Clinical Outcome of Telovelar Approach to Fourth Ventricular Tumors

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Abstract: Background: The cerebellomedullary fissure as a corridor for exposure of the fourth ventricle without vermian splitting is enjoying increasing application as a technique for exposure, to avoid the com-plications related to vermian splitting. The purpose of this study is to describe the operative findings and the results in 25 fourth ventricular tumours removed via telovelar approach. The impact of the pathological nature of the lesion on the degree of tumour removal is also discussed. **Methods:** Telovelar approach to the fourth ventricle was used in 25 consecutive patients. The charts were reviewed retrospectively. The pathological changes in the tela choroidea and inferior medullary velum, degree of tumour removal, and the clinical outcome are described. **Findings:** The tela choroidea was thinned out and streched over the tumour surface in 10 cases (large tumours). In epidermoid and dermoid cysts (3 cases), the tela choroidea was amalgamated with the tumour capsule. The inferior medullary velum was infiltrated by the tumour and was not detected as a separate layer in 6 cases (3 cases vermian astrocytomas and 3 cases medulloblastomas). The inferior medullary velum was thinned out and stretched as a neural tissue sheet over the tumour surface in 10 cases (4 ependymomas, 2 meningiomas, 2 epidermoids, one dermoid and one choroid plexus papilloma). Total removal was achieved in 11 out of 16 patients (68.75%). Subtotal removal was achieved in the remaining patients (31.25%); three epen-dymomas, one medulloblastoma, and one anaplastic astrocytoma. Cerebellar mutism was not observed in any patient and there was no mortality. **Interpretation.** Despite the panoramic view provided by the telovelar approach, the pathological nature of the lesion and vital neural tissue infiltration are limiting factors for total tumour removal. Total removal of tumours focally attached to critical areas in the fourth ventricle should not be attempted at the expense of patient's morbidity and mortality. To achieve optimum outcome, near total excision is acceptable in cases where complete removal may endanger function or life.
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1. Introduction:

Conventional suboccipital craniotomy with splitting of the inferior vermis or with partial removal of the cerebellar hemisphere was used as the approach to fourth ventricular tumours [4, 7]. Vermian incision and lateral retraction of dentate nuclei may explain the development of cerebellar mutism syndrome particularly in children [1, 6].

Using the cerebellomedullary fissure corridor with opening of the tela choroidea and inferior medullary velum allows maximum exposure of the entire fourth ventricle without splitting of the inferior vermis [6, 8, 10, 13].

The purpose of this study is to describe the operative findings and the results in 25 fourth ventricular tumours removed via the telovelar approach. The pathological nature of the lesion on the degree of tumour removal is also discussed.

2. Patients and Methods

Telovelar approach to the fourth ventricle was used in 16 consecutive patients. The clinical care was given at the Neurosurgery department of Al-Azhar University (in New Damietta, Egypt), between September 2013 and December2016. Computed tomography (CT) scan and magnetic reso-nance images (MRI) of the brain were performed. The operative records of these 25 patients were retrospectively analyzed.

Telovelar approach

The telovelar approach is described previously in the literature [8–11]. The medullotonsillar space of the cerebellomedullary fissure and the uvulotonsillar space are sharply dissected to release the tonsils from uvula and medulla oblongata bilaterally. The two cerebellar tonsils are then retracted laterally to expose the floor of the fissure i.e. inferior medullary velum and tela choroidea. The tela choroidea which forms the caudal part of the lower half of the roof of the fourth ventricle is incised from the foramen of Magendi and then followed laterally to the foramen of Luschka on both sides. The inferior medullary velum is then incised. After this step, the uvula is now free to be retracted from side- to side in a horizontal direction and also in an upward and downward direction to expose the fourth ventricle. Using ultrasonic aspiration, central tumour debulking is carried out till a considerable thickness of the tumour's wall is reached. Care should

be taken not to perforate the wall during its dissection to avoid brainstem injury. In our series the tumour was large enough (in 10 cases) to protrude through the obex which necessitates initial tumour debulking before incision of the tela choroidea and inferior medullary velum.

3. Results:

There were 25 patients of whom, 12 were females and 13 were males. The age ranged from 6 years to 45 years with an average of 18.8 years. Headache and ataxia were the constant clinical finding in all patients. Pathologically, there were 7 ependymomas, 4 vermian astrocytomas (2 low grade, while one was of the anaplastic type), 7 medulloblastomas, 2 epidermoids, 2meningiomas (one meningotheliomatous, another was psommomatous), one choroid plexus papilloma, while the last case was a dermoid cyst.

Pathological changes of the tela choroidea and inferior medullary velum

In 10 cases (large tumours), tela choroidea was thinned out and streched over the tumour surface and the tumour was protruding through the obex. In these 10 cases, initial debulking was performed to decrease tumour bulk and then followed by tela choroidea incision. In epidermoid and dermoid cysts (3 cases), the tela choroidea was amalgamated with the tumour capsule. In these 3 cases, the tela choroidea and tumour capsule were fused together probably from the adhesions caused by escaped oily and keratinaceous material. So, both tumour capsule and tela choroidea were opened simultaneously.

In cases of vermian tumours extending into the fourth ventricle (3 vermian astrocytomas, and 3 medulloblastomas), the inferior medullary velum was infiltrated by tumour and was not identified as a separate layer. In two out of three astrocytoma cases (low grade astrocytoma), the tumour was totally excised, with the pre-existing ataxia improving postoperatively. In another case (ana-plastic astrocytoma), the undersurface of the pyramid was infiltrated, subtotal removal was achieved (less than 5% residue), the ataxia was temporally worsened (Fig. 1A, B). In two cases with medulloblastoma, total removal was achieved but permanent worsening of the pre-existing ataxia was observed with injury of uvula and pyramids (Fig. 2A, B). However, in another medulloblastoma case, subtotal removal was achieved with temporay worsening of the pre-existing ataxia.

In pure fourth ventricular tumours (4 ependymomas, 2 meningiomas, 2 epidermoids, one dermoid and one choroid plexus papilloma), the inferior medullary velum was thinned out and was stretched as a neural tissue sheet over the tumour surface.

Ependymoma and its degree of removal

Three cases with ependymoma were focally attached to the floor while the fourth case was focally attached to the foramen of Luschka. The first two cases were focally attached to the obex and along the inferior cerebellar peduncles and the mass fungated into the fourth ventricle. Subtotal removal was achieved, with a small remnant being left behind, attached to the obex which required postoperative radiotherapy (Fig. 3A, B).

In the third case the tumour was focally attached to the right facial colliculus. Subtotal removal was achieved; permanent postoperative facial and abducent palsy developed from manipulation around the facial colliculus.

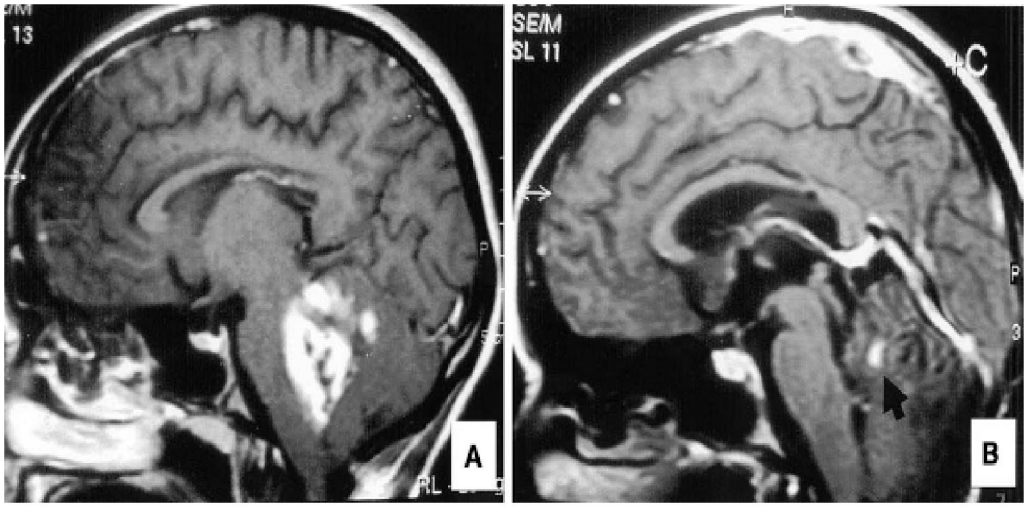

Fig. 1(A, B). In (A) sagittal T1-weighted MRI with Gd-DTPA showing vermian mass with inhomogenous contrast enhancement. In (B) postoperative sagittal, T1-weighted MRI with Gd-DTPA showing less than a 5% residue. Residual tumour is indicated by black arrowhead. Histopathologically, it was an anaplastic astrocytoma

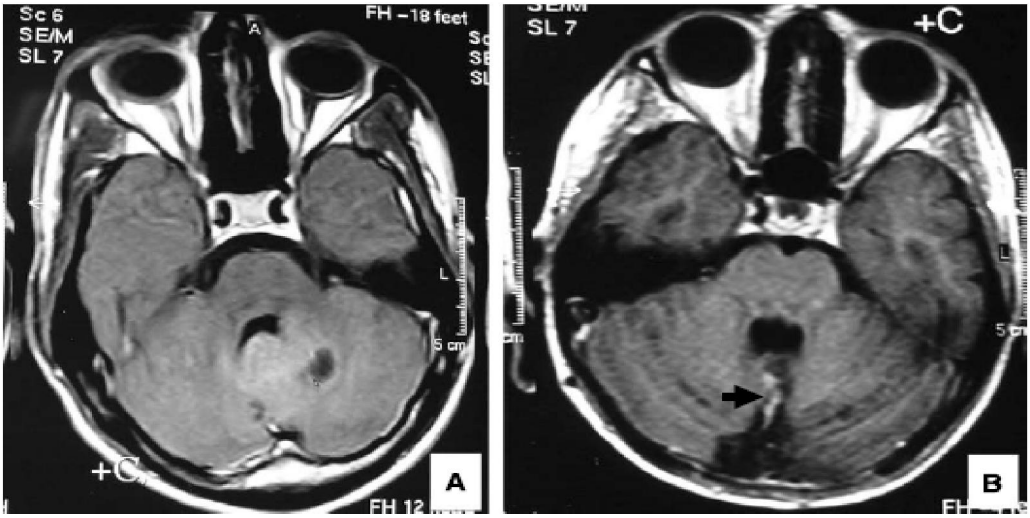

Fig. 2(A, B). In (A) axial T1-weighted MRI with Gd-DTPA showing vermian tumour with inhomogenous contrast enhancement. In (B) postoperative axial, T1-weighted MRI with Gd-DTPA showing total tumour removal. Injured vermis is indicated by black arrowhead. It was a medulloblastoma and the pre-existing ataxia was permanently worsened.

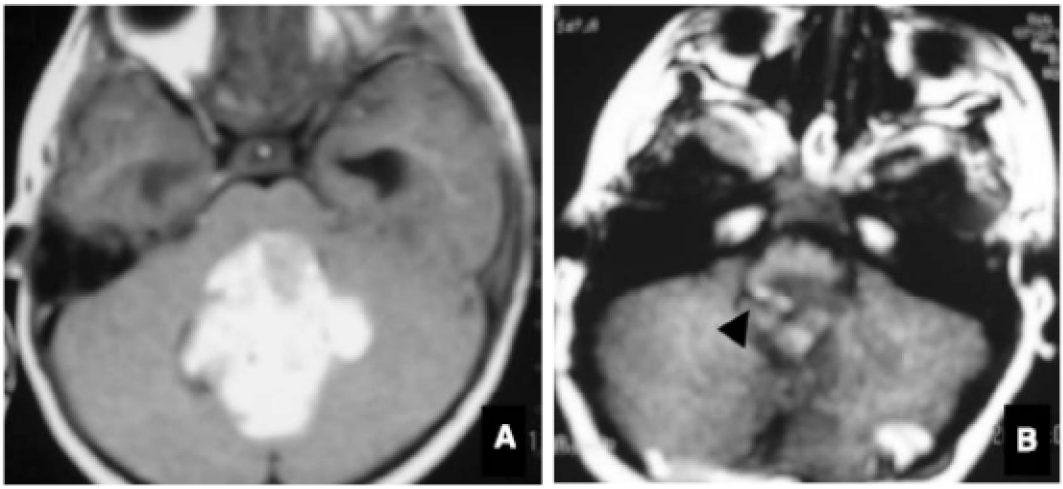

Fig. 3(A, B). In (A) axial T1-weighted MRI with Gd-DTPA showing fourth ventricular tumour in a 6 years old child with homogenous contrast enhancement. In (B) postoperative axial, T1-weighted MRI with Gd-DTPA showing subtotal tumour removal. Residual tumour attached to the inferior cerebellar peduncle is indicated by black arrowhead. It was an ependymoma.

In the fourth case, the tumour was focally arising from right lateral recess at the foramen of Luschka. Contra-lateral uvular retraction with rotation of operating table allowed optimum panoramic exposure of the foramen of Luschka. Total removal was achieved but the patient developed transient lower cranial nerves palsy. Endogasteric feeding and tracheostomy were necessary post-operatively for 2 months.

Postoperative outcome and neurological deficits

In this series, there was no mortality. No recurrence was observed during the limited follow up period, which ranged from 7 months to 43 months, with a mean fol-low-up of 24 months.

Total tumour removal was achieved in 11 out of patients (68.75%) [2 meningiomas, 2 low grade astro-cytomas, 2 epidermoids, 2 medulloblastomas, one ependymoma, one dermoid cyst, and one choroid plexus papilloma]. Subtotal removal was achieved in 5 cases (31. 25%).

Postoperatively, the pre-existing ataxia improved in patients (62.5%), unchanged in 2 patients (12.5%). Preoperative ataxia was temporary worsened in 2 patients (12.5%); one anaplastic astrocytoma and another medulloblastoma. The pre-existing ataxia was

permanently worsened in two other cases (12.5%); medulloblastomas that were totally removed. Cerebellar mutism did not occur in any patient of this series.

4. Discussion

Rhoton [10, 11] and Matsushima [8, 9] deserve credit for their pioneer work describing the microsurgical anatomy of the telovelar and trans-cerebellomedullary fissure approaches to the fourth ventricle without vermian splitting.

The cerebellomedullary fissure is a natural cleft between the cerebellum and medulla oblongata, and incision of the tela choroidea and inferior medullary velum proved to result in no neurological deficits. Via this natural cleft and the hazardless incision of these two sheets, we operated on 25patients with different fourth ventricular tumours without vermian splitting.

For large tumours that extend upward to the aqueduct, previous reports suggest a combined approach through the fourth ventricle below and a minimum of 1 cm midvermian incision may be used to avoid whole vermian injury [1]. Experience with 10 cases harbouring large fourth ventricular tumours, with extension to the aqueduct above, obex below, and lateral recesses bilaterally, indicate that by telovelar approach alone, vermian incision was not needed. Opening of thinned inferior medullary velum and tela choroidea on both sides with multidirectional uvular retraction was found to be sufficient to deal with large tumours. Matsushima et al. [9] in 2001 used the trans-cerebellomedullary fissure approach to expose the fourth ventricle in 19 patients. They de-scribed the extensive (aqueductal) opening method in which the uvulotonsillar and medullotonsillar spaces are dissected bilaterally together with cutting not only the taeniae but also the posterior margins of the lateral recesses on both sides to deal with large fourth ventricular tumours. However, in the 10 large ventricular tumours described, central debulking was performed at first, followed by opening of the thinned inferior medullary velum and tela choroidea on both sides with multi-directional uvular retraction. This was found to be sufficient to deal with large tumours. Thus, abandoning the need for resection of the posterior margins of both lateral recesses, as cutting of the taeniae bilaterally may injure the inferior cerebellar peduncles resulting in postoperative neurological deficits [9]. Jean and his associates [5] used the subtonsillar approach to deal with foramen of Luschka tumours in 5 patients. They mod-ified the cerebellomedullary fissure approach by adding a new step in the form of partial drilling of the occipital condyle in a lateral decubitus position. In 10 out of 25 patients, the tumours were large enough to extend to both lateral recesses and in one large ependymoma, the tumour was found to be focally attached to the foramen of Luschka on the right side. Contralateral retraction of the released uvula and maximum lateral tonsillar retrac- tion aided by operating table rotation and changing the angle of work provided an excellent far lateral panora- mic view to the foramen of Luchka. Thus, abandoning the need for occipital condyle drilling. Opening of the cisterna magna and subtonsillar release of arachnoid fila- ments helped in the dissection and decreasing pressure, which minimized the need for condylar drilling.

Conservative surgical strategy in ependymomas

We have operated upon four cases with ependymomas attached focally to the fourth ventricular floor (facial colliculus, foramen of Luschka, and obex). The patient in whom the focal attachment was to the facial colliculus, subtotal removal was obtained leaving behind a small sheet of tumour capsule adherent to the floor. This patient developed postoperative permanent facial and abducent palsy as a result of microdissection. The patient in whom the tumour was focally attached to the foramen of Luschka, total removal was achieved but with postoperative transient lower cranial nerves palsy for 2 months. However, the two patients of ependymoma in whom the focal attachment was to the obex, subtotal removal was performed avoiding injury to the inferior cerebellar peduncles and lower cranial nerves, a concept previously mentioned to minimize morbidity. Lower cranial nerve dysfunction is the most serious sequala of this surgery, and if an effort is made to remove this last fragment, it must be recognized that there is a trade-off in terms of postoperative morbidity [8].

Impact of lesion pathology

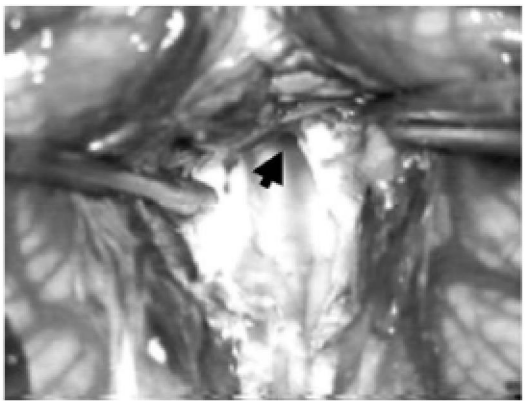

Fig. 4. Intraoperative photo graph showing the panoramic view of the fourth ventricle obtained via the telovelar approach. Aqueduct is indicated by black arrowhead.

Despite the panoramic view provided by the telovelar approach (Fig. 4), pathological nature of the

lesion and vital neural tissue infiltration are limiting factors for total tumour removal. In this study subtotal removal was achieved in 5 cases. This result was not due to inadequate exposure via this corridor, but it was related to the nature of the tumour and vital tissue infiltration. So near total removal is acceptable in cases where complete removal may endanger function or life.

Cerebellar ataxia and cerebellar mutism

The conventional transvermian approach to the fourth ventricle is accompanied by inherent risks, including cerebellar mutism. Cerebellar mutism is a transient complication which may appear after removal of mid-line cerebellar tumours involving the vermis in children [6, 9]. Cerebellar mutism can also occur in adults [12]. Cerebellar mutism is characterized by a lack of speech in the a wake patient with intact speech comprehension which is sometimes associated with oral apraxia [1]. Cerebellar mutism was not recorded in any of our patients owing to the use of natural clefts as an approach instead of the transvermian corridor. However, permanent worsening of the pre-existing ataxia was observed in two patients with medulloblastoma which were totally removed. The uvula and pyramids were damaged during the multidirectional uvular retraction together with excessive dissection along the undersurface of the vermis. These two factors seem to be responsible for the permanent worsening of the pre-existing ataxia.

Conclusion

The telovelar approach provides an excellent tumour exposure and adequate panoramic visualization of the entire fourth ventricle without splitting of the vermis. Pathological nature of the lesion and vital neural tissue infiltration are limiting factors for total tumour removal. Total removal of tumours focally attached to critical areas in the fourth ventricle should not be attempted at the expense of the patient's morbidity and mortality. Near total excision is acceptable in cases where complete removal may endanger function or life.

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