METASTATIC PINEAL TUMORS
A CLINICOPATHOLOGIC REPORT OF TWO CASES*

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(Received for publication July 11, 1949)

Metastasis to the lung from pineal tumor is known to be exceedingly rare. However,
among 13 fatal cases of pineal tumor which reached the Army Institute of
Pathology during World War II there were 2 in which metastasis to the lung had
occurred. Only 1 such case has been previously reported—that of Stowell, Sachs and
Russell.25 Their patient, a boy of 15, had been ill for 3 weeks before entering hos-
pital. At operation a large tumor, diagnosed as a primary intracranial chorionepi-
thelioma, was removed from the pineal region. Death occurred approximately 3
months after the onset of symptoms. On postmortem examination no pineal tissue
was found, but there were many arenaceous bodies in the region where the pineal
body normally is present. The conclusion reached was that the tumor arose as a
teratoma in the pineal region and that its chorionepitheliomatous portion grew
rapidly at the expense of the other elements, destroying the original teratoma and
the pineal body. The tumor had invaded the superior sagittal sinus and other blood
vessels, and had metastasized to all lobes of both lungs.

Metastasis of other primary intracranial tumors to extracranial structures is also
infrequent. This mode of spread has usually occurred by way of the blood stream
or lymphatics, or both, as will be noted in the following examples gathered from the
literature: basophil adenocarcinoma of the hypophysis with metastases to liver;4
chromophobe cell carcinoma of the hypophysis to liver;18 adenocarcinoma of the
hypophysis to liver and hepatic lymph nodes;6 adenocarcinoma of the hypophysis
to liver, kidneys, urinary bladder, uterus, vagina and para-aortic lymph nodes;11
benign adenoma of the hypophysis to bones;27 malignant mixed chromophobe and
chromophile hypophysial tumor to cervical lymph nodes;9 large-cell carcinoma
of the hypophysis to cervical lymph nodes, lungs and pleura;2 sarcomatous menin-
gioma to cervical lymph nodes;12 meningioma to one of both lungs;5,6,19,58 meningi-
omia, in 3 cases, 1) to lungs, pleura, abdominal lymph nodes, lumbar vertebra, 2)
to lung, liver, mediastinum, and 3) to pleura;21 hemangioblastoma to lungs and
hilus nodes;4 medulloblastoma to subcutaneous tissue over sternum;23 medulloblas-
toma to vertebrae;19 spongioblastoma multiforme to lung, shoulder region and arm;7
glioblastoma multiforme to lungs;17 astroblastoma to thoracic vertebrae, ribs, lungs
and peribronchial lymph nodes;24 probable atypical oligodendroglioma to neck.24

CASE REPORTS

Case 1.† A white male, aged 34 years, entered hospital‡ on Feb. 1, 1944. For 6 weeks he
had had dull, constant headache, bifrontal and left occipital, and had noted visual
fatigue on reading. For 5 weeks he had been unable to write, though he understood what
he read and knew what he wanted to write. He denied having had motor weakness

* This study supported in part by a grant from The American Cancer Society to the American
Registry of Pathology.
† Army Institute of Pathology Accession 157997.
‡ 83rd General Hospital, then in Tunisia.
or altered sensation. It is noteworthy that he had served as an infantry squad leader in
combat until 3 weeks before admission.

Examination. The patient could understand adequately the spoken and written word;
however, his writing was poorly performed. While walking, he held his head stiffly erect, and
whereas the left arm was kept partly flexed, the right hung immobile. The Romberg test was
positive, the patient tending to fall backward and slightly to the right. Coordination and
sucception tests were normal on the left side of the body but were defective on the right.
There was motor weakness of the entire right side, including the lower part of the face. The
right palpebral fissure was narrowed. On the right side the deep reflexes were slightly hyper-
active and the Oppenheim and Hoffmann signs could be elicited. There was papilledema of
1 D. on the right, and 2 D. on the left.

Ventriculograms indicated a tumor midway between the posterior portions of the bodies
of the lateral ventricles. The roof of the 3rd ventricle was displaced downward, and the walls
of the posteromedial portion of the lateral ventricles bulged outward. Calcification corre-
sponding to the position of the pineal body also was visible.

Operation, Feb. 8, 1944. Cranietomy (E.H.C., assisted by Dr. J. L. Pool) via a right
parieto-occipital approach. The falk cerebri was normal. Slight yellowish discoloration was
noted near the splenium of the corpus callosum. The posterior portion of the corpus callosum
was split in the midline for a distance of 3 or 4 cm. Beneath it was found material which at
first glance resembled an organized hematoma, but further dissection showed it to be a well-
encapsulated tumor. Exirpation was then undertaken. A 3 cm. cone of the right parietal lobe
was removed from the post-Rolandic region to afford exposure of the right and superior as-
pects of the tumor; then, in order to gain access to the left side of the tumor, the lower two-
thirds of the falk cerebri were divided, clipped and retracted. The corpus callosum was split
further anteriorly. The tumor was found to be attached near the junction of the falk and in-
cisura (Fig. 1A). At the attachment a vein, believed to be the right lesser vein of Galen, was
found to traverse the tumor. The anterior pole, which extended fully 5 cm. anterior to the
level of the incisura, was lifted from its bed, leaving the tela choroidea intact and exposed.
On tipping the tumor, a thumb-sized posterior projection was seen to extend along the under-
surface of the tentorium. Here arose a considerable portion of the tumor’s blood supply.

The postoperative course was stormy, with prolonged unconsciousness and frequent fits
involving the left side. On one occasion the wound was re-explored and old blood clots and
necrotic tissue were removed. By Mar. 17, 1944, the patient was again alert and cooperative.
The left hemiplegia had receded and sphincter control was being slowly regained. He was
strong enough to walk, but was incoordinate on the left side. There was some reduction of
hearing bilaterally. Improvement continued until April 26, 1944, when he showed unmistak-
able evidence of increasing intracranial pressure. A CSF fistula developed at the operative
site. Death occurred on May 5, 1944, about 5 months after onset of symptoms and 3 months
after operation.

Pathologic Examination. Microscopic. The tumor removed at operation revealed near the
tip of its posterior extension, i.e., in the region where normally the pineal body is to be found,
a number of arachnoid bodies, which were embedded in masses of large spheroidal cells
separated by an anastomosing connective-tissue stroma bearing a variable number of small
cells (Fig. 1B). The large (parenchymal) cells had fairly abundant loculated cytoplasm (Fig.
2A). The nuclei were relatively large and contained a delicate chromatin network and one or
two conspicuous nucleoli, generally basophilic. The characteristics of the small cells varied
with the field examined. They were most abundant in the vicinity of the eratwhile pineal body.
Most of them resembled small lymphocytes, i.e., they had a densely chromatic spherical or
ovoid nucleus which contained fine or coarse chromatin bodies, and cytoplasm which was
scanty and usually homogeneous. In some regions there were cells that resembled large
lymphocytes and sometimes plasma cells (Fig. 2A). In a few stromal areas there were, in
addition, scattered small polygonal and elongated cells with vesicular nuclei and homogeneous
eosinophilic cytoplasm. An occasional eosinophilic leukocyte was noted. There were a few
abnormal mitotic figures. This portion of the tumor, regarded as a “pinealoma,” was clearly
demarcated from the remainder of the tumor (Fig. 1B).
Fig. 1. Case 1. (A) Gross view, showing position of tumor. (B) Photomicrograph of tumor. Many arenaceous bodies (the small black structures) are embedded in a mosaic of large and small cells. This part of the tumor emerges abruptly with the carcinomatous part (upper left corner of field). A short distance beyond the field shown the tumor is a frank teratocarcinoma. Hematoxylin and eosin stain, X18.

The great mass of the tumor had a varied structure. The predominant pattern was alveolar or papillo-alveolar, with a stromal core consisting of stellate or elongated cells overlaid by cuboidal or columnar epithelium (Fig. 2B); in many regions the epithelial cells were in wild disarray. Encountered here and there were foci of hyaline cartilage (Fig. 2B), large elongated cells in pseudo-rosette arrangement, groups of smooth muscle fibers, and structures resembling mucous glands of enteric type as well as serous glands and respiratory epithelium. No organoid structures were noted.
Fig. 2. Case 1. (A), Pinealomatous portion of tumor. The large cells have reticulated, slightly granular cytoplasm and relatively large vesicular nuclei possessing one or two prominent nucleoli. The small cells vary in appearance. Most of them are similar to small lymphocytes. Some resemble large lymphocytes (L), others plasma cells (P); still others are unidentified. ×700. (B) Teratocarcinomatous portion of tumor. The tissue is mesenchymatous and is arranged in alveoli, the surfaces of which are overlaid by cuboidal epithelium. Islands of cartilage are present. Hematoxylin and eosin stain, ×105.
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**Fig. 3.** Case 1. Pulmonary metastasis. (A) Gross view of one of the nodules. X5. (B) Representative field of a tumor nodule. There is a mosaic of large and small cells in considerable disarray. A similar structure was seen in the portion of the intracranial tumor adjacent to the pinealoma (Fig. 1B), and within the straight sinus. Hematoxylin and eosin stain, X200.

**Autopsy.** There was a massive recurrence of the tumor, with invasion of the centrum ovale of the right cerebral hemisphere above the lateral ventricle and extension into the corpus callosum as far forward as the level of the tip of the temporal horn. Moreover, the tumor had extended by way of the corpus callosum to involve the left hippocampal gyrus and the anterior portion of the left occipital lobe. The right lateral wall of the straight sinus was grossly invaded by the tumor; dissection revealed a solid mass occupying the lumen; it extended
rostrally into the vein of Galen and the right anterior cerebral vein, and caudally to the torcular. The lateral and 3rd ventricles were dilated. Histologically, the tumor in the straight sinus was regarded as a pineal carcinoma.

The lungs contained several nodules varying from 0.4 to 1.0 cm. in diameter. Some were deep in the pulmonary tissue, others near the pleura. Those deeply situated were spherical, while those on the surface were somewhat flattened externally. One of the larger nodules is shown in Fig. 3A. On section the nodules were found to be yellow-grey and crumbly. Each was surrounded by a narrow zone of subcrepitant dark red parenchyma. Microscopically the cells of the metastases closely resembled those of the intracranial "pinealoma," but architecturally (Fig. 3B) they were virtually identical with those in the portion of the tumor that had invaded the straight sinus. Abnormal mitotic figures were in profusion. The stroma was abundant and was permeated by small lymphoid cells; the larger lymphoid cells were relatively more numerous than in the primary tumor. The nodules were devoid of frankly teratomatous elements. The pulmonary growth was regarded as an alveolar carcinoma of pinealomatous derivation.

The remaining viscera showed little of consequence. Gross serial sections of the testes showed neither tumor nor scar, and microscopic examination also failed to reveal changes. The mediastinal, cervical, retroperitoneal and coccygeal regions were free from tumor, as were also the lymph nodes.

Case 2.* A white male, aged 31, was admitted to hospital April 12, 1943 because of headache, diplopia, tinnitus and impairment of hearing, all of about 3 weeks' standing.

Examination. He was found to be mentally sluggish. There was marked papilledema with retinal hemorrhage, lateral rectus palsy and nerve deafness bilaterally, and slight weakness of the right side of the face. By April 16, 1943 his mental acuity was further depressed, and incoordination of the upper and lower extremities had developed. Ventriculography on April 19 revealed symmetric dilatation of the lateral and 3rd ventricles and evidence of a mass in the region of the pineal body which projected into the posterior portion of the 3rd ventricle.

Operation, April 23, 1943. Craniotomy† disclosed a large tumor in the region of the pineal body. It was partially removed. Histological diagnosis: "Pinealoma."

Course. On May 30, 1943, X-ray therapy was instituted, after which the patient steadily improved and became ambulant. Encephalography on July 5, 1943 disclosed a considerable reduction in the size of the tumor and of the ventricular system. Another course of X-ray therapy then was given.

The patient had improved considerably when, on Feb. 15, 1944, he began to complain of difficulty in walking, and shortly thereafter spastic paraplegia developed. The optic discs showed no abnormalities. CSF withdrawn on Feb. 8, 1944 was bloody and contained fragments of necrotic tissue in which neoplastic cells were identified. X-ray therapy was then applied to the vertebral column, with resulting improvement in the spastic paraplegia. However, the patient's general condition gradually deteriorated, death occurring Aug. 28, 1944, approximately 17 months after onset of symptoms.

Gross Pathology. In the pineal region there was a firm mass, 3 x 2.5 x 2 cm. in size, which was adherent to adjacent falx cerebri and tentorium cerebelli. On section, its central portion was found to consist of cotton packing. Just in front of the mass was a discolored, calcified structure measuring 1.0 x 0.8 x 0.7 cm. in size, which was regarded as a remnant of the pineal body. Within the 3rd ventricle and in the leptomeninges of the medulla oblongata, interpeduncular fossa, and base of the 3rd ventricle were tumor nodules varying in diameter up to 1.0 cm. Neither the spinal cord nor the hypophysis was removed at autopsy.

In the upper lobes of both lungs and in the lower lobe of the left lung were several well-circumscribed, firm, whitish nodules. Most of them were adjacent to the pulmonary surface. The largest, 3.0 x 1.5 x 0.6 cm. in size, was situated in the left upper lobe close to the peri-

* Army Institute of Pathology Accession 95307.
† Not performed by one of us.
Fig. 4. Case 2. (A) Section through the pineal region. There are numerous arenaceous bodies in a loose fibrous matrix. X75. (B) Section of a tumor nodule adjacent to dorsal portion of medulla oblongata. It consists almost exclusively of large (parenchymal) cells. Around some of the vessels a few small cells are present. Hematoxylin and eosin stain, X175.

cardium. Several enlarged hilar lymph nodes were found. Section of them yielded homogeneous whitish masses surrounded by greyish, darkly pigmented parenchyma. Further examination revealed gross abnormalities only in the kidneys and urinary bladder: in the kidneys there were miliary greyish-yellow nodules in the cortex and reddish purulent streaks in the pyramids, and in the mucosa of the bladder a number of hemorrhagic and purulent foci. Some
Fig. 5. Case 2. Metastases in lung and lymph nodes. (A) The major portion of the tumor occupies interlobular septa, but tumor cells are present also in alveolar sacs. X10. (B) A hilar lymph node replaced by tumor, and one below it which is relatively intact. X10. (C) Field from a pulmonary tumor. The large cells have abundant cytoplasm, and nuclei which are either deeply chromatic or vesicular. Most of these cells have inconspicuous nucleoli. The small cells vary in appearance. Many resemble small lymphocytes. A few simulate large lymphocytes (L) and fibroblasts (F). Hematoxylin and eosin stain, X700.
of the mesenteric lymph nodes were enlarged, one being $2.0 \times 0.8 \times 0.3$ cm. in size; section revealed "greyish-tan" parenchyma. None was removed for study.

Microscopic Examination. A study of sections through the retropineal region confirmed the presence of cotton fibers; they were surrounded by abundant fibrous tissue and many foreign-body giant cells. The small calcareous structure which at autopsy was thought to be a remnant of the pineal body was found to consist of dense fibrous tissue in which many arenaceous bodies were embedded (Fig. 4A). The original tumor, as well as the leptomeningeal and intraventricular nodules, was composed of masses of relatively large cells separated in places by connective-tissue stroma in which small cells were very sparse or non-existent (Fig. 4B). The nuclei of the large cells contained scattered clumps of chromatin, and the nucleoli were basophilic, usually of average size, occasionally large, and frequently not discernible; the cytoplasm was sparse. Pseudo-rosettes were frequent. There were numerous abnormal mitotic figures. In the lungs the tumor occupied alveolar sacs and interlobular septa (Fig. 5A). Tumor cells were present also in lymphatic channels of the lung. The affected lymph nodes were virtually replaced by tumor (Fig. 5B). Histologically the tumor nodules in the lungs and tracheobronchial lymph nodes were identical to the intracranial tumor as far as the large cells were concerned, even to the frequent lack of prominence of nucleoli, but differed in that many small cells were present in the stromal tissue (Fig. 5C). The small cells were predominantly lymphoid, but moderate numbers simulated large lymphocytes and plasma cells; also there were a few small polygonal cells with vesicular nuclei and well-defined eosinophilic cytoplasm.

Other findings were acute pyelonephritis and cystitis. In the testis there was suppression of spermatogenesis, only spermatagonia, Sertoli cells and a few spermatids being present. None of the other tissues showed abnormalities.

COMMENT

In both cases the evidence indicated that the intracranial tumor was primary and that the tumor nodules in the lungs were metastatic. In Case 1 the tumor was found to have invaded the straight sinus and grown within its lumen, whereas in Case 2 the site of entrance of the tumor into the blood stream was not ascertained. Moreover, in both instances the cytologic structure of the pulmonary tumors was sufficiently similar to that of the intracranial tumor to leave no doubt as to their source. Operative manipulation of the tumor in both cases may have been responsible for introduction of tumor fragments into the venous blood stream, resulting in the pulmonary tumors. Although these may not have been produced by natural mechanisms, they are none the less metastases. In the literature cited in the introductory paragraphs, operation had been performed in all except 4 cases and possibly 2 others in which the data on this point were indefinite.

The pineal body being such a small structure, it is not possible to determine the precise origin of the tumors, i.e., whether pineal or parapineal. However, in Case 1 it may be presumed that the tumor arose in the pineal body since arenaceous bodies were scattered in the tumor and since no normal pineal remnant was observed. In Case 2 the arenaceous bodies were embedded in a mass of relatively acellular loose connective tissue, and there was no evidence of tumor in the immediate vicinity. It might be presumed that all tumor remaining in this region following operation was completely destroyed by X-rays.

The question arises as to the diagnosis of these tumors. In Case 1, in which the bulk of the tumor was regarded as a teratocarcinoma, a small part in the pineal region consisted of neoplastic tissue which had all the features of "pinealoma." Much of the metastatic tumor in the lungs was neither frankly pinealomatous nor teratocarcinomatous but represented an alveolar carcinoma composed of cells
having the appearance of anaplastic pinealomatous cells, such as were seen in a part of the intracranial tumor. In Case 2 the primary and metastatic tumors were pure “pinealomas,” and differed only in that the metastatic tumor had a relatively much greater number of small cells than did the intracranial tumor.

There can be no doubt but that the small portion of the tumor in the pineal region in Case 1 and the entire tumor in Case 2 fall into the category of many of the “pinealomas” described by a number of authors.\(^2,13,14,22\) Recently, however, the commonly accepted criteria of the “pinealoma” have been called into question. Dorothy Russell\(^20\) has concluded that many so-called pinealomas are atypical teratomas, though true pinealomas also exist, a view concurred in by Friedman.\(^10\) Since the “atypical teratomas” of the pineal body so closely resemble the seminomas of the testis, the two were regarded by these workers as analogous. Our Case 2 would fall into their category of atypical teratoma or seminoma, and Case 1 also, so far as its central part was concerned. Whether or not the viewpoint of Dorothy Russell and Friedman is justified will have to await further studies.

CONCLUSIONS

Two cases of tumor arising in the pineal body or its immediate vicinity and metastasizing to the lungs, are reported. In 1 of them a further extension to the hilar nodes occurred. In Case 1 a portion of the tumor which occupied the region of the pineal body had a pinealomatous structure, while the remainder was carcinomatous and teratocarcinomatous. In Case 2 the entire tumor had the features of a “pinealoma.” In both tumors there were histologic structures which simulated that seen in the germinoma, or seminoma, of the testis.

REFERENCES

REMOVAL OF BULLET FROM THE THIRD VENTRICLE

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(Received for publication August 23, 1949)

Reports of movable foreign bodies in the ventricles are not numerous, and only one instance was found of the removal of a foreign body from the 3rd ventricle.\(^4\) The clinical picture of intraventricular foreign bodies usually consists of repeated attacks of severe meningeal irritation or meningitis, ending in death if the offending object is not removed or, rarely, in recovery if the migration stops—the fragment becoming encysted somewhere in the wall of the ventricle.

Cushing\(^2\) reported 30 cases of penetrating wounds of the ventricles with 8 recoveries; 16 of these were bullet wounds and all patients died. Regard\(^3\) extracted a bullet from the lateral ventricle after it was made to drop posteriorly into the occipital horn. Small\(^6\) reported a migratory bullet in the lateral ventricle which eventually came to rest in the substance of the occipital lobe and was not removed because there were no symptoms. Campbell, Howard, and Weary\(^4\) reported a migratory buckshot in the lateral ventricle removed from the occipital region after a severe attack of meningeal irritation. Dandy\(^3\) mentioned the removal of one bullet attached by a pedicle to the wall of the lateral ventricle and another freely movable which was removed through a ventriculoscope. Furlow, Bender, and Teuber\(^4\) reported the removal from the 3rd ventricle of a large piece of shrapnel which had lodged there after migrating from the occipital region, presumably from the right posterior horn of the lateral ventricle. This is the only previously recorded case of a foreign body removed from the 3rd ventricle. It is similar in several features to the one which I shall present, particularly in regard to character change and rapid weight increase.

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