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Pituitary apoplexy in the magnetic resonance imaging era: clinical significance of sphenoid sinus mucosal thickening

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Object. The authors report their experience with pituitary apoplexy and evaluate the clinical significance of sphenoid sinus mucosal thickening found on magnetic resonance (MR) imaging.

Methods. The cases of 28 patients (19 males and nine females) with pituitary apoplexy were reviewed retrospectively. The mean age of the patients was 50 years (range 16–83 years), and the mean follow-up duration was 32 months (range 1–104 months). Admission MR imaging demonstrated hemorrhage or infarction in a pituitary tumor in each patient. A clinical grading scale for apoplexy was devised as follows: Grade I, presence of acute headache and/or endocrine abnormality (12 patients); Grade II, presence of the foregoing symptoms as well as cranial nerve deficit (visual and/or oculomotor; 15 patients); and Grade III, presence of all of these symptoms and a decreased level of consciousness (one patient).

Twenty-five patients (89%) underwent early transsphenoidal resection within 9 days (80% within 72 hours) of diagnosis. Headaches and oculomotor paresis resolved completely in 100%, visual function resolved completely in 44% and partially in 56%, and hypopituitarism was reversed in 25%. Twelve patients (43%) required long-term hormone replacement therapy. Two of the three patients who were treated conservatively had prolactin-secreting adenomas, which were treated with dopamine agonist therapy. Thickening of sphenoid sinus mucosa was present in 22 patients (79%). Fifty percent of patients in Grade I and 100% of those in Grades II and III, including all those with persistent hypopituitarism and residual visual deficits, had thickened sphenoid sinus mucosa on MR imaging. Patients with thickened sphenoid sinus mucosa had larger tumors that compressed the optic chiasm or cavernous sinus, and these individuals also had a higher rate of cranial nerve deficits at presentation than those without mucosal thickening (73% compared with 0%). Patients with thickened mucosa had a higher rate of hypopituitarism and subsequent long-term hormone replacement therapy than those without thickened mucosa (55% compared with 17%).

Conclusions. Thickened sphenoid sinus mucosa may correlate with higher grades of pituitary apoplexy and worse neurological and endocrinological outcomes.

KEY WORDS • **pituitary adenoma** • **pituitary apoplexy** • **transsphenoidal surgery**

PITUITARY apoplexy is a clinical syndrome characterized by an abrupt onset of signs and symptoms associated with hemorrhage or infarction into a preexisting pituitary adenoma.[9,17,18,27,31] In most instances, the syndrome occurs in patients with no history of a pituitary tumor and may represent the first definite indication that one is present. The lesion swells and expands, leading to compression of local suprasellar and parasellar structures. The patient typically presents with abrupt onset of a severe headache often associated with nausea, vomiting, and meningism. This can be accompanied by deterioration of visual acuity and visual fields, ophthalmoplegia, a decreased level of consciousness, and/or hypopituitarism.[9,29] When severe pituitary apoplexy is misdiagnosed and left untreated, the neurological sequelae can result in permanent blindness and coma. Although conservative management in select patients has been advocated by some, corticosteroid administration and urgent transsphenoidal decompression remain the mainstay of treatment.[4,11,17,21,29]

Hemorrhage into a pituitary adenoma was first described in 1898 by a neurologist, Pearce Bailey,[3] in a 50-year-old man with acromegaly who presented with a sudden onset of headache, nausea, vomiting, fever, oculomotor palsies, and visual loss. Autopsy findings revealed hemorrhage in the intrasellar adenoma and endarteritis of the adenohypophysial vasculature. A similar case was reported by Bleibtreu[5] in 1905. This clinical entity remained obscure until 1950, when Brougham and coworkers[8] described a clinicopathological syndrome in five patients postmortem. The syndrome was characterized by an abrupt onset of headache, ophthalmoplegia, blindness, stupor, or coma, and these authors named it pituitary apoplexy.

Since then, numerous case reports and only a few series of patients with pituitary apoplexy have been reported in the literature.[4,11,26,29,32] The patients in the majority of these clinical series received this diagnosis before the MR imaging era. Arita, et al.,[2] recently described thickening of sphenoid sinus mucosa as a radiological finding during the acute stage of pituitary apoplexy (within 7 days after the onset of apoplectic symptoms) but did not correlate it with the severity or clinical outcome of this disorder. In this study, we review our experience with 28 patients who presented with

Abbreviations used in this paper: CT = computerized tomography; MR = magnetic resonance.

pituitary apoplexy in the MR imaging era. A clinical grading scale that we have developed to facilitate classification of pituitary apoplexy is described. We also investigated and report on the clinical significance of thickened sphenoid sinus mucosa found on MR imaging.

Clinical Material and Methods

A retrospective review was performed in patients in whom pituitary apoplexy was diagnosed at the University of Utah School of Medicine between 1996 and 2005. Chart reviews were performed in accordance with the Health Insurance Portability and Accountability Act regulations and university guidelines. The diagnosis was made based on clinical presentation and neuroimaging findings. Only patients who exhibited abrupt onset of symptoms of headache, endocrine or cranial nerve deficits, or altered level of consciousness were included in the study. Patients with asymptomatic (silent) hemorrhages did not meet the criteria of clinical pituitary apoplexy and were therefore excluded. Those who presented with symptoms from Rathke cleft cysts, lymphocytic hypophysitis, and nonadenomatous lesions were also excluded. Patients in whom diagnostic MR imaging was performed more than 7 days after the onset of apoplectic symptoms were also excluded. Only patients who had suffered apoplexy from pituitary adenomas and in whom MR images were obtained within 7 days after the onset of apoplectic symptoms were included.

Patient Population

Twenty-eight patients with pituitary apoplexy were identified. The male/female ratio was approximately 2:1 (19 males and 9 females). The mean age was 50 years (range 16–83 years). The mean follow-up duration was 32 months (range 1–104 months). Twenty-five patients had nonfunctioning adenomas, two had prolactin-secreting adenomas, and one had a growth hormone–secreting adenoma. The overall incidence of pituitary apoplexy among patients with surgically treated pituitary adenomas during the study period was 10% (25 of 252 cases).

Clinical Presentation

Each patient was evaluated for clinical presentation, neuroimaging findings, possible precipitating factors, histopathological features, tumor type, visual and cranial nerve outcome, and endocrinological outcome. All patients underwent an endocrinological workup at the time of admission and were started on a regimen of intravenous corticosteroid drugs. Patients with prolactin-secreting adenomas were considered for dopamine agonist therapy.

Each MR image was evaluated for the presence of thickening and enhancement of sphenoid sinus mucosa. The thickness of the sphenoid sinus mucosa adjacent to the sellar floor was measured on T_1- or T_2-weighted MR images obtained after addition of Gd. The mucosa adjacent to the sellar floor was chosen as the point of measurement because this region was the epicenter of the mucosal thickening, which tapered off in the areas adjacent to the sella turcica within the sphenoid sinus, although some patients exhibited holosphenoidal mucosal thickening. Mucosal thickness less than 1 mm was considered normal, whereas mucosa thicker than 1 mm were considered abnormal, as previously described by Arita, et al.[2] A positive finding was defined as the presence of both thickening greater than 1 mm, and enhancement on T_1-weighted Gd-enhanced MR images.

Apoplexy Grading Scale

A clinical grading scale for apoplexy (Table 1) was devised based on clinical presentation: Grade I was assigned for the presence of acute headaches and/or endocrine abnormalities only; Grade II for the presence of the aforementioned symptoms and cranial nerve deficits (visual and/or oculomotor); and Grade III for the presence of the foregoing symptoms and a decreased level of consciousness. The patients categorized as Grade I were further subclassified into Grade Ia (absence of endocrine abnormality), or Grade Ib (presence of endocrine abnormalities with or without headaches).

Results

The most common presenting symptom was an abrupt onset of headaches, occurring in 27 patients (96%) (Table 2). Oculomotor paresis, defined as a palsy of the third, fourth, and/or sixth cranial nerve, was present in nine patients (32%). Loss of visual fields and/or acuity was found in nine patients (32%). Only two patients (7%) presented with both oculomotor paresis and visual loss. One patient (4%) presented with a decreased level of consciousness. Twelve patients (43%) had evidence of hypopituitarism at presentation, three patients (11%) had mild diabetes insipidus, and one patient (4%) had a growth hormone deficiency.

According to the clinical apoplexy grading scale described earlier, 12 patients (43%) were classified as Grade I, 15 (53%) were Grade II, and one (4%) presented as Grade III. Of the Grade I patients, 50% were subclassified in Grade Ia and 50% were in Grade Ib.

Precipitating Factors

The majority of patients (79%) had no precipitating factors implicated in their apoplectic event. Six patients, however, had a possible precipitating factor. Of these, one patient was receiving growth hormone replacement therapy and another patient was being treated with bromocriptine therapy. One patient was receiving anticoagulation therapy, and one presented immediately after an argument. Two patients presented with pituitary apoplexy immediately after surgical procedures; one had undergone a total knee replacement and the other a laparoscopic anterior lumbar interbody fusion.

Neuroimaging Findings

In all patients, MR images demonstrated hemorrhage and/or infarction in a pituitary tumor. Only 11 patients (39%) had undergone CT scanning: nine of these had a hyperdense lesion in the sella turcica consistent with hemorrhage, and two had an isodense lesion consistent with nonhemorrhagic infarction. The MR imaging modality was sensitive in detecting both a pituitary tumor and hemorrhage in 100% of cases. The CT scans demonstrated a pituitary tumor in 100% of cases, but revealed hemorrhage in only 82% of cases.

TABLE 1

*Pituitary apoplexy grading scale**

Grade	Description	No. of Patients	SSMT
I†	presence of acute headaches &/or endocrinological abnormalities	12	50%
II	presence of Grade I symptoms & cranial nerve deficits (visual &/or oculomotor)	15	100%
III	presence of Grade I & II symptoms & decreased level of consciousness	1	100%

* SSMT = sphenoid sinus mucosal thickening.

† Grade Ia = absence of endocrinological abnormalities; Grade Ib = presence of endocrinological abnormalities with or without headaches.

Surgical Treatment

Twenty-five (89%) of the 28 patients underwent transsphenoidal resection of their apoplectic pituitary tumors: 10 were categorized as Grade I patients, 14 were Grade II, and one was Grade III. The majority of these patients (80%) underwent surgery within 72 hours of the time of diagnosis, whereas five (20%) of the 25 patients underwent surgery between 5 and 9 days from the time of diagnosis. Hemorrhagic and/or necrotic tumors were found at surgery in all 25 patients.

Headaches resolved in 100% of the 25 patients who were treated surgically. Oculomotor paresis also resolved completely in all eight patients who had this symptom. Visual function, including both visual fields and acuity, was regained completely in four (44%) and partially in five (56%) of nine patients. Preoperative hypopituitarism resolved in three (25%) of 12 patients. Twelve patients (43%) required long-term hormone replacement therapy (cortisol and thyroid replacements). Mild diabetes insipidus in three patients at presentation resolved after surgery; none developed permanent diabetes insipidus.

Nonsurgical Treatment

In three (11%) of the 28 patients, the lesions were managed nonsurgically. One patient presented with acute headaches only and had normal pituitary function (Grade Ia). This patient's case was managed with surveillance MR imaging. The headaches improved and the hemorrhage resolved on follow-up MR imaging (Fig. 1). The other two patients had prolactin-secreting adenomas (one Grade Ia, one Grade II) and were treated with dopamine agonist therapy. Both patients demonstrated normalization of serum prolactin levels and tumor shrinkage on follow-up MR imaging. The patient with Grade II apoplexy initially presented with headaches and a third cranial nerve palsy, which resolved completely within 48 hours of initiation of dopamine agonist therapy.

TABLE 2

Clinical presentation of pituitary apoplexy in 28 patients

Symptom	No. of Patients (%)
headaches	27 (96)
ocular paresis	9 (32)
visual field &/or acuity loss	9 (32)
ocular paresis & visual loss	2 (7)
hypopituitarism	12 (43)
mild diabetes insipidus	3 (11)
decreased level of consciousness	1 (4)

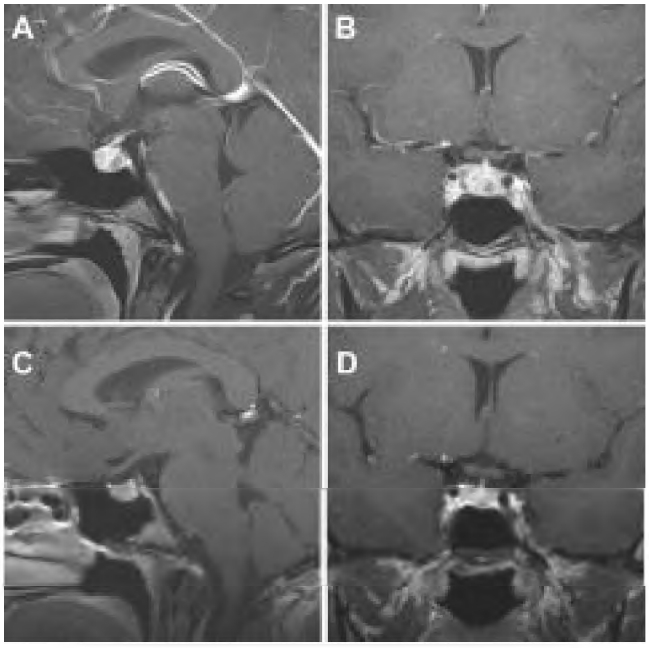

FIG. 1. Illustrative case of Grade Ia pituitary apoplexy. This 32-year-old woman presented with a 3-day history of headaches associated with nausea. Results of the visual and cranial nerve examination were normal. Initial sagittal (A) and coronal (B) T_1-weighted MR imaging with addition of Gd demonstrated hemorrhage in a pituitary tumor, and there was no thickening of sphenoid sinus mucosa. The tumor was small and did not exhibit compression of the optic chiasm or cavernous sinus on neuroimages. The patient was treated conservatively with close observation. Repeated MR imaging (sagittal and coronal views; C and D, respectively) at the 3-month follow-up evaluation demonstrated a decrease in tumor size as well as resolution of hemorrhage and necrosis. This case illustrates successful conservative management of Grade I pituitary apoplexy in the absence of endocrinological abnormality and thickened sphenoid sinus mucosa.

Thickening of Sphenoid Sinus Mucosa

In 22 patients (79%), thickening of sphenoid sinus mucosa was observed on MR imaging at the time of diagnosis. Fifty percent of patients in Grade I and 100% of those in Grades II and III had thickening of sphenoid sinus mucosa. Patients with thickened sphenoid sinus mucosa had a higher rate of cranial nerve deficits at presentation than those without mucosal thickening (73% compared with 0%). All of the Grade I patients who exhibited thickening of sphenoid sinus mucosa had evidence of tumor compression of either the optic chiasm or cavernous sinus on MR imaging (Fig. 2). Interestingly, none had objective visual or oculomotor deficits. The remainder of the Grade I patients without sphenoid sinus mucosal thickening did not experience compression of the optic chiasm or cavernous sinus.

Patients with thickened mucosa had a higher rate of hypopituitarism and subsequent long-term hormone replacement therapy than those without this symptom (55% compared with 17%; Fig. 3). Of the 12 patients who even-

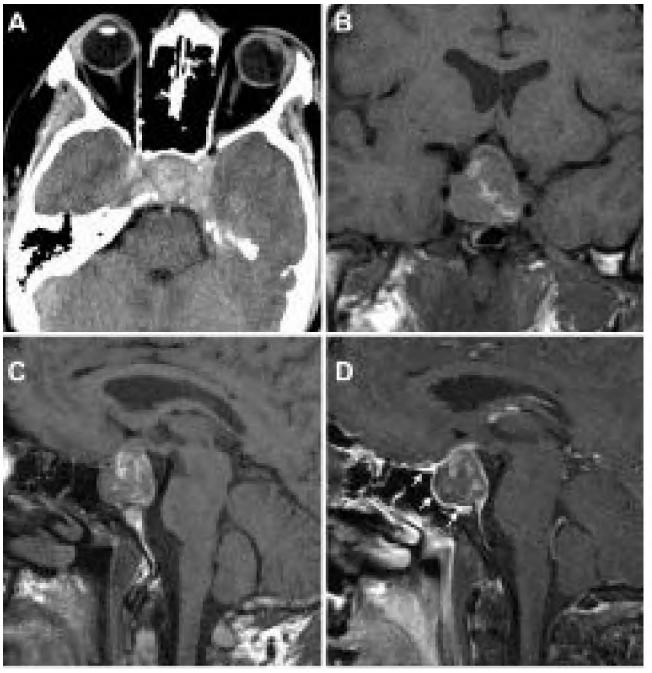

FIG. 2. Illustrative case of Grade Ib pituitary apoplexy. This 45-year-old man awoke with the worst headache of his life. Results of his neurological examination were normal, with the exception of mild diabetes insipidus. Endocrinological workup demonstrated hypogonadotropic hypogonadism. An unenhanced axial CT scan (A) demonstrated a hyperdense lesion in an expanded sella turcica. Admission MR imaging (B, T_1-weighted coronal view; C, T_1-weighted sagittal view; and D, T_1-weighted Gd-enhanced sagittal view) revealed a hemorrhagic macroadenoma with compression on the optic chiasm and bilateral cavernous sinuses. The patient did not exhibit visual or oculomotor deficits. Thickening and enhancement of the sphenoid sinus mucosa of more than 1 mm was also present *(arrows)*. The patient was started on a regimen of intravenous corticosteroid drugs and he underwent urgent transsphenoidal resection of the pituitary tumor. Postoperatively, his headaches and diabetes insipidus resolved, but he required long-term cortisol and thyroid replacement therapy.

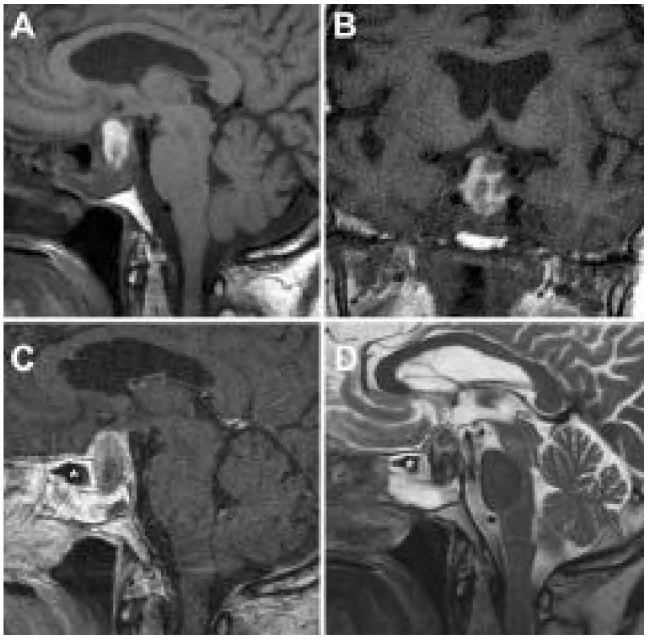

FIG. 3. Illustrative case of Grade II pituitary apoplexy. This 79-year-old man presented with acute onset of headaches and bitemporal hemianopia. His extraocular movements were intact. Endocrinological workup revealed hypopituitarism. Admission MR imaging (A, T_1-weighted sagittal view; B, T_1-weighted coronal view; C, T_1-weighted sagittal view after addition of Gd; and D, T_2-weighted sagittal view) demonstrated hemorrhage into a pituitary macroadenoma with suprasellar extension compressing the optic chiasm. Thickening and enhancement of sphenoid sinus mucosa was also present *(asterisks)*. The patient was started on intravenous corticosteroid drugs and he underwent urgent transsphenoidal resection of the pituitary tumor. Postoperatively, the patient's headaches and visual symptoms improved, but he required long-term cortisol and thyroid replacement therapy.

tually required long-term hormone replacement therapy, 100% had thickening of sphenoid sinus mucosa (two in Grade Ib, nine in Grade II, and one in Grade III). Of the 16 patients who did not require long-term hormone replacement, 62% had thickening of sphenoid sinus mucosa (two in Grade Ia, two in Grade Ib, and six in Grade II) and 38% did not. All five patients who experienced residual visual field loss had thickening of sphenoid sinus mucosa.

Discussion

Pituitary Apoplexy in the MR Imaging Era

The use of neuroimaging studies to facilitate the diagnosis of pituitary apoplexy has evolved over the last several decades.[26] In pituitary apoplexy series published before 1990, CT was the dominant neuroimaging study of choice.[11,32] In the last 15 years, MR imaging has been used increasingly to facilitate the diagnosis of pituitary apoplexy. It is significantly more sensitive than CT scanning in detecting both a pituitary tumor and an intratumoral hemorrhage or infarct.[4,17,29] In 1991, McFadzean, et al.,[21] reported on 15 patients with pituitary apoplexy, four (27%) of whom underwent MR imaging. In an analysis in 1993 by Bills, et al.,[4] three (8%) of 37 patients with pituitary apoplexy underwent MR imaging. More recently, in 2005, Semple, et al.,[29] reported on a series of 62 patients with pituitary apoplexy, of whom the 37 most recently treated patients (60%) had undergone MR imaging as the primary neuroimaging investigation.

We describe a contemporary series of 28 patients in whom clinical pituitary apoplexy was diagnosed, supported by documented MR imaging in 100% of patients. In our series, 43% of the patients presented with headaches or endocrine abnormalities alone without cranial neuropathy (Grade I apoplexy), thus making the specific clinical diagnosis of pituitary apoplexy more difficult. However, MR imaging played an important role in facilitating the diagnosis by demonstrating a pituitary tumor and an associated hemorrhage or infarct. Certainly, if visual deficits, ocular paresis, and a decreased level of consciousness were present along with an acute onset of headaches, clinical pituitary apoplexy should be suspected immediately.

The reported incidence of clinically symptomatic pituitary apoplexy has ranged from 0.6 to 9%.[6,7,11,13,20,22,24,26,29,32] In our series, the overall incidence of pituitary apoplexy was

10%, which is slightly higher than what has been reported previously. This may be due to increased detection of Grade I pituitary apoplexy with the increased use of MR imaging. It may also be attributed to the referral patterns of our tertiary care academic medical center. The increased use of CT and MR imaging for the workup of headaches among the general population has resulted in increased detection of incidental pituitary adenomas.[28] In a recent metaanalysis by Ezzat, et al.,[12] the prevalence of pituitary adenomas was estimated to be 16.7% (14.4% identified in autopsy studies and 22.5% in neuroimaging studies), which suggests that pituitary tumors are extremely common in the general population. It is possible that the increased use of MR imaging in the workup of acute headaches may be the reason for the increased recognition of hemorrhagic and necrotic pituitary tumors.

Clinical Apoplexy Grading Scale

In our study, the characteristics of the patient population, including the age and sex and the distribution of clinical features, were similar to those in other surgical series of pituitary apoplexy.[4,26,29] There was a wide spectrum of presenting symptoms, ranging from an acute headache alone to visual deficits and ocular paresis, and even a decreased level of consciousness. We describe a grading scale for patients with pituitary apoplexy based on their initial clinical presentation. Our proposed grading scale can be used to classify the degree and severity of symptoms at clinical presentation and to help facilitate urgent treatment.

Patients categorized in Grade I (those with the presence of acute headaches and/or endocrine abnormalities only) constituted 43% of our patients, whereas patients in Grade II (those with the presence of the aforementioned symptoms and visual and/or oculomotor deficits) comprised 53% of our patients. These data support the suggestion that a significant number of patients with pituitary apoplexy can present with headaches alone in the absence of cranial neuropathies or a decreased level of consciousness. One patient classified as Grade I presented with increased fatigue from hypocortisolemia with no headaches. The large number of patients with Grade I apoplexy may be attributed to detection of pituitary apoplexy in patients with less obvious symptoms or signs, which are detectable on MR imaging as discussed earlier.

In most series, a decreased level of consciousness is an uncommon presenting symptom.[4,26,29] Only one patient (4%) in our series was classified as Grade III (having the symptoms of Grades I and II as well as a decreased level of consciousness), which was slightly less than in other reported series (8–13%).

Clinical Significance of Thickened Sphenoid Sinus Mucosa

The presence of thickened sphenoid sinus mucosa has been reported during the acute stage of pituitary apoplexy (within 7 days after the onset of apoplectic symptoms).[2] In our study, 79% of patients had thickening of sphenoid sinus mucosa on MR imaging at the time of diagnosis. This finding was associated with higher grades of pituitary apoplexy. Of the patients with Grades II and III apoplexy, 100% had thickening of sphenoid sinus mucosa, whereas thickening was present in only 50% of patients in Grade I. Of the patients categorized as Grade I, those with sphenoid sinus mucosal thickening had evidence of tumor compression of either the optic chiasm or the cavernous sinus on MR imaging. Interestingly, despite the compression, these patients did not exhibit visual or oculomotor deficits on clinical examination. Figure 2 illustrates pathological features in a patient with Grade I apoplexy who had sphenoid sinus mucosal thickening and in whom radiographically confirmed compression of the optic chiasm was found, but who presented with only headaches and no visual or oculomotor deficits.

Thickening of the sphenoid sinus mucosa during acute pituitary apoplexy may also be associated with a worse endocrinological and neurological outcome. Patients with thickened mucosa had a higher rate of hypopituitarism and subsequent long-term hormone replacement therapy than those without this characteristic (55 compared with 17%). In our study, of the 12 patients who required long-term hormone replacement therapy, 100% had thickening of sphenoid sinus mucosa on the initial MR imaging studies. Of the 16 patients who did not require long-term hormone replacement therapy, 62% had sphenoid sinus mucosal thickening. This suggests that sphenoid sinus mucosal thickening is sensitive but not specific for poor endocrinological outcome. This radiological finding should raise concern for potential endocrine dysfunction in patients with pituitary apoplexy. Similarly, each of the five patients who experienced persistent visual field loss or incomplete visual recovery also had thickening of sphenoid sinus mucosa.

Arita, et al.,[2] proposed that a possible mechanism of the thickening and enhancement of the sphenoid sinus mucosa may be venous congestion caused by obstruction of the out-to-in transsellar venous flow, which is attributable to a sudden increase in intrasellar pressure. Increased intrasellar pressure has also been implicated in the mechanism of hypopituitarism seen in acute pituitary apoplexy.[33] Early surgical decompression can help prevent ischemic necrosis of the anterior pituitary gland and subsequent hypopituitarism. We believe that thickening of the sphenoid sinus mucosa represents an indirect measure of increased intrasellar pressure during the acute stages of pituitary apoplexy and should raise concern for possible endocrine dysfunction. Our data support the suggestion that this finding is associated with higher grades of apoplexy, larger tumors with radiographically confirmed compression of parasellar structures, and worse endocrinological and neurological outcomes. The true mechanism for the mucosal thickening has not been defined; in addition to the mechanism proposed by Arita, et al.,[2] it is possible that this condition may have an endocrinological or neurogenic basis.

Management and Outcome

Once the diagnosis of pituitary apoplexy is suspected, initial medical management requires prompt administration of corticosteroid medications and close monitoring of the fluid and electrolyte balance because of the high prevalence of hypopituitarism and subsequent adrenal insufficiency.[1,9,17] Steroid drugs may also improve visual function. There is some disagreement regarding the role of early surgery for pituitary apoplexy. Although cases of spontaneous recovery with conservative treatment have been reported,[14,19,25] most experienced neurosurgeons have advocated early surgical decompression via the transsphenoidal approach.[4,11,15,17,18,21,23,26,29,31]

The clinical course of conservatively managed pituitary apoplexy is often unpredictable, whereas early transsphenoidal surgery effectively reverses or improves neuroophthalmological deficits with low rates of morbidity and mortality.[4,26,29] Patients treated conservatively with corticosteroid medications alone may have a higher mortality rate.[10] Urgent decompression is advocated in the clinical setting of visual deterioration or progressive neurological deficits. Early decompression promotes significant neurological improvement, rapid recovery from diencephalic symptoms, resolution of ocular paresis, restoration of compromised vision, and sometimes, improvement of pituitary function.[1,4,9,11,18,21,30,33]

The timing of surgery is important for obtaining favorable outcomes. In a retrospective analysis of 37 patients, Bills and coworkers[4] found that those who underwent surgery within 7 days of the onset of pituitary apoplexy achieved significant recovery of visual acuity and resolution of visual field deficits. Visual improvement was retarded in patients who underwent surgery after the 7th day. Transsphenoidal decompression resulted in improvement in ocular paresis in 100%, visual acuity deficits in 88%, and visual field deficits in 95% of patients. Randeva, et al.,[26] also noted higher rates of complete resolution of ocular paresis in patients who underwent surgery within 8 days (74%) than in those who underwent surgery after 8 days (42%). In a review by Cardoso and Peterson,[9] the extent of visual recovery was more dependent on early transsphenoidal decompression than on the severity of the initial visual loss. Patients were more likely to recover from ocular paresis than visual loss.

All but one of the surgically treated patients in our study underwent their procedures within 6 days; the remaining one was treated at 9 days. The majority (80%) underwent transsphenoidal decompression within 72 hours of diagnosis. Headaches resolved in 100% of patients; oculomotor paresis disappeared completely in 100%; and visual function, including both visual fields and acuity, was regained completely in 44% and partially in 56%. Three (25%) of 12 patients in whom hypopituitarism was found on presentation did not require long-term hormone replacement therapy after transsphenoidal surgery. Forty-three percent of our patients required long-term hormone replacement therapy. None suffered permanent diabetes insipidus.

Conservative management may be considered in carefully selected cases; in our series, pituitary apoplexy was successfully managed with conservative therapy in three patients. The patient whose case is illustrated in Fig. 1 presented with acute headaches only and had normal pituitary function (Grade Ia apoplexy). The absence of thickening of the sphenoid sinus mucosa was associated with a low-grade hemorrhage. The tumor was small and neuroimaging did not reveal compression of parasellar cranial nerves. Because the pituitary function was normal, there was no endocrinological indication for surgery.

Some patients with prolactin-secreting adenomas may also be considered for medical therapy with dopamine agonists if severe visual compromise is absent. Brisman, et al.,[7] reported on a patient with a macroprolactinoma who presented with pituitary apoplexy and a third cranial nerve palsy, which was reversed with bromocriptine and corticosteroid agents. We treated two patients with prolactinomas by using dopamine agonist therapy. Both patients demonstrated normalization of serum prolactin and tumor shrinkage on follow-up MR imaging. One patient, whose case is illustrated in Fig. 4, presented with headaches and a third cranial nerve palsy (Grade II) that resolved completely within 48 hours of initiation of dopamine agonist therapy (this patient was briefly described in a recent review of prolactinomas).[16] We do not recommend this treatment if severe visual deficits are present. Surgical decompression should be considered if cranial nerve palsies do not resolve or if the patient worsens neurologically.

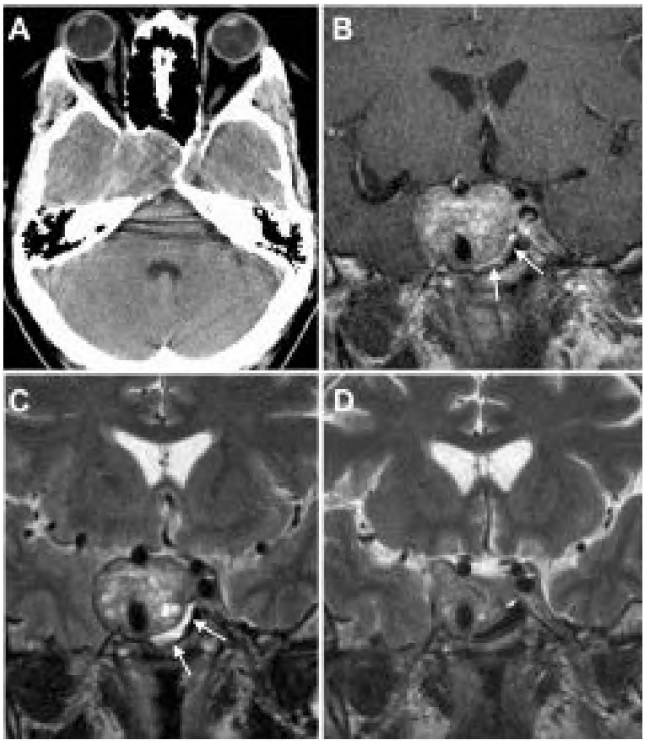

FIG. 4. Illustrative case of Grade II prolactinoma apoplexy. This 63-year-old man awoke from knee surgery with acute headaches, nausea, vomiting, and a right third cranial nerve palsy. His visual fields and acuity were intact. An unenhanced axial CT scan (A) demonstrated a large isodense lesion arising from the expanded sella turcica, with involvement of the right cavernous sinus. No evidence of hemorrhage was detected. Admission MR imaging (B, T_1-weighted coronal view after Gd enchancement; and C, T_2-weighted coronal view) demonstrated a large infarcted pituitary macroadenoma that was compressing the right cavernous sinus. Thickening and enhancement of the sphenoid sinus mucosa were present *(arrows)*. The patient's serum prolactin was 5401 ng/ml, for which he received intravenous corticosteroid medications and bromocriptine therapy. Within 24 to 48 hours, his ophthalmoplegia resolved completely. Follow-up MR imaging (D, T_2-weighted coronal view) performed 3 weeks later revealed dramatic tumor shrinkage. The serum prolactin level at the 8-month follow-up evaluation had normalized to 6 ng/ml. Panel C is reproduced with permission from Liu JK, Couldwell WT: Contemporary management of prolactinomas. **Neurosurg Focus 16(4):**E2, 2004.

Conclusions

The presence of thickened sphenoid sinus mucosa correlates with more severe pituitary apoplexy as defined by the

higher grades of the scale proposed in this paper. This finding appears to be associated with worse endocrinological and visual outcomes.

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