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SHORT REPORT

Awake craniotomy for brain tumours in Pakistan: An initial case series from a developing country

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Abstract

Awake craniotomy offers safe resection of brain tumours in eloquent area. Aga Khan University Hospital, Karachi, recently started the programme in Pakistan, and the current study was planned to assess our experience of the first 16 procedures. The retrospective study comprised all such procedures done from November 2015 to May 2016. Pre-operative and post-operative variables were analysed. Of the 16 patients, 11(68.75%) were males and 5(31.25%) were females. The overall median age was 37 years (interquartile range[IQR]: 23-62 years). The most common presenting complaint was seizures 8(50%), followed by headache6(38%). The common pathologies operated include oligodendroglioma and glioblastoma. Pre-operative mean Karnofsky Performance Status score was 76±10, which increased to 96±7 post-operatively at discharge. Besides, 2(12.5%) intra-operative complications were observed, i.e. seizure and brain oedema, in the series. The study had median operative time of 176 minutes (IQR: 115-352) and median length of stay of 4 days (IQR: 3-7).Awake craniotomy was highly effective in maintaining post-operative functionality of the patient following glioma resection. It was also associated with shorter hospital course and so lower cost of management.

Keywords: Awake craniotomy, Eloquent areas, Developing country, Postoperative deficits.

Introduction

Awake craniotomy is a surgical technique performed under local anaesthesia so that brain tumours, especially those in eloquent area, are resected without giving patient any new neurological deficit. It has significant advantages over the primitive craniotomy under general anaesthesia which includes avoiding the risks of general anaesthesia, less intensive care unit (ICU) admissions, shorter operative time, shorter overall length of stay, reduced number of required arterial lines and catheters.[1]

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The procedure plays a key role in modern neurosurgery in the developed world but its use in developing countries is still limited.[1]

Pakistan is a developing country which suffers significant economic burden due to surgical diseases, especially after brain tumour surgery. The economic burden is further worsened once patient develops functional dependability and inability to continue his employment and self-care.[2]

Developing the appropriate facilities for this technique was obviously not easy and required extensive training of the involved personnel. The current study was planned to report our initial experience of awake craniotomy cases.

Methods and Results

This retrospective case series was conducted at the Aga Khan University (AKUH), Karachi, and comprised all patients who had undergone awake craniotomy from November 2015 to May 2016. All these procedures had been done by a single neurosurgeon. Medical record files of the patients were reviewed. Data collected included demographics, pre- and post-operative symptomology, radiology, intra-operative time, new neurological deficit, histopathology and adjuvant treatment. All the data collected was kept confidential to preserve the anonymity of the patients. The data was analysed using SPSS 19.

A team compromising neurosurgeon and anaesthesiologists was sent to the United States where they received orientation for awake craniotomy. Thereafter, consensus on selection criteria for Pakistani population was developed and included patients with brain tumours, especially those in eloquent areas, low-grade gliomas, supratentorial elective tumour surgery, who were alert, oriented, willing for the procedure, and had adequate understanding of the procedure. All such patients were selected in the clinic. Magnetic resonance imaging (MRI) neuro-navigation, functional MRI and diffusion tractography were performed pre-operatively when required.

The anaesthetic technique mainly focussed towards the use 'awake throughout' approach. The institution of scalp block was mainstay of the plan. In addition to routine pre-operative assessment, we arranged special sessions with

Table-1: Detail of cases. The cases have been sorted by date of surgery.[1] These include eloquent areas that were involved or in proximity to the lesion.[2] Recurrent cases with history of craniotomy.

Case	Sex	Age	Primary Diagnosis	Pathology Grade	Site of Lesion	Side of Lesion	Eloquent Areas[1]
1	M	54	GBM	4	Parietooccipital Lobe	L	FM,IFO,ILF
2	M	35	Oligodendroglioma	2	Parietal Lobe	L	none
3	F	25	Astrocytoma	2	Parietooccipital Lobe	L	FM,CC,CR,SLF,C,IFO,ILF
4	F	35	GBM	4	Parietooccipital Lobe	L	CS,CP,CB,STR,CR,T,SLF
5	M	32	Oligodendroglioma	2	Frontotemporal Lobe	L	CR,SFO,SLF,CS,CP,CB,ILF,IFO,UF
6	F	34	Central Neurocytoma	2	Intraventricular Space	n/a	n/a
7	F	62	Metastasized Breast Ca	N/A	Occipital Lobe	R	OR,FM,IFO,ILF
8	M	46	GBM	4	Parietal Lobe	L	CR,SLF
9	M	48	Oligodendroglioma[2]	3	Temporal Lobe	R	CR,CS,CP,CB,STR,C,ILF,ST,IFO
10	M	39	Oligodendroglioma	2	Frontal Lobe	L	CR,IFO,UF
11	M	58	GBM	4	Temporal Lobe	L	ILF,IFO
12	M	28	Oligodendroglioma[2]	3	Frontal Lobe	R	n/a
13	F	44	Oligodendroglioma[2]	3	Parietal Lobe	R	n/a
14	M	32	GBM[2]	4	Parietal Lobe	L	FM,IFO,ILF,CR,T
15	M	23	GBM	4	Frontal Lobe	L	CR,IFO,UF,STR,IC,CC
16	M	50	Oligodendroglioma[2]	2	Frontal Lobe	R	CR,IFO,UF,STR,IC,CC

N/A: not applicable. n/a: not available; FM: forceps major; IFO: inferior frontooccipital; ILF: inferior longitudinal fasciculus; CC: part of corpus callosum; CR: part of coronoid radiate; C: cingulum; CS: corticospinal; CP: corticopontine; CB: corticobulbar; STR: superior thalamic radiation; T: tapetum; SFO: superior frontooccipital; UF: uncinate fasciculus; OR: optic radiation; IC: part of internal capsule. GBM: glioblastoma.

patients to let them know about technique, its conduct and to respond any queries from patient's side. Anatomical block to supraorbital, auriculotemporal and greater occipital nerves was done bilaterally. Local infiltration was also done towards the pins side.

During the procedure, patients were put in the most neutral position possible using mayfield clamp, preferably supine or lateral, and covered in transparent drapes to document neurological exam. Cortical mapping was performed intra-operatively. Following scalp block, standard craniotomy using neuro-navigation was done. After craniotomy, dura was anesthetised by packing it with xylocaine-soaked patties. Standard durotomy was followed with excision of tumour while monitoring the neurological response. A neurosurgery resident would assess neurology concerned on frequent intervals, especially while working near eloquent cortex. Tumour resection was done until gross total resection without comprising any neurological function; if it was felt that patient's neurology was deteriorating the tumour, resection at that eloquent area would be stopped and residual tumour had to be left.

Post-operatively, a patient was neurologically assessed in recovery room and then in wards. MRI scan was done within 24 to 48 hours post-operatively. A majority of patients were shifted out of special care units within 24 hours post-operatively, with removal of invasive lines.

Of the 16 patients who underwent awake craniotomy, 11(68.75%) were males and 5(31.25%) females. The median age was 37 years (interquartile range [IQR]: 23-62). The pathologies observed were oligodendroglioma, glioblastoma (GBM), astrocytoma, central neurocytoma and metastasized breast cancer. Moreover, 5(31.25%) cases were recurrent in nature with history of previous craniotomy under general anaesthesia. Only 1(6.25%) case was metastatic, in which the patient had stage 4 breast cancer (Table-1).

Patients primarily presented with wide variety of symptoms, the most common being seizures 8(50%), followed by headache 6(38%). The mean Karnofsky Performance Status (KPS) score on admission was 76±10. Following awake craniotomy, the mean post-operative KPS improved significantly to 96±7, with 12(75%) patients having maximum KPS score on discharge. Only 2(12.5%) patients developed new neurological deficits, which included left homonymous hemianopia (case 7) and mild facial nerve weakness (case 4). The median operative time was 176 minutes (IQR: 115-352). The median length of stay for all patients was 4 days (IQR: 3-7) (Table-2).

In addition, 2(12.5%) intra-operative complications were observed in the study. Case 7 had intra-operative right occipital oedema which was managed with intracranial pressure (ICP) lowering manoeuvres which included mannitol and raising headside along with quick resection of tumour. Case12 had intra-operative seizure and was managed with midazolam. The seizures stopped

Table-2: Hospital course of the patients.

Case	Admission Symptoms	Admission KPS	Discharge Symptoms	New Deficits	Discharge KPS	Follow up Plan
1	H	90	none	none	100	Chemoradiation
2	S	80	none	none	100	Close monitoring
3	H, Vb, Vo	70	none	none	100	Chemoradiation
4	S, iM(R-U), iS(R-U)	60	iM(R-F)	iM(R-F)	90	Chemoradiation
5	S, iM(R-Hp)	60	none	none	100	Chemoradiation
6	H, Vo	80	none	none	100	Radiation
7	Vb, iM(R-Hp)	60	HH-L	HH-L	80	Chemoradiation
8	S, Vr	80	none	none	100	Chemoradiation
9	S	80	none	none	100	Radiation
10	S, H, HH-L	70	HH-L	none	100	Close monitoring
11	A	70	none	none	100	Chemoradiation
12	S	90	none	none	100	Chemoradiation
13	iM(L-U)	90	none	none	100	Chemoradiation
14	Ap, A, H, Vr, iS(R-L)	80	Ap;iS(R-L)	none	80	Chemoradiation
15	D, Vb, H, Vo, P(L)	70	P(L)	none	90	Chemoradiation
16	S	80	none	none	100	Chemoradiation

H: headache; S: seizures; Vo: vomiting; Vr: vertigo; Vb: blurred vision; iM: impaired motor function (R: right; L: left - U: upper limb; L: lower limb; Hp: hemiparesis; F: Facial);
iS: impaired sensation (R; L - U; L; Hp; F); P: pronator drift (R; L); HH: homonymous hemianopia (R; L). KPS: Karnofsky Performance Status.

thereafter so it was decided to continue with the awake procedure. This patient had another episode of seizure in recovery room which was managed with phenytoin.

Conclusion

Operating near an eloquent area for resection had been a huge challenge for neurosurgeons with regard to the post-operative functionality of the patient and the eventual quality of life. Awake craniotomy allows the surgeon to know when the patient starts to compromise any neurological function, so that the surgeon resects the lesion only to extend that the patient does not develop any new neurological deficit after the surgery. Hence, this technique has lower risk of compromising patient's quality of life after the surgery.[3] Its efficacy to avoid post-operative neurological deficit further improves by the use of pre-operative functional imaging and tractography along with intra-operative brain mapping.[4]

In our study, the most common presentation was seizures, similar to a recent study conducted in Tehran.[5] Patients in that study also significantly complained of speech disturbance and hemiparesis, but headache was uncommon, unlike in our case where headache was the second-most common complaint, followed by other symptoms.

The mean post-operative KPS improved significantly in our study, which defines the favourable outcome of this procedure. It is similar to the three-month post-operative mean KPS score of 93.7 in a study where 374 patients underwent awake craniotomy for intra-axial supratentorial cerebral lesion.[6]

We operated in adults only with median age of 37 years, while in another study surgery was done in a variety of cases ranging from a child aged below10 years to a pregnant female.[7] We operated most commonly for oligodendroma, both for low and high grade, followed by GBM, with all located supretentorially. In the developed countries, awake craniotomy is even used for infratentorial lesions or histopathology other than glioma, like meningioma.[8]

Two intra-operative complications were observed in our study, including intra-operative seizures and brain oedema. The complication of intra-operative seizures is well known in the literature, with an average of 9.5%.[9] Literature also mentions respiratory distress, hypertension and tachycardia,[3] which was not observed in our study.

The limitations of the current study included small number of cases, no control group for comparison, and the fact that all surgeries were performed at a single institution and by a single neurosurgeon.

Therefore, awakecraniotomy was found to be a highly effective procedure in improving functionality and quality of life post-operatively in patients with brain tumours, especially in an eloquent area.

Conflict of Interest: None.

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