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# Transcortical approach to lateral ventricular central neurocytomas: a case series and review of the literature

Ahmad Elsayed Desoukey Elayouty\* , Ahmed Hamad and Ashraf Ghobashi

## Abstract

**Background:** Central neurocytomas (CN) are relatively rare intrinsic brain tumors of an ectodermal origin that usually arise in the lateral ventricles close to the foramen of Monro and septum pellucidum. Surgical gross total resection is now considered the gold standard treatment for CNs. The choice of the most convenient approach (transcortical or transcallosal) remains controversial. This study was designed to assess the efficiency and safety of gross total resection using the transcortical approach in the treatment of patients with lateral ventricular central neurocytomas.

**Patients and methods:** This is a retrospective observational study conducted on eight patients who underwent surgical treatment for a lateral ventricular tumor that had a postoperative histopathological diagnosis of central neurocytoma via the transcortical approach. The included patients were operated upon at Ain Shams University Hospitals between October 2012 and August 2017. The postoperative clinical data were analyzed for the assessment of changes in the initial data and for any procedure-related complications.

**Results:** The current study included two males and six females (a total of eight patients) with a mean age of 24. Seventy-five years ranging from 12 to 34 years. The main presenting symptom was a persistent headache. The mean duration of symptoms prior to diagnosis was 2.625 months ranging from 1 to 6 months. Preoperatively, five patients had hydrocephalic changes due to obstruction of the cerebrospinal fluid pathways; however, none of them had a cerebrospinal fluid diversion prior to direct tumor attack. Gross total resection (radiologically proven) was achieved in six (75%) patients. One patient had an approach-related visual field defect and one patient had postoperative epilepsy that required long-term use of antiepileptic therapy. The mean postoperative follow-up duration was 26 months ranging from 6 to 60 months. Regarding functional outcome, by the end of the third postoperative month, seven patients could achieve a score of 5 according to the Glasgow Outcome Scale.

**Conclusion:** The transcortical approach provides a safe and effective corridor for the achievement of gross total resection of lateral ventricular central neurocytomas with the main limitation of being less effective regarding the degree of resection in cases of bilateral tumors.

**Keywords:** Central neurocytomas, Transcortical approach, Lateral ventricle, Intraventricular

\* Correspondence: [dr.ahmad\\_elsayed@med.asu.edu.eg](mailto:dr.ahmad_elsayed@med.asu.edu.eg);  
[dr.ahmad\\_elsayed@hotmail.com](mailto:dr.ahmad_elsayed@hotmail.com); [dr.ahmad\\_elsayed@yahoo.com](mailto:dr.ahmad_elsayed@yahoo.com)  
Ain Shams University, Cairo, Egypt

## Introduction

Central neurocytomas (CNs) are relatively rare intrinsic brain tumors of an ectodermal origin that usually arise in the lateral ventricles close to the foramen of Monro and septum pellucidum [1]. CNs were first described by Hassoun et al. in 1982 [2]. They are generally slow-growing well-delineated WHO Grade II neuroepithelial intraventricular tumors that account for around 0.25 to 0.5% of all primary brain tumors and affect young adults (between 20 and 40 years) predominantly [3–10]. There have been less than 500 cases reported in the literature since its first description [11]. CNs possess no gender predilection. Some reports confirmed higher incidences in Korea, India, and Japan, which is possibly a genetic phenomenon among different races [5].

On computed tomographies, CNs appear heterogeneously hyperdense with contrast enhancement while on magnetic resonance imaging; they are isointense on T1-weighted images and slightly hyperintense on T2-weighted images with vivid contrast enhancement [12]. These features may be confused with other intraventricular tumors especially ependymomas, oligodendrogliomas, and subependymal astrocytomas even after histopathology. So, immunohistochemistry is of utmost importance for accurate diagnosis [4].

Surgical gross total resection is now considered the gold standard treatment for CNs that can be achieved in 30–50% of cases with a reported 99% 5-year survival rate that came down to 86% when subtotal resection was performed [5, 7, 12]. The proximity to the deep critical structures and high vascularity make the achievement of such goal a real challenge. Moreover, choice of the most convenient approach (transcortical or transcallosal) remains controversial [10, 13, 14]. This is the reason for having some surgeons emphasizing on the superiority of the interhemispheric transcallosal approach to avoid violation of the cerebral cortex [7]. While others consider the conventional transcortical approach exclusively effective for near total tumor resection with the least morbidity [15].

## Aim of the study

This study was designed to assess the efficiency and safety of using the transcortical approach to perform gross total resection in the treatment of patients with lateral ventricular central neurocytomas.

## Patients and methods

This is a retrospective observational study conducted on eight patients who underwent surgical treatment for a lateral ventricular tumor that had a postoperative histopathological diagnosis of central neurocytoma via the transcortical approach. The included patients were operated upon at Ain Shams University Hospitals between

October 2012 and August 2017. An approval from the research ethics committee of the Faculty of Medicine at Ain Shams University (reference number, FWA 00006444) was obtained on 12/9/2017. Furthermore, being a retrospective study, patients' consents for participation and for publication were not applicable. Additionally, the co-authors had neither financial nor non-financial competing interest to report.

A thorough review of the preoperative clinical and radiological data for all enrolled patients was performed. Each one of the operated patients had his/her surgery done under general anesthesia in the supine position through a formal frontal (or parietal in two cases) craniotomy on the right side whenever applicable. A surgical corridor was created through the anterior part of the middle frontal gyrus heading posteromedial with a slight caudal inclination towards the tip of the frontal horn of the ipsilateral ventricular cavity where the tumor was identified and removed with maximum care not to violate any normal neural tissue. In cases of posteriorly located tumors, a posterior parietal approach was used to approach the tumor through the occipital horn of the ipsilateral ventricle. Whenever safe, gross total resection was performed; otherwise, tumor debulking was considered in cases where gross total resection was not applicable. Meticulous hemostasis was always performed and sought for due to the vascular nature of such tumors and high rates of intraoperative and/or postoperative bleeds. In cases where preemptive cerebrospinal fluid diversion was not done, an intraventricular catheter was left behind for at least 72 h postoperatively for temporary cerebrospinal fluid drainage. However, testing for the need for a permanent cerebrospinal fluid shunting was done prior to catheter removal via temporary closure of the catheter with a concomitant close observation of the patient's status.

The postoperative clinical data were analyzed for the assessment of changes in the initial data and for any procedure-related complications.

Clinical data from the early postoperative period and every 2 weeks for at least 3 months then every 3 months were assessed and documented. However, only the data from the immediate (considered early postoperative) and the 3 months (considered late postoperative) interval assessments were included in the current study. Early postoperative CT scan (within the first 48 h) was routinely carried out to assess for hydrocephalus or any procedure-related complication, and it was repeated once after 2 weeks or whenever necessary. A contrasted brain MRI was performed 3 months after surgery to assess for the actual degree of tumor resection and the need for further therapies. For evaluation for possible tumor recurrences, contrasted MRIs were done every 3 months for the first postoperative year, and then

**Table 1** Frequencies of different symptoms and signs on presentation

	Male	Female	Total
Headache	2	6	8
Vomiting	0	4	4
Blurred vision	2	5	7
Epilepsy	0	1	1
Gait disturbance	2	1	3
Alternation in level of consciousness	0	0	0
Papilledema	2	5	7
Visual field defect (non-specific)	2	5	7

patients were advised to have an MRI every year for at least 5 years.

## Results

The current study included two males and six females (a total of eight patients) (Additional file 1). The mean age at diagnosis was 24.75 years ranging from 12 to 34 years. All patients had manifestations of increased intracranial pressure in the form of a headache and/or deterioration in visual functions. The main presenting symptom was a persistent headache that was a consistent complaint in all patients. The mean duration of symptoms prior to diagnosis was 2.625 months ranging from 1 to 6 months. On presentation, only one patient had a motor deficit in the form of a right hemiparesis with a grade 4 power. Otherwise, the rest of the included patients had neither motor nor sensory deficits, and none of them had sphincters dysfunction. Frequencies of different symptoms and signs on presentation are summarized in Table 1.

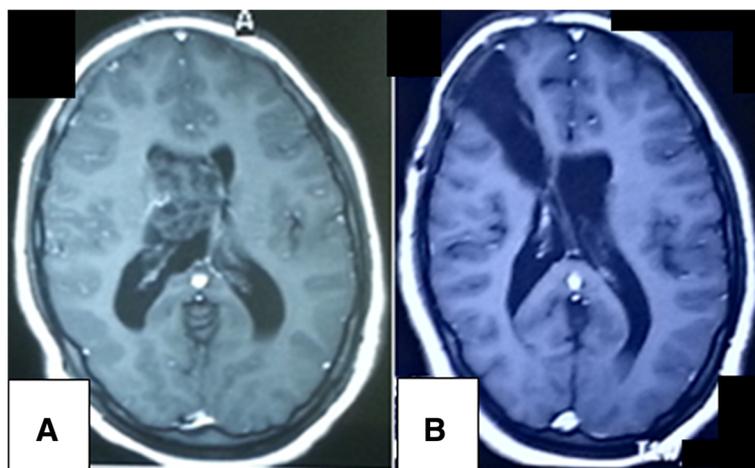
Regarding tumor location, two patients had tumors affecting both sides of the ventricular body, two patients

had tumors confined to the left lateral ventricular body, and one patient had a tumor confined to the body of the right lateral ventricle. The remaining three patients had tumors in the right frontal horn of the lateral ventricle. Preoperatively, five patients had hydrocephalic changes; however, none of them had a cerebrospinal fluid diversion prior to direct tumor attack. Intraoperative ultrasonography guidance was used in two surgeries (both had gross total resection). Gross total resection (radiologically proven) was achieved in six (75%) patients, and partial tumor excision, on the other hand, was performed in two patients due to the bilaterality of the lesion. Figure 1 illustrates a representative case where gross total resection was achieved while another case where partial resection was performed is illustrated in Fig. 2. Frequencies of different approaches performed are outlined in Fig. 3.

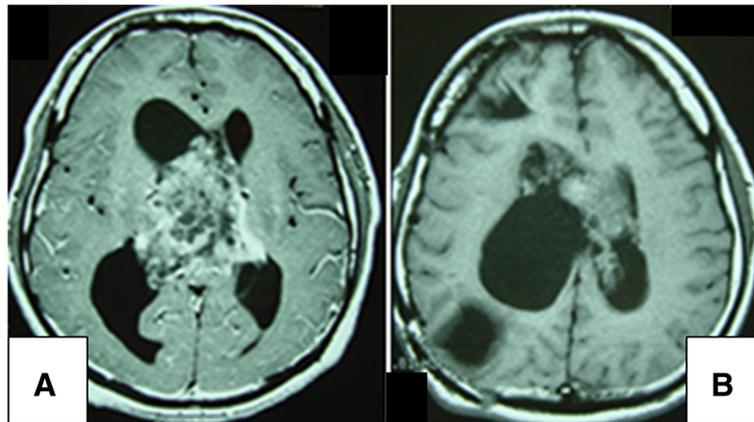
Temporary external ventricular drainage was used in all patients and left for a mean duration of 4.75 days. However, none of the included patients needed post-tumor resection permanent cerebrospinal fluid diversion. Early (within 48 h) and late (persistent for more than 3 months) postoperative complications are illustrated in Table 2.

One patient had an approach-related visual field defect (right lower quadrantanopsia in a patient operated via the parietal approach). Moreover, one patient had postoperative epilepsy that required long-term use of anti-epileptic therapy.

The mean postoperative follow-up duration was 26 months ranging from 6 to 60 months. No adjuvant postoperative treatments were used for any of the included patients throughout their follow-up periods with no evident recurrences. Regarding functional outcome, by the end of the third postoperative month,



**Fig. 1** Preoperative (a) and 12 months postoperative (b) axial brain contrasted T<sub>1</sub> magnetic resonance images for a patient where gross total resection was achieved



**Fig. 2** Preoperative (a) and 3 months postoperative (b) axial brain contrasted T<sub>1</sub> magnetic resonance images for a patient where partial tumor resection was achieved

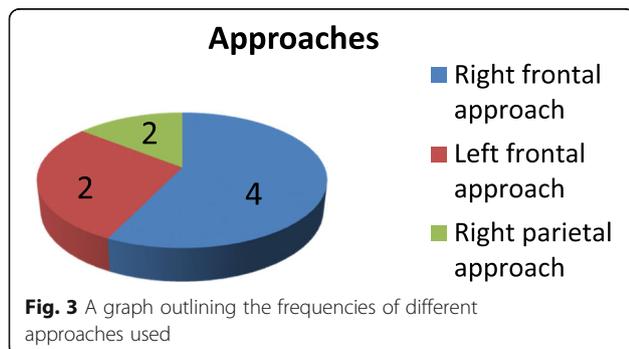
seven patient could achieve a score of 5 according to the Glasgow Outcome Scale [16]; moreover, the remaining patient had a score of 4 denoting an overall favorable functional outcome.

**Discussion**

Central neurocytoma is a tumor of the young adults as observed in the results of the current study (mean age 24.75 years) and supported by the literature [4, 5, 8, 9, 11]. The affection of such a young age group makes safe radical resection of that relatively benign tumor a common demand and a surgical gold standard that can help avoid radiation therapy [5, 8, 9, 17, 18]. However, postoperative radiation therapy and/or chemotherapy may be recommended for atypical neurocytomas and for recurrent cases and was not needed in our cohort [11].

From the aforementioned results, it can be observed that the main persistent morbidity secondary to the transcortical surgery was mild non-disabling motor deficit that could be detected in two (25%) out of the eight included patients, a single case of postoperative epilepsy and a single case of visual field defect. Moreover, the functional outcome was satisfactory in all patients and not adversely affected by attempts to accomplish gross

total tumor resection as can be demonstrated by the patients’ Glasgow Outcome Scores. Using the transcortical approach, gross total tumor resection was achieved in all patients but two, due to the bilaterality of the lesion. In that case, a second session surgery had to be performed. These results may be different from those published by Wang et al. [6] who reported a gross total resection rate of 54% of the 63 patients included in their series. This discrepancy in the gross total resection rates may be attributed to the larger number of their studied patients’ group. Moreover, the inclusion of different approaches other than the transcortical approach might have affected the degree of tumor resection. On the other hand, results of the current study were remarkably similar to those published by Park et al. [18] who reported that gross total resection could be achieved in each of their 12 included patients either in the primary surgery or after a second-look surgery. Additionally, they reported no mortalities and four transient surgery-related morbidities (zero mortality and two minor morbidities in the current study). The presence of hydrocephalus is the factor that could be considered when discussing the width of the surgical field that facilitated gross total excision, and this can be supported by the results of Nagasawa et al. [14]. However, as previously mentioned, the two cases where gross total resection in the first surgery was not applicable had biventricular tumor extensions, and this incident



**Fig. 3** A graph outlining the frequencies of different approaches used

**Table 2** Early (within 48 h) and late (persistent for more than 3 months) postoperative complications

	Meningitis	Minor motor deficit	Dense motor deficit	Sensory deficit	Mortality	Patients
Early	1	6	1	2	0	
Late	0	2	0	0	0	

clearly demonstrates the insufficiency of the transcortical approach in such instances with superior resection capabilities of the transcallosal approach. This observation was also supported by the results of Chen et al. [8].

It is also to be mentioned that none of the included patients in the current study needed a permanent cerebrospinal fluid diversion, and this is attributed the proper re-establishment of the natural pathway as supported by the results of Chen et al. [8] in their study on nine cases of neurocytoma.

## Conclusion

In conclusion, the transcortical approach provides a safe and effective corridor for the achievement of gross total resection of lateral ventricular central neurocytomas with the main limitation of being less effective regarding the degree of resection in cases of bilateral tumors.

## Additional file

**Additional file 1:** The excel worksheet containing data from the included patients. (XLSX 10 kb)

## Abbreviations

CN: Central neurocytoma; CT: Computerized tomography; MRI: Magnetic resonance images

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## Availability of data and materials

The dataset supporting the conclusions of this article is included within the article (and its additional file).

## Patient's consents to participate

Being a retrospective study, patients' consents for participation were not applicable.

## Authors' contributions

AEDE had a substantial role in the study design, manuscript editing, data acquisition, and interpretation. In addition, AH actively participated in the data acquisition, interpretation, and manuscript revision while AG had a fundamental role in the study design and editing and revision of the manuscript. All authors read and approved the final manuscript.

## Ethics approval and consent to participate

An approval from the research ethics committee of the faculty of medicine at Ain Shams University (reference number: FWA 00006444) was obtained on 12/9/2017.

## Consent for publication

As the manuscript contains no identifiable human data, such consent was not applicable.

## Competing interests

It is to be mentioned that all co-authors have seen and agreed with the contents of the manuscript and there is neither a financial nor a non-financial competing interest to report.

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