Rathke cleft cyst

MRI criteria for presumptive diagnosis

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ABSTRACT

الأهداف: شرح طريقة التصوير بالرنين المغناطيسي للتشخيص الظني لكيسات شقة الراتكة في الغدة النخامية.

الطريقة: قمنا بمراجعة أشعة 103 مريض بكيسات شقة الراتكة في الغدة النخامية خلال الفترة من يناير 2005م حتى يناير 2011م بأسلوب رجعي للمؤشرات التالية: موقع الورم، وكثافة T1 وT2 والأبعاد والتصالبة البصرية والثبات لأكثر من عام.

النتائج: من خلال 103 مريض أظهرت كيسات شقة الراتكة في الغدة النخامية نتائج مفاجئة في 82.5% العدد=85 مريض. كانت آلام الرأس أكثر الأعراض انتشاراً في 11.6%، العدد=12 مريض، قصور النظر 3.8% العدد= 4، وكلا من آلام الرأس وقصور النظر 0.97%، العدد=1. كان الورم عالي الكثافة في T1 لدى 57.2% العدد=59 مريض، وقليل الكثافة في 42.7% العدد=54 مريض. لم يظهر الورم أي تركيز في 80.5% العدد=83، وتركيز هامشي سخيف في 19.4% العدد=20 مريض. كما أظهر الورم مظهر متزن في 99%، 102 مريض بعد عام من المتابعة.

خاتمة: أن كيسات الراتكة في الغدة النخامية كيسية الشكل مع ارتفاع الكثافة T1 واحياناً قليلة الكثافة، وإشارة T2 المتغيرة وتركيز هامشي سخيف أو انعدامه والذي يكون متزناً مع مرور الوقت.

Objectives: To define MRI criteria for the presumptive diagnosis of Rathke cleft cyst (RCC).

Methods: One hundred and three patient MRI scans suggesting RCC performed between January 2005 and January 2011 were retrospectively reviewed for indications, cyst location, T1 and T2 signal intensity, dimensions, encroachment on optic chiasm, enhancement pattern, and stability over a year.

Results: Of the 103 patients analyzed, the suggestion of RCC was an incidental finding in 82.5% (n=85) of patients. Headache was the most common symptom in 11.6% (n=12), visual field deficit in 3.8% (n=4), and both headache and visual field deficit in 0.97% (n=1). The cyst was hyperintense on T1 in 55.3% (n=57), hypointense in 27.1% (n=28), and isointense in 17.4% (n=18). The cyst was T2 hyperintense in 57.2% (n=59), and iso-hypointense in 42.7% (n=54). The cyst showed no enhancement in 80.5% (n=83), and a thin marginal enhancement in 19.4% (n=20). The cyst showed a stable appearance in 99% (n=102) of patients after at least one year follow-up MRI study.

Conclusion: Rathke cleft cysts typically have a cystic appearance with T1 hyperintensity, sometimes with T1 iso- or hypointensity, variable T2 signal, and no or thin marginal enhancement and remain stable in size over time.

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Rathke cleft cysts (RCC) arise from the embryonic remnants of the Rathke pouch. These non-neoplastic lesions can be seen in the sella with or without suprasellar extension, and also exclusively in the suprasellar region. In the sella, they have been commonly described between the pars intermedia and the pars distalis of the pituitary gland in 2-26% of routine autopsy series.[1] It is difficult to differentiate the non-neoplastic RCC from other cystic neoplastic lesions in this region, such as craniopharyngioma, and cystic pituitary adenoma. A pre-operative diagnosis is important because most of the RCC are stable, and hence do not require any treatment. However, sometimes they can be symptomatic, in which case decompression of the cyst may be sufficient treatment. The objective of this study is to define MR criteria to distinguish RCC from other cystic lesions of the sella-suprasellar region.

Methods. After approval by the Institutional Ethics Committee at the University of Alabama at Birmingham, Birmingham, Alabama, United States of America, between October 2011 and June 2012, we retrospectively reviewed records of 252 patients with MR scans suggesting RCC performed between June 2005 and January 2011, for indication for initial MR study, location of cyst, signal intensity on T1 and T2 weighted images, dimensions of the cyst, encroachment on the optic chiasm, pattern of enhancement, and stability of the cyst for more than one year on follow-up MR studies. Of those who had surgical resection/decompression, indication for surgery and histopathology of the cyst were reviewed. Of all the initial MRI studies, 82.5% (n=85) were performed according to routine brain MRI protocol on an 1.5T MRI scanner. The remaining studies (17.5%), and all subsequent follow-up studies were performed according to a pituitary MRI protocol, which also included 3 mm thin coronal T2 and pre and post contrast T1 weighted imaging along with the dynamic pituitary contrast enhanced scan. We excluded 149 patients from the study based on the following exclusion criteria: 1) Hormonally active (hyper functioning) pituitary lesion. 2) Cysts with an enhancing mural nodule. 3) Histologically proven non RCC cystic lesions and, 4) Cysts with less than one year follow-up (n=114).

Results. In our study of 252 patients, the age group ranged from 20-86 years (mean age 63) at the time of initial MR study. After exclusion criteria were applied, 103 remaining patients were analyzed, of which 68.9% (n=71) were females, and 31.1% (n=32) males. The suggestion of RCC was an incidental finding in 82.5% (n=85). Headache was the presenting symptom in 11.6% of patients (n=12), visual field deficit only in 3.8% of patients (n=4), and both headache and visual field deficit in 0.97% (n=1). Fifty-eight (56.3%) cysts were located in the sella, 33% (n=34) had both sellar and suprasellar components, and 10.6% (n=11) were exclusively in the suprasellar region. The cyst had T1 hyperintensity (**Figure 1a**) in 55.3% (n=57) of patients, T1 hypointensity (**Figure 1b**) in 27.1% (n=28), and

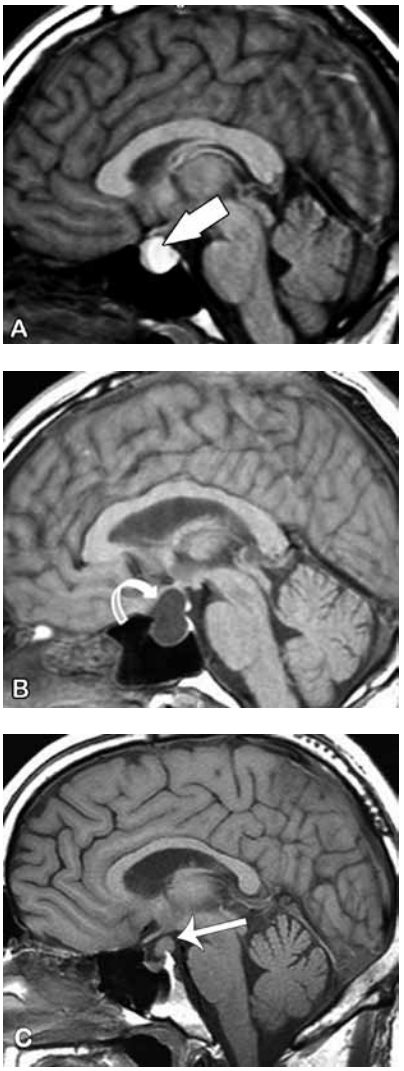

Figure 1 - Pre contrast T1 weighted images of Rathke cleft cyst showing **A)** intra sellar T1 hyperintense Rathke cleft cyst (arrow) located between the pars distalis and pars intermedius. **B)** T1 hypointense Rathke cleft cyst with both sellar and suprasellar component (curved arrow), and **C)** T1 isointense Rathke cleft cyst in posterior suprasellar region sitting on the dorsum sella (arrow).

isointense T1 signal (**Figure 1c**) in 17.4% (n=18). Post contrast images demonstrated no enhancement in 80.5% (n=83) (**Figures 2a & 2b**), and thin marginal enhancement in 19.4% (n=20) (**Figure 2c**). The T2 signal intensity was hyperintense in 57.2% (n=59) (**Figure 3a**), and iso-hypointense in 42.7% (n=44) (**Figures 3b & 3c**). There was a T2 hypointense and T1 hyperintense mural nodule, which was non-enhancing in 24.2% of patients (n=25) (**Figures 4a & 4b**). The posterior ledge sign (upward extension through the diaphragma sellae with a ledge of tissue overlying the posterior lobe) was seen in only one patient (**Figure 4c**), which was histologically verified as RCC. One hundred and two patients (99%) demonstrated stable appearance of the cyst after at least one year follow-up MR study. Of the 5 patients histologically verified as RCC, the surgical indication was a visual field deficit in 2 patients, progressive headache in 2, and increasing size with headache in one.

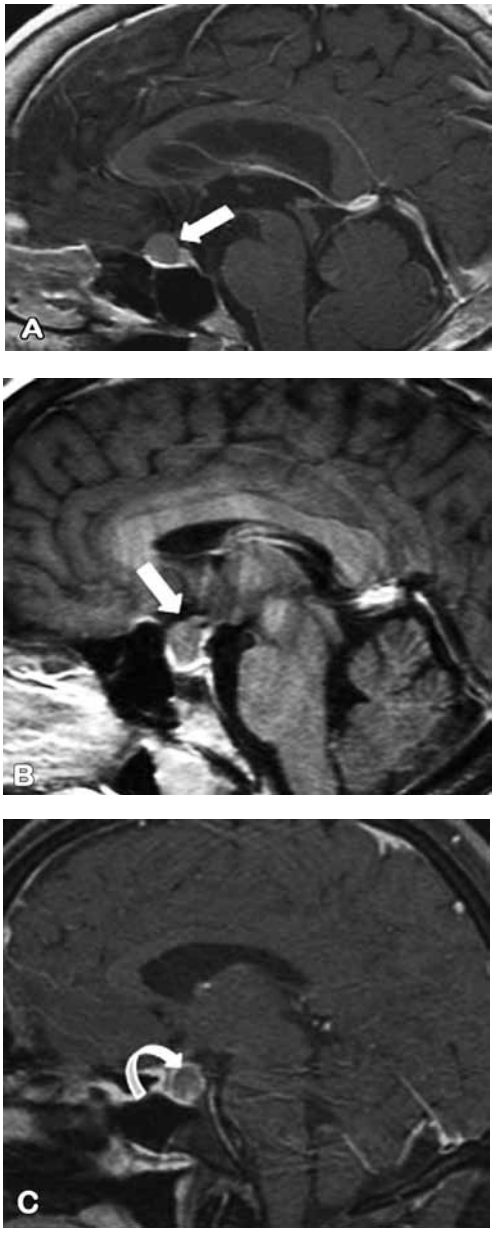

Figure 2 - Post contrast T1 weighted images Rathke cleft cyst showing **A & B**) No enhancement in the Rathke cleft cyst (arrows) and **C**) thin marginal enhancement (curved arrow).

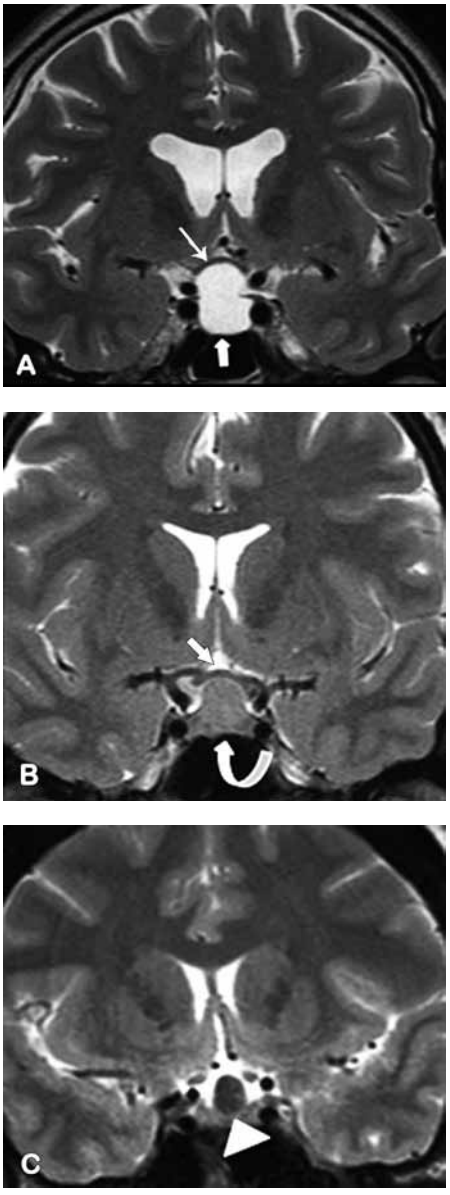

Figure 3 - T2 weighted images of Rathke cleft cyst showing **A**) T2 hyperintense (arrow), and **B**) T2 isointense (curved arrow), Rathke cleft cyst with both sellar and suprasellar components resulting in stretching of optic chiasm (small arrow). **C**) T2 hypointense Rathke cleft cyst in the suprasellar region (arrow head).

Discussion. Rathke cleft cysts are not uncommon non-neoplastic cystic masses in the sella and suprasellar regions. It is thought to be an embryonic remnant of the Rathke pouch. The out pouching from the primitive oral cavity (stomodeum) forms the craniopharyngeal duct.[2-4]

Figure 4 - Characteristic signs of Rathke cleft cyst. **A**) T2 weighted MR image showing intrasellar Rathke cleft cyst with T2 dark (arrow), eccentric intracystic nodule, **B**) which appears hyperintense on corresponding T1 weighted MR sagittal image (arrow). **C**) Post contrast T1 sagittal image showing "posterior ledge sign" (curved arrow) (upward extension through the diaphragma sellae with ledge of tissue overlying the posterior lobe), which is described as pathognomonic sign for Rathke cleft cyst.

The anterior wall of the duct forms the pars distalis, and the posterior wall results in the pars intermedia, and the lumen forms the cleft, which usually disappears by 12 weeks of gestation. Persistence and enlargement of this cleft result in RCC. Most of RCC described in the literature are incidental findings on imaging,[5] or at autopsy. Among the symptomatic patients, the most common presenting complaints described are pituitary dysfunction (70%), followed by headache (50%), and visual field deficit.[6-9] Although pituitary hormonal dysfunction is reported as the most common symptom associated with RCC, in our study we had only one patient with hormonal dysfunction (hypopituitarism) on follow-up, which was a complication of surgery on RCC rather than a presenting symptom. Most of the symptomatic cysts and all the resected RCC in our study had a suprasellar component to it.

The RCC are slightly more common in females,[10-12] and are described in the intrasellar region (40%), the suprasellar,[13] and also involving both compartments.[14,15] In our study, the most common location of the cyst was the intrasellar region (56.3%) (**Table 1**).

The MRI appearance of RCCs varies greatly, and the neuroimaging diagnosis of an RCC is often difficult. The signal intensity of the cyst varies depending on the protein content in the intracystic fluid. The cyst can be hyperintense (50%) or even iso or hypointense (50%) on T1WI, and hyperintense (70%), or iso-hypointense on T2WI. In our study, T1 hyperintensity was a common feature (55.3%) followed by hypointensity (27.1%) and isointensity (17.4%). The signal intensity of the cyst was variable on T2. The presence of a T2 dark intracystic nodule has been reported in up to 75% of RCC in the literature,[16-18] however, in our study we found that only 24.2% (n=25) had an intracystic nodule. Post contrast T1 images did not show any significant enhancement, except for thin marginal enhancement (**Table 2**).[4,16,19-22]

The 'posterior ledge sign' is described as a pathognomonic sign for RCC in the literature.[23,24] Although in our study this sign was demonstrated in only one patient, indicating that the sensitivity of this sign is very low, histologically it was proven to be a RCC, indicating high specificity of this sign. Rarely, there can be hemorrhage in the cyst, which can lead to a sudden increase in the size of the cyst, as in one of our cases, which was constantly increasing in size due to the fluid level. On surgery, it was proven to be an RCC with hemorrhage. The RCC remain stable in dimension with time and no neoplastic transformation is reported in the literature.

Table 1 - Clinical features of histologically verified Rathke cleft cyst (RCC).

Case no.	Age/ gender	Clinical presentation	Location	Mass effect on OC	Pre op diagnosis	Indication for surgery	Surgery performed	Histology	Post surgical outcome
1.	34/M	Headache	S-SS	Stretching	RCC	Headache and growing cyst	Trans-sphenoid endoscopic resection	RCC	Hypopituitarism
2.	59/F	Headache	SS with posterior fossa extension	Stretching	Craniopharyngioma	Progressive OC stretching and HA	Pterional craniotomy	RCC	Normal
3.	42/F	Hypothyroidism and impaired peripheral vision	S-SS	Progressive stretching	RCC	Peripheral visual field defect	Trans-sphenoid endoscopic resection	RCC	CSF leak
4.	78/F	Visual field defect	S-SS	Progressive stretching	RCC v/s Craniopharyngioma	Progressive visual field defect	Trans-sphenoid endoscopic resection	RCC	Residual visual field defect
5.	63/F	Headache	S-SS	Contacting OC	RCC v/s Craniopharyngioma v/s cystic adenoma	Persistent headache	Trans-sphenoid endoscopic resection	RCC	Normal

S-SS - Sella-suprasellar extension, OC - optic chiasm, RCC - Rathke cleft cyst, v/s - versus, HA - headache

Table 2 - Imaging features of histologically verified Rathke cleft cyst (RCC).

Case no.	T1	T2	Post contrast T1	Craniocaudal dimension
1	Hypointense	Hyperintense	Marginal enhancement	9.8 to 18.6 mm over 3 years
2	Isointense	Hyperintense	Marginal enhancement	19.8 to 25 mm over 1 year
3	Hyperintense	Hypointense	Nil	11.5 to 13 mm over 2 years
4	Hypointense	Hyperintense	Nil	21 mm
5	Hyperintense	Isointense	Nil	15 mm

The major limitations of our study are its retrospective nature, and the small number of histologically verified RCC. Despite these limitations, we consider the exclusion criteria excluding slow growing hypo enhancing neoplasms such as cystic adenoma or craniopharyngioma, which mimic RCC, is one of the strengths of our study.

In conclusion, RCC typically have a cystic appearance with T1 hyperintensity, and sometimes with T1 iso- or hypointensity, variable T2 signal, and no or thin marginal enhancement, remaining stable in size over time. Therefore, T1 hyperintensity, in the setting of null or thin marginal enhancement with stable dimensions of a cystic sellar/suprasellar lesion over at least a one year period favors the presumptive imaging diagnosis of RCC.

References

1. Voelker JL, Campbell RL, Muller J. Clinical, radiographic, and pathological features of symptomatic Rathke's cleft cysts. *J Neurosurg* 1991; 74: 535-544.
2. Koutourousiou M, Kontogeorgos G, Wesseling P, Grotenhuis AJ, Seretis A. Collision sellar lesions: experience with eight cases and review of the literature. *Pituitary* 2010; 13: 8-17.
3. Kunii N, Abe T, Kawamo M, Tanioka D, Izumiyama H, Moritani T. Rathke's cleft cysts: differentiation from other cystic lesions in the pituitary fossa by use of single-shot fast spin-echo diffusion-weighted MR imaging. *Acta Neurochir (Wien)* 2007; 149: 759-769.
4. Munich SA, Leonardo J. Spontaneous involution of a Rathke's cleft cyst in a patient with normal cortisol secretion. *Surg Neurol Int* 2012; 3: 42.
6. Jagannathan J, Kanter AS, Sheehan JP, Jane JA Jr. Benign brain tumors: sellar/parasellar tumors. *Neurol Clin* 2007; 25: 1231-1249.
7. Zhou L, Luo L, Hui X, Chen H, Yu B, Guo G, et al. Primary Rathke's cleft cyst in the cerebellopontine angle associated with apoplexy. *Childs Nerv Syst* 2010; 26: 1813-1817.
8. Aho CJ, Liu C, Zelman V, Couldwell WT, Weiss MH. Surgical outcomes in 118 patients with Rathke cleft cysts. *J Neurosurg* 2005; 102: 189-193.
9. Benveniste RJ, King WA, Walsh J, Lee JS, Naidich TP, Post KD. Surgery for Rathke cleft cysts: technical considerations and outcomes. *J Neurosurg* 2004; 101: 577-584.
10. Cohan P, Foulad A, Esposito F, Martin NA, Kelly DF. Symptomatic Rathke's cleft cysts: a report of 24 cases. *J Endocrinol Invest* 2004; 27: 943-948.
11. Kasperbauer JL, Orvidas LJ, Atkinson JL, Abboud CF. Rathke cleft cyst: diagnostic and therapeutic considerations. *Laryngoscope* 2002; 112: 1836-1839.
12. Kim JE, Kim JH, Kim OL, Paek SH, Kim DG, Chi JG, et al. Surgical treatment of symptomatic Rathke cleft cysts: clinical features and results with special attention to recurrence. *J Neurosurg* 2004; 100: 33-40.

13. Wen L, Hu LB, Feng XY, Desai G, Zou LG, Wang WX, et al. Rathke's cleft cyst: clinicopathological and MRI findings in 22 patients. ***Clin Radiol*** 2010; 65: 47-55.
14. Ealmaan Kim. A Case of Ectopic Rathke's Cleft Cyst in the Prepontine Cistern. ***J Korean Neurosurg Soc*** 2012; 52: 152-155.
15. Wenger M, Simko M, Markwalder R, Taub E. An entirely suprasellar Rathke's cleft cyst: case report and review of the literature. ***J Clin Neurosci*** 2001; 8: 564-567.
16. Byun WM, Kim OL, Kim D. MR imaging findings of Rathke's cleft cysts: significance of intracystic nodules. ***Am J Neuroradiol*** 2000; 21: 485-488.
17. Tominga JY, Higano S, Takahashi S. Characteristics of Rathke's cleft cyst in MR imaging. ***Magn Reson Med Sci*** 2003; 2: 1-8.
18. Binning MJ, Gottfried ON, Osborn AG, Couldwell WT. Rathke cleft cyst intracystic nodule: a characteristic magnetic resonance imaging finding. ***J Neurosurg*** 2005; 103: 837-840.
19. Zada G, Lin N, Ojerholm E, Ramkissoon S, Laws ER. Craniopharyngioma and other cystic epithelial lesions of the sellar region: a review of clinical, imaging, and histopathological relationships. ***Neurosurg Focus*** 2010; 28: E4.
20. Raghunath A, Sampath S, Devi BI, Chandramouli BA, Lal GJ, Chickabasaviah YT, et al. Is there a need to diagnose Rathke's cleft cyst preoperatively? ***Neurol India*** 2010; 58: 69-73.
21. Nishioka H, Haraoka J, Izawa H, Ikeda Y. Magnetic resonance imaging, clinical manifestations, and management of Rathke's cleft cyst. ***Clin Endocrinol (Oxf)*** 2006; 64: 184-188.
22. Rao VJ, James RA, Mitra D. Imaging characteristics of common suprasellar lesions with emphasis on MRI findings. ***Clin Radiol*** 63: 939-947.
23. Osborn AG. Rathke cleft cyst. In: Osborn AG, Salzman KL, Barkovich AJ, editors. Diagnostic Imaging: brain. 2nd ed. Philadelphia (PA): Amirsys; 2010. p. 16-19. 24.
24. Pisaneschi M, Kapoor G. Imaging the sella and parasellar region. ***Neuroimaging Clin N Am*** 2005; 15: 203-219.

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Elwatidy SM. Adult craniopharyngioma. *Clinical, radiological presentation and outcome of management*. ***Neurosciences*** 2004; 9: 271-275.

Elwatidy SM, Jamjoom ZA, Jamjoom AB, Yakoub AO. Craniopharyngioma: *Analysis of factors that affect the outcome*. ***Neurosciences*** 2002; 7: 27-31.