SURGICAL EMERGENCIES RELATED TO THE PITUITARY AND NEIGHBOURING AREAS

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The intention of this paper is to present some of the experiences, clinical and operative, with a special view to surgical emergencies, in a total of 79 cases of surgical lesions in the pituitary and adjacent areas. With a few exceptions—operations at which I had the opportunity of assisting some of my former co-workers—all the craniotomies in this series were carried out by myself, as a rule by the subfrontal intradural approach as inaugurated by Dandy, Olivecrona and Tönnis.

Surgical emergency not infrequently arises in lesions located around the sella turcica. It will be discussed under the following headings: (1) Impending blindness due to bilateral macular scotoma. (2) Raised intracranial pressure. (3) Acute mental derangement. (4) Pituitary apoplexy.

1. IMPENDING BLINDNESS

It is not my intention to enlarge here on those cases in which field defects have already advanced so far as to make the patient virtually blind in both eyes. In these cases surgical treatment as a rule appears too late and is unwarranted; and, the mortality rate amounts to 60%,[25] even in competent hands. Instead, it is intended to restrict the discussion to those cases where impending blindness is due to bilateral central (macular) scotomata, with or without bitemporal field defect.

It has been known since Cushing's work (1930) that a bilateral macular scotoma, when clearly brought out by careful perimetry, may pin-point the lesion within the optic chiasm to damage to the bundle of macular fibres which originate in the maculae luteae of central vision and decussate near the posterior margin of the chiasm. These fibres are obviously exposed to pressure from above or behind by lesions that extend into the retrochiasmal angle, which from a clinical point of view means the interpeduncular space.[15,3,1] Henderson,[14] who in 1937 reviewed Cushing's series of 338 pituitary adenomas, enumerates 6 cases of bilateral central scotomata due to lesions impinging on the posterior margin of the chiasm.

In the present series there were 4 cases in which bilateral macular scotomata were recorded (Table I). Amongst these were 2 adenomas of the hypophysis, 1 tumour of Rathke's pouch with a huge suprasellar extension, and 1 case in which the operative diagnosis was aneurysm of the basilar artery at its bifurcation. In the last-mentioned case, unfortunately, no vertebral angiogram was available, while the carotid angiogram was normal. In this patient, a woman of 52, the vision (and the level of consciousness) deteriorated so rapidly that we were unable to chart the fields carefully; consequently, the diagnosis of a bilateral central scotoma was not clearly established.

According to Cushing[10] the tumours of hypophysial-duct origin are especially apt to cause bilateral central scotomas, and one is ready to think this is so because of their being so often located in the suprasellar region; however, it is not borne out by the present series. One of the two adenomas mentioned above presented at operation as an intrasellar growth and, on the other hand, in a craniopharyngioma with a proved retrochiasmal extension (on the air studies and at operation) a unilateral macular scotoma had been found only on the left; it seems reasonable to assume that in similar cases an unsuspected retrochiasmal nodule or 'nubbin'[15] was responsible for the failure of central vision.

Traquair[26] has drawn attention to the rapidity of compression by a tumour or an inflammatory lesion; as well as certain peculiarities of vascular supply to the macular fibres. Recently, Dawson[13] has reported on data related to local chiasmal ischaemia. It seems likely that cases of rapid visual failure in patients with Vincent's type of arachnoiditis must be explained on the basis of these findings.

In one case of bilateral macular scotoma included here there was an obstruction at the level of the foramen of Monro caused by a suprasellar Rathke's tumour. (Case W in Table I). This patient, a woman of 27, had bilateral high papilloedema with retinal haemorrhages on the left; there was no hemianopia. She died 3 weeks after craniotomy from an insufficiently relieved hydrocephalus. The operation by the subfrontal approach had disclosed the left optic nerve acutely angulated

TABLE I. THE FOUR CASES OF BILATERAL MASCULAR SCOTOMA

Name, Age	*Type of Lesion*	*Air Studies*	*Fundoscopy*	*Operative Findings*	*Outcome*
W. 27	Suprasellar craniopharyngioma	Filling defect in 3rd ventr.	Bilat. high papilloedema with retinal haemorrhages	Pre-fixed chiasm	Died 3 weeks after op. from obstructive hydrocephalus.
R. 40	Chromophobe adenoma with turricephaly and 'Drusenpapille'	Elevation of floor of 3rd ventr. and displacement of suprasellar cistern	Bilat. primary optic atrophy	Intrasellar tumour with ? infundibular extension	Died following day. Hyperthermia. Cushing ulcers of stomach.
N. 25	Pituitary adenoma, retrochiasmal extension	None	Optic papillae sharply outlined; ? pallor	Partial removal from intrasellar portion. Extension into right middle fossa	Survived.
G. 52	Aneurysm	Spherical suprasellar mass outlined	Within normal both sides; very slight pallor temporal half on right	Post-fixed chiasm; retrochiasmal aneurysm ruptured during op.	Died 2 hours after op.

and flattened by the calcified and thickened walls of the tumour. Only at autopsy was it realized that this tumour had occupied the greater part of the 3rd ventricle. This case is specially mentioned because it shows clearly that papilloedema (or its sequelae) and blockage of the CSF passages can produce bilateral macular failure without necessarily causing dilatation of the 3rd ventricle and bulging of its floor owing to pressure on the chiasm from above and behind. This mechanism has been stressed by Klingler and Condrau.[17]

In a case I saw at Zürich under Prof. H. Krayenbühl, a symmetrical macular scotoma when found at first examination was thought to be due to optic (retrobulbar) neuritis. Only later was a pituitary tumour found and extension behind the chiasm suspected. It was confirmed by operation, by which time the tumour had spread also into the right middle fossa.

Of 7 cases of retrochiasmal extension (proved on craniotomy or at necropsy, or both) there were only 2 with a clear-cut central scotoma. One of these two—bilateral—has just been mentioned; in the other the macular failure was only on the left. In another of the 7 cases (Fig. 1) there was an upper-quadrant bitemporal hemianopia. In 2 others

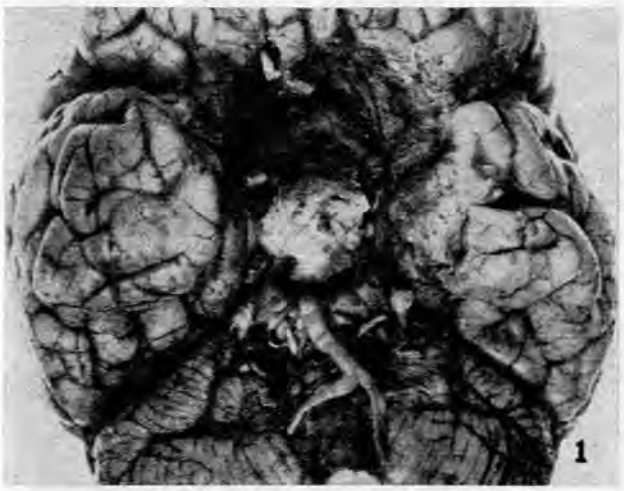

Fig. 1. Necropsy specimen in a case of pituitary adenoma with suprasellar and interpeduncular extension. Clinically, extrasellar extension was not suspected and air studies were not done. At the operation by the subfrontal route the tumour presented as an intrasellar adenoma. Patient died 11 days after craniotomy from pulmonary embolism arising from a thrombosis of the femoral vein. Necropsy: No signs of increased pressure, no clot present. Note suprasellar portion of the tumour extending between the frontal lobes. Compression of pons and basilar artery by the retrochiasmal part of the tumour. (Autopsy done by Prof. H. Spatz.)

perimetry was impossible because of lack of cooperation. The record on perimetry is not available from one of the patients. In the last of the 7, a Bantu child aged 4, the fields were not charted, and clinically there was no indication and no complaint of failing vision.

Summary

1. Macular scotoma, especially the bilateral type, associated with tumour in the sellar region, should always raise suspicion of an obstruction either at the foramen of Monro or at the aqueduct of Sylvius. Papilloedema or secondary optic atrophy supports this diagnosis. These cases always call for urgent ventriculography.

2. Retrochiasmal extension (or a single retrochiasmal nodule) may be expected in cases of suprasellar calcification indicative of Rathke's tumour, and in pituitary adenomas in the presence of pyramidal signs, ataxia or incoordination, or choreatic dyskinesia; in the young, differential diagnosis from a Sydenham's chorea may require ventriculography.

3. The possibility of a pre-fixed chiasm[15] must be taken into account pre-operatively in cases of suspected or proved retrochiasmal extension, as well as in patients presenting with a macular failure; technically, this may mean a difficult approach by the subfrontal way. Jefferson[15] has stressed the usefulness of ventriculography in establishing pre-fixation. Unfortunately, cases of this type often spread out in many directions, giving rise to mental derangement, epileptic convulsions, or lack of concentration and inability to cooperate, and often preclude a proper charting of the visual fields.

In every case, central scotomata deserve special attention, no less than a 3rd nerve palsy, which is diagnostic[15] of cavernous-sinus invasion.

2. RAISED INTRACRANIAL PRESSURE

In surgical emergencies of this type neither time-consuming laboratory tests nor long-term steroid premedication are feasible. Seen from the angle of surgery a raised intracranial pressure is the prominent feature to deal with. It means either fronto-temporal extension of the hour-glass type of Jefferson,[15] or obstruction of the CSF passages; in either case, then, extrasellar extension.

Experiences gained from the present series indicate that the cases with poor prognosis as regards hormonal control are those of poor risk from the point of view of surgery. In the large series of 163 operations on the pituitary reviewed by Troen and Rynearson,[27] from the Mayo Clinic, the mortality rate was not significantly different for the various degrees of pre-operative pituitary insufficiency, and even appeared unrelated to pre- and post-operative endocrine derangement. This is borne out clearly in the present series by the following brief discussions of 9 operative fatalities which occurred up to 6 days after craniotomy, analysed in terms of the various complicating factors to be faced before, during, and after operation:

1. In cases of raised intracranial pressure as evidenced by tightness of the dura mater and flattened convolutions, and likely to be associated with frontal extension of the lesion, the ventricles may be found too small to afford any relief by tapping. Then de-capping, or even partial ablation of the frontal lobe, becomes necessary. This is preferable to sinking a shaft through the frontal lobe,[2] which easily results in cortical damage and spreading cerebral oedema. It may be advisable to restrict surgery to biopsy and temporary relief of pressure if technically practicable.

2. Failure adequately to decompress an obstructive hydrocephalus may result in fatal outcome soon or within 2-3 weeks after operation. A subfrontal instead of an intraventricular approach may imply failure to recognize the anatomical relationships or the infiltrating character of the growth. These are the cases where air studies, usually by ventriculography, are indispensable. Repeated aspiration of

a cystic cavity,[6] better than a ventricular catheter, may be indicated as a preliminary decompressive measure.

3. Lateral extension of a tumour, solid or cystic, between the optic nerve and the carotid artery, leading to separation of these structures to such an extent as to necessitate incision and at least partial removal lateral to the optic nerve, was encountered 3 times among the operative fatalities. We found this to be an important factor complicating the operation, especially when unsuspected because of lack of neurological signs of ocular palsy. Sharp angulation of the chiasm or the optic nerves owing to pressure against the dural sleeve of the optic canal or the anterior cerebral artery are not uncommon and, in fact, necessitated division of the right anterior cerebral artery between silver clips in 2 cases. This procedure has been illustrated by Henderson[14] in Fig. 589 of his review of Cushing's series. In the present series, the right anterior cerebral artery had to be severed during operation in 5 cases; 2 of these patients (those mentioned above) died. The impression is that division of the right anterior cerebral artery alongside the optic nerve or chiasm does not *per se* contribute essentially to the fatal outcome, although Jacksonian fits and/or slight hemiparesis may complicate the post-operative course.

4. A progressive blunting of consciousness during the first few days after craniotomy makes the differential diagnosis from a post-operative clot both imperative and difficult. Caughey *et al.*[7] had to re-explore the wound in 3 cases, in 2 patients even twice. In the present series re-opening of the craniotomy wound was thought necessary in 4 patients; only in one was a subdural clot found and removed.

5. Finally, the malignant nature of a tumour may well be missed on exposure. In my series this happened in 2 cases, in both of which the tumour presented at the operation as a classical intrasellar adenoma. In one of them[22] the tumour turned out to be an ependymal spongioblastoma of the posterior pituitary; in the other patient, who survived, microscopy revealed an adenocarcinoma of the hypophysis.[18,21] In yet another case (at Zürich) the histological picture was much in favour of a malignancy though this diagnosis was not beyond doubt (Dr. F. Lüthy); on exposure this tumour had presented as an adenoma with suprasellar extension.

3. ACUTE MENTAL DERANGEMENT

Various degrees of disturbed consciousness, including coma, are known to be related to the pituitary gland and the anatomical structures subserving its functional links with the trophotropic as well as the ergotropic area of the diencephalon.[8,9] On the other hand, psychotic states and behavioural aberrations have long been known closely associated with diencephalic lesions. To H. Zondek[30] the concept is due to what he calls 'diencephalopathia mentalis'; he also described a case of manic-depressive psychosis in a woman with a Cushing's basophilic adenoma of the pituitary.

Extrasellar pituitary tumours frequently result in a whole range of mental disorders, of which White and Cobb,[29] gave a comprehensive review, completing their series with 5 cases of their own. Disorders of this kind may range from a 'lobotomy syndrome' to manic agitation and aggressiveness, indicating extension of the growth either between the frontal lobes or into the hypothalamus, not infrequently with consequent blockage of the CSF flow.

The present series includes a remarkable and — as far as I could ascertain — unique case of an acute psychotic episode in a man of 36 in whom Cushing's adenoma had been diagnosed previously. He had undergone repeated X-ray therapy of the pituitary and finally was admitted as an emergency case because of a mental derangement characterized by excessive irritability and wild agitation, with hallucinations and delusions. At operation an intracapsular haematoma was found, confined to the intrasellar space, and removed by suction. The patient recovered rapidly; no mental symptoms recurred although he remained amnesic for the psychotic episode, including the operation. There were no signs of a subarachnoid bleed, or of obstructive hydrocephalus. Further, this was not an acute pituitary insufficiency or Addisonian crisis such as occasionally occurs after X-ray therapy of the pituitary. Deep therapy has been repeatedly found responsible for acute necrosis and haemorrhage within a pituitary adenoma.[23]

The type of psychotic reaction exhibited by our patient is not unlike those acute mental derangements induced by some of the newer hallucinogenics, e.g. lysergic acid diethylamide. Kinross-Wright, in his paper before the South African Medical Congress in Durban (1957) has described them as 'a true exogenous toxic type of reaction with hallucinations and delusions, impairment of judgment, memory and orientation'. Many attempts have been made to pin-point the effect of these psychogenic agents within the central nervous system, and more specifically, within the hypothalamus.

For some reason as yet unknown, some of the lesions within or affecting the diencephalic area are likely to produce an acute psychosis with a distinct paranoid trend, which was clearly shown by our patient, too. A tendency of this kind was emphasized by White and Cobb[29] in their series of giant pituitary adenomas mentioned above; it was illustrated by 2 of their own 5 cases. I have seen the same in yet another case, a man of 27 with a cystic retrochiasmal Rathke's tumour, producing on the air encephalogram a filling defect in the floor of the 3rd ventricle. This patient, on the 15th day after aspiration and partial removal of the cyst, developed an acute paranoid hallucinosis lasting until his death from another cause; at autopsy no meningitis was present.

4. PITUITARY APOPLEXY

Haemorrhage into a pituitary adenoma is not uncommon.[11] Müller and Pia[20] found 19 haemorrhages in 270 adenomas, and Uihlein *et al.*[28] collected 71 cases from the literature, 35 of them acute, adding 2 of their own. A haemorrhage of this kind may be the cause of sudden death, even after operation. Schloffer,[24] who was the first to attack surgically a pituitary tumour (by the transsphenoidal route) reported on the sudden death of his patient due to haemorrhage into the tumour $2\frac{1}{2}$ months after the operation. It was thought at one time that such haemorrhages were more likely to occur in chromophobe adenomas; Courville's case[11] and the 5 patients described by Röttgen and Peters[23] all had chromophobe tumours. However, the statement of Kirshbaum and Chapman[16] that subarachnoid haemorrhage as a complication of an eosinophile adenoma is most unusual has not been borne out by later experience. Many patients with pituitary tumours into which haemorrhage has taken place are now known to present with acromegaloid features, like the earlier cases reported by Cairns[5] and by Jefferson.[15]

It seems advisable to restrict the term *pituitary apoplexy* to a clinical syndrome characterized by (*a*) acute onset with headaches, rapid decline of vision, mental derangement, and

meningeal irritation; (*b*) ballooning or erosion of the sella turcica. As a rule, blood is present in the lumbar fluid, which, however, may be clear and colourless as in the case reported above. Clinical signs of a pituitary adenoma may be present or absent (see cases V and T below). If there are no signs of a pituitary adenoma the differential diagnosis from an aneurysm may be somewhat difficult;[12] in one of my own cases an aneurysm of the anterior portion of the circle of Willis coincided with a pituitary adenoma.

Case V. Pituitary apoplexy in a woman of 38 *with signs of 'burnt-out acromegaly. Massive subarachnoid bleed followed by 3rd-nerve involvement and blindness on the right. Improvement after intracapsular removal of a diffluent adenoma.*

A woman of 38 was admitted as an emergency case with signs of massive subarachnoid bleed. She was taken ill suddenly with severe occipital headache and vomiting, and with twitchings affecting predominantly the left side of her body, followed by loss of consciousness. A second attack of Jacksonian fits followed in 5 hours and left the patient with her right eye blind.

Signs of an eosinophilic adenoma had developed over the last 10 years, since the birth of her last child. Her vision gradually deteriorated, but she remained able to write and to read without glasses. She had lost her periods and complained frequently of headaches, but had refused to see a doctor.

On admission, she was slightly confused and restless, complaining of persistent severe headache. She was an advanced acromegalic and showed generalized muscular weakness, pronounced thoracic kyphoscoliosis, and marked hirsutism (Fig. 2). Her right eye was blind. On the left, there was a temporal field defect; in the nasal half of the field, finger movements were seen only at a distance of 25 cm. Perimetry was not attempted because of lack of cooperation. Fundoscopy showed no atrophy or papilloedema. The right upper eyelid was drooping, and there was a divergent squint of the right eye. The right pupil was dilated and fixed. On the left, the reaction to light was present. The other neurological findings were within normal. There was no glycosuria.

Fig. 2. Case V. Woman of 38 with arrested acromegaly and sudden subarachnoid bleed due to haemorrhage into an intrasellar adenoma (pituitary apoplexy). Blindness of right eye. Note operation scar on right. (Operation by Dr. J. F. P. Erasmus.)

X-rays of the skull showed advanced sella excavation, erosion of the clinoids, and the characteristic signs of acromegaly. On lumbar puncture the fluid was under pressure and uniformly mixed with blood; next day the lumbar fluid became xanthochromic. Carotid angiography on the right showed no aneurysm.

Operation. At a right frontal exposure the dura mater was found to be tight and the ventricular fluid colourless. There was fresh blood in the subarachnoid spaces around the chiasm, which was displaced backward by a diffluent adenoma compressing and lifting up the right optic nerve. After incision of the sellar diaphragm the tumour was rongeured away and removed by suction. The post-operative course was uneventful. I saw the patient again 2 years later. Her right eye was blind but with her left eye she was able to read the paper. She had returned to her previous post in a printing works.

On histological examination of the tumour specimen (Prof. J. Barnetson) necrotic areas were seen, with considerable leucocyte infiltration. In the residual pituitary tissue no eosinophilic adenoma could be found.

Comment. Necrosis with leucocyte infiltration has been reported by others in cases of pituitary apoplexy.[23] Endocrine disorders in our patient started after childbirth; however, the clinical course was not that of a postpartum Simmonds-Sheehan's pituitary insufficiency and, although no residual adenomatous tissue was found under the microscope, the clinical picture leads to the conclusion that this is a case of haemorrhage into an eosinophilic adenoma bursting into the surrounding subarachnoid spaces in a patient with acromegaly. There was no histological proof of the eosinophilic nature of the tumour.

Case T. Massive subarachnoid bleed in a woman aged 56. *Left carotid angiography revealing aneurysm adjacent to a ballooned sella. Ligation of the internal carotid artery followed by death.*

This patient was referred by an ophthalmologist because of severe headache and right hemianopia; only later was it learned that she had had a suspected transient hemiparesis some 6 months previously. No disturbance of the external ocular movements was noted. A left carotid angiogram (Fig. 3) disclosed a rather big berry aneurysm arising either from the horizontal portion

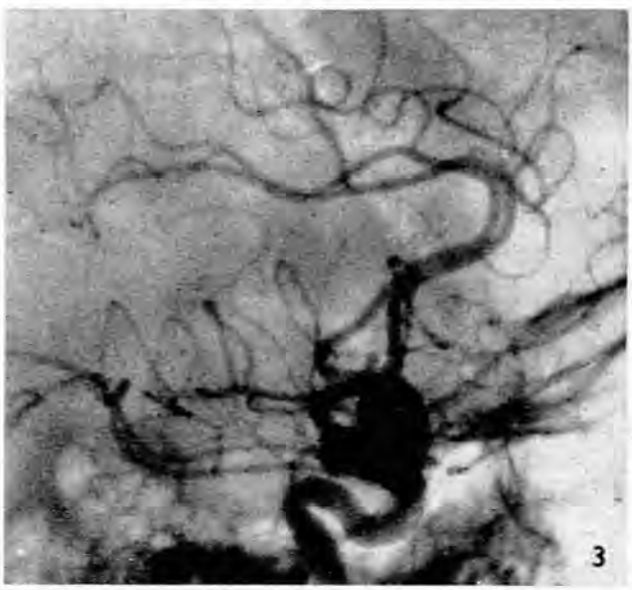

Fig. 3. Case T. Left carotid angiogram (lateral view) in a woman of 56 with massive subarachnoid haemorrhage from a ruptured aneurysm arising from the anterior half of the circle of Willis. Note fusiform distention of carotid syphon and ballooning of sella turcica which was due to a chromophobe intrasellar adenoma. No signs of intracerebral clot.

of the left anterior cerebral artery or the carotid syphon. A kind of fusiform enlargement of the upper loop of the carotid syphon was also present, overlapping the berry aneurysm in both the anterior and lateral views.

Subsequently, a one-stage ligation of the left internal carotid in the neck was carried out as an emergency measure. This was followed by a right hemiplegia and aphasia about 4 hours later; the ligature was removed, and after a short period of improvement the patient died the following night. At autopsy the salient features were as follows: There was a diffuse subarachnoid and intraventricular bleed including the 4th ventricle. A distinct cerebellar cone was present. On the cut surface through the hemispheres the white substance showed no oedema, but there were a few petechial haemorrhages and a small intracerebral clot near the left lentiform nucleus. The cisternae around the optic chiasm contained CSF mixed with blood, and the left half of the optic chiasm, including the optic nerve and tract, were flattened and splayed out by an intrasellar adenoma. The infundibular part of the hypothalamus was softened, giving the impression of a diffluent infarcted mass. On dissection of the intracranial part of the left internal carotid artery a ruptured aneurysm was found adjacent to the infundibular stalk and taking its origin near the point of emergence of the ophthalmic artery. On dissecting out the contents of the sella it was found to be considerably enlarged, and the posterior clinoids were eroded, crumbling away under the dissecting forceps. Histological examination of the sellar contents revealed a chromophobe adenoma of the pituitary with confluent areas of necrosis and infarction. The middle and posterior lobes of the hypophysis showed obvious signs of displacement and compression by the expanding adenoma.

Comment. This is a rare instance of coincidence of a parasellar fusiform and berry aneurysm with a chromophobe adenoma of the pituitary gland. The tumour was clinically silent, except for a query right hemianopia and a transient left hemiparesis in the history. According to Courville[11] (p. 434) a haemorrhage arising within a pituitary adenoma may break through the capsule and erode adjacent vessels with consequent haemorrhage from these. It is difficult to imagine that in this case the bleed from the internal carotid was due to erosion of this vessel by an expanding pituitary tumour which, on the post-mortem table, was confined to the intrasellar space (though eroding the posterior clinoids) and in view of the angiogram demonstrating clearly, apart from an aneurysm at a common site, a diffuse enlargement of the internal carotid itself. The necrosis within the adenoma, extending into the hypothalamus, seems to indicate either a pressure phaenomenon due to the expanding aneurysmal sac, or—possibly more consistent with the macroscopic appearance—consequent on collapse or thrombosis of small feeding arteries arising from the affected part of the carotid. This, however, remains open to speculation in view of lack of microscopic confirmation.

SUMMARY

In the light of 79 personal cases, surgical emergencies arising from lesions of the sellar region are discussed under 4 headings. Bilateral macular scotoma leading to rapid decline of vision calls for differential diagnosis from Vincent's optochiasmatic arachnoiditis, retrochiasmal extension producing Monro blockage, and aneurysms. Cases of imminent hormonal failure require careful examination and handling in view of the surgical approach and the operative complications to be expected, in addition to steroid hormonal replacement. Three cases of pituitary apoplexy are described one presenting as an acute mental derangement with hallucinations, one showing an eosinophile adenoma, and one with a combination of aneurysm and a chromophobe adenoma of the hypophysis.

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