

Germinoma of the Pineal

Its Identity with Germinoma ("Seminoma") of the Testis

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In 1944 Dorothy Russell (15) published the results of a study of pineal tumors. She presented a rational explanation for the well known similarity in histologic appearance of "pinealomas" and "seminomas." She suggested that many "pinealomas" were in truth teratoid tumors. The present report proposes to confirm her observations and to extend her interpretations in accord with the teratologic concepts gained through study of nearly 1,000 tumors of the testis at the Army Institute of Pathology (6).

The files of the Institute contain pathologic material from 23 patients with tumors of the pineal or ectopic "pinealomas." Fifteen tumors were submitted by military installations¹ (Group 1), and 8 were obtained from civilian sources² (Group 2). The essential data in all 23 cases are listed in Table I.

Seven of the 15 tumors in group 1 were identical with the testicular tumor termed "spheroidal cell carcinoma," or "atypical teratoma," by Russell (15) and called "seminoma" by many pathologists; this neoplasm is identical with the disgerminoma of the ovary. Because this type of new growth is probably made up of germ cells, possibly even of primordial germ cells, the designation "germinoma," which has been suggested (6) for the tumor which occurs in the gonads, is equally appropriate for that which appears in the pineal. Two neoplasms in group 1 were teratomatous tumors; 1 was an adult teratoma, and the other was a teratocarcinoma which also had germinomatous areas. Although there were 6 neural tumors in the group, only 2 presented the biphasic cellular mosaic of the classic pinealoma.

Of the 8 neoplasms in group 2, 3 were germinomas and 3 were teratocarcinomas. One of the latter also contained both chorioepitheliomatous and

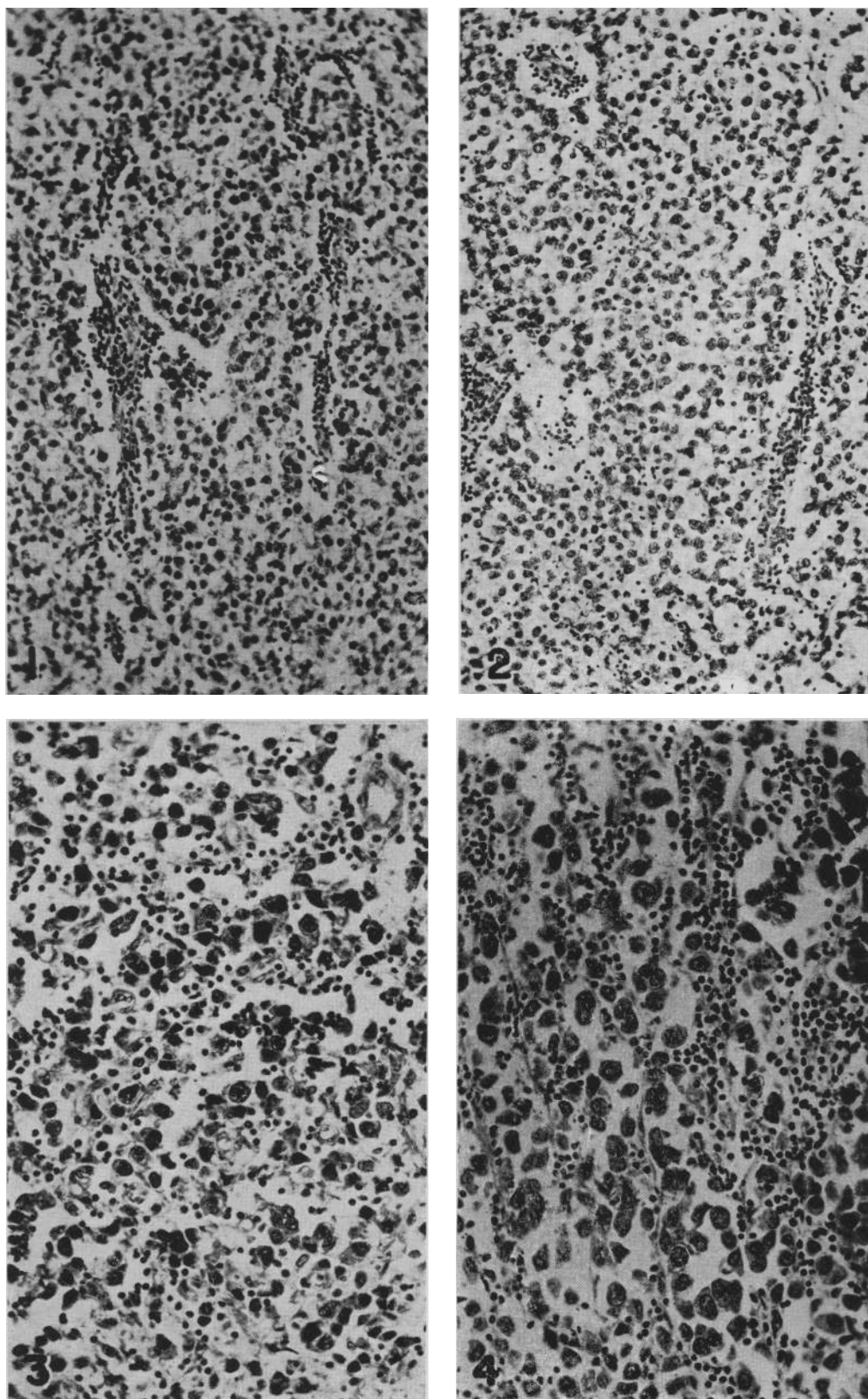
germinomatous elements. Only 2 tumors in this group of 8 appeared to be of neural origin; one, which had the pattern of a classic pinealoma, was

TABLE I: DATA IN TWENTY-THREE CASES OF PINEAL NEOPLASM

Case No.	Sex	Age, years	Type of neoplasm	Special features
GROUP 1				
1	M	29	Neural	
2	M	22	Germinoma	Extrapineal. Pituitary involved. Diabetes insipidus. Hypogonadism.
3	M	17	Neural	
4	M	18	Germinoma	Pituitary involved. Diabetes insipidus.
5	M	21	"	Pulmonary metastases. Radiosensitivity.
6	M	23	"	Pituitary involved. Diabetes insipidus.
7	M	18	"	Pituitary involved.
8	M	28	"	" "
9	M	24	Neural	
10	M	30	"	
11	M	26	Germinoma	
12	M	28	Neural	
13	M	—	"	
14	M	34	Teratocarcinoma	Pulmonary metastases.
15	M	26	Teratoma	
GROUP 2				
16	F	22	Germinoma	Extrapineal. Pituitary involved. Diabetes insipidus. Polyglandular insufficiency.
17	M	18	"	Spinal metastasis.
18	M	10	Teratocarcinoma	Pubertas praecox
19	M	13	Germinoma	
20	—	—	Teratocarcinoma	
21	—	—	"	
22	F	7	Neural	
23	M	10	"	Pubertas praecox

¹ Cases 5 and 14 are being reported in detail by Tompkins, Campbell and Haymaker.

² Material supplied from the laboratories of Dr. Shields Warren, Dr. Lawrence W. Smith, Dr. Norman Elton, Dr. Percival Bailey, Dr. Joseph H. Globus, and Dr. Abner Wolf.



diagnosed by Bailey (3), at the seminar of the American Society of Clinical Pathologists in 1943, as a pinealoblastoma. The tumor presented at that same meeting as a pinealoma falls into the germinoma category.

Of the entire group of 23 tumors, 10 were germinomas and 5 were teratomas or teratocarcinomas. If this group can be considered representative, approximately 2 of every 3 neoplasms of the pineal are not neural tumors.

In Figs. 1, 2, 3 and 4 the histologic appearance of representative "pinealomas" (pineal germinomas) is compared with that of testicular neoplasms of the germinoma type. It is remarkable that all the patterns encountered in germinomas of the testis can be matched in the pineal tumors of this type. For example, the pineal germinoma in case 17 showed a granulomatous reaction (Fig. 5) such as is commonly seen in both testicular and ovarian germinomas; similar granulomatous stroma and giant cells are evident in the "pinealomas" in Figs. 21, 27 and 29 of the report by Globus and Silbert (8). Some germinomas of the gonads and the pineal lack "lymphoid stroma" altogether; others form pseudotubular structures. Finally, the cytoplasm of the principal cells may be either clear or darkly stained.

On the basis of the published illustrations, one may conclude that the tumors in cases 1, 2, 3 and 4 of Globus' 1941 report (7), those in cases 4 and 7 of the 1925 study by Horrax and Bailey (11) and the neoplasm in case 2 of Baggenstoss and Love (2) are germinomas.

In view of the morphologic identity of the two types of neoplasms, it is interesting that they sometimes exhibit a similar sensitivity to irradiation. The testicular germinoma ("seminoma") is a notoriously radiosensitive neoplasm; in one case in group 1 striking regression of a pineal germinoma took place after irradiation, a course of events which has been noted in other instances of "pinealoma" (1, 10).

The fact that two different biphasic tumors, the pinealoma and the germinoma, occur in the same tiny organ has led to much confusion. However, Figs. 6, 7 and 8 show the striking differences in cellular

size, structure and arrangement of the true pinealoma and the pineal germinoma which Russell (15) emphasized.

The structural patterns observed in the teratomatous tumors of the pineal are comparable with those seen in testicular tumors. For example, chorionepithelioma and combinations of teratoma and germinoma (Fig. 9) or embryonal carcinoma and germinoma as well as typical teratocarcinoma were encountered. The germinomatous tissue observed in pineal teratomas in the past has usually been incorrectly considered a focus of "pinealoma." Even some new growths of the pineal which appear frankly teratomatous in photomicrographs (Horrax and Bailey [12], case 1, Figs. 3 and 5; Baggenstoss and Love [2], case 4), have been classified as neurogenic tumors.

There is no universally acceptable explanation for the development of both the gonadal and the extragenital teratomatous tumors. One may postulate that neoplastic development of the germ cells normally present in the testis and ovary gives rise to the teratomas of those organs. It is more difficult to explain the origin of the extragenital growths. Such neoplasms may develop from displaced germ cells or arise from somatic cells which have retained some embryonic potencies, a hypothesis which Schlumberger (16) recently employed in attributing mediastinal teratomas to dislocations of tissue during embryogenesis.

The theory that the primordial germ cells are segregated from the somatic cells early in embryonic life and migrate through certain tissues before arriving in the gonadal region affords a logical explanation for the origin of the extragenital teratomas and germinomas. The possible importance of such wandering germ cells is emphasized by the fact that ectopic "pinealomas," usually of the germinoma type, have been found in the third ventricle and other structures near the pineal (case 2, group 1; case 16, group 2; Russell [15]; Ford and Muncie [5]). However, no explanation for the localization of germ cells in the pineal region has been advanced. Swift (17) described primordial germ cells in the

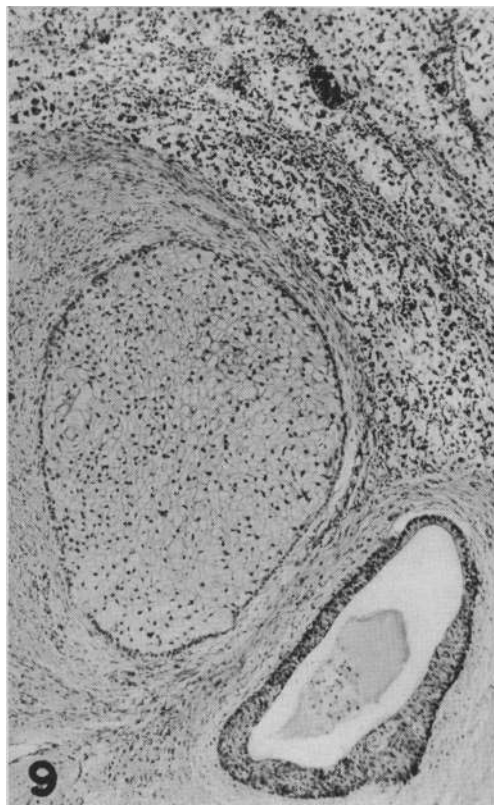
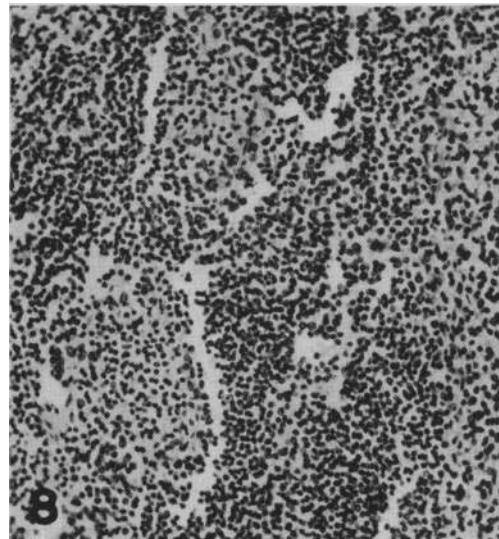
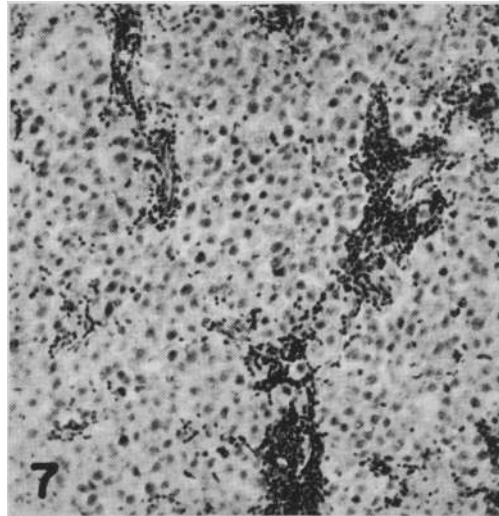
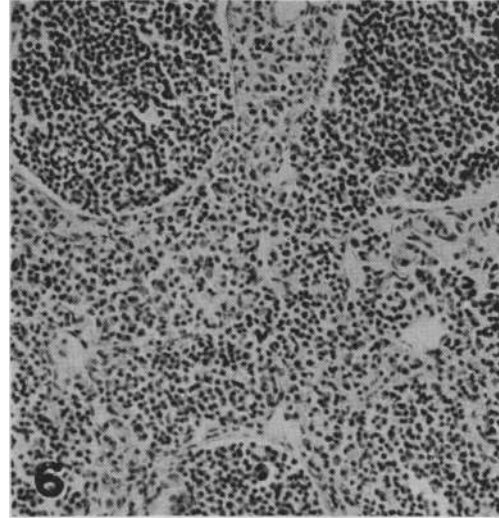
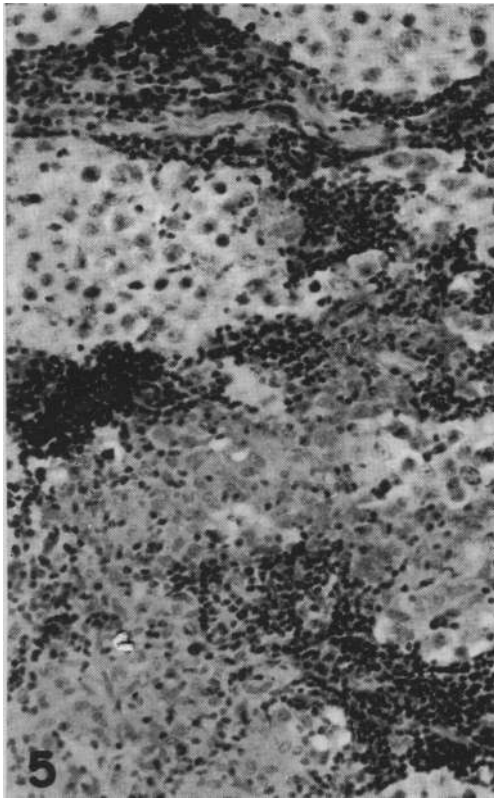
DESCRIPTION OF FIGURES 1 TO 4

FIG. 1.—Germinoma of pineal; compare with germinoma of testicle in Fig. 2. This pattern, in which sheets of uniform neoplastic elements are traversed by trabeculae of connective tissue containing lymphoid cells, is common (case 19). Mag. \times 160.

FIG. 2.—Germinoma of testicle; compare with tumor of pineal, shown at same magnification, in Fig. 1. Mag. \times 160.

FIG. 3.—Germinoma of testicle; compare with neoplasm of pineal in Fig. 4. Intimately intermingled lymphoid elements and neoplastic cells make up one pattern encountered in both pineal and testicular germinomas. Mag. \times 250.

FIG. 4.—Germinoma of pineal; compare with photomicrograph, taken at same magnification, of testicular tumor in Fig. 3 (case 7). Max. \times 250.



head region of a chick embryo of 25 somites, and his paper includes a picture showing a group of such cells in a vessel immediately adjacent to the developing forebrain. However, such primordial germ cells move caudad and reach the genital ridge via the mesentery, and it appears reasonable to assume that tumors originating from such elements would develop in the caudal periaortic mesenchyme (9, 13) rather than in the pineal. Because of the route taken by the primordial germ cells their inclusion in Rathke's pouch, which might afford a means of entrance to the central nervous system, also appears unlikely.

The alternative possibility, that somatic cells with undeveloped potencies are included in the developing pineal gland and later give rise to teratomatous growths, has already been advanced. Krabbe (14) stated that the fact that the "germ of the gland" came near the surface of the developing embryo facilitated the penetration of elements of foreign tissue. Charlton (4), in discussing a teratoid tumor of the pineal in a mackerel, expressed the opinion that the neoplasm arose from "mesectoderm" and pointed out that the pineal develops near the anterior neuropore, where ectoderm and neurectoderm meet. Although the pineal actually develops farther caudad than Charlton implied, it may be significant that the sacrococcygeal teratomas occur in the region of the posterior neuropore and neurenteric canal.

Until embryologic investigation supplies a satisfactory explanation of the genesis of pineal germinomas and teratomas, the point of view of the pathologist must remain that stated in 1932 by Harris and Cairns (10): ". . . we are not able to exclude the possibility that this pineal tumour is a tumour of toti-potent cells. It may be more than coincidence that both the pineal gland and the testis . . . which are known to give rise to teratomas, also give rise to spheroidal celled tumours that bear a strong resemblance to one another."

SUMMARY

Study of 23 neoplasms of the pineal collected at the Army Institute of Pathology confirms the view, expressed by other workers, that many so-called pinealomas are identical with certain tumors of the testicle. It is suggested that such new growths may arise from primordial germ cells and should be called germinomas. This hypothesis would account for the relative frequency of teratomas in the pineal. Only 1 of 3 tumors of the pineal originates from neural elements.

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DESCRIPTION OF FIGURES 5 TO 9

FIG. 5.—Germinoma of pineal. Epithelioid cells in lower portion of photomicrograph form a granuloma similar to those encountered in germinomas of testis and ovary. (case 17). Mag. \times 250.

FIG. 6.—Pinealoma with classic biphasic cellular mosaic comparable to pattern seen during normal morphogenesis of pineal. Compare size and structure of cells with those of pineal germinoma, shown at same magnification in Fig. 7 (case 1). Mag. \times 160.

FIG. 7.—Germinoma of pineal; compare size of cells with those of true pinealoma, shown at same magnifica-

tion, in Fig. 6. Small lymphoid cells in germinomas are separate, distinct components and show no transitions to large neoplastic elements (case 17). Mag. \times 160.

FIG. 8.—Pinealoma showing transitions between 2 cellular components of mosaic; the 2 cell types do not merge in germinoma. Photomicrograph was taken at same magnification as Figs. 6 and 7 (case 22) Mag. \times 160.

FIG. 9.—Teratocarcinoma of pineal. In upper right portion of photomicrograph is germinomatous area such as is occasionally encountered in teratocarcinoma of testicle (case 21). Mag. \times 60.

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