Transsphenoidal Approach for Pituitary Tumor

Chare Phonprasert, MD, FACS
Supat O'charoen, MD
Vitaya Sridama, MD

Transsphenoidal approach with the aid of microsurgical technique was used for removal of the pituitary tumor on 5 patients. Of the five; two were acromegalics, three had non-secreting chromophobe adenoma. The operative technique has been thoroughly described. There was no postoperative morbidity and mortality in our series. The normal pituitary tissue could be preserved in each patient and none required long term steroid replacement therapy.

Department of Surgery (Neurosurgical section) and Department of Medicine (endocrine section), Faculty of Medicine and Chulalongkorn Hospital, Chulalongkorn University, Bangkok, Thailand.

As quoted by Rhoton,[1] the transsphenoidal approach for sellar tumors was first reported to be used by Schloffer in 1907, Hirsch in 1910 and Cushing in 1912. This approach was not popular at that time due to the difficulty in operating through such a deep, narrow exposure, with inadequate illumination, apart from the high incidence of complications. This method of transsphenoidal approach for pituitary tumors was revived again by Guiot[2] and has become a standard neurosurgical procedure due to the development and application of the operating microscope and radiofluoroscopy by Hardy.[3] To the best of our knowlege, successful transsphenoidal approach for pituitary tumors has never been performed, nor reported in the literature in Thailand. The purposes of this report are : 1) To describe the technique, using a limited number of instruments. 2) To show the results of the operations, and 3) To stimulate our neurosurgical colleagues to use this method of treatment for pituitary tumors more frequently.

MATERIALS

Between August 1978 to March 1980, five patients underwent transsphenoidal operation. Of the five; two were acromegalics, three had non-secreting tumors (so called chromophobe adenoma), and one of these had pituitary apoplexy. There were 2 females and 3 males, ages ranged from 25 to 64 years, with an average age of 42 years.

METHOD OF MANAGEMENT

Endocrinological work up : Due to limited facilities for endocrinological studies in our institution, the preoperative and postoperative endocrine evaluation was directed to the testing of the target organ functions for the patients who were suspected of having pituitary tumor. These comprised preoperative and postoperative determination of thyroid function, T_4, urinary 17 ketosteroids and 17 hydroxysteroids and a metapyrone test. In acromegaly, preoperative and postoperative blood samples were collected for determination of growth hormone level. The preoperative and postoperative endocrine studies would serve as a guide for replacement therapy. The full account of the endocrine studies will not be included in this report but will be present in the future.

Radiological evaluation : In addition to the conventional roentgenograms of the skull, the cone-down and biplane hypocycloidal polytomograms of the sellar turcica and the sphenoid sinus were obtained in all patients with clinical evidence of pituitary tumor in order to assess the abnormal changes of the sellar tur-

cica and the anatomy of the sphenoid sinus. Bilateral carotid angiograms were performed to evaluate the location of the cavernous portion of the internal carotid artery and to detect any unsuspected carotid aneurysms. Pneumoencephalography with the aid of polytomography are the most helpful procedures used to define the boundary of the tumor extension, expecially suprasellar and lateral extension. The empty sellar will be detected by this procedure. Unfortunately, one of our patients, not included in this report, with an empty sellar who presented with panhypopituitarism and enlarged sellar turcica was not demonstrated by this procedure. The computerized axial tomography was used as an emergency procedure in one patient with pituitary apoplexy who clinically presented with subarachnoid hemorrhage.

Neuro-ophthalmological evaluation : This included visual acuity, visual field and eye's motility. Two patients with non-secreting tumor had visual field defects; one with bitemporal hemianopsia, the other with constricted field of the left eye.

Operative technique :

Positioning : After an induction with sodium pentothal, the general anesthesia is administered by an endotracheal tube placed in the left angle of the mouth. The pharyngeal cavity is packed with moist sponges to prevent bronchial aspiration. The patient is then placed in semisitting position with the head firmly resting on the occipital headrest and slightly flexed at an angle of 20° from the horizontal plane. In order to have the surgeon in a relaxed position during the procedure, the patient's neck is then tilted 40° on the left shoulder and the head rotated to the right so as to remain in a vertical plane. In this manner, the patient's body is out of the way and the surgeon is in front of the face working in a strickly median sagittal plane (Figure 1). A portable image intensifier is then positioned on the side of the patient's head so that the horizontal beam is centered on the sellar turcica. The television screen is placed behind and above the patient's head. If an institution has not acquired an image-intensifier, as does ours yet, the portable X-ray can readily be used as an alternative. The assistant is on the left side and the scrub nurse on the other side of the table. The anesthesiologist is on the left side and behind the patient's head. The physical layout of all instrumentation and operating room personnel is schematically represented in figure 2.

Preparation : The face, oral cavity and nasal cavities are prepared with an aqueous antiseptic solution. Infiltration of the nasal mucosa and upper gum with 1% xylocaine containing adrenalin facilitates the submucosal dissection and diminishes bleeding. The draping covers the face with an opening at the upper lip. Sterile sponges are placed in the mouth so that only the upper gingival margin is exposed.

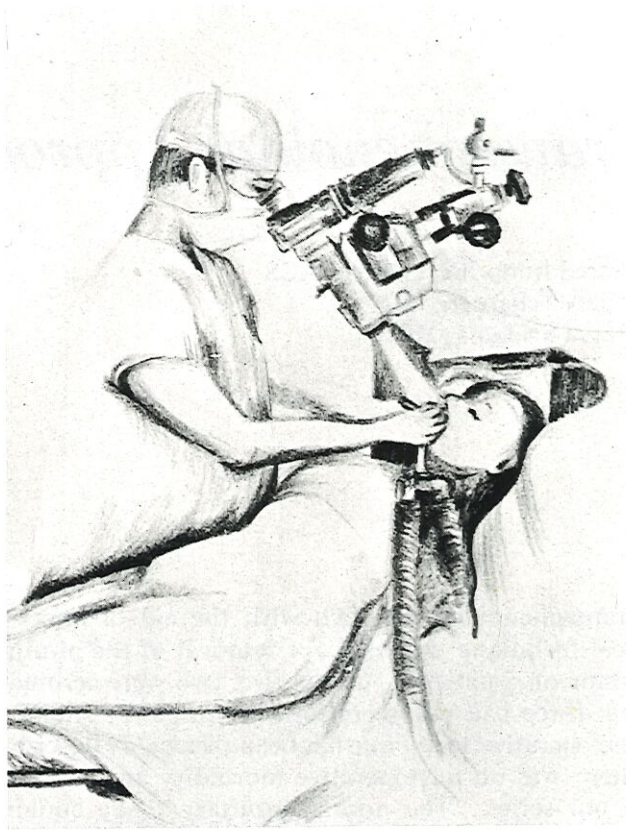

Fig. 1 Position of the surgeon and the patient

Approach to the sellar : A horizontal incision is made just under the upper lip at the junction of the gum, extending the canine fossa on each side (Figure 3). The incision is carried out deep to the bone of the maxilla so that the incised upper lip and the periosteum can be elevated with a narrow periosteal elevator. The mucosa of the floor of the nose is first elevated on both sides with a small periosteal elevator (Figure 4). If a wider operative field is needed, the lateral ascending rami of the maxilla can be sheared off with a down-biting rongeur to enlarge the nasal opening. The mucosa is then detached only from one side of the nasal septum, in order to prevent any perforation of the nasal septum. When the periosteal elevator reaches the bottom of the cavity, a check on the television screen or the lateral view of the skull film will verify the proper pathway towards the floor of the sphenoid sinus (Figure 5). The Hardy nasal speculum is then introduced into the nasal cavity for a short distance between the septal mucosa and the nasal cartilage attached to the mucosa of the other side. The inferior third of the cartilagenous septum is resected and preserved for a later use to seal the sellar

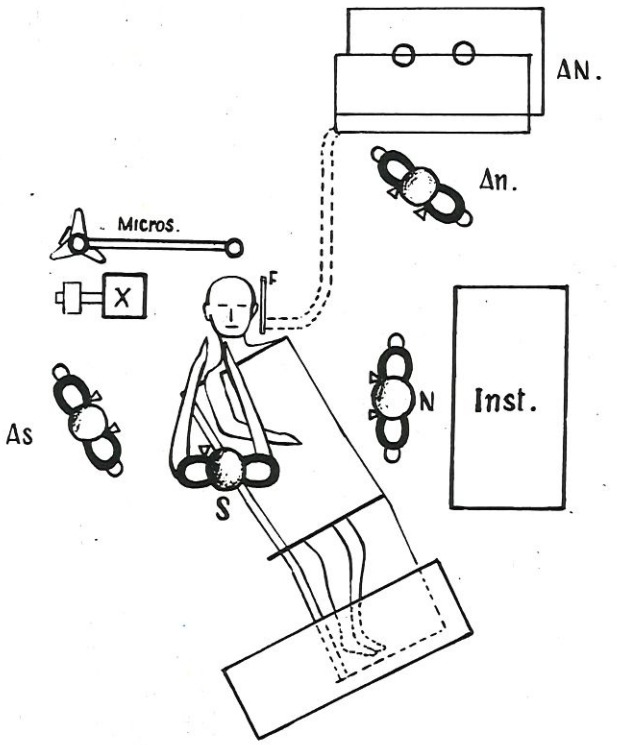

Fig. 2 Schematical layout of instrumentation and operating personnel using for transsphenoidal surgery (AS = surgical assistant, AN = anesthesiologist and machine, F = X-ray film, Micros = operating microscope, N = scrub nurse, S = surgeon, X = portable X-ray machine)

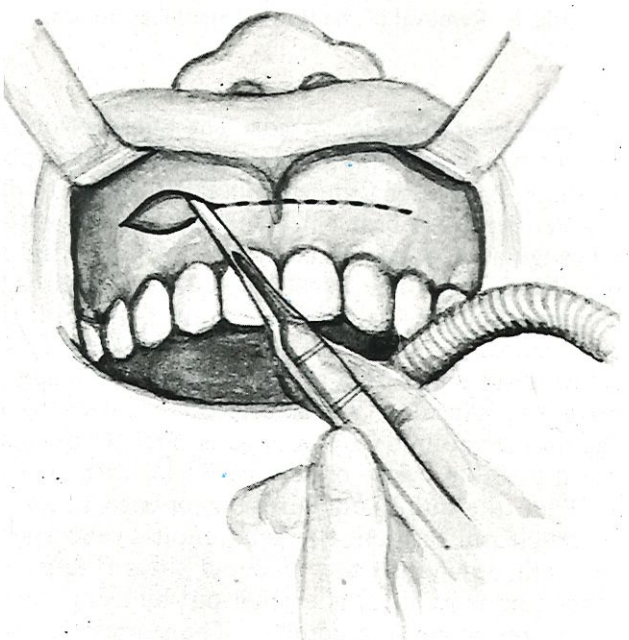

Fig. 3 Gingival incision

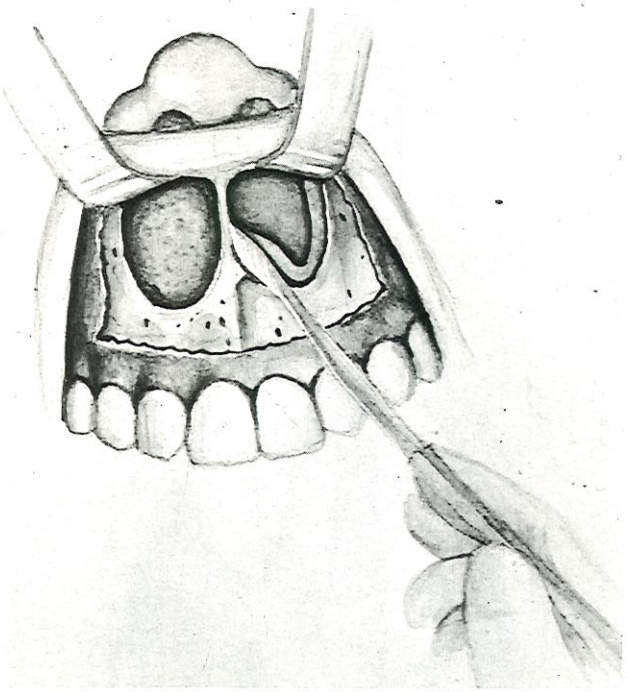

Fig. 4 Elevation of the nasal mucosa from the floor of nose

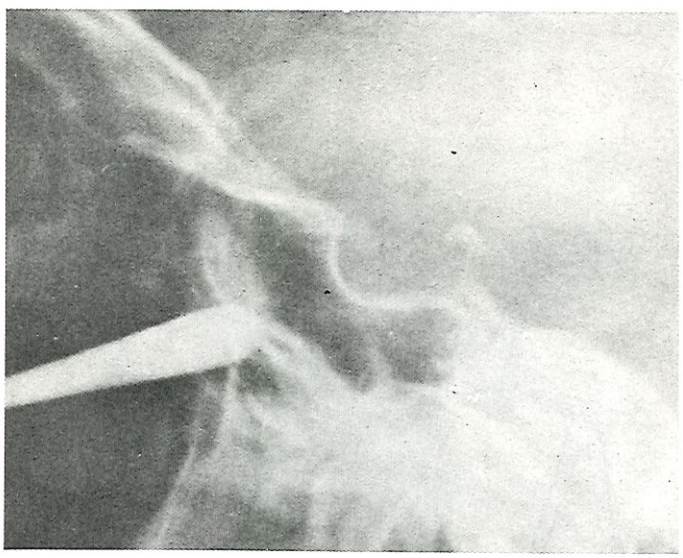

Fig. 5 Checking the position of the elevator on lateral view of skull film.

floor. The mucosa is detached from the vomer bone. The vomer is invariably in the mid line and is the most reliable guide to locating the midline position essential for this operative approach (Figure 6). The vomer and the sphenoid floor are removed using a small Kerrison rongeur and with the aid of a gouge

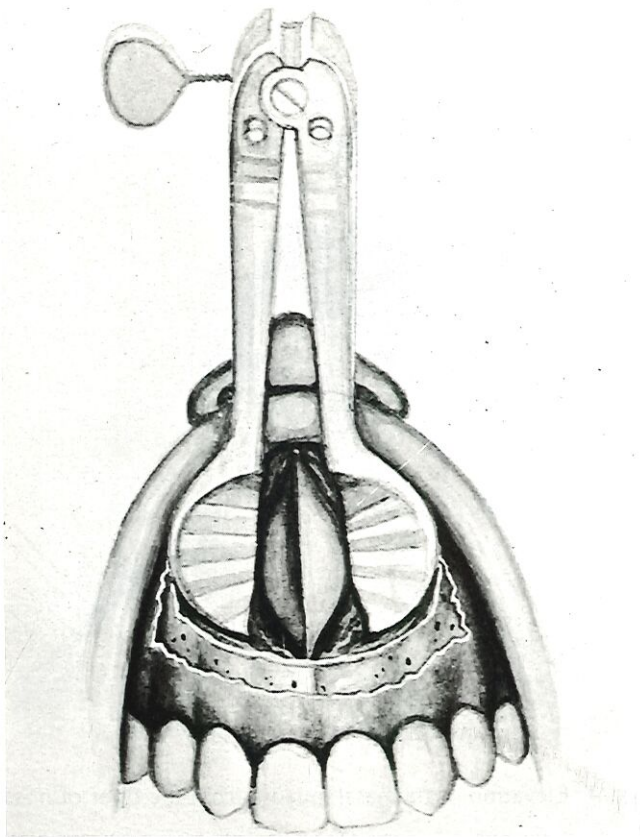

Fig. 6 Exposure of vomer bone

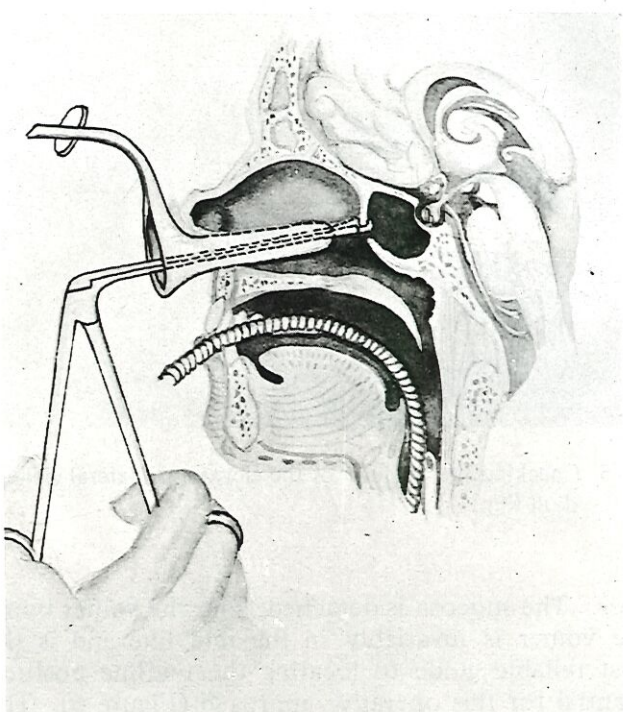

Fig. 7 Removal of vomer and sphenoidal floor

for a thick or acromegalic vomer. Further resection of the sphenoid floor will give a wider exposure of the sphenoidal cavity (Figure 7). The sinus mucosa is pierced and reflected. Bony septae are removed thus exposing the entire posterior aspect of the sinus and the floor of the sellar turcica. The boundaries of the sellar turcica are carefully determined under direct vision and fluoroscopic control. The upper recess underneath the tuberculum sellae defines the upper limit of the opening. A groove formed by the bulging carotid artery on either side can be identified by palpation with a blunt instrument. The Hardy nasal speculum should not be advanced into the sinus because this does not increase the exposure and may cause damage to the poorly protected carotid arteries and cranial nerves within the lateral walls of the sinus. The surgical binocular microscope is now moved into place.

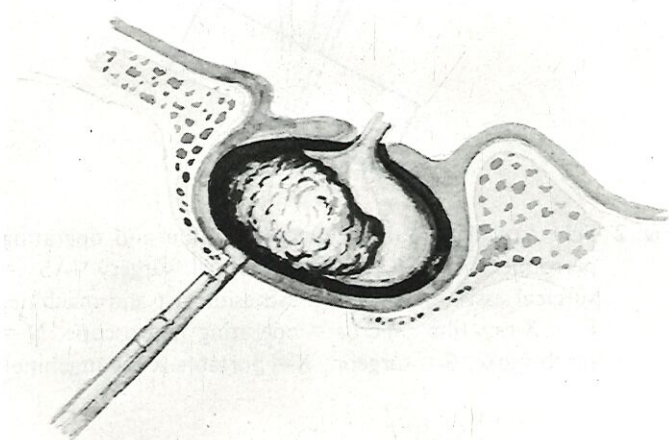

Fig. 8 Removal of the floor of the sellar turcica.

Removal of pituitary tumor : The bulging floor of the sellar which partially or completely fills the sphenoid sinus, is usually thinned and easily opened with No. 4 Penfield dissector. It is further resected with a small angulated sellar rongeur in a round window shape (Figure 8). The dural aponeurosis which is in fact the capsule of the tumor, is contiguous with the lateral wall of the sellar and forms the inner aspect of the cavernous sinus. No attempt should be made to remove the capsule. Transdural puncture using 18 gauge needle mounted on syringe is carried out to aspirate a possible cystic or semiliquid necrotic adenoma. When the dural aponeurosis is opened in an oblique cruciform fashion, the gelationous, yellow gray tumor will burst into the sphenoid sinus (Figure 9). Further tumor removal is carried out by using aspiration and the angle ring curette. The suprasellar portion of the tumor will be pushed downward into the sellar cavity by injecting air into the lumbar subarachnoid catheter. This technical maneuver will also help

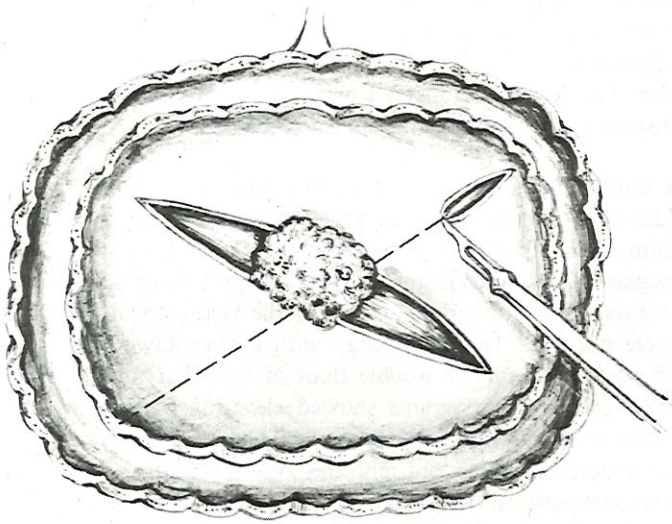

Fig. 9 Opening of the dura

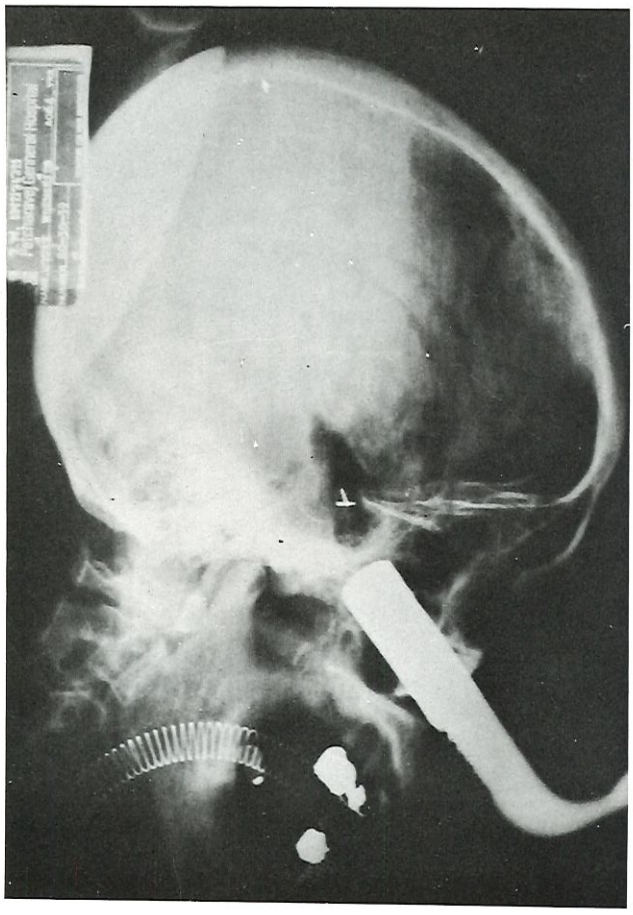

Fig. 10 Two metallic clips; one at the inferior surface of the diaphragm and the other at the dural edge. The 3rd ventricle filled with air descended to the sellar cavity.

in outlining the boundary of the suprasellar extension. Every step of tumor removal is carried out under direct microscopic vision magnified 10 or 16 times with f 300 m.m. lens. Intermittent check with the radiofluoroscopy or portable X-ray of skull will be helpful during the procedure. Two metallic clips, one applied at the inferior surface of the diaphragm and the other at the dural edge, will serve as markers for postoperative radiologic follow up for possible tumor recurrence (Figure 10).

Closure : A piece of muscle or fat of the same volume as the tumor is packed into the sellar cavity and a graft of cartilage from the previously removed nasal septum is used to hold the muscle plug in place and to seal the sellar floor (Figure 11). No packing of the sphenoid sinus is required. Antibiotic powder is dusted into the sphenoid cavity and the nasal mucosa is reapproximated with endonasal packs of long vaseline sponges. These are removed after 72 hours. For the comfort of the patient, nasopharyngeal tubes are put in each nostril to ensure free nasal airways. The gingival mucosa is reapproximated with interrupted cat gut sutures (Figure 12). The stress doses of steroid (Solucortef) which are given during the operation, are continued and tailed off on the fifth postoperative day.

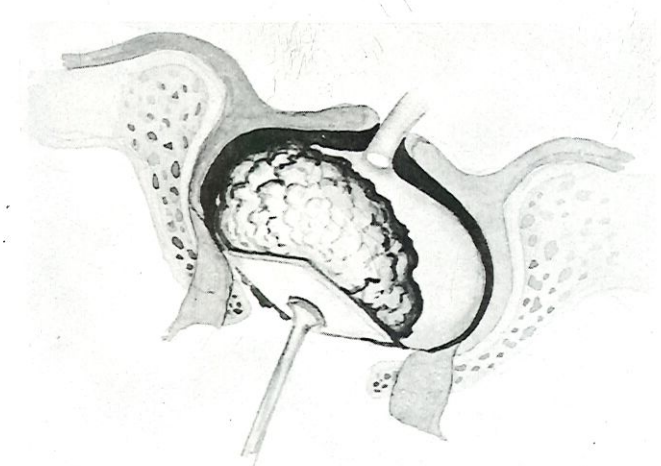

Fig. 11 Packing the sellar cavity with muscle and sealing the floor with a piece of nasal cartilage.

CASE REPORTS

CASE 1 : A 47 years old man came to the hospital with a chief complaint of blurring of vision for one year and a dull aching headache for 7 months. The physical examination revealed vision 20/30 on the right, 20/50 on the left, optic atrophy and

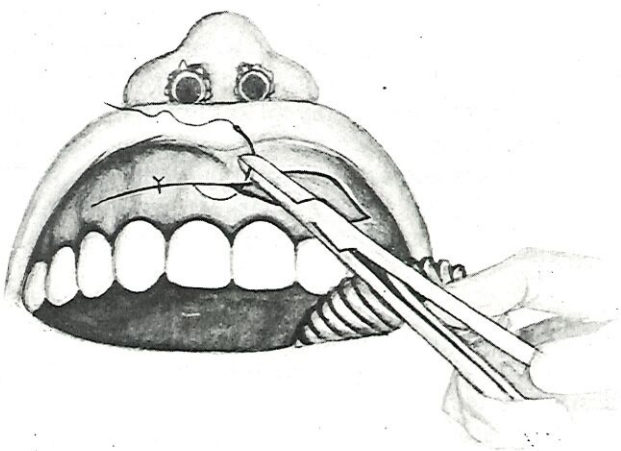

Fig. 12 Closure of gingival wound

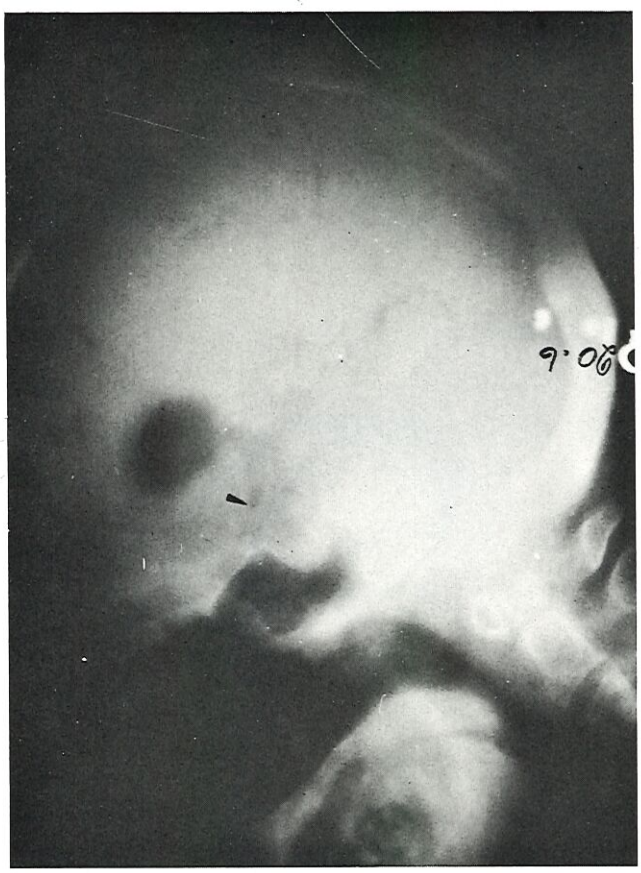

Fig. 13 Pneumoencephalogram of case 1. No air fills the chiasmatic cistern, the arrow points to the normal position of the chiasmatic recess of the 3rd ventricle.

constricted visual field of the left eye. The rest of the examination was normal. The endocrine studies for the target organ functions were normal. The skull X-ray showed an enlarged sellar turcica. The suprasellar extension of the tumor filling the chiasmatic cistern could be seen on the pneumoencephalogram (Figure 13). The transsphenoidal removal of the tumor with preservation of the normal pituitary tissue was carried out. The postoperative course was uneventful except for a transient cerebro-spinal fluid (CSF) rhinorrhea on the second postoperative day which disappeared without special treatment. The histology of the tumor was chromophobe adenoma.

CASE 2 : A 25 year old unmarried woman presented with a history of amenorrhea and galactorrhea for 3 years prior to admission. Physical examination revealed bitemporal hemianopsia. The fundoscopic examination and visual acuity were normal. The endocrine studies for the target organ functions were normal. The skull X-ray with a cone down sellar view showed enlarged and double floor of the sellar turcica. Bilateral carotid arteriograms showed elevation of each A_1 segment of the anterior cerebral artery. The voluminous suprasellar extension filling entirely the anterior third ventricle was demonstrated on the pneumoencephalogram (Figure. 14). Two weeks after the transsphenoidal removal of the chromophobe adenoma, the bitemporal field defect had returned to normal (Figure 15A & B).

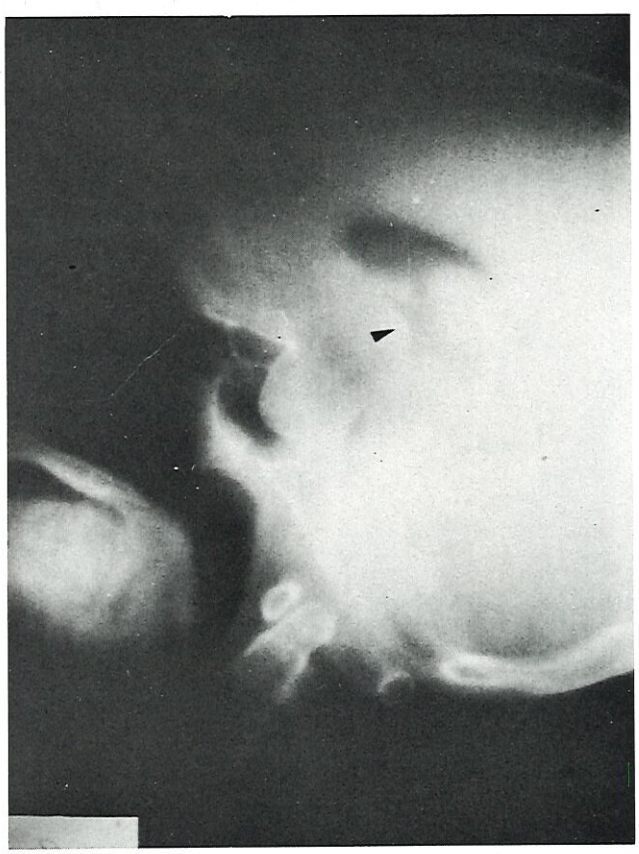

Fig. 14 Pneumoencephalogram of case 2. An upward displacement of the anterior 3rd ventricle by the voluminous suprasellar extension of the tumor was demonstrated (arrow).

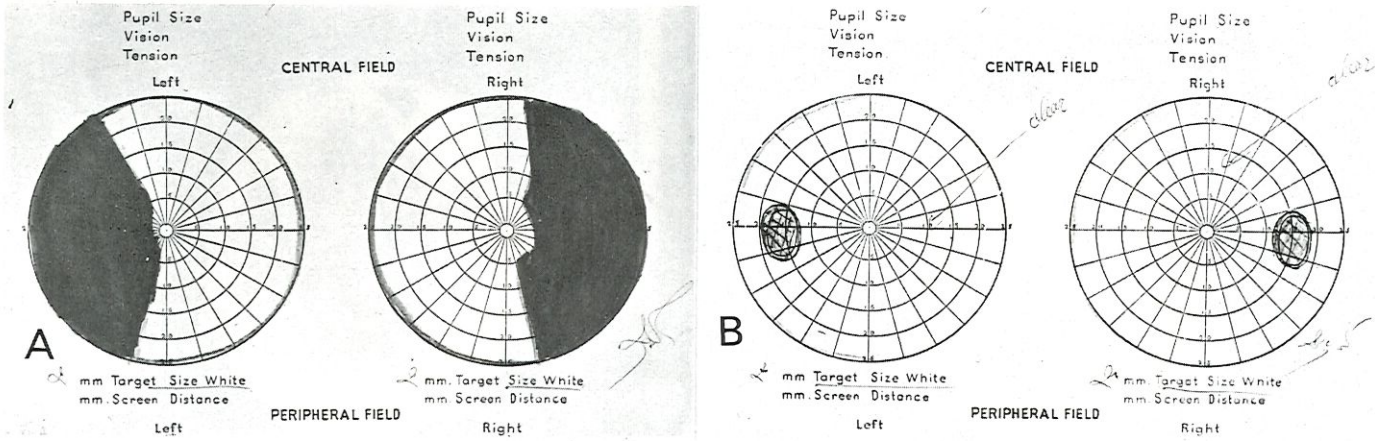

Fig. 15 A. Preoperative visual field.
B. Postoperative visual field.

CASE 3 : A 39 year old married woman came to the hospital because of amenorrhea and headache for one year and polyuria and polydipsia for 3 months prior to her admission. She also noted enlargement of her feet, hands, jaw and lips for about 6 months. Physical examination revealed the typical features of acromegaly, normal visual fields, acuity and fundi. The fasting blood sugar of 468 mg % was reduced to 288 mg % with daily treatment of 80 units of NPH and 20 units of regular insulin. It was further reduced to 148 mg % with addition of 20 mg per day of Bromocriptine. Bilateral carotid angiograms were normal and pneumoencephalograms showed no suprasellar extension of the tumor (Figure 16). After the transsphenoidal removal of the acidophilic adenoma while preserving the normal pituitary tissue, only 60 units of NPH were required to control her diabetes. She was discharged without any replacement therapy. Unfortunately, she was lost to follow up.

CASE 4 : A 46 year old man was admitted to the hospital because of epilepsia partialis continua affecting the right arm for 3 days. Since the age of 42, he could not find any pair of shoes to fit his feet. The physical examination revealed typical features of acromegaly, adversive seizures with preservation of consciousness manifested by clonic movement of the right upper extremity, face and eyes turning to the right side. The blood sugar was 546 mg % with normal values of electrolytes and blood urea. In addition to phenobarbitone, the seizure stopped after an addition of 50 units of NPH to control the hyperglycemia. Repeated neurological examination revealed no abnormality. The skull X-ray showed an enlarged and double floored sellar turcica. There was no suprasellar extension of the tumor demonstrated on the carotid arteriograms and pneumoencephalograms with polytomograms. After the successful transsphenoidal removal of the mixed acidophilic and chromophobe adenoma with preservation of the normal pituitary tissue, the patient required no insulin nor steroid replacement at the third postoperative week. He was discharged home with a fasting blood sugar of 90 mg %.

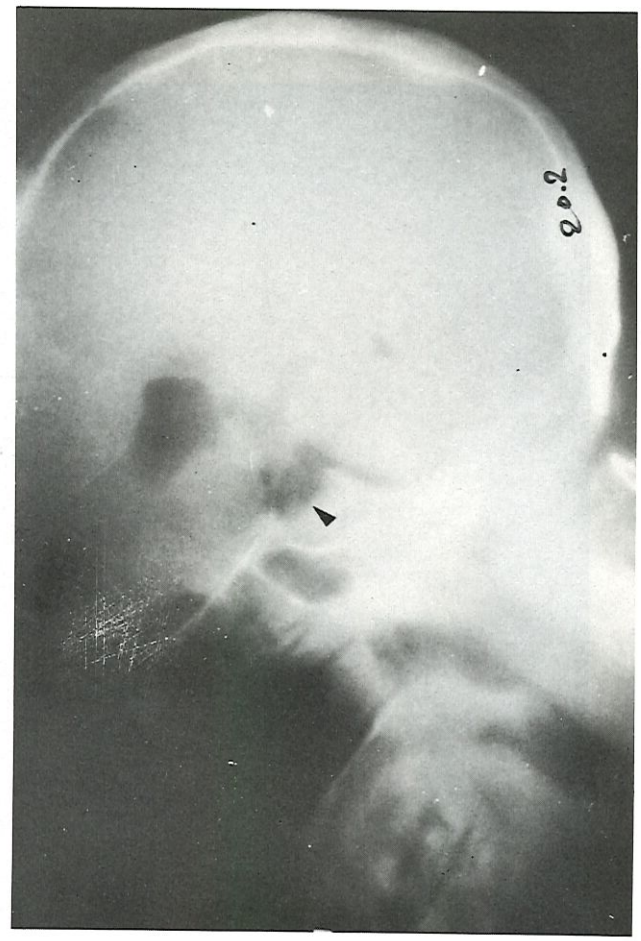

Fig. 16 Pneumoencephalogram of case 3. There was no suprasellar extension of the tumor demonstrated by air filling the chiasmatic cistern (arrow).

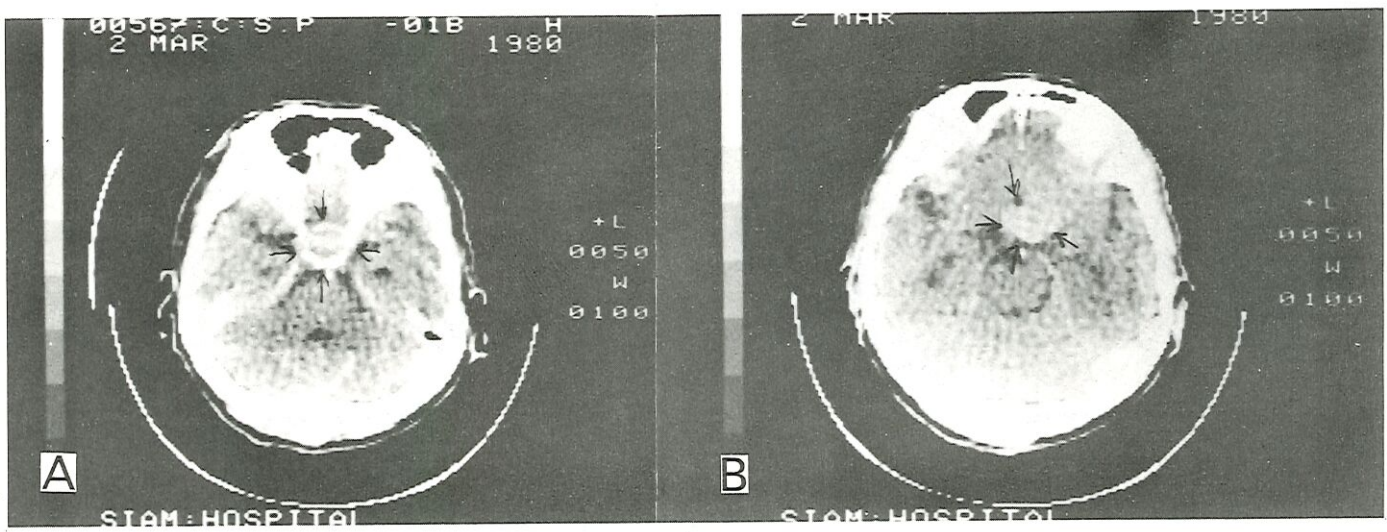

Fig. 17 A & B Computerized axial tomograms (case 5).
A. Intrasellar mass
B. Suprasellar extension

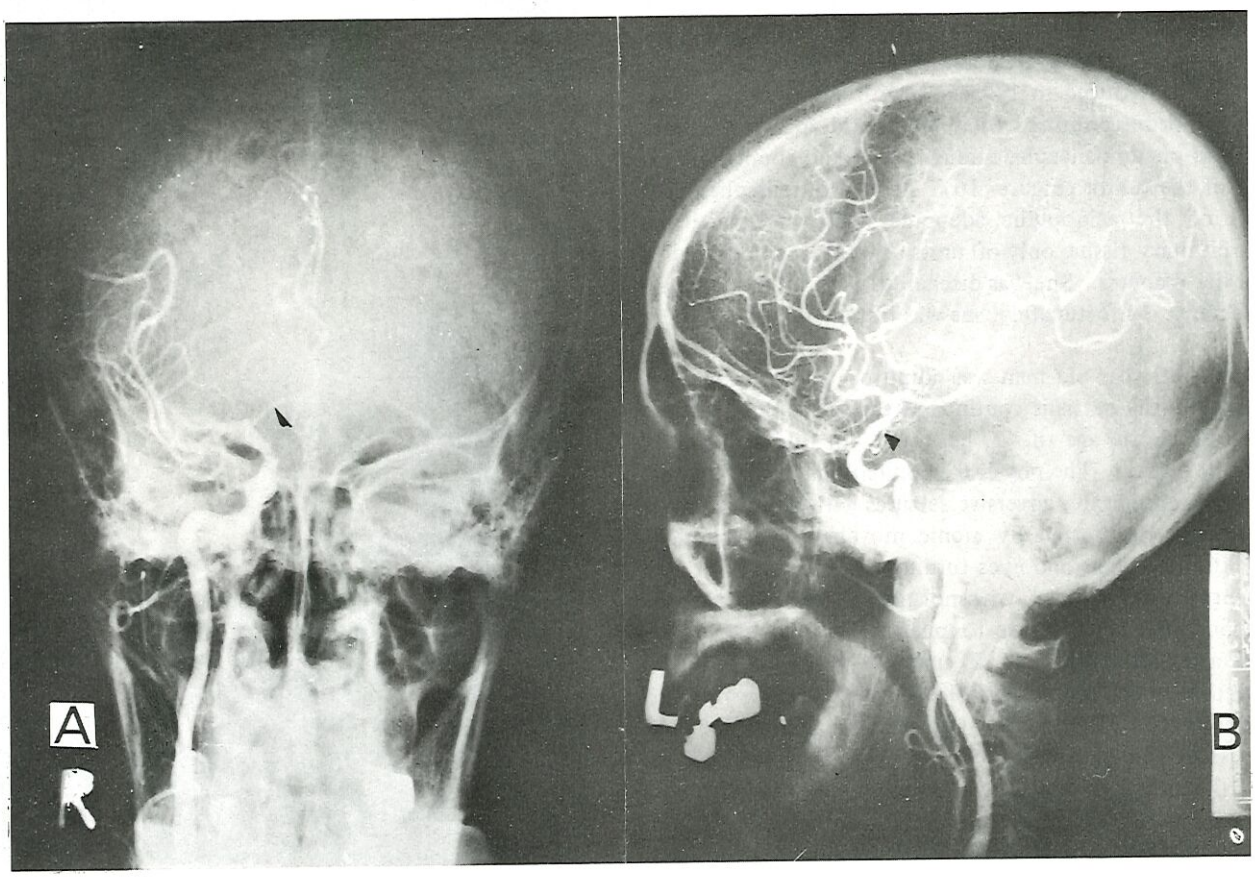

Fig. 18 A & B Computerized axial tomograms (case 5).
A. A-P view, elevation of A_1 segment was shown by the arrow.
B. Lateral view, opening of the carotid siphon and irregularity of supraclinoid portion were demonstrated (arrow).

CASE 5 : A 64 year old Chinese male was admitted to Petcharavej Hospital with the history of sudden onset of severe headache, nausea and vomiting one week prior to admission. The headache was initially and temporarily relieved by Chinese medication. Physical examination revealed drowsiness, a stiff-neck, and left 6th and 7th cranial nerve paresis. The visual fields, acuity and fundi were normal. Lumbar puncture yielded xanthochromic CSF with the pressure of 210 mm of water, sugar 66 mg %, protein 94 mg % and no cells. The roentgenograms of the skull showed an enlarged sellar turcica with thinning of the posterior clinoid processes. The computerized axial tomograms showed the sellar mass about 2.5 cm in diameter with suprasellar extension (Figures 17A & B). The author (C P) was called in for consultation, and pituitary apoplexy was diagnosed. Bilateral carotid arteriograms were performed and showed elevation of the A_1 segment of the anterior cerebral artery on each side (Figure 18A), and an opening of the carotid siphon (Figure 18B). After arteriography, the patient developed the syndrome of inappropriate antidiuretic hormone manifested by lethargy, agitation and hyponatremia (serum sodium 114 mEq/L) which was successfully corrected by means of heavy doses of hydrocortisone and restriction of fluid intake. Transsphenoidal removal of the hemorrhagic and necrotic pituitary adenoma with preservation of the normal pituitary tisfue was successfully performed. The postoperative course was uneventful and the patient was discharged home with replacement therapy of 25 mg of cortone acetate. The replacement therapy was tailed off at the end of the 4th week. The histology of the tumor was chromophobe adenoma with recent hemorrhage.

RESULTS

All 5 patients in whom the transsphenoidal approach has been used for removal of the pituitary tumor, had uneventful postoperative courses. The patients were able to be up and about and to eat on the following day. There was no postoperative infection. One patient (case 1) had transient CSF rhinorrhea on the second postoperative day which disappeared on the following day without any special treatment. The normal pituitary tissue could be preserved in each patient and none required long term steroid replacement therapy. The visual field defect in cases 1 & 2 had returned to normal postoperatively. In 2 acromegalics; one (case 3) who preoperatively had required 100 units of NPH insulin plus 20 mg. of Bromocriptine for controlling her diabetes mellitus, needed only 60 units of NPH postoperatively, and the other (case 4) who preoperatively had required 50 units of NPH for her diabetes, had a postoperative fasting blood sugar of 90 mg.% without the use of insulin or any hypoglycemic agent. There was no diabetes insipidus transiently or permanently. The intraoperative pneumoencephalography facilitated successful removal of the suprasellar extension in each case (cases 1, 2 & 5). There was no serious morbidity and mortality in our series of transsphenoidal operations.

DISCUSSION

Pituitary adenomas which are divided into secreting and non-secreting chromophobe adenomas can be treated with different therapeutic modalities; such as irradiation[4], transsphenoidal cryosurgery[5], transfrontal[6,7] and transsphenoidal operations[8]. If there is compression of the suprasellar and parasellar structures by the tumor, the surgical removal of the tumor is indicated. Although the transfrontal approach for removal of the pituitary tumor has been performed with low morbidity and lower mortality the permanent steroid hormonal dependency postoperatively is still a disadvantage. The introduction of microsurgical technique and radiofluoroscopy by Hardy has made possible preservation of the normal pituitary tissue and greater accuracy in the removal of a secreting microadenoma. The transsphenoidal approach is superior to the transfrontal approach because craniotomy with brain retraction is not needed and postoperative long term steriod replacement therapy is no longer required; in addition to this no operative scar is visible. This procedure can be performed in a relatively short period of time on the patients who are classified as poor surgical candidates. The risk of contamination from the sphenoidal sinus is no greater than with the transfrontal approach. The enlarged ballooned-out sellar turcica makes the transsphenoidal operation easier than that of the hypophysectomy with normal sellar and the portable X-ray can readily be used as an alternative to radiofluoroscopy. Transsphenoidal approach is contraindicated in the patient who has massive suprasellar and lateral extension of the tumor and in a non pneumatized sphenoid. The experience gained from these 5 patients has convinced us that the transsphenoidal approach is the ideal procedure for the removal of the pituitary tumor.

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