Rathke’s Cleft Cyst Intracystic Nodule: A Characteristic MRI Finding

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Running Title: Rathke’s Cleft Cyst Intracystic Nodule
Abstract

Objective: The fluid content of Rathke’s cleft cysts (RCCs) has variable appearances on magnetic resonance (MR) imaging and can be radiographically indistinguishable from other intrasellar or suprasellar cystic lesions. Intracystic nodules associated with RCC have been noted, but their significance has not been fully explored.

Methods: We retrospectively reviewed MR studies of patients with intrasellar/suprasellar lesions consistent with RCCs for the presence and imaging characteristics of an intracystic nodule.

Results: An intracystic nodule was present in 9 of 20 (45%) patients with a RCC. All intracystic nodules were clearly visible and had characteristic low signal intensity on T2-weighted images. The nodule was only visualized on T1-weighted images in 4 cases because of consistent high signal intensity similar to the cyst fluid intensity. The nodules did not enhance with intravenous contrast.

Conclusion: Although it is difficult to differentiate RCCs from other sellar cystic lesions because of variable signal intensities on MR imaging, the intensity of the intracystic nodule seems consistent on T1- and T2-weighted images and is always clearly visible on T2-weighted images. With a non-enhancing cystic lesion that is not causing significant symptoms, an intracystic nodule with characteristic signal intensity will aid in the diagnosis of RCC and the selection of conservative management.
Introduction

Rathke’s cleft cysts (RCCs) are non-neoplastic sellar and suprasellar lesions derived from remnants of Rathke’s pouch. With the advent of modern imaging techniques such as computed tomography (CT) and magnetic resonance (MR) imaging, these lesions are often discovered incidentally. RCCs are usually asymptomatic, however, as they are not typically large enough to cause compression or mass effect on surrounding structures. When symptomatic, patients often present with headaches or symptoms that result from compression of optic chiasm, hypothalamus, or pituitary gland.\textsuperscript{6,8,17,21}

Although RCCs are now more readily noticed on CT and MR imaging, a new diagnostic dilemma may arise because it can be difficult to distinguish RCCs from other cystic sellar lesions, including cystic pituitary adenomas and craniopharyngiomas, which have different treatment approaches. A recent series of 160 patients with RCC demonstrated that 42 patients who were asymptomatic and had their lesions discovered incidentally had no growth on magnetic resonance (MR) images and did not progress to require surgical intervention.\textsuperscript{1} Thus, the radiographic diagnosis of RCC may have some prognostic value, and specific imaging characteristics would be helpful to differentiate RCCs from other sellar lesions such as craniopharyngiomas and pituitary tumors.

Many reports of various MR characteristics of RCCs have been published, but the authors agree that this lesion has variable cyst signal intensities without any consistent or definitive characteristics aside from lack of contrast enhancement, which is often difficult to interpret because of enhancement of the adjacent pituitary.\textsuperscript{3,5,13} A few papers have mentioned the presence of an intracystic nodule associated with a RCC,\textsuperscript{9,10,20} but only one
previous report has detailed the importance of the intracystic nodule in aiding diagnosis of RCCs and therefore in guiding treatment options (none in the English neurosurgical literature). In this series, we review the literature on RCCs, specifically those series that describe intracystic nodules, and describe our own series of RCCs associated with intracystic nodules, discussing their incidence and clinical significance for the clinical neurosurgeon.

Methods

This paper involved a review of charts and MR imaging of patients with a diagnosis of RCC. A search of databases from the Departments of Radiology and Pathology was performed to generate a list of patients with RCC. Only patients with MR imaging available for retrospective review were included in this study. All patients had undergone MR imaging between 1995 and 2004. All chart review was undertaken following HIPAA guidelines and the University of Utah Internal Review Board (IRB) regulations.

None of the patients who were identified from the radiology database required surgical intervention and none were symptomatic from their lesions. The radiological diagnosis of RCC was based on criteria described below. Of these patients, only those patients clearly diagnosed with RCC by our neuroradiologist (AGO) were included in this review. Patients who were given a mixed diagnosis of RCC, cystic pituitary adenoma, and/or cystic craniopharyngioma because of the absence of several criteria diagnostic for RCC or the presence of imaging signs more specific for these other diagnoses were excluded. The criteria for radiologic diagnosis was the presence of an intrasellar and/or
suprasellar cystic lesion that did not contrast enhance (and if there was a nodule it also
did not enhance), homogenous cystic fluid intensity on T1- and T2-weighted images, and
the absence of a wall to the cyst or an associated extracystic mass. When patients
underwent MR imaging multiple times, all images were evaluated for changes in the cyst
size or imaging qualities. A lack of growth across images further supported the diagnosis
of the benign RCC.

All MR imaging of patients identified from either database were evaluated for the
presence of an intracystic nodule and also for the intensity of the cyst fluid and for the
nodule on T1- and T2-weighted images. In patients who underwent surgery, the operative
report was reviewed to determine whether a nodule was seen during surgical resection.
Also, the pathology report was reviewed to evaluate whether the nodule was seen on
histology.

Results

A search of the pathology database resulted in 5 patients with a histologically
confirmed diagnosis of a RCC and preoperative MR imaging available for review, and a
search of the radiology database resulted in 15 patients who were given a single diagnosis
of RCC because of characteristic imaging and the lack of any qualities representative of a
cystic adenoma or craniopharyngioma, and all of these patients had MR imaging
available for retrospective review.

On review of the MR images, 9 of 20 (45%) patients with RCCs had an intracystic
nodule (40%) (Table 1, Figures 1 and 2). In all of these 9 patients, the nodule was easily
seen on T2-weighted images, where the nodule appeared hypointense compared with the
cyst fluid. On T1-weighted imaging, the nodule was only seen in 4 of the 9 patients (44%) where it appeared more hyperintense compared with a hyperintense cyst (Figure 1). No contrast enhancement of any of the walls of the RCC or of the nodule (when present) was observed.

None of the patients who had incidentally discovered RCCs had interval changes in the size or imaging qualities of their lesions on serial imaging or progressed to require surgical intervention. In cases with an intracystic nodule, it also did not vary in size or intensity across imaging.

In the two cases of patients with surgically and histologically verified RCCs with associated intracystic nodules, a complete resection was achieved and at 36 months follow-up, neither patient had a recurrence. At surgery, in one case the nodule appeared as a clear, mucinous mass and in the other case, it was described as abnormal tissue associated with the cyst wall. In both cases, histology described the nodule as a mass of cellular debris.

**Discussion**

Although the radiographic characteristics of RCCs have been extensively explored and described in the literature, it often remains difficult to differentiate them from other cystic sellar or suprasellar lesions. Commonly, the MRI signal intensity is extremely variable on T1- and T2- weighted imaging, the location of the cyst is not consistent, and overall, no single, unique, or consistent pathognomonic sign for diagnosing RCC on MR imaging can be identified.\(^3,5,13\) RCCs may appear similar to other cystic sellar and suprasellar lesions such as craniopharyngiomas and pituitary
adenomas. An attempt to differentiate RCC from these other lesions on MR imaging is typically based on signs including smooth contours, lack of a cyst wall or extra-cystic solid component, absence of calcification, homogeneous attenuation, and absence of enhancement. 2,3,5,9,11-16,18

Currently, the most reliable sign to differentiate RCC from cystic pituitary adenomas and craniopharyngiomas that do not have an associated solid lesion is the 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 non-neoplastic cysts. Typically, RCCs do not enhance, whereas the other lesions invariably have enhancement of their walls. RCCs can appear to have enhancement, but this is actually due to enhancement of the adjacent normal pituitary gland. In questionable cases, it is recommended to perform dynamic pituitary studies that clearly differentiate enhancement of the normal pituitary that occurs early after contrast administration from cyst wall enhancement that occurs after enhancement of the pituitary.

In addition to the lack of contrast enhancement, this report demonstrates that the presence of an intracystic nodule with consistent low signal intensity on T2-weighted images and possible visualization with high signal intensity on T1-weighted images can be used to differentiate RCC from other cystic lesions. Overall, 17 patients have been described in the literature with a nodule associated with a pathologically confirmed RCC, 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 tissue-confirmed diagnosis of RCC and in 47% of patients diagnosed radiographically.
The largest series of intracystic nodules found associated with RCC was described by Byun, et al., and they noted that 10 of 13 patients (77%) with pathologically confirmed RCC had a nodule. They showed that the nodules consistently showed high signal intensity on T1-weighted images and low signal intensity on T2-weighted images. As in the current series, they found that detecting the intracystic nodules on T1-weighed images was more difficult because of similarities in the cyst and nodule intensity, whereas the nodule was easily appreciated on T2-weighted images because most of the intracystic nodules revealed low signal intensity relative to that of surrounding cyst fluid. At surgery, the nodules were waxy, solid masses, pathology demonstrated a mucinous mass, and biochemical studies demonstrated that they consisted of cholesterol and protein. The authors noted that the nodules were floating freely without a connection by any membrane.

Three other articles mentioned the presence of an intracystic nodule with RCC, but the reports did not provide radiographic details of the signal intensities of the nodules. Sumida, et al., noted the presence of an intracystic nodule in 3 of 18 patients with a RCC. Kuwahara and colleagues described a patient with a RCC that was associated with an intracystic nodule, but in this case the nodule was connected to the surrounding tissue and was described as a “moving globular mass.” Kucharczyk, et al., noted that 3 of 7 pathologically confirmed RCCs had a solid waxy component that was adherent to the cyst wall. They reported that pathological examination showed epithelial-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 2 nodules that
were seen on pathology appeared to be adherent to the cyst wall and consisted of cellular debris.

Although the intracystic nodule with its characteristic imaging qualities (as described in the current series and by Byun and colleagues\textsuperscript{4}) is unique to RCCs, it is important to realize that nodules are also common to craniopharyngiomas. In contrast with RCCs, craniopharyngiomas typically have a well-defined cystic mass with a mural nodule, and the nodules are characteristically hypointense on T1-weighted images and hyperintense on T2-weighted images and strongly enhance heterogeneously with contrast.\textsuperscript{7} Thus, these nodules can be easily differentiated from those found in RCCs.

**Conclusion**

It can be difficult to distinguish various intrasellar and suprasellar cystic lesions based on MR imaging characteristics alone because of the wide variations in signal intensities. Because RCCs are benign and often asymptomatic lesions, it is important to find ways to distinguish these lesions from other pathologies without surgical intervention. Intracystic nodules in association with RCCs are common findings on MRI, have consistent and characteristic signal intensities on MR imaging, and are thought to be diagnostic of RCC when present. Thus, a non-enhancing cystic lesion that has an intracystic nodule with low signal intensity on T2-weighted images and high signal intensity on T1-weighted images (if seen) may be considered a RCC; in the absence of significant symptoms or signs of optic apparatus compression or pituitary–hypothalamic dysfunction, the treating physician can have more confidence in assigning the diagnosis of RCC and recommending conservative management.
References


Figure Legends

Figure 1. MR imaging of a tissue-confirmed RCC with a nodule in the posterior aspect of the cyst (arrow in inset) that displays high signal intensity on T1-weighted imaging (A) and low signal intensity on T2-weighted imaging (B).

Figure 2. T2-weighted MR images of two different patients demonstrating a hypointense nodule within a hyperintense RCC.
Table

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