central Nervous System Tumor Distribution at a Tertiary Referral Center in Uganda

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INTRODUCTION

Cancer has become the leading cause of death and disability in the developing world, with more than 55% of the 12.7 million known cancer cases globally and 64% of the known 7.6 million cancer related deaths worldwide occurring in lower- and middle-income countries (LMICs) (43). Of these cancer diagnoses, up to 20% are central nervous system (CNS) tumors. Significant variation exists between the reported incidence of primary CNS tumors in the United States and other high-income countries (HICs) and LMIC worldwide: 20.1 per 100,000 and 3.2–3.9 per 100,000 respectively (3, 7, 15).

Although there is known geographic variation in cancer incidence, the 5-fold lower comparative rate for global CNS tumors is likely an underestimate because of limited diagnostic health infrastructure in many LMICs (37). In East Africa, there is 1 neurosurgeon per 9 million people, compared with 1 per 62,500 people in the United States, with even fewer pathologists and radiation oncologists (9). In Uganda, before 2007 only 5 neurosurgeons were available to serve a population of more than 36 million people (12, 17, 22). With restricted neurosurgical services, CNS tumor biopsies are not routinely performed, contributing to the limited availability of epidemiologic data and treatment options in the East African Population.

In 2007, a collaborative effort between Duke University Department of Neurosurgery and Mulago Hospital in Kampala, Uganda, expanded neurosurgical capabilities with delivery of surplus equipment and establishment of neurosurgical training camps. As a result, Mulago Hospital began to offer more complex surgical treatment for patients, including an increased number of craniotomies for intracranial tumors (17). It is now the only neurosurgical referral center in Uganda, treating patients from all 13 municipalities, providing a more comprehensive patient population to evaluate CNS tumor distribution.

This study is a retrospective review of clinically diagnosed neurosurgical masses at Mulago Hospital in Kampala, Uganda from 2009 to 2012. We describe the distribution of identified masses by demographics, location, clinical diagnosis, and surgical treatment. This study identified key differences in CNS tumor distribution between the United States and Mulago Hospital and highlights the need for the development of a comprehensive CNS tumor registry.

METHODS

Admission records, clinic registries, and surgery registries from 2009–2012 were reviewed for patients seen in the Mulago Hospital neurosurgery clinic or admitted to Mulago National Referral Hospital in Kampala, Uganda. Individual medical records were further reviewed for patients identified as having intracranial or spinal cord masses presumed to be neoplastic, including the search terms "posterior fossa mass," "intracranial tumor," "brain tumor or mass" or "spinal tumor or mass." Extracted data were then analyzed to determine the frequency of CNS tumors in the patient population at Mulago Hospital. Recorded data were deidentified but included demographic (age and sex), diagnosis, and treatment received. The presence of tumor was determined radiographically, and diagnoses were recorded as written in the medical record, with biopsy confirmation when available. These data were not available for every patient, with incomplete data for sex in 30% (n = 123), age in 2% (n = 10/411), and tumor location in 22% (n = 91/411). Descriptive statistical analysis was performed on the dataset to determine the distribution of CNS tumors by sex, age, and year, and analyzed using the Pearson's χ^2 test (JMP Pro v10; SAS Institute, Cary, North Carolina, USA). Additional analysis included the distribution of clinical diagnoses and tumor localization.

RESULTS

A total of 419 patients treated at Mulago National Referral Hospital from 2009 to 2012 had radiographically identified intracranial and spinal cord masses. Five patients initially suspected of having CNS

Key words
- Brain neoplasm
- Developing countries
- Neurosurgery
- Uganda

Abbreviations and Acronyms
CNS: Central nervous system
HIC: High-income country
IQR: Interquartile range
LMIC: Lower- and middle-income country
NOS: Not otherwise specified

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tumors were later found to have an acute or chronic infection and were excluded from further analysis. In addition, developmental abnormalities including 1 case each of myelomeningocele, epidermoid cyst, and fibrous dysplasia were similarly excluded. The remaining 411 patients were included in this analysis.

Tumor Location

A total of 23.6% (n = 97) of the tumors did not record a location; 32.1% (n = 132) tumors were extra-axial, 25.1% (n = 103) supratentorial, 13.9% (n = 57) infratentorial, and 5.3% (n = 22) spinal cord. Data were further divided by sublocation and is listed in Table 1.

Clinical and Histologic Diagnosis

Incomplete records limited available diagnostic information, with 34.8% (n = 143) of the cases not identifying diagnosis beyond the generic term "brain tumor" or "brain mass." Meningioma was the most commonly identified diagnosis (23.8%), followed by pituitary adenoma (7.8%), glioma not otherwise specified (NOS) (6.3%), and spinal cord tumor NOS (4.1%). Additional diagnoses are listed in Table 2.

Table 1. Central Nervous System Tumor Distribution by Location

Location	Number	%	Median Age (IQR)	% Male
Supratentorial	**103**	**25.1**		
Hemispheric	45	10.9	28 (14–47)	42.1
Sellar	33	8.0	30 (16–46)	47.4
Suprasellar/parasellar	14	3.4	33.5 (17.25–38)	75.0
Pineal	4	1.0	16 (13–28.5)	80.0
Orbit	3	0.7	16 (11.5–39)	50.0
Ventricular	4	1.0	24.5 (17–38)	25.0
Infratentorial	**57**	**13.9**		
Posterior fossa NOS	54	13.1	14 (6.5–31)	66.1
Brainstem	3	0.7	27 (19–30)	100.0
Spinal cord	**22**	**5.4**		
NOS	17	4.1	26 (15.5–48)	31.3
Sacrococcygeal	3	0.7	2 weeks	0.0
Extraaxial	2	0.5	28.5 (18.39)	100.0
Mesenchymal	**132**	**32.1**		
Meninges	96	23.4	40 (30–46)	42.9
Soft tissue and bone	28	6.8	33.5 (17.25–48)	66.6
Peripheral nerve	8	1.9	32 (16–43)	50.0
Not specified	**97**	**23.5**		
Parenchymal	96	23.3	37 (20–49)	57.3
Other	1	0.2	17 (3.25–31.5)	100.0
Total	411	100		

IQR, interquartile range; NOS, not otherwise specified.

Age and Sex

The median age of diagnosis for the entire cohort was 31.5 years (interquartile range [IQR] 15–45) (Figure 1). Median ages of the most common diagnosis were 22 years for brain tumor NOS (IQR 11–40), 39 years for meningioma (IQR 30–46), 30 years for

Table 2. Distribution of Central Nervous System Tumors by Diagnosis

Clinical/Histologic Diagnosis	Number	%
Unspecified brain tumor	**141**	**34.3**
Meningioma	**98**	**23.8**
Parasellar	**44**	**10.7**
Pituitary	32	7.8
Craniopharyngioma	12	2.9
Gliomas	**49**	**11.9**
NOS	26	6.3
Low grade	9	2.2
Pilocytic astrocytoma	3	0.7
Oligodendroglioma	1	0.2
Diffuse astrocytoma	1	0.2
Ependymoma	4	1.0
High grade	14	3.4
Anaplastic	2	0.5
GBM	12	2.9
Other	**27**	**6.6**
Extraaxial sarcoma	14	3.4
Lipoma	7	1.7
Hemangioma	4	1.0
Hemangioblastoma	1	0.2
Lymphoma	1	0.2
Spinal cord tumor	**19**	**4.6**
Germ cell tumor	**13**	**3.2**
Dermoid cyst	10	2.4
Sacrococcygeal teratoma	3	0.7
Tumor of nerve sheath/peripheral nerve	**9**	**2.2**
Neurofibroma	7	1.7
Neurilemoma	1	0.2
PNST	1	0.2
Pineal tumor NOS	**4**	**1.0**
PNET/medulloblastoma	**4**	**1.0**
Metastatic	**3**	**0.7**
Total	411	100

NOS, not otherwise specified; GBM, glioblastoma multiforme; PNST, peripheral nerve sheath tumor; PNET, primitive neuroectodermal tumor.