Endoscopic endonasal transsphenoidal approach for symptomatic Rathke cleft cyst: A case series

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Abstract. The purpose of the present study was to evaluate the safety and effectiveness of the surgical method by reviewing the long-term outcomes of a series of symptomatic Rathke cleft cyst (RCC) cases. The surgical approach was the endoscopic transsphenoidal approach and the surgical strategy was intracapsular decompression, excision of cyst contents, partial excision of the cyst wall and no filling of the cyst cavity. The present study retrospectively analyzed 61 cases of symptomatic RCC treated at Chongqing General Hospital (Chongqing, China) between April 2014 and August 2021, and a detailed evaluation was performed on these cases, including clinical symptoms, imaging features, cyst location and characteristics, intraoperative conditions, postoperative outcomes, postoperative complications and long-term follow-up. In the three aspects of clinical symptom relief, postoperative complications and postoperative recurrence rate, this surgical method was analyzed and evaluated. The results suggested that this surgical method is safe and effective for the treatment of symptomatic RCC, which may effectively relieve symptoms and reduce postoperative complications and recurrence.

Introduction

Rathke cleft cysts (RCCs) are remnants originating from Rathke's pouch, which is usually located near the sellar region. According to the specific location, RCCs may be divided into the intrasellar, intrasellar to suprasellar and the suprasellar type (1). The detection rate of RCCs in routine autopsy may reach 12-33% (2). RCCs may occur in individuals of all ages, but mostly occur above the age of 30, and it is more common in middle-aged individuals than in children and the elderly (3). The status of RCCs is variable, most of them remain stable, certain cases exhibit spontaneous regression and others expand gradually and continuously (4). Among them, patients with RCCs with stable and spontaneous regression are usually not symptomatic and such RCCs are classified as asymptomatic RCCs. However, gradually expanding RCCs have a great impact on the surrounding structures (such as the pituitary, hypothalamus and optic chiasm), so that patients exhibit clinical symptoms and complaints, such as headache, impaired vision or pituitary dysfunction, and these RCCs are classified as symptomatic RCCs (5-7). Barkhoudarian *et al* (8) indicated that ~60% of RCCs were asymptomatic. For asymptomatic RCCs, follow-up is usually recommended, while for symptomatic RCCs, surgical treatment is necessary (9). In recent years, with the rapid development of neuro endoscope technology and hardware equipment, the endoscopic endonasal transsphenoidal approach (EETA) has been widely used, with the advantages of a clear field of vision deep into the sellar region, direct vision of lesions, less trauma, minimal post-operative discomfort and rapid recovery. In the present study, 61 cases of symptomatic RCCs treated by EETA were retrospectively analyzed. Information regarding the clinical symptoms, MRI features, tumor location and characteristics, intraoperative conditions, postoperative outcomes, postoperative complications and long-term follow-up was collected and analyzed in detail. In addition, the effectiveness and safety of surgical strategies based on intracapsular decompression, total resection of cyst contents, partial resection of the cyst wall and no filling of the cyst cavity were evaluated and verified based on the relief of clinical symptoms, postoperative complications and recurrence rate.

Materials and methods

Patient selection. All cases included in the present study were required to meet the inclusion criteria. The specific conditions for inclusion were as follows: The RCCs were symptomatic and their diagnosis was made according to the general criteria (10); the patients underwent EETA at the Department of Neurosurgery, Chongqing General Hospital (Chongqing, China) between April 2014 and August 2021; postoperative pathology confirmed RCCs (when the resected part contained the cyst wall and cyst contents, a pathological examination was performed on both parts. When there was no cyst wall and only cyst content in the resected part, the pathological examination was performed on the cyst content). The specific conditions for exclusion were as follows: Inflammation in the nasal cavity and paranasal sinuses; coagulation dysfunction; patients in

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a poor physical condition and not able to tolerate the operation. According to the inclusion criteria, 61 eligible patients were enrolled. The present study was approved by the ethics committee of the hospital (approval no. KY S2022-032-01).

Surgical procedure. In general, patients received EETA within 2 weeks after the diagnosis of symptomatic RCCs. The specific surgical procedure was as follows: After general anesthesia, the patient was placed in the supine position and the head was turned 10˚ to the right. After routine nasal disinfection and towel laying, the endoscope was placed along the right nasal cavity. The IMAGE1 S camera system (Karl Storz) was used during surgery. Under the guidance of the endoscope, first, the opening of the right sphenoid sinus was located, then the mucosa above the opening of the sphenoid sinus was cut, then the sphenoid sinus and sellar base bone were opened, and finally, the dura mater was exposed. The dura was cut and enlarged to expose the pituitary gland and lesions. At the weakest part of the cyst wall, the RCCs were opened for intracapsular decompression. The outflow cystic fluid was a yellow-white chylous fluid, a colloidal translucent substance or a mucus-like substance. The curette and aspirator were used to remove the cyst fluid and normal saline was used to repeatedly flush the cyst cavity until the residual cyst contents were resected. Whether the cyst wall of RCCs is removed depends on the specific situation. When the cyst wall of RCCs is close to the pituitary and difficult to remove from the pituitary structure, it is not recommended to remove the cyst wall of RCCs. When the cyst wall of RCCs is not closely connected with the pituitary tissue, it is easy to peel the cyst wall from the surrounding pituitary tissue, which is recommended to resect. Finally, the skull base was repaired and the specific steps were as follows: The skull base was directly repaired with artificial dura with no filling in the cyst cavity. Hemostatic gauze was used for external filling and iodoform gauze strips were inserted into the right nasal tract. The operation time was ~40 to 100 min, with an average of 61 min. In conclusion, the surgical strategy for EETA resection of RCCs was intracapsular decompression, total resection of cyst contents, partial resection of cyst wall and no filling of the cyst cavity.

Histopathological examination. After the operation, a pathological examination was performed to observe the histopathological characteristics and confirm the diagnosis. At room temperature, tissue samples from patients were fixed in 10% neutral formalin solution for 12 h, then embedded in paraffin, cut into 3-μm sections and subjected to H&E staining. Pathological examination was performed under a light microscope (BX43; Olympus Corporation), including analysis of the type and degree of cystic fibrosis and the presence of inflammatory infiltration.

Results

Patient demographics and clinical characteristics. The characteristics of the 61 patients are provided in Table I. Combined with preoperative MRIs and intraoperative conditions and according to the location of the RCCs, 61 patients with RCC were divided into groups of intrasellar RCCs (n=38), intra- and supra-sellar RCCs (n=14) and suprasellar RCCs (n=9). Patient age ranged from 13 to 69 years, with a median age of 47 years. Specifically, for patients with RCCs in different locations, there were certain differences in age range and median age, which were 13-69 and 47 years (intrasellar), 17-64 and 40 years (intra- and supra-sellar) and 18-54 and 52 years (suprasellar). The cohort comprised 22 males and 39 females, including 17 males and 21 females in the intrasellar, 4 males and 10 females in intra- and supra-sellar, and 1 male and 8 females in the suprasellar group. The main clinical symptoms of the patients with RCC were headache, visual impairment and pituitary dysfunction. Among all patients, 88.5% (n=54 cases) suffered from headaches, including 35 cases in the intrasellar, 11 cases in the intra- and supra-sellar and 8 cases in the intrasellar group, with proportions of as high as 92.1, 78.6 and 88.9%, respectively. Furthermore, 30 patients had visual impairment, accounting for 49.2%, including 17 cases in the intrasellar, 8 cases in the intra- and supra-sellar and 5 cases in the suprasellar groups, accounting for 44.7, 57.1 and 55.6%, respectively. In addition, there were 8 patients (13.1%) with pituitary dysfunction, including 5 cases (13.2%) in the intrasellar, 1 case (7.1%) in the intra- and supra-sellar and 2 cases (22.2%) in the suprasellar group. The RCCs had a maximum diameter of <1, 1-2, 2-3, 3-4 and >4 cm in 1, 54, 5, 0 and 1 cases, respectively. Furthermore, the average diameter of these symptomatic RCCs was ~1.55x1.48x1.33 cm, which was measured by caliper measurement tool of the medical imaging system. In addition, in only one case it was confirmed that the RCC was enlarged prior to the operation, while the RCCs of the other patients were not significantly enlarged.

Postoperative outcomes. After surgery, headache and pituitary dysfunction of all patients were improved, while visual ability was improved in 22 cases, accounting for 73.3%. The postoperative complications were transient diabetes insipidus (DI) and hypopituitarism (HP). Transient DI occurred in 14 cases (23%), including 5 cases (13.2%) in the intrasellar, 8 cases (57.1%) in the intra- and supra-sellar and 1 case (11.1%) in the suprasellar group, while transient HP occurred in 7 cases (11.5%), including 3 cases (7.9%) in the intrasellar and 4 cases (28.6%) in the intra- and supra-sellar group. None of the patients with transient DI received treatment and automatically returned to normal within ~10 days. Patients with transient HP returned to normal within ~3 weeks after oral administration of thyroxine and hydrocortisone. The follow-up time ranged from 1 to 47 months and there was no recurrence based on MRI during follow-up. In addition, it is worth noting that 28 patients did not come to our hospital for follow-up after discharge. Their follow-up time was recorded as 1 month and their recurrence was judged by postoperative MRI.

Imaging and histopathological findings. Figs. 1-3 present the relevant images of an intrasellar case, an intra- and supra-sellar case, and a suprasellar case, including preoperative MRI (Figs. 1-3A-C), intraoperative images (Figs. 1-3D-F) and postoperative MRI (Figs. 1-3G-I). Usually, preoperative MRI is used to judge the location and type of lesions. From the preoperative MRI, it may be observed that all 3 cases had obvious space-occupying lesions, which were located in the intrasellar, the intra- and supra-sellar and the suprasellar region, respectively, and were preliminarily diagnosed as RCCs. The intraoperative images indicate the process of removal of cyst contents. Comparing the postoperative with the preoperative

Table I. Characteristics of all patients (n=61).

Item	Intrasellar (n=38)	Intra- and supra-sellar (n=14)	Supersellar (n=9)	Total
General information				
Age, years	47 (13-69)	40 (17-64)	52 (18-54)	47 (13-69)
Sex (male/female)	17/21	4/10	1/8	22/39
Clinical symptoms				
Headache	35 (92.1)	11 (78.6)	8 (88.9)	54 (88.5)
Visual impairment	17 (44.7)	8 (57.1)	5 (55.6)	30 (49.2)
Pituitary dysfunction	5 (13.2)	1 (7.1)	2 (22.2)	8 (13.1)
Clinic symptoms outcome				
Headache relief	35 (100)	11 (100)	8 (100)	54 (100)
Vision improvement	11 (64.7)	7 (87.5)	4 (80.0)	22 (73.3)
Improvement of pituitary function	5 (100)	1 (100)	2 (100)	8 (100)
Postoperative complications				
Transient diabetes insipidus	5 (13.2)	8 (57.1)	1 (11.1)	14 (23.0)
Transient hypopituitarism	3 (7.9)	4 (28.6)	0 (0.0)	7 (11.5)
Follow up, months	6 (1-29)	5 (1-22)	13 (1-47)	7 (1-47)
Recurrence	0	0	0	0

Values are expressed as n (%) or mean (range).

MRI, it may be observed that the space-occupying lesions were successfully removed. Fig. 4A-C provides histopathological images of three cases, patients 1, 2 and 3, respectively. From the pathological image of patient 1, pink unstructured cystic fluid may be observed. The pathological image of patient 2 indicates that the cyst wall is covered by cubic epithelium. The pathological image of patient 3 is similar to that of patient 1, indicating pink unstructured cystic fluid, but the difference is that slit-like structures are visible. In conclusion, according to histopathology (Fig. 4), all three cases were diagnosed as RCCs.

Discussion

The preoperative diagnosis of RCCs and their differentiation from other intracranial lesions are important and have a guiding role in formulating treatment plans and surgical strategies. RCCs are usually located in the sellar region and close to pituitary tissue. In general, round, oval and dumbbell-shaped thin-walled cystic lesions are displayed on MRI. Furthermore, due to the different cystic liquid properties of RCCs, RCCs may display as high, equal and low signals on T1-weighted imaging (T1WI) and T2WI (10). The above characteristics of RCCs are similar to those of pituitary adenoma, craniopharyngioma and meningioma, so RCCs should be differentiated from these tumors prior to surgery. Pituitary adenoma is the most common space-occupying lesion in the sellar region. MRI usually displays isointense to gray matter on TIWI and hyperintense on T2WI (11). Craniopharyngioma is also a lesion in the sellar region. The cystic components tend to be hyperintense on T2WI. Enhancement of the cyst wall and heterogeneous enhancement of the solid portions are common (12). Meningiomas may also be located in the sellar region, presenting as an isosignal on T1WI and T2WI, usually exhibiting strong uniform enhancement (13). These tumors exhibit similarities on MRI and it is difficult for MRI to distinguish these tumors. In addition, these tumors are located in the sellar region and close to pituitary tissue, which may cause similar clinical symptoms, such as headache, changes in vision and visual field or endocrine symptoms. Therefore, it is difficult to distinguish them from their clinical symptoms. Finally, the differential diagnosis between RCCs and these tumors is based on the pathological diagnosis.

In general, the size of RCCs is closely related to the clinical symptoms. Most of the smaller RCCs are scattered and asymptomatic, while the larger RCCs expand the pressure on the surrounding tissues, which may lead to clinical symptoms such as headache, visual field defect and pituitary dysfunction. Therefore, RCCs are divided into asymptomatic and symptomatic RCCs, and the symptomatic treatment methods for these two types of RRC are also different. For asymptomatic RCCs, conservative treatment has been highly recognized and widely used. The long-term follow-up results of 75 cases with asymptomatic RCCs accidentally diagnosed by radiology have indicated that the lesions of most patients remain unchanged or shrink over time, indicating that conservative treatment of asymptomatic RCCs is reasonable (14). For symptomatic RCCs, surgery is a recognized treatment. In recent years, EETA has become a standard surgical approach for symptomatic RCCs. The specific surgical strategy is intracapsular decompression, excision of cyst contents, partial excision of the cyst wall and no filling of the cyst cavity. In the present study, 61 cases of symptomatic RCCs treated at our department from 2014 to 2021 were retrospectively analyzed. Specifically, common clinical symptoms were analyzed, such as headache,

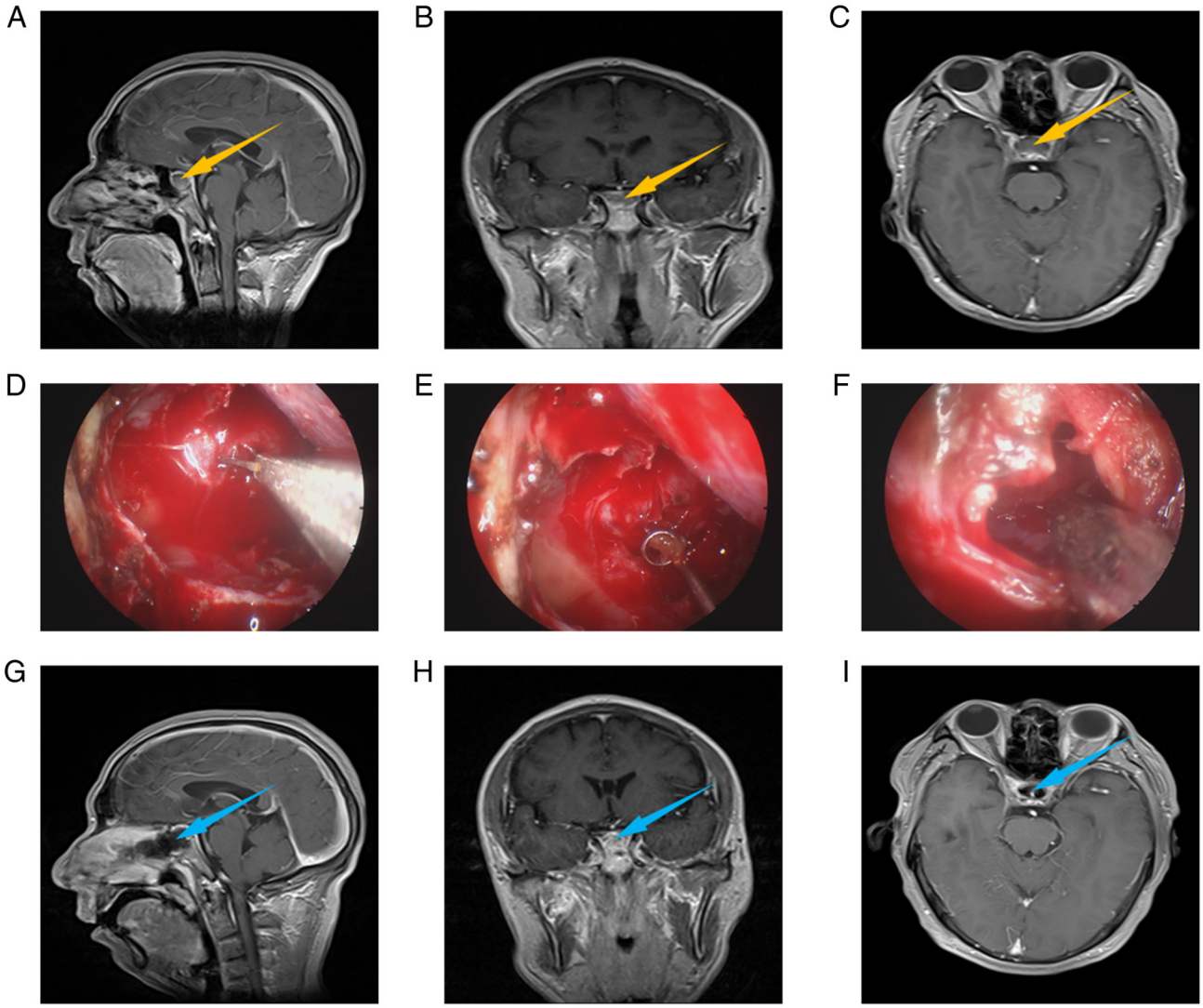

Figure 1. Case illustration of patient no. 1. (A-C) Preoperative MRI scans, which are gadolinium-enhanced T1-weighted (A) sagittal image, (B) coronal image and (C) transverse image, reveal an intrasellar RCC. (D-F) Intraoperative images displaying how (D) the cyst at the weakest part of the cyst wall was opened, (E) the contents of the cyst were removed by a curette and (F) the residual cyst contents were aspirated by an aspirator. (G-I) Postoperative MRI, which are gadolinium-enhanced T1-weighted (G) sagittal image, (H) coronal image and (I) transverse image. The yellow arrow indicates the preoperative RCC and the blue arrow indicates the cystic cavity after the resection of the RCC. RCC, Rathke cleft cyst.

abnormal visual acuity and field and pituitary insufficiency, and the corresponding possible causes and relief, as well as the postoperative complications and recurrence. The surgical results suggested that this surgical method may effectively relieve symptoms and reduce postoperative complications and recurrence. As the study is a case series study, there is no division between any control group and an experimental group; furthermore, no statistical comparison was performed among the three different groups and there was a relatively short follow-up time for certain cases, which are limitations.

The most common clinical manifestation of symptomatic RCCs is headache, particularly paroxysmal headache in the forehead, which is a common and characteristic symptom of symptomatic RCCs (15). In the cohort of the present study, 88.5% (54 cases) of the patients had headache symptoms, the rate of which was significantly higher than that of other clinical symptoms. The headache types were paroxysmal, persistent, forehead, temporal, parietal, occipital, tingling and dilative headaches. A total of 39 cases presented with paroxysmal headache in the forehead, accounting for 72.2%. However, most of the patients did not go to the hospital for treatment when they had a headache, but their symptoms were temporarily relieved after taking medication by themselves. Therefore, their headache was not diagnosed as a specific type of headache. Only one case was diagnosed as a headache caused by sinusitis. After the operation, the headache of these 54 patients was relieved. According to the literature, the same surgical method is used to treat RCCs and the relief rate of headache in RCC patients after the operation has reached 80-93% (16,17). Headaches may be due to the space-occupying effect or the intermittent inflammatory reaction caused by the contents of the cyst (17,18). Therefore, intracapsular decompression may relieve the headache caused by the space-occupying effect and total resection of the contents of the cyst may alleviate the inflammatory reaction caused by the contents.

The abnormal visual acuity and field are significantly related to RCC size and optic nerve or optic chiasma compression. The incidence of visual impairment in patients with RCCs

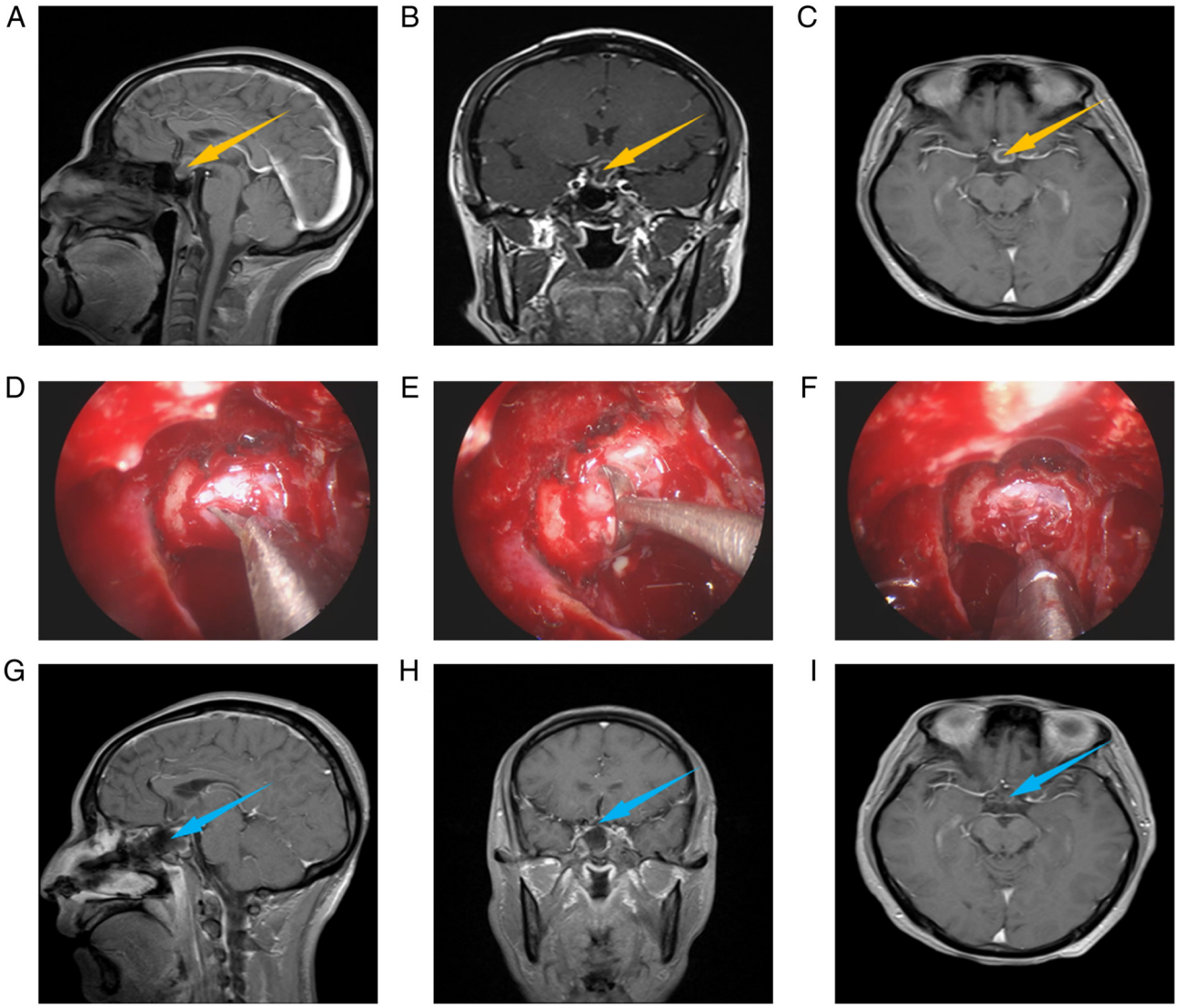

Figure 2. Case illustration of patient no. 2. (A-C) Preoperative MRI scans, which are gadolinium-enhanced T1-weighted (A) sagittal image, (B) coronal image and (C) transverse image, reveal an intra-and supra-sellar RCC. (D-F) Intraoperative images displaying how (D) the cyst at the weakest part of the cyst wall was opened, (E) the contents of the cyst were removed by a curette and (F) the residual cyst contents were aspirated by an aspirator. (G-I) Postoperative MRI, which are gadolinium-enhanced T1-weighted (G) sagittal image, (H) coronal image and (I) transverse image. The yellow arrow indicates the preoperative RCC and the blue arrow indicates the cystic cavity after the resection of the RCC. RCC, Rathke cleft cyst.

has been reported to be in the range of 11-75% (19,20). Of the patients in the present study, 30 cases had visual impairment, accounting for 49.2%. Among the patients with visual impairment, the maximum diameter was <1, 1-4 and >4 cm in 1, 28 and 1 cases, respectively. The visual acuity of these cases with visual impairment was documented by formal visual testing, including 28 cases of blurred vision, 2 cases of visual defect and 4 cases of diplopia. It is worth noting that certain patients may suffer from two types of visual impairment. From the statistical results of visual impairment, it may be seen that the intra- and supra-sellar and suprasellar RCCs had a higher probability of causing visual impairment, as the intra-and supra-sellar and suprasellar RCCs are more likely to compress the optic chiasm. It is considered that the effect of RCCs on visual acuity is mainly caused by the cyst breaking through the sellar diaphragm and growing on the sellar, which compresses the optic tract, the optic chiasm or the related blood vessels supplying the optic nerve, resulting in changes in visual acuity and visual field. After the operation, visual acuity was improved in 22 of the 30 cases and the visual acuity improvement rate reached 73.3%, which is comparable with the results of a previous study using the same surgical method (21).

Due to the close relationship between RCCs and the pituitary, patients with symptomatic RCCs may have pituitary insufficiency. The cohort of the present study included 8 cases (13.1%) of pituitary insufficiency, whose gonadal axis was affected, including 4 cases with decreased testosterone level and 4 cases with increased prolactin, resulting in decreased libido or menstrual disorder. The maximum diameter of RCCs in 8 cases was in the range of 1-4 cm, of which 6 cases (11.1%) were 1-2 cm and 2 cases (40%) were 2-3 cm, indicating that the larger-size RCCs may cause hormone dysfunction. A previous study reported that the space-occupying features and contents of RCCs may affect the surrounding pituitary tissue, resulting in abnormal secretion of pituitary-related hormones (22). Specifically, the cyst contents leaked from RCCs rupture not

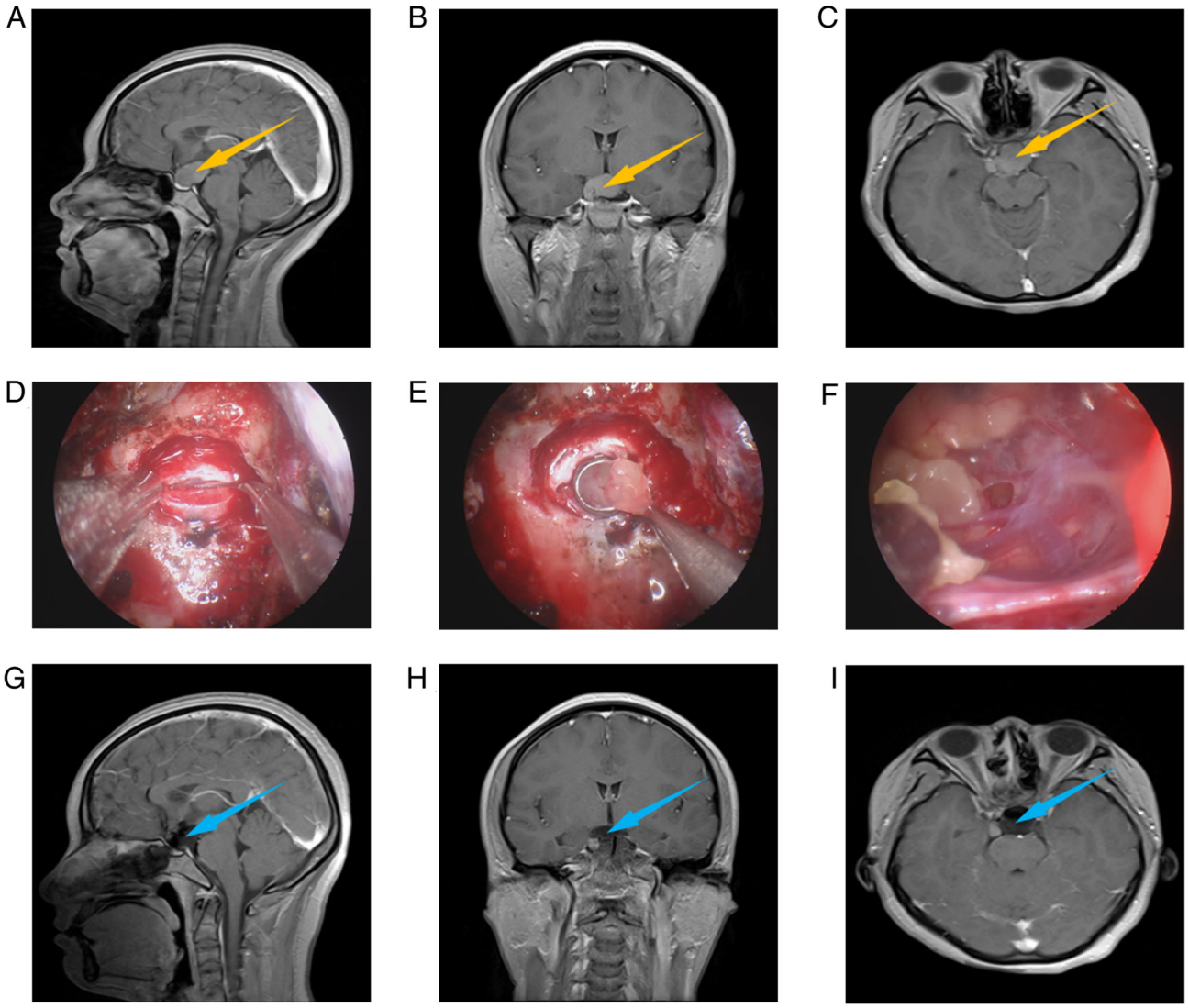

Figure 3. Case illustration of patient no. 3. (A-C) Preoperative MRI scans, which are gadolinium-enhanced T1-weighted (A) sagittal image, (B) coronal image and (C) transverse image, reveal a suprasellar RCC. (D-F) Intraoperative images displaying how (D) the cyst at the weakest part of the cyst wall was opened, (E) the contents of the cyst were removed by a curette and (F) the residual cyst contents were aspirated by an aspirator. (G-I) Postoperative MRI, which are gadolinium-enhanced T1-weighted (G) sagittal image, (H) coronal image and (I) transverse image. The yellow arrow indicates the preoperative RCC and the blue arrow indicates the cystic cavity after the resection of the RCC. RCC, Rathke cleft cyst.

only erode and stimulate the pituitary tissue but may also cause secondary pituitary inflammation, affecting the surrounding pituitary tissue. Therefore, the pituitary insufficiency caused by RCCs is mainly related to the space-occupying effect of RCCs and the leakage of cyst rupture contents. After the operation, the hormone levels of 8 patients returned to normal.

The main postoperative complications after EETA were cerebrospinal fluid leakage, infection, DI and HP (23). In the cohort of the present study, postoperative complications included transient DI in 14 cases and transient HP in 7 cases, accounting for 34.5%, which was also acceptable. Furthermore, patients with transient DI did not receive treatment and automatically returned to normal within ~10 days. Furthermore, patients with transient HP returned to normal within ~3 weeks after oral administration of thyroxine and hydrocortisone. Postoperative DI is mostly caused by the traction of the pituitary stalk during operation. Excessive cutting and pulling of pituitary tissue during the operation may lead to damage to pituitary function and a decrease in pituitary-related hormone levels. In addition, the incidence of postoperative complications may be related to the degree of cyst wall resection and whether the cyst wall is cauterized with alcohol. Fan *et al* (24) reported that the incidence of postoperative complications of radical resection for symptomatic RCCs reached up to 47%. Furthermore, Benveniste *et al* (6) indicated that the possibility of new-onset anterior pituitary defects increased after radical resection of symptomatic RCCs. Cabuk *et al* (25) reported that after radical resection for symptomatic RCCs, there was even new-onset pituitary dysfunction, such as 1 case of new-onset cortisol decline and another case of new-onset hypogonadism. It was observed that radical resection for symptomatic RCCs markedly increased the probability of postoperative complications. Based on this, it was reported that radical resection of the cyst wall should be performed only where it is possible to do so without causing additional and unnecessary pituitary damage (26). To reduce postoperative complications, partial resection of the cyst

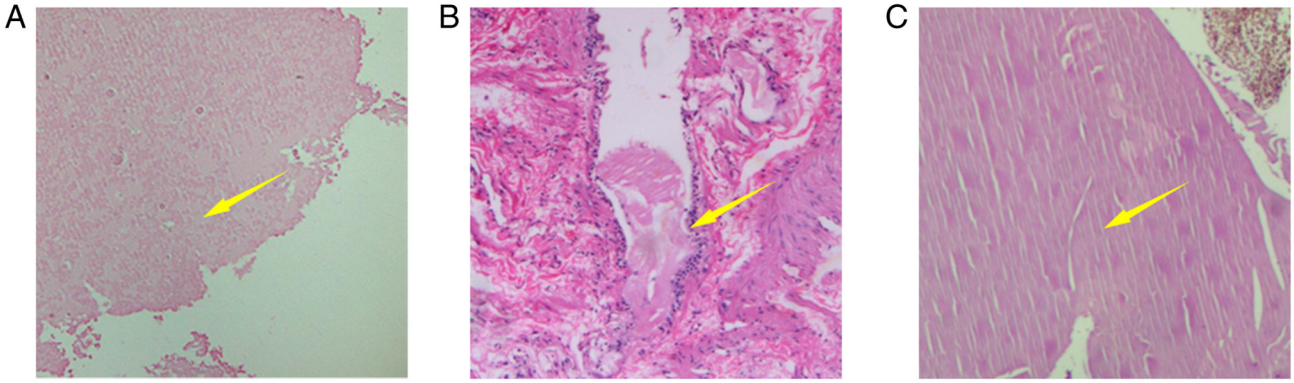

Figure 4. Histopathological presentations of Rathke cleft cyst from patients no.1-no.3 (hematoxylin and eosin staining; magnification, x100). (A) Pathological image of case no. 1, in which the arrow indicates pink unstructured cystic fluid. (B) Pathological image of case no. 2, in which the arrow indicates the cyst wall covered with cuboidal epithelium. (C) Pathological image of case no. 3, in which the arrow indicates pink unstructured cystic fluid and slit-like structures are visible.

wall for symptomatic RCCs has been widely adopted and recognized. The incidence of postoperative complications of partial resection for symptomatic RCCs was reduced to ~3.8% (20,21). It was reported that absolute alcohol injected into empty cysts may increase the incidence of complications (23). Therefore, injection of alcohol into the empty cyst has no effect, and no filling of the empty cyst is the simplest and best method.

Recurrence of symptomatic RCCs is considered to be related to the extent of cyst wall resection. However, the extent of cyst wall resection in symptomatic RCCs is still controversial (18). At present, there are two surgical strategies to deal with the cyst wall of symptomatic RCCs: One is to completely remove the cyst wall (radical resection) to prevent recurrence and reduce the recurrence rate, while the other is to partially remove the cyst wall (partial resection) to protect pituitary function and reduce postoperative complications (27,28). The recurrence rate is the gold standard for evaluating these two surgical strategies. In general, eradication resection is considered to be an effective measure to reduce the recurrence rate of symptomatic RCCs, but it is not so in practice. Aho *et al* (23) compared the recurrence rates of radical resection and partial resection for symptomatic RCCs and the results indicated that 6 of 33 patients who underwent radical resection had recurrence, with a recurrence rate of 18.2%, while 18 of 85 patients who underwent partial resection had recurrence, with a recurrence rate of 21.2% (P=0.473). Higgins *et al* (29) reported 61 patients with symptomatic RCCs, including 32 patients in the radical resection group, of which 5 cases exhibited recurrence, with a recurrence rate of 9%, and 29 patients in the partial resection group, of which 3 cases exhibited recurrence, with a recurrence rate of 17%. Koutourousiou *et al* (30) reported the outcomes of radical resection in 14 patients with symptomatic RCCs, of which 2 cases exhibited recurrence and the recurrence rate was 14.3%. Potts *et al* (31) reported that 151 patients with symptomatic RCCs underwent cyst drainage (partial resection), with a recurrence rate of 11%. Wait *et al* (22) reported 8 recurrences in 73 patients and 7 of the 8 recurrences arose after radical resection. There is increasing evidence that radical resection does not exhibit greater advantages than partial resection in terms of the recurrence rate of symptomatic RCCs. The reason for RCC recurrence is that inflammatory cell infiltration may stimulate squamous cell metaplasia, thus promoting the formation of cyst wall and leading to cyst fluid accumulation, which is not directly related to radical resection and partial resection of the cyst wall of symptomatic RCCs (16,32). In addition, there are different opinions regarding whether an empty cyst of symptomatic RCCs should be dealt with or not. In the past, absolute alcohol was injected into empty cysts to burn the cyst wall and reduce the chance of recurrence, but the results were not ideal (33). Lillehei *et al* (20) reported that in the alcohol-treated group, the cyst recurred in 8 (12.9%) of the 62 patients over the follow-up period, while in the no-alcohol treatment group, none (0%) of the 13 patients had a recurrence, indicting a limited role for alcohol cauterization in the treatment of symptomatic RCCs. It was reported that if absolute alcohol was injected into empty cysts, the recurrence rate of symptomatic cysts was not decreased (23). Therefore, partial excision of the cyst wall and no filling of the cyst cavity is indicated to not increase the recurrence rate of patients, but even reduce the recurrence rate.

Through the review of 61 patients with symptomatic RCCs who underwent surgeries, the present study put forward various suggestions and surgical strategies. First, due to the location of RCCs, EETA has become a standard treatment for symptomatic RCCs, which may reduce trauma and improve the recovery rate. Furthermore, after intracapsular decompression and removal of cyst contents, partial resection of the cyst wall was adopted, which may effectively protect pituitary function and reduce postoperative complications without increasing the recurrence rate. Finally, the skull base was repaired directly without filling the empty cyst to reduce inflammation as much as possible and the recurrence rate. In conclusion, for the treatment of symptomatic RCCs, EETA, partial removal of cyst wall and no filling of the empty cyst are key to reducing postoperative complications and recurrence rate.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

CT, PW, JL, HJ, GZ and NW participated in the conception and design of the study and data acquisition. CT participated in drafting and revising the manuscript. PW critically revised the paper. NW ensured that questions related to the integrity of any part of the work were appropriately investigated and resolved. CT, PW, JL, HJ, GZ and NW confirm the authenticity of all the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by the ethics committee of Chongqing General Hospital (approval no. KY S2022-032-01).

Patient consent for publication

Written informed consent was obtained from the patients for the publication of anonymized data and any accompanying images.

Competing interests

The authors declare that they have no competing interests.

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