J Neurosurg 103:837–840, 2005

Rathke cleft cyst intracystic nodule: a characteristic magnetic resonance imaging finding

Mandy J. Binning, M.D., Oren N. Gottfried, M.D., Anne G. Osborn, M.D., and William T. Couldwell, M.D., Ph.D.

Departments of Neurosurgery and Radiology, University of Utah, Salt Lake City, Utah

Object. The fluid content of Rathke cleft cysts (RCCs) displays variable appearances on magnetic resonance (MR) images and can appear indistinguishable from other intrasellar or suprasellar cystic lesions. Intracystic nodules associated with individual RCCs have been noted, but to date their significance has not been fully explored.

Methods. The authors retrospectively reviewed MR imaging studies obtained in patients harboring intrasellar or suprasellar lesions that were consistent with RCCs to identify the presence and imaging characteristics of intracystic nodules.

An intracystic nodule was present in nine (45%) of 20 patients with an RCC. All intracystic nodules were clearly visible and displayed a characteristic low signal intensity on T_2-weighted MR images. The nodule was only visualized on T_1-weighted images in four cases, in which it exhibited a consistent high signal intensity similar to that of the cyst fluid. The nodules did not enhance following the intravenous administration of a contrast agent.

Conclusions. Although it is difficult to differentiate RCCs from other sellar cystic lesions because of the variable signal intensities displayed on MR images, the intensity of the intracystic nodule seems consistent on T_1- and T_2-weighted images, and the nodule is always clearly visible on T_2-weighted images. With a nonenhancing cystic lesion that does not cause significant symptoms in the patient, the identification of an intracystic nodule with a characteristic signal intensity will aid in the diagnosis of RCC and the selection of conservative management.

Key Words • Rathke cleft cyst • intracystic nodule • magnetic resonance imaging

Rathke cleft cysts are nonneoplastic sellar and suprasellar lesions derived from remnants of the Rathke pouch. With the advent of modern imaging techniques such as computerized tomography and MR imaging, these lesions are often discovered incidentally. Rathke cleft cysts usually are asymptomatic because typically they are not large enough to cause compression or a mass effect on surrounding structures. When they are symptomatic, patients harboring them often present with headaches or symptoms that result from compression of the optic chiasm, hypothalamus, or pituitary gland.[6,8,17,21]

Although RCCs are now more readily noticed on computerized tomography and MR images, it can still be difficult to distinguish RCCs from other cystic sellar lesions, including cystic pituitary adenomas and craniopharyngiomas. This poses a diagnostic dilemma because these lesions require different treatment approaches. In a recent series of 160 patients with RCCs, investigators demonstrated that, among 61 patients without symptoms whose lesions were discovered incidentally, in 42 no growth was documented on MR images and the lesions did not progress to the point at which the patients would require surgical intervention.[1] Thus, a neuroimaging-based diagnosis of RCC may have some prognostic value, and knowledge of specific imaging characteristics would be helpful to differentiate the RCCs from other sellar lesions such as craniopharyngiomas and pituitary tumors.

Abbreviations used in this paper: MR = magnetic resonance; RCC = Rathke cleft cyst.

A variety of MR characteristics of RCCs have been reported, but authors agree that this lesion displays variable cyst signal intensities without any consistent or definitive characteristics aside from lack of contrast enhancement, which is often difficult to interpret because of the enhancement of the adjacent pituitary.[3,5,13] The presence of an associated intracystic nodule has been mentioned in a few papers,[9,10,20] but only one previous report contains a detailed discussion of the importance of the intracystic nodule in aiding diagnoses of RCCs and, therefore, in guiding treatment options.[4] This report is not included in the English-language neurosurgical literature. In the present article, we review the literature on RCCs, specifically those reports in which intracystic nodules have been discussed, and describe our own series of RCCs associated with intracystic nodules, noting their incidence and clinical significance for the practicing neurosurgeon.

Clinical Material and Methods

This study involved a review of charts and MR images associated with patients with a diagnosis of RCC. A search of the databases maintained by the Departments of Radiology and Pathology at the University of Utah was performed to generate a list of patients with an RCC. Only patients in whom MR images were available for retrospective review were included in this study. All patients had undergone MR imaging between 1995 and 2004. All chart reviews were undertaken following guidelines set by the Health Insurance Portability and Accountability Act of 1996 and reg-

TABLE 1

*Magnetic resonance imaging signs of cyst and nodule, and follow up of nine patients with an RCC and an associated intracystic nodule**

Patient Age (yrs)	Cyst Size (mm)	Follow Up (mos)	Signal Displayed by Nodule		Signal Displayed by Cyst		Contrast Enhancement of Cyst Wall or Nodule
			T_1-Weighted	T_2-Weighted	T_1-Weighted	T_2-Weighted	
54	11 × 16	36	high	low	high	low	no
30	8 × 7	36	absent	low	high	low	no
27	5 × 6	9	absent	low	high	high	no
51	10 × 5	85	high	low	intermediate	high	no
28	7 × 7	NA	absent	low	high	high	no
29	9 × 7	NA	high	low	low	high	no
46	9 × 5	NA	absent	low	high	high	no
68	8 × 5	113	high	low	low	high	no
48	6 × 7	65	absent	low	high	high	no

* NA = not available.

ulations determined by the University of Utah Internal Review Board.

None of the patients from the radiology database who were identified required surgical intervention and none displayed symptoms from their lesions. The neuroimaging diagnosis of RCC was based on criteria described later in this paragraph. Among these patients, only those whose RCC had been diagnosed by our neuroradiologist (A.G.O.) were included in this review. Patients with a mixed diagnosis of RCC, cystic pituitary adenoma, and/or cystic craniopharyngioma based on the absence of several criteria diagnostic for an RCC or the presence of imaging signs more specific for these other diagnoses were excluded. The criteria for the neuroimaging-based diagnosis were the following: the presence of an intrasellar and/or suprasellar cystic lesion that did not enhance in response to the contrast agent; if there was a nodule it also did not enhance; a homogeneous cystic fluid intensity on T_1- and T_2-weighted MR images; and the absence of a cyst wall or an associated extracystic mass. When patients underwent MR imaging multiple times, all images were evaluated for changes in cyst size or imaging qualities. Images further supported the diagnosis of a benign RCC if they revealed a lack of cyst growth.

All MR images that had been obtained in patients identified from either database were evaluated for the presence of an intracystic nodule and also to document the intensity of the cyst fluid and the nodule on T_1- and T_2-weighted images. In patients who underwent surgery, the surgical report was reviewed to determine whether a nodule was seen during resection. The pathology report was also reviewed to evaluate whether the nodule was seen on histological sections.

Results

The search of the pathology database yielded five patients with a histologically confirmed diagnosis of an RCC and preoperative MR images that were available for review. A search of the radiology database uncovered 15 patients with a single diagnosis of RCC because of characteristic imaging and the lack of any qualities representative of a cystic adenoma or craniopharyngioma; MR images were available for retrospective review in all these patients.

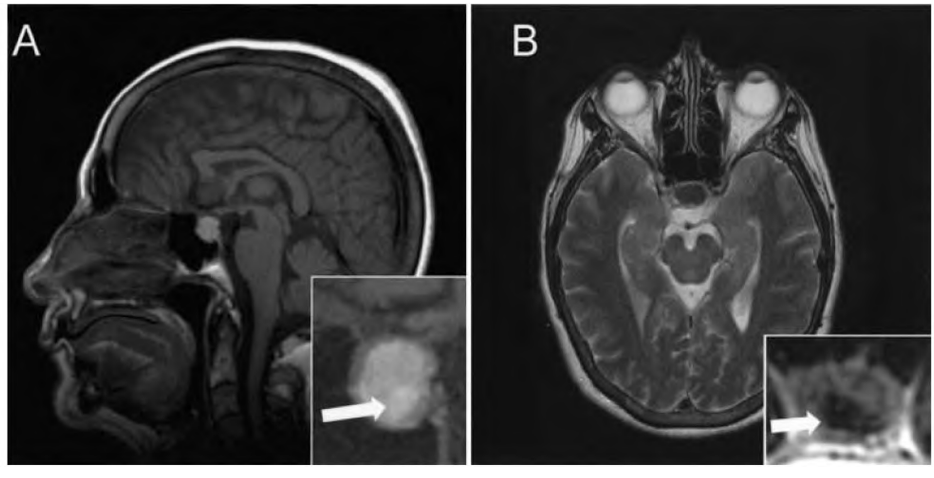

FIG. 1. Magnetic resonance images demonstrating a histologically confirmed RCC with a nodule in the posterior aspect of the cyst (*arrows* in *insets*) that displays a high signal intensity on the T_1-weighted image (A) and a low signal intensity on the T_2-weighted image (B).

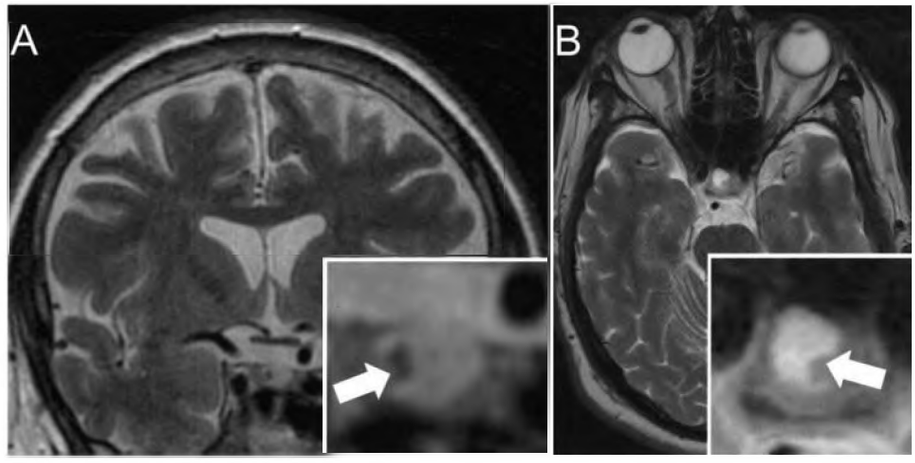

FIG. 2. Magnetic resonance T_2-weighted images obtained in two different patients demonstrating a hypointense nodule within a hyperintense RCC (*arrows* in *insets*).

A review of MR images showed that nine (45%) of 20 patients with RCCs had an intracystic nodule (Table 1, Figs. 1 and 2). In all nine patients, the nodule was easily seen on T_2-weighted images, in which the nodule appeared hypointense compared with the cyst fluid. On T_1-weighted imaging, the nodule was only seen in four (44%) of the nine patients, in whom it appeared even more hyperintense than the usually hyperintense cyst (Fig. 1). No contrast enhancement of any of the walls of the RCC or of the nodule (when present) was observed.

In none of the patients in whom an RCC had been incidentally discovered were there interval changes in the size or imaging qualities of their lesions on serial imaging or any indication of lesion progression that would require surgical intervention. In cases in which an intracystic nodule was identified, there was no variation in its size or intensity across the imaging studies.

Complete resection was achieved in the two patients who harbored surgically and histologically verified RCCs with associated intracystic nodules, and at 36 months of follow-up review, neither patient had experienced a recurrence. In one case the nodule appeared as a clear, mucinous mass at surgery, and in the other case it was described as abnormal tissue associated with the cyst wall. In both patients, a histological examination showed that the nodule was a mass of cellular debris.

Discussion

Although the neuroimaging characteristics of RCCs have been extensively explored and have been described in the literature, it often remains difficult to differentiate RCCs from other cystic sellar or suprasellar lesions. Often, the MR imaging signal intensity is extremely variable on T_1- and T_2-weighted images, the location of the cyst is not consistent, and overall, no single, unique, or consistent pathognomonic sign leading to a diagnosis of RCC on MR imaging can be identified.[3,5,13] Rathke cleft cysts may appear similar to other cystic sellar and suprasellar lesions such as craniopharyngiomas and pituitary adenomas. An attempt to differentiate RCCs from these other lesions on MR images is typically based on signs including smooth contours, the lack of a cyst wall or an extracystic solid component, absence of calcification, homogeneous attenuation, and absence of enhancement.[2,3,5,9,11–16,18]

Currently, the most reliable sign used to differentiate RCCs from cystic pituitary adenomas and craniopharyngiomas that do not have an associated solid lesion is enhancement of the cyst wall. Enhancement of the wall of a cystic sellar or suprasellar lesion on contrast-enhanced MR images plays an essential role in differentiating neoplastic from nonneoplastic cysts. Typically, RCCs do not enhance, whereas the walls of other lesions invariably display enhancement. Rathke cleft cysts can appear to enhance but this is actually due to enhancement of the adjacent normal pituitary gland. In questionable cases, it is recommended that the investigator perform dynamic pituitary studies to clearly differentiate enhancement of the normal pituitary, which occurs early after administration of the contrast agent, from enhancement of the cyst wall, which occurs after enhancement of the pituitary.

In addition to the lack of contrast enhancement, we demonstrate that the presence of an intracystic nodule with a consistent low signal intensity on T_2-weighted images and possible visualization with a high signal intensity on T_1-weighted images can be used to differentiate RCCs from other cystic lesions. Overall, 17 patients in whom a nodule was associated with a pathologically confirmed RCC have been described in the literature, and the reported incidence in three series was 17, 43, and 77%.[4,9,20] In the current series, an intracystic nodule was demonstrated in 40% of patients with a histologically confirmed diagnosis of RCC and in 47% of patients in whom the diagnosis was based on neuroimaging findings.

The largest series of intracystic nodules found to be associated with RCCs was described by Byun, et al.,[4] who noted that 10 (77%) of 13 patients who harbored a pathologically confirmed RCC had an associated nodule. The authors showed that the nodules consistently displayed a high signal intensity on T_1-weighted MR images and a low signal intensity on T_2-weighted MR images. As in the current series, they found that detection of the intracystic nodules on T_1-weighted images was more difficult because of similarities in the cyst and nodule intensities, whereas the nodule

was easily observed on T_2-weighted images because most intracystic nodules revealed a low signal intensity relative to that of surrounding cyst fluid. At surgery, the nodules were found to be waxy solid masses. A pathological examination demonstrated a mucinous mass, and biochemical studies demonstrated that the nodules consisted of cholesterol and protein. The authors noted that the nodules floated freely without any connection to a membrane.

In three other articles the authors mentioned the presence of an intracystic nodule with an RCC, but did not provide neuroimaging details on the signal intensities of the nodules. Sumida, et al.,[20] noted the presence of an intracystic nodule in three of 18 patients who harbored an RCC. Kuwahara and colleagues[10] described a patient with an RCC that was associated with an intracystic nodule, but in their case the nodule was connected to the surrounding tissue and was described as a "moving globular mass." Kucharczyk and associates[9] noted that three of seven pathologically confirmed RCCs had a solid waxy component that was adherent to the cyst wall. They reported that the pathological examination showed epithelium-lined cysts containing acellular proteinaceous material with a white nodule of adherent soft tissue that represented cellular debris. Similarly, in the current case series, the two nodules examined during the pathological examination appeared to be adherent to the cyst wall and consisted of cellular debris.

Although the intracystic nodule with its characteristic imaging qualities (described in the current series and by Byun and colleagues[4]) is unique to RCCs, it is important to realize that nodules are also common to craniopharyngiomas. In contrast to RCCs, craniopharyngiomas typically have a well-defined cystic mass with a mural nodule, and the nodules characteristically appear hypointense on T_1-weighted images and hyperintense on T_2-weighted images and strongly enhance heterogeneously in response to administration of contrast agent.[7] Thus, these nodules can be easily differentiated from those found in RCCs.

Conclusions

It can be difficult to distinguish various intrasellar and suprasellar cystic lesions based on MR imaging characteristics alone because of the wide variation in signal intensities. Because RCCs are benign and often asymptomatic lesions, it is important to find ways to distinguish these lesions from other types of lesions without surgical intervention. Intracystic nodules in association with RCCs are common findings on MR images, have consistent and characteristic signal intensities on MR images, and are thought to be diagnostic of an RCC when present. Thus, a nonenhancing cystic lesion with an intracystic nodule that displays a low signal intensity on T_2-weighted images and a high signal intensity on T_1-weighted images (if seen) may be considered an RCC; in the absence of significant symptoms or signs of optic apparatus compression or pituitary–hypothalamus dysfunction, the treating physician can have more confidence in assigning the diagnosis of RCC and recommending conservative management.

References

1. Aho CJ, Liu C, Zelman V, Couldwell WT, Weiss MH: Surgical outcomes in 118 patients with Rathke cleft cysts. **J Neurosurg 102:**189–193, 2005
2. Asari S, Ito T, Tsuchida S, Tsutsui T: MR appearance and cyst content of Rathke cleft cysts. **J Comput Assist Tomogr 14:** 532–535, 1990
3. Brassier G, Morandi X, Tayiar E, Riffaud L, Chabert E, Heresbach N, et al: Rathke's cleft cysts: surgical-MRI correlation in 16 symptomatic cases. **J Neuroradiol 26:**162–171, 1999
4. Byun WM, Kim OL, Kim D: MR imaging findings of Rathke's cleft cysts: significance of intracystic nodules. **AJNR Am J Neuroradiol 21:**485–488, 2000
5. Christophe C, Flamant-Durand J, Hanquinet S, Heinrichs C, Raftopoulos C, Sariban E, et al: MRI in seven cases of Rathke's cleft cyst in infants and children. **Pediatr Radiol 23:**79–82, 1993
6. Cohan P, Foulad A, Esposito F, Martin NA, Kelly DF: Symptomatic Rathke's cleft cysts: a report of 24 cases. **J Endocrinol Invest 27:**943–948, 2004
7. Hald JK, Eldevik OP, Skalpe IO: Craniopharyngioma identification by CT and MR imaging at 1.5 T. **Acta Radiol 36:**142–147, 1995
8. Kleinschmidt-DeMasters BK, Lillehei KO, Stears JC: The pathologic, surgical, and MR spectrum of Rathke cleft cysts. **Surg Neurol 44:**19–27, 1995
9. Kucharczyk W, Peck WW, Kelly WM, Norman D, Newton TH: Rathke cleft cysts: CT, MR imaging, and pathologic features. **Radiology 165:**491–495, 1987
10. Kuwahara T, Shinohara Y, Sugiura M, Hiramatsu H: [A Rathke's cleft cyst with a moving mass in the cyst.] **No Shinkei Geka 25:** 177–180, 1997 (Jpn)
11. Mnif N, Hamrouni A, Iffenecker C, Oueslati S, Fruexer F, Doyon D, et al: IRM dans le diagnostic des Kystes de la poche de Rathke. **J Radiol 84:**699–704, 2003
12. Nakasu Y, Isozumi T, Nakasu S, Handa J: Rathke's cleft cyst: computed tomographic scan and magnetic resonance imaging. **Acta Neurochir (Wien) 103:**99–104, 1990
13. Naylor MF, Scheithauer BW, Forbes GS, Tomlinson FH, Young WF: Rathke cleft cyst: CT, MR, and pathology of 23 cases. **J Comput Assist Tomogr 19:**853–859, 1995
14. Nemoto Y, Inoue Y, Fukuda T, Shakudo M, Katsuyama J, Hakuba A, et al: MR appearance of Rathke's cleft cysts. **Neuroradiology 30:**155–159, 1988
15. Niwa J, Tanabe S, Ibayashi Y, Hashi K: [Clinicopathological findings in symptomatic Rathke's cleft cyst: correlation between enhancement effects on MRI and histopathology of the cyst wall.] **No Shinkei Geka 24:**125–133, 1996 (Jpn)
16. Oka H, Kawano N, Yagishita S, Kobayashi I, Saegusa H, Fujii K: Ciliated craniopharyngioma indicates histogenetic relationship to Rathke cleft epithelium. **Clin Neuropathol 16:**103–106, 1997
17. Ross DA, Norman D, Wilson CB: Radiologic characteristics and results of surgical management of Rathke's cysts in 43 patients. **Neurosurgery 30:**173–179, 1992
18. Saeki N, Sunami K, Sugaya Y, Yamaura A: MRI findings and clinical manifestations in Rathke's cleft cyst. **Acta Neurochir (Wien) 141:**1055–1061, 1999
19. Shanklin WM: On the presence of cysts in the human pituitary. **Anat Rec 104:**379–407, 1949
20. Sumida M, Uozumi T, Mukada K, Arita K, Kurisu K, Eguchi K: Rathke cleft cysts: correlation of enhanced MR and surgical findings. **AJNR Am J Neuroradiol 15:**525–532, 1994
21. Voelker JL, Campbell RL, Muller J: Clinical, radiographic, and pathological features of symptomatic Rathke's cleft cysts. **J Neurosurg 74:**535–544, 1991

Manuscript received May 25, 2005.

Address reprint requests to: William T. Couldwell, M.D., Ph.D., Department of Neurosurgery, University of Utah Medical Center, 30 North 1900 East, Suite 3B409, Salt Lake City, Utah 84132. email: william.couldwell@hsc.utah.edu.