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Outcome and mid-term prognosis after maximum and radical removal of craniopharyngiomas with the priority to the extended transsphenoidal approach—A single center experience

Yoshikazu Ogawa [a,*], Tomohiro Kawaguchi [a], Teiji Tominaga [b]

[a] Department of Neurosurgery, Kohnan Hospital, Sendai, Miyagi, Japan
[b] Department of Neurosurgery, Tohoku University Graduate School of Medicine, Sendai, Miyagi, Japan

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ABSTRACT

Objective: The transsphenoidal approach has been increasingly used for the surgical treatment of craniopharyngiomas with/without sellar enlargement. However, the optimum indications for the extended transsphenoidal approach with opening of the posterior ethmoidal sinus in addition to opening of the sellar floor are still controversial.
Methods: Forty-two patients with craniopharyngiomas treated by the extended transsphenoidal approach were retrospectively studied from a series of 993 cases of pituitary surgeries between April 2004 and September 2013. Removal rate, visual function, endocrinological changes, and mid-term prognosis were investigated.
Results: Gross total removal was achieved in 31 of 42 patients (73.8%) overall, in 24 of 27 patients (88.9%) undergoing initial treatment, and in 7 of 15 patients (46.7%) undergoing re-treatment after previous transcranial tumor removal and/or radiation therapy. The major cause of abandonment of surgery in the re-treatment group was tight adhesion and/or encasement of the perforating arteries. The rate of total removal showed a significant difference between initial treatment and re-treatment groups (logrank test, $p < 0.001$). Only one patient suffered tumor recurrence after total removal, but the others remained disease-free during the follow-up period. Postoperative visual acuity was improved in 20 of 40 patients evaluated, remained steady in 20, and deteriorated in none, indicating good ophthalmological outcomes in all 40 patients. The pituitary stalk was intentionally sectioned in 18 of 42 patients, and 9 of the 18 patients could discontinue usage of antidiuretic hormone in the follow-up period. All patients were discharged without neurological deficits, except for two patients with preoperative dysfunction of the mammillary bodies, and all maintained independence in daily life with hormonal supplementation. No other complications including cerebrospinal fluid leakage were experienced in the follow-up period.
Conclusions: Maximum and radical removal through the extended transsphenoidal approach achieved high rate of total removal and good visual outcomes. However, re-treatment still presents challenges.

1. Introduction

Craniopharyngioma is a slow-growing tumor classified as benign, but is located very close to vital structures such as the pituitary gland, optic apparatus, third ventricle floor, and mammillary bodies. Tight adhesion and significant local infiltration are also common, so long-term tumor control and maintenance of quality of life are sometimes difficult despite modern microsurgery techniques and precise anatomical understanding [1,2]. Fractionated radiotherapy and/or chemotherapy are sometimes preferred to treat cystic lesions [3–8], but the most significant prognostic factor is extent of tumor removal in terms of survival and recurrence-free survival [1,9,10]. The transsphenoidal approach has been used for the removal of craniopharyngioma located within the sella turcica and without calcification [5,11]. Recent technical advances in skull base repair have extended the indications, with some preliminary experiences [12–18]. This approach provides a straight working axis to the lower plane of the optic chiasm, allowing the surgeon to operate in a wider and clearer field. However, there are significant limitations in the treatment of cases with lateral and/or deeper extension in the third ventricles [14,19].

* Corresponding author at: Corresponding author. Tel.: +81 22 248 2131; fax: +81 22 304 1641.
E-mail address: yogawa@kohnan-sendai.or.jp (Y. Ogawa).

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Gross total removal was reported in 40.9% to 77.8% of previous cases [12–14,17,18], and giant tumors and cases with third ventricle involvement were thought to indicate worse prognosis [4,14]. However, the optimum indications for the extended transsphenoidal approach with opening of the posterior ethmoidal sinus in addition to opening of the sellar floor are still controversial, and the mid and long-term outcomes remain unclear.

We describe our series of craniopharyngiomas treated through the extended transsphenoidal approach in a single institute, and discuss the initial outcomes and mid-term prognosis after maximum and radical removal of the tumor.

2. Materials and methods

This retrospective review identified 21 males and 21 females aged from 4 to 80 years (mean 48.81 years) with craniopharyngiomas (Table 1) who were treated through the extended transsphenoidal approach from April 2004 to September 2013 by a single surgeon (YO), accounting for 4.23% of 993 cases of skull base tumor treated through the transsphenoidal approach during the same period at the Department of Neurosurgery, Kohnan Hospital. All diagnoses were confirmed by histological findings. All tumors were located from the sella turcica up to the suprasellar cistern. No evident cleavage was found between pituitary stalks and the tumors in 18 cases, which were initially the peri-infundibular type and later became large tumors extending from the sella turcica to the suprasellar cistern.

Surgery was intended to achieve maximum and radical removal without causing neurological deficits. Exposure was extended to the posterior ethmoidal sinus in addition to opening of the sellar floor through the sphenoidal sinus due to the tumor size in all patients. To visualize and obtain a straight corridor to the cleavage between the optic chiasm and the tumor anterior margin, dural windows were also extended from the sella turcica over the tuberculum sellae to the planum sphenoidale. Great care was taken to preserve the fine arteries running over the surface of the optic chiasm, which frequently had diameters of less than 300 μm, and the arachnoid sheath around the optic chiasm. If the tumor bed involved the posterior lobe of the pituitary gland, pituitary stalk, and/or third ventricle floor, these structures were removed en bloc together with the tumor. In such cases, the pituitary stalk was incised just at the transition to the posterior lobe of the pituitary gland, and the third ventricle floor was incised 1.5 mm anterior from the mammillary bodies.

Microsurgical techniques were mainly utilized to form the fine dissection plane between the tumor and the arachnoid sheath around the optic chiasm and for dissection of normal vessels, whereas the endoscope was essentially used to access areas in the dead angle of the microscope including the regions behind the dorsum sellae or anterior third ventricle. Eight patients were treated with the pulsed laser-induced liquid jet system to dissect the tumor from vital neurological structures, a new technique now undergoing multi-center clinical trials for transsphenoidal surgery in Japan [19–21]. The surgical microscope and neuroendoscope were utilized as required during the operation.

Reconstruction of the skull base was performed with autologous fascia tightly sutured to the dural edge of the sellar floor, fortified with epidural attachment of muscle pieces, and the entire surface of the dural window was wrapped with mucosal flap of the sphenoidal sinus. No type of marsupialization was performed. Continuous spinal drainages were placed for 4 days to prevent cerebrospinal fluid leakage, and the patients were confined to bed rest during this period. Postoperative prophylactic use of antibiotics was continued for 7 days.

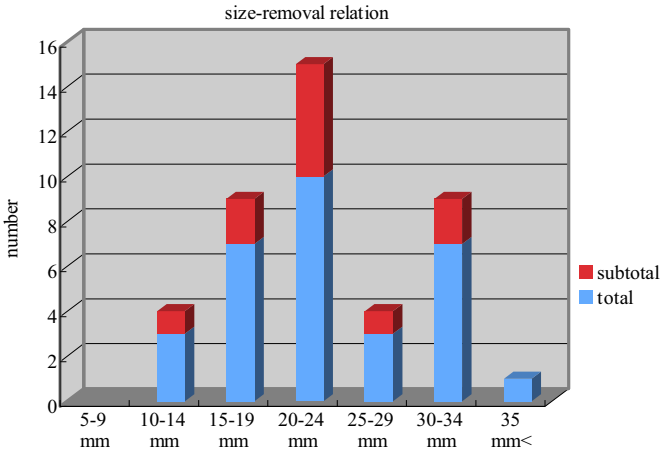

Fig. 1. Overall surgical outcomes. Gross total removal was achieved in 31 of the 42 cases.

All patients underwent coronal and sagittal T1-weighted, with and without contrast medium, and T2-weighted magnetic resonance (MR) imaging (1.5 tesla system; Magnetom, Siemens AG, Erlangen, Germany and Signa Horizon, General Electric, Milwaukee, WI, USA) preoperatively, just after the operation, and 3 months after the operation. Follow-up MR imaging was performed at 6-month intervals after the operation. Gross total removal was defined as absence of visible tumor bulk on both intraoperative findings and postoperative MR imaging. Visual acuity and visual field were also evaluated using the Humphrey field analyzer both preoperatively and 11 days after the operation. The morning serum concentrations of luteinizing hormone, follicle-stimulating hormone, thyroid-stimulating hormone, free T3, free T4, growth hormone, insulin-like growth factor-1, prolactin, adrenocorticotropic hormone, and cortisol were measured in addition to urinary free cortisol, both preoperatively and 11 days after the operation. If hyposecretion was suspected, supplemental glucocorticoid and/or levothyroxine were administered after confirmation of diabetes insipidus by stimulation tests as well as desmopressin acetate (DDAVP). If recurrence or re-growth of the tumor was detected, follow-up MR imaging was discontinued, and gamma knife surgery or re-operation was performed. The follow-up period ranged from 3 to 110 months (mean 41.95 months).

The surgical policy was explained preoperatively to the patients and the study design was approved by the Ethics Committee of Kohnan Hospital 2013. Statistical comparisons used Mini Statmate software (ATMS Co., Ltd., Tokyo, Japan) and p values of less than 0.05 were regarded as significant.

3. Results

Overall, gross total removal was achieved in 31 of 42 patients (73.8%), but small tumor remnants persisted in 11 patients (Fig. 1). Gross total removal was achieved in 24 of 27 patients (88.9%) undergoing initial treatment, and tumor remnants persisted in 3 patients (Fig. 2). One of these three patients had tumor remnant strongly adhered to the surface of optic chiasm due to disruption of the arachnoid sheath around the chiasm. Another of these patients had small remnant tightly adhered to the inner wall of the cavernous sinus. The third patient with tumor remnant presented with transformation from Rathke's cleft cyst to papillary type craniopharyngioma, initially treated by aspiration of the cyst content and partial membranectomy. Gross total removal was only achieved in 7 of 15 patients (46.7%) undergoing re-treatment after previous transcranial tumor removal and/or radiation therapy (Fig. 3). The major cause of abandonment of surgery in this group was