

Short term outcomes following surgery in brain tumours sans neuronavigation

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Abstract

Objective: To determine the presentation and frequency of various intracranial neoplasms and assess outcomes for patients who underwent surgery without neuronavigation.

Methods: This retrospective study was conducted at Combined Military Hospital, Peshawar, Pakistan, and comprised medical records related to the period from August 2011 to July 2014. Patient histories, examination reports and preoperative and post-operative radiological scans were reviewed and extent of excision was determined based on these coupled with recurrence rates. Intraoperatively, tumour excision was determined largely by the experience of the surgeon and preoperative planning using bony landmarks and radiological scans as an objective guide to resection. SPSS 21 was used for data analysis.

Results: Of the 143 patients, 83(57.9%) were males and 60(42.1%) were females. Gliomas were the most common tumours, occurring in 20(33.3%) females and 35(42.2%) males. One-year survival rate for grade 4 astrocytomas was poor (39.4%) and was excellent for meningiomas (100%) and pituitary tumours (100%)

Conclusion: Time-tested methods of careful neurological examination and knowledge of neuroanatomy can allow a surgeon with limited resources to plan and accommodate for accurate tumour resection with adequate margins.

Keywords: Neuronavigation, Brain tumours, Stereotaxy. (JPMA 68: 170; 2018)

Introduction

The first foray into surgery of primary brain tumours was done on November 25, 1884, by Rickman J. Godlee. This resulted in a glioma that was completely removed and a patient that later died of meningitis. Prior to this, surgery of intracranial tumours had been restricted to what are now considered to be meningiomas with osseous involvement.¹ Godlee's first procedure gained wide coverage in literature due to his ability to accurately localise the lesion using meticulous history taking and examination. These principles were employed by Harvey Cushing with incredibly improved success in the early 1900s with Dandy's ventriculography technique and X-rays, taking it up an extra notch in localisation of tumours. Cushing, however, believed that the pneumoencephalogram should be reserved for obscure lesions. Notable figures who contributed to cerebral localisation included Jackson, Horwitz, Ferrier, Charcot and Horseley amongst others.² The years 1973 and 1978 saw the introduction of computed tomography (CT) and magnetic resonance (MR) scanning, respectively, and by 1981 these had become the gold standard in the diagnosis and follow-up of brain tumours.³

For the next many years, surgery of brain tumours was

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accomplished using the proven trifecta of a detailed history, clinical examination and radiology. Surgeons were required to have an immaculate knowledge of the anatomy, physiology and pathology of the brain. A surgeon's experience was considered vital to successful and acceptable removal of brain tumours. Orientation was achieved by careful measurements from radiological scans and preoperative planning. The identification of the tumour from normal tissue was also dependent on past experience.

The next step in brain tumour surgery came in the form of neuronavigation that provided intraoperative orientation to the surgeon. The image-guided system provided the ability to accurately resect lesion that had been previously fed into the computer coupled with CT or magnetic resonance imaging (MRI) scans. This system gave the surgeon an unprecedented control over tumour excisions that could be confirmed intraoperatively.⁴ This has led to more radical resection in glioblastomas without prolonging operating time.⁵

In modern-day neurosurgery, neuronavigation has become the standard of care for brain tumour surgery. The prohibitive costs of having neuronavigation prompted us to explore our own experience with brain tumour resection using resources limited to history, clinical examination and radiology. The current study was planned to determine the epidemiology of intracranial space occupying lesions in our centre.

Patients and Methods

This retrospective study was conducted at the general neurosurgical ward of Combined Military Hospital (CMH), Peshawar, Pakistan, and comprised medical records from August 2011 to July 2014. Record of all patients who had presented, were admitted, investigated and operated for space occupying lesions in brain were included. Demographic variables included age, gender, geographical distribution, presenting symptoms and morphological classification of brain tumours in all patients. Patients were arbitrarily divided in to six groups: group A (1-10 years), group B (11-20 years), group C (21-30 years), group D (31-40 years), group E (41-50 years), group F (51-60 years), group G (61-70 years), and group H (above 70 years). On follow-up, complete neurological examination and radiographic scans were done. Data was regularly noted.

SPSS 21 was used for data analysis. For some tumours 5- and 10-year survivals are warranted, but this study was aimed at checking short-term survivals in patients undergoing surgery without neuronavigation, and, hence, noted the 1-year survival. It focussed on recurrence of tumours instead to determine completeness of excision. Surgical outcomes, as defined by the Karnofsky performance scale.⁶ The radiographic scans (CT/MRI), presenting signs and symptoms along with the knowledge of surface anatomy were utilised for the localisation of brain lesions. Well-known examples of craniometric points used, included the pterion, asterion, vertex of the skull, the lambda stephanion glabella and the opisthion. The

location of brain tumours was studied in relation to these craniometric points and other structures including sylvian fissure, coronal suture, motor strip, superior sagittal sinus, transverse sinus, top of the pinna and external auditory canal in all planes (coronal, sagittal and axial). All of this knowledge was incorporated in preoperative planning in the operating room using Taylor-Haughton (TH) lines.

Results

Of the 143 patients, 83(57.9%) were males and 60(42.1%)

Table-1: The various types of lesions observed with the frequency.

	Female	Male	Total count
Abscess	1	4	5
Neurenteric cyst	0	1	1
Craniopharyngioma	1	2	3
Epidermoidtumour	1	2	3
Gliomas	20	35	55
Haemangioblastoma	1	0	1
Haemangioma	1	1	2
Haemangiopericytoma	0	1	1
Implantation dermoid	0	1	1
Medulloblastoma	1	0	1
Meningioma	19	15	34
Non-Hodgkin's Lymphoma	2	1	3
Pineal tumour	0	1	1
Pituitary adenoma	7	12	19
Primitive Neuroectodermal Tumour	0	2	2
Vestibular Schwannoma	5	5	10
	59	83	142

Table-2: Results of postoperative one year follow up of the brain tumours.

Type of Tumour	Survival rate at 1 year Percentage	Post OP radiation given Yes/No	Recurrence of tumour	Over all prognosis (Karnofsky Performance Scale)
Craniopharyngioma	100%	Yes	Yes (1 case only)	Poor (<70)
Epidermoidtumour	100%	No	No	Good (>90)
Oligodendroglioma	81.8%	Yes	Yes	Moderate (70-90)
Ependymoma	100%	(For 1 recurrent case)	Yes (1 case only)	Good (>90)
Astrocytoma (Grade 3)	67%	Yes	Yes	Poor (<70)
Glioblastomamultiformis (Grade 4 astrocytoma)	40%	Yes	Yes	Poor (<70)
Haemangio-blastoma	100%	No	No	Moderate (70-90)
Haemangioma	100%	No	No	Moderate (70-90)
Haemangio-pericytoma	100%	Yes	No	Moderate (70-90)
Implantation dermoid	100%	No	No	Good (>90)
Medullo-blastoma	Dead	Yes	Yes	Poor (<70)
Meningioma	100%	Yes (In 2 cases for residual tumor)	No	Good (>90)
NHL	67%	No	Yes	Good (>90)
Pineal tumour	100%	Yes	Residual persisted	Good (>90)
Pituitary adenoma	100%	Yes (for somatotropinomas)	Yes in somatotropinoma	Good (>90)
Primitive Neuroectodermal Tumour	50%	Yes	Yes	Poor (<70)
Vestibular schwannoma	100%	Yes (only 1 case for residual tumour)	No	Good (>90)

OP: Operation

NHL: Non-Hodgkin's lymphoma.

Table-3: Age wise distribution of space occupying lesions in the brain in patients operated at our center.

Age Group (Years)	Frequency
Group A (1-10)	11 %
Group B(11-20)	13 %
Group C(21-30)	29 %
Group D (31-40)	24 %
Group E (41-50)	28 %
Group F (51-60)	22 %
Group G (61-70)	14 %
Group H(Above 70years)	4 %

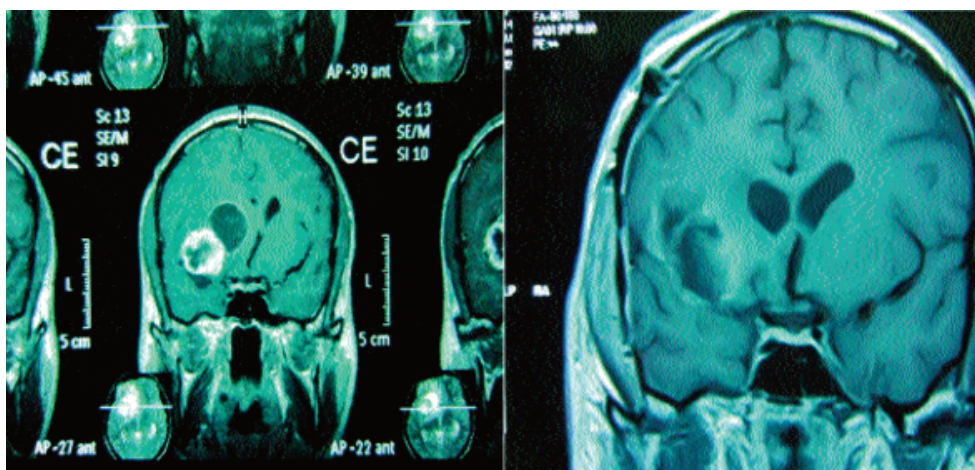
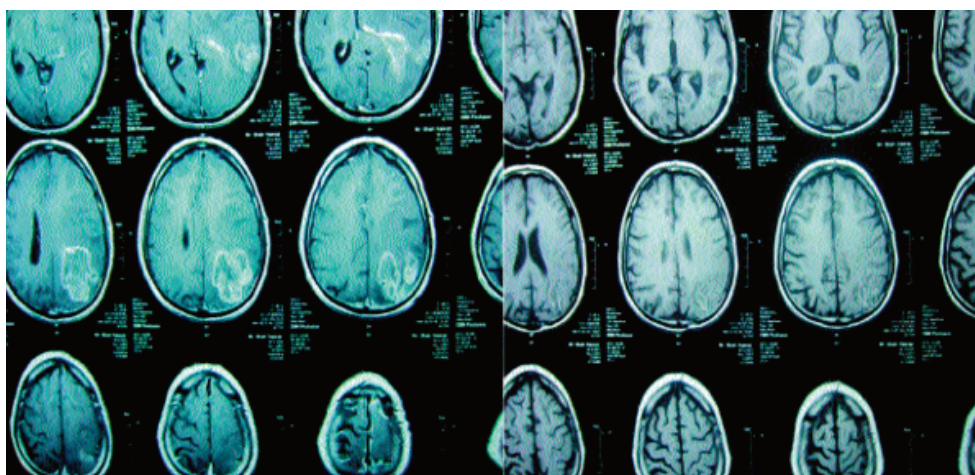
females. Therefore, the male-to-female ratio was 1.37:1. Gliomas were the most common tumours, occurring in 20(33.3%) females and 35(42.2%) males; meningioma was the second commonest tumour and was observed in

19(31.7%) females and 15(18.1%) males; and pituitary tumours were third commonest found in 7(11.7%) females and 12(14.5%) males (Table-1).

Supratentorial lesions were found in 96(66.9%) cases and infratentorial lesions in 47(33.1%). Various types of histopathologically proven gliomas were astrocytomas 93(64.91%), oligodendroglioma 28(19.3%), ependymoma 12(8.77%) and mixed 10(7.02%).

One-year survival rate was worst for grade 3 and 4 astrocytomas (67% and 39.4% respectively), medulloblastoma (0%) and primitive neuroectodermal tumours (50%) while surgical outcomes were poor with a score less than 70 on the Karnofsky performance scale for craniopharyngiomas, ependymomas and oligodendrogliomas. Outcomes for schwannomas (100%, 1 year survival rate) and meningiomas (100%, 1 year survival rate), in which total excision was done, were excellent with a score in excess of 90 (Table-2).

The frequency of brain tumours appeared to be increased in 3rd (29%), and 5th (28%) decade of life, respectively (Table-3). Clinical presentation of different types of lesions varied and was usually a function of location of the lesion. Overall, 42% of patients had headache, 28% had hemiplegia, 26% had fits and 11% had presented with coma. Other complaints were decreased level of consciousness, decreased vision, vomiting, hearing loss, acromegalic features, numbness, proptosis, cerebrospinal fluid (CSF) rhinorrhoea, altered behaviour, ataxia, blindness, dysphagia, oculomotor nerve palsy, diplopia, vertigo, monoplegia, post-auricular discharge and tinnitus.

**Figure-1:** Gross total resection of glioblastomamultiformes (GBM): Pre-operative and Post-operative (2 years).**Figure-2:** Pre-operative and Post-operative (2 years) radiographic scans of glioblastomamultiformes (GBM) showing gross total resection.

Discussion

This study was intended to determine the demographics and surgical outcome for

intracranial space occupying lesions without neuronavigation, from the developing countries. This allowed us to study various types of lesions in the patients of Khyber Pakhtunkhwa (KPK) province, and also to compare the findings with other studies conducted in Pakistan and developed countries. For some tumours, 5- and 10-year survivals are warranted, but this study was aimed to check short-term survivals in patients undergoing surgery without neuronavigation, hence the 1-year survival.

Time-tested methods of careful neurological examination and knowledge of neuroanatomy can allow a surgeon with limited resources to plan and accommodate for accurate tumour resection with adequate margins. Every patient was methodically worked up with a detailed history and physical examination. The patient then underwent either a CT, MRI or both. Contrast studies were ordered as required. After the location of the lesion was identified, approach was planned using external landmarks as a guide. This was particularly important in locating the eloquent areas of the brain such as the motor strip. Gross total resection was attempted for grade 3 and grade 4 astrocytomas even in deep-seated and strategically located tumours, as evident by the radiological scans (Figures-1 and 2). One-year survival rate was determined and was related to the histology of the tumour. It was worse for malignant tumours of brain, i.e. grade 3 and 4 astrocytomas (67% and 39.4%, respectively), medulloblastoma and primitive neuroectodermal tumours (50%). Adjuvant radiotherapy was given to all the patients with grade 3 and grade 4 astrocytomas, craniopharyngiomas, oligodendroglioma, primitive neuroectodermal tumour, pineal tumour, medulloblastoma and haemangiopericytomas. Recurrence and residual of the tumours in all cases were treated with radiotherapy.

Gross total resection results in the prolongation of survival, but the risk of postoperative neurological deficit increases with radical resection of the tumour.⁷ In one study,⁸ gross total resection was achieved in 86% of the patients with supratentorial gliomas and improvement or stability was seen in 97% of these patients, while the rate of neurological morbidity was 40% with partial resection.⁸ Therefore, resection of the tumour should be individualised with greater possible resection, avoiding the strategic locations so that maximum benefit can be obtained from surgery. Another study⁹ compiled the results of intra-operative stimulation brain mapping (ISM) for glioma surgery. Results showed that neurologic deficits were less (3.4% of patients) after resections with ISM, and greater without ISM in (8.2% patients). The

percentages of gross total resections, radiologically confirmed, were 75% with ISM and 58% without ISM. So, it was concluded that the glioma resections using ISM are associated with fewer late severe neurologic deficits and more extensive resection, and they involve eloquent locations more frequently.⁹

Primary brain tumours occur in around 250,000 people a year globally, making up less than 2% of cancers.¹⁰ The incidence of metastatic tumours is more prevalent than primary tumours by 4:1.¹¹ In our study, gliomas (39.3%) were the most common tumours, followed by meningiomas (22.1%) and pituitary tumours (13.1%). A study by Irfan et al.¹² showed that the gliomas comprised 32.1% of the total cases, followed by meningiomas (13.7%) and pituitary tumours (13.2%), which showed that there was small difference in the frequency of gliomas in our study. In developed countries, gliomas account for 40-67% and meningiomas for 9-27% of primary tumours in population-based studies.¹³

Different types of gliomas studied were glioblastoma multiformes (GBM) 64.91%, oligodendroglioma 19.3%, ependymoma 8.77% and mixed 7.02%. These results were comparable to a previous study conducted by Ahmed Z et al.¹⁴ which showed that the frequency of GBM were 71.37%, oligodendrogliomas 15.06%, ependymomas 8.77% and mixed 3.16%. In another study, gliomas of astrocytic, oligodendroglial and ependymal type accounted for more than 70% of all brain tumours with glioblastoma being most frequent (65%) and malignant histological type.¹⁵

In our study, males constitute 57.9% and females 42.1% of patients with male-to-female ratio of 1.37:1. In another study,¹² the ratio was 2:1. A study in India¹⁶ showed the male-to-female ratio of primary brain tumours to be 2.3:1. In our study, gliomas presented with male-to-female ratio of 1.71: 1, meningiomas with 1: 1.28 and pituitary tumours with 1.71: 1. Western data also shows that the sex ratio varies considerably by histological type. Gliomas are higher in males while meningiomas are higher in females.¹⁷ Our study shows similar findings. In our study, supratentorial lesions were 66.9% and infratentorial lesions were 33.1%. A study¹² found that 77% of patients had a supratentorial and 23% had infratentorial lesions. The frequency of brain tumours appeared to be increased in 3rd (Group C), 4th (Group D) and 5th (Group E) decade. In that study,¹² the highest incidence was seen in the second and third decades.

One of the major limitations of the current study was that its findings cannot be generalised since our centre is

mainly used for referrals from the armed forces of Pakistan.

Conclusion

Careful neurological examination and knowledge of neuroanatomy allow a surgeon to plan and accommodate for accurate tumour resection with adequate margins. In developing countries, the surgical outcome of the brain tumours is still good even without neuronavigation, but excellent results can be obtained by the modern technologies of neuroimaging and neuronavigation.

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Conflict of Interest: None.

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