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OPERATIVE TECHNIQUES

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Neuroendoscopic placement of Ommaya reservoir into a cystic craniopharyngioma

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Abstract *Introduction:* Total removal of the tumor is the most acceptable therapeutic modality in the management of craniopharyngioma; however, there are innumerable factors that can upset treatment plans. Unresectable lesions are often treated with gamma knife surgery (GKS). Reduction of the cystic volume is necessary, to decrease the area to be treated with GKS. An Ommaya reservoir system is usually placed during open surgery or by stereotactic access. *Materials and methods:* The authors use a neuroendoscope for safer and less invasive placement of the Ommaya reservoir into deep-seated cystic lesions. The cystic component is aspirated, and the Ommaya reservoir tube is precisely guided and placed into the cyst cavity under neuroendoscopic control with a newly developed two-burr-hole technique. This neuroendoscopic procedure could make it easier to reduce cystic volume prior to GKS as the final procedure. This technique may also be used for instillation of chemotherapeutic agents and for repeat aspirations, making the achievement of cystic control more likely. This type of neuroendoscopic management is a safe and effective procedure and could be considered as an alternative management technique for some stubborn cystic craniopharyngiomas.

Keywords Neuroendoscope · Ommaya reservoir · Craniopharyngioma · Cyst

Introduction

Craniopharyngioma is often associated with cystic components. Gross total resection of the tumor is enough to prevent recurrence of the cyst, but most of these lesions are adjacent to the third ventricle, and sometimes they cannot be resected because they are so extensive. Although open surgery may provide a temporary improvement in the clinical status of the patient in such cases, the cysts regularly recur and require adjuvant therapy. In this event, endoscopic placement of an Ommaya reservoir avoids open surgery and multiple passes through the neuraxis and allows for aspiration of the cyst, making alternative therapies for the craniopharyngioma possible. We have placed Ommaya reservoir systems under neuroendoscopic guidance with a newly developed two-burr-hole technique in a patient with a recurrent cyst that was judged to be surgically unresectable.

Illustrative case

The patient initially presented in our institution at the age of 10 years, with headaches and impairment of visual acuity. She was found on general physical examination to be obese. Magnetic resonance imaging (MRI) imaging studies revealed a small enhancing nodule in the sella, with a huge cyst spanning the pons and medulla oblongata (Fig. 1A). The lesion was diagnosed as a giant cystic craniopharyngioma on the basis of the pathological findings after an initial operation. Postoperative imaging studies revealed complete cystic decompression (Fig. 1B). In addition, the patient's visual acuity and headaches improved after cystic decompression. Recurrence of the cyst was then found on a subsequent MRI scan 1 month later (Fig. 2A). She underwent placement of an Ommaya

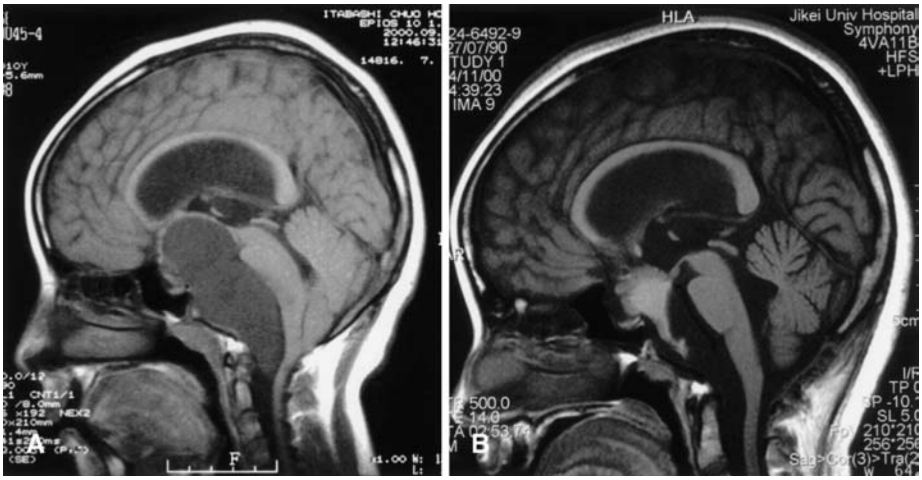

Fig. 1 **A** Sagittal T1-weighted magnetic resonance imaging (MRI) scan with gadolinium. There is a small enhancing nodule in the sella and a huge cystic lesion spanning the pons and medulla oblongata. **B** A postoperative axial CT scan demonstrates complete cystic decompression

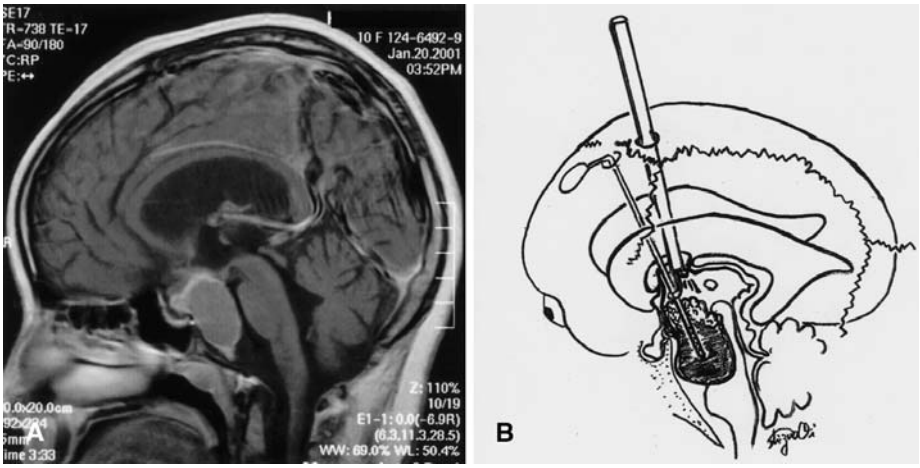

Fig. 2 **A** MRI showing recurrence of the cyst 1 month after surgery. **B** Schematic illustrating the ventricular catheter and the Ommaya reservoir system installed in the cystic component by the two-burr-hole technique with neuroendoscopic guidance

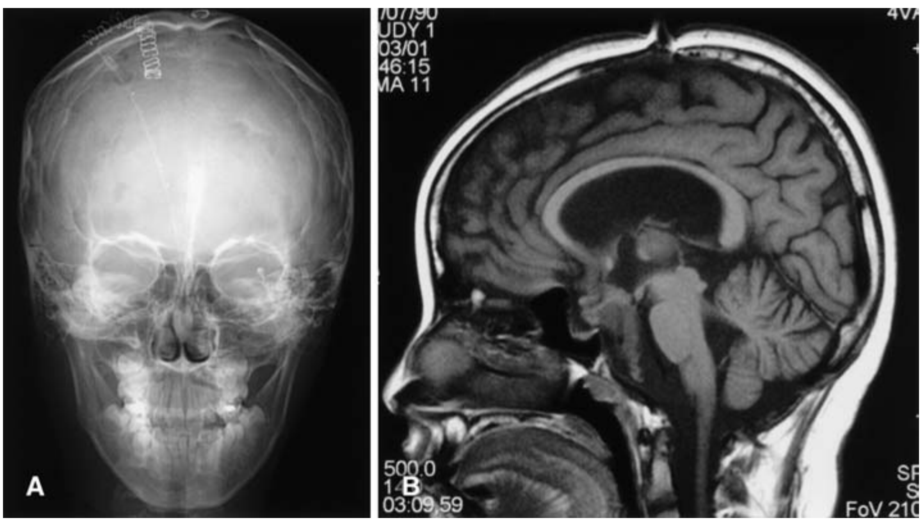

Fig. 3 **A** Postoperative craniogram and **B** sagittal MRI demonstrates accurate placement of the catheter and virtually complete decompression of the cyst

reservoir under neuroendoscopic guidance using a new two-burr-hole technique (Fig. 2B) for drainage of the cystic component. Initially, approximately 15 ml of viscous yellow fluid was obtained by aspiration. Over time, the fluid cleared and larger volumes were obtained, which were much greater than the predicted cyst volume. Postoperative craniograms were obtained to ensure accurate placement of catheters, and postoperative MRI revealed that cyst decompression was now adequate for GKS to be performed

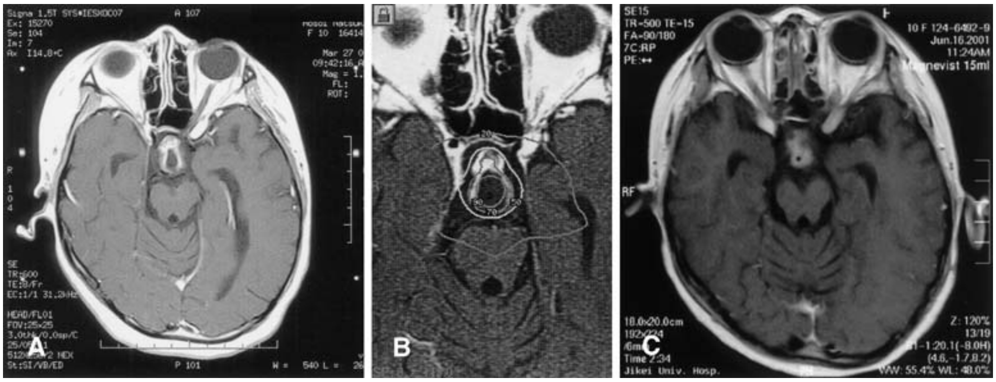

Fig. 4 **A** MRI shows decompression of the cyst is adequate for GKS. **B** GKS is planned in such a way that the dose delivered to the tumor margin is 6 Gy (median: 12 Gy), achieved by enclosing the tumor within the 50–95% isodose line. **C** MRI 6 months later shows no growth of the tumor or cyst since GKS

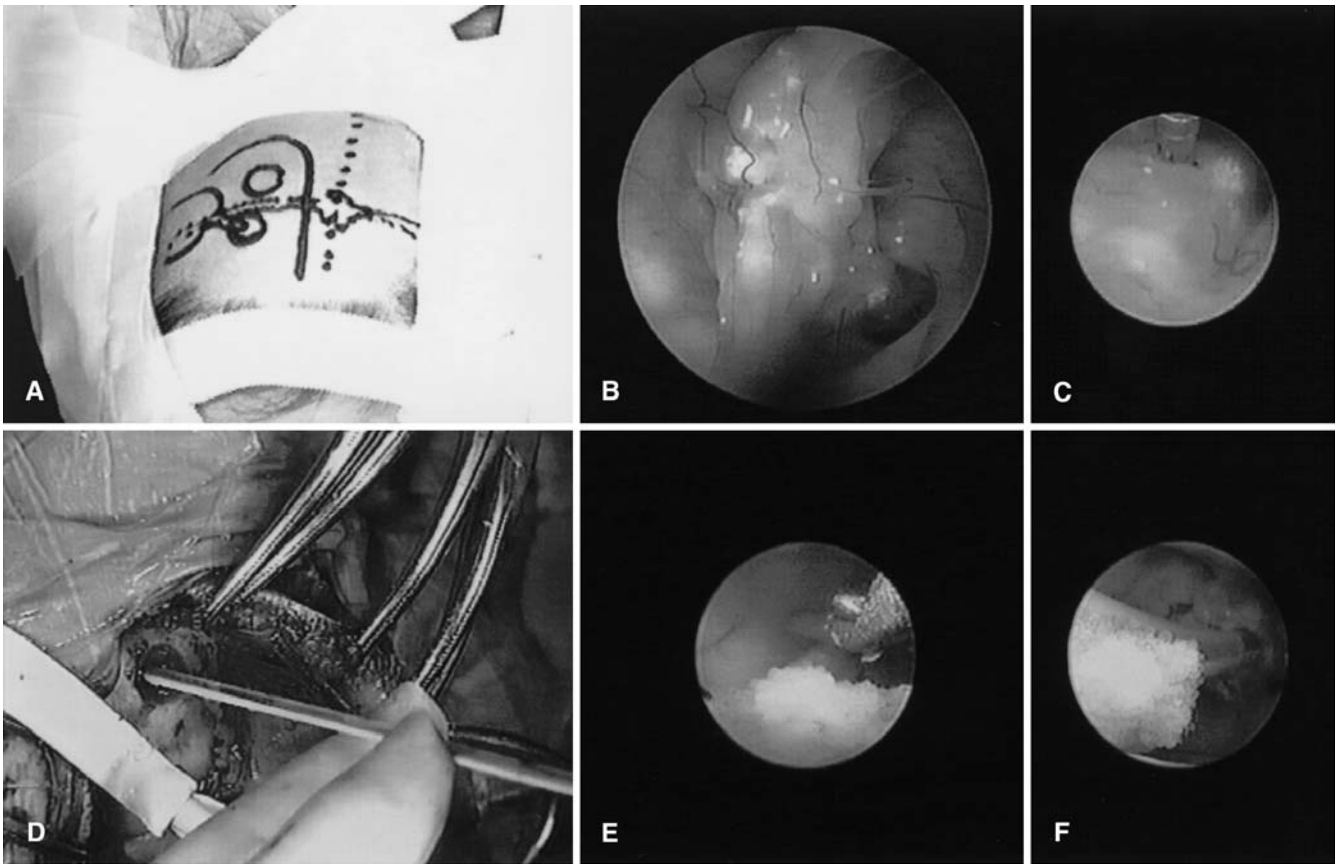

Fig. 5 **A** Two burr holes made in right frontal region on papillary line. **B** Superior aspect of the tumor and cyst is seen on the third ventricle floor. **C** The cyst is fenestrated by microforceps. **D** Ventricular catheter is placed in the anterior burr hole towards foramen of Monro. **E** The ventricular catheter is captured by microforceps in lateral ventricle. **F** The ventricular catheter is inserted in the fenestration of the cyst, i.e., through the foramen of Monro via the lateral ventricle

(Fig. 3A, B). GKS was then done to deal with the solid component, and the cyst wall was decompressed (Fig. 4A). The radiation dose delivered to the tumor margin was 6 Gy (median: 12 Gy), which was achieved by enclosing the tumor and cyst within the 50–95% isodose line (Fig. 4B). Six months after the above procedures, the patient remained intact neurologically, and repeat MRI revealed only a small residual tumor (Fig. 4C).

Surgical technique

The cyst's location was confirmed by contrast-enhanced MRI scans. Two burr holes were made in the right frontal region on the pupillary line, one anterior to and the other behind the coronal suture (Fig. 5A). Ventricular taps were made by using a manometric ventricular trocar [10] directed toward the right foramen of Monro from each burr hole. The trocar used behind the coronal suture was replaced by a 14-F peel-away sheath (Cook, Bloomington, Ind.). An Oi-Samii neuroendoscopic system (Oi-Samii Handi Pro; Karl Storz, Germany) was introduced into the peel-away sheath, and a ventricular catheter (Pudenz-Shulte Medical Corporation, Goleta, Calif.) was inserted from the frontal burr hole towards the right foramen of Monro. The operative technique is described elsewhere [8]. A rigid-rod endoscope (4.0 mm in diameter) was first inserted into the right lower frontal burr hole and moved into the lateral ventricle to allow observation of the gross morphological characteristics of the ventricle. The residual tumor located in the lower half of the third ventricle involved the entire floor of the ventricle (Fig. 5B). The superior aspect of the cyst was fenestrated by means of microforceps (Fig. 5C). Via the anterior burr hole, a ventricular catheter was introduced and advanced towards the foramen of Monro under direct vision by means of the neuroendoscope inserted directly via the posterior burr hole into the anterior horn of the lateral ventricle just above the foramen (Fig. 5D). The ventricular catheter was captured, to be guided into the cystic portion of the tumor (Fig. 5E). The ventricular catheter was inserted in the fenestration of the cyst, i.e., through the foramen of Monro via the lateral ventricle (Fig. 5F). A subcutaneous pocket was then made away from the skin incision, and a flat-bottom-side inlet Ommaya CSF reservoir (Hayer-Shulte, Deerfield, Ill.) was inserted and connected to the catheter with a connector.

Discussion

Cystic lesions that are adjacent to the third ventricle often have a substantial mass effect and cause neurological and general deterioration. Drainage of the cystic lesion by less invasive procedures leads to neurological improvement [6, 9, 17]. The treatment options for cystic lesions in the suprasellar cistern include surgical resection, stereotactic aspiration, stereotactic intracavitary implantation of radioisotopes, GKS, and combined therapy. Open surgical access to lesions in the suprasellar cistern is not always possible without significant risk to the patient. Stereotactic aspiration of cystic lesions of the brain stem is a safe method that carries a low level of surgical risk [1, 4, 9, 17]. Against this background, it proved possible to implant an Ommaya reservoir to decompress the cyst, which was causing the acute symptoms, and GKS could subsequently be safely performed. It is hoped that this will avoid further side effects and the risks usually associated with GKS. However, further follow-up is needed to determine the highest tolerable dose of radiation to the surrounding critical structures and the long-time outcome in terms of tumor control [2, 3, 7]. Colloidal chromic phosphate (^{32}P) has been used previously with this approach in the treatment of eight cystic craniopharyngiomas [5], and Takahashi et al. have successfully treated a cystic craniopharyngioma by injecting bleomycin via an Ommaya reservoir [16].

The statement that cystic craniopharyngiomas with tumor volumes up to 25 ml can be safely and effectively treated with GKS is controversial, because the dose delivered to the optic apparatus is kept as low as possible. Therefore, if a large cystic component is present, this should be decompressed before GKS is applied [2]. Ommaya reservoir systems have been placed to access fluid cavities within the brain since they were originally described in 1963 [12]. In 1968 Ratcheson and Ommaya [14] reported a series of 60 patients in whom Ommaya reservoirs were implanted. Multiple series have since documented the indications for and the safety and efficacy of implantation of this type of access device into fluid cavities in the brain [6, 7, 13, 15].

We have already reported the use of two-burr-hole strategies for insertion of extraventricular drainage tubes and for tumor resection in the case of pineal region tumors [11]. The two-burr-hole strategy is an attractive option for the management of deep-seated cystic lesions, as it would avoid subdural fluid collections after neuroendoscopic surgery in some cases. It is suggested that in our case GKS accompanied by neuroendoscopically guided placement of an Ommaya reservoir by the two-burr-hole technique should be performed as an alternative way of treating recurrent or residual craniopharyngiomas if further microsurgical excision cannot promise a cure.

In conclusion, we have usually used the neuroendoscope for placement of Ommaya reservoir systems to access cystic lesions of craniopharyngioma in children. This can facilitate cystic aspiration and reduce the cystic volume, making it possible to avoid excessive treatment with GKS and also to prevent the development of a subdural fluid collection. No technical problems occurred in placement of the catheters in our patient, and we have not encountered any postoperative infections or equipment malfunctions when we have used the neuroendoscope.

References

1. Apuzzo ML, Chandrasoma PT, Cohen D, Zee CS, Zelman V (1987) Computed imaging stereotaxy: experience and perspective related to 500 procedures applied to brain masses. Neurosurgery 20:930–937
2. Chung WY, Pan HC, Guo WY, Shiau CY, Wang LW, Wu HM, Lee LS (1998) Protection of visual pathway in gamma knife radiosurgery for craniopharyngiomas. Stereotact Funct Neurosurg 70 [Suppl 1]:139–151
3. Chung WY, Pan DH, Shiau CY, Guo WY, Wang LW (2000) Gamma knife radiosurgery for craniopharyngiomas. J Neurosurg 93 [Suppl 3]:47–56
4. Hood TW, McKeever PE (1989) Stereotactic management of cystic gliomas of the brain stem. Neurosurgery 24:373–378
5. Kobayashi T, Kageyama N, Ohara K (1981) Internal irradiation for cystic craniopharyngioma. J Neurosurg 55:896–903
6. Machado M, Salcman M, Kaplan RS, Montgomery E (1985) Expanded role of the cerebrospinal fluid reservoir in neurooncology: indications, causes of revision, and complications. Neurosurgery 17:600–603
7. Mann KS, Yue CP, Ong GB (1983) Percutaneous sump drainage: a palliation for oft-recurring intracranial cystic lesions. Surg Neurol 19:86–90
8. Mokry M (1999) Craniopharyngiomas: a six-year experience with gamma knife radiosurgery. Stereotact Funct Neurosurg 72:140–149
9. Oi S, Matsumoto S (1988) Manometric ventricular trocar – a new shunting apparatus with intraventricular fluid pressure monitoring. Neurol Med Chir (Tokyo) 28:559–561
10. Oi S, Hidaka M, Honda Y, Togo K, Shinoda M, Shimoda M, Tsugane R, Sato O (1999) Neuroendoscopic surgery for specific forms of hydrocephalus. Childs Nerv Syst 15:56–68
11. Oi S, Shibata M, Tominaga J, Honda Y, Shinoda M, Takei F, Tsugane R, Matsuzawa K, Sato O (2000) Efficacy of neuroendoscopic procedures in minimally invasive preferential management of pineal tumors: a prospective study. J Neurosurg 93:245–253
12. Ommaya AK (1963) Subcutaneous reservoir and pump for sterile access to ventricular cerebrospinal fluid. Lancet II:983–984
13. Ommaya AK (1984) Implantable devices for chronic access and drug delivery to the central nervous system. Cancer Drug Deliv 1:169–179
14. Ratcheson RA, Ommaya AK (1968) Experience with the subcutaneous cerebrospinal-fluid reservoir: preliminary report of 60 cases. N Engl J Med 279:1025–1031
15. Rogers LR, Barnett G (1991) Percutaneous aspiration of brain tumor cysts via the Ommaya reservoir system. Neurology 41:279–282
16. Takahashi H, Nakazawa S, Shimura T (1985) Evaluation of postoperative intratumoral injection of bleomycin for craniopharyngioma in children. J Neurosurg 62:120–127
17. Zamorano L, Ausman JI, Chorni D, Dujovny M (1992) Stereotactic management of midline brain lesions. Stereotact Funct Neurosurg 59:142–150