Acta neuropath. (Berl.) 32, 103—113 (1975)

Some New Observations in an Intracranial Germinoma

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Received December 23, 1974; Accepted February 12, 1975

Summary. A case of an intracranial germinoma from the suprasellar region of a 9-year-old girl was examined in the electron microscope. The tumor consists, for the most part, of both large polygonal and small lymphocyte-like elements. Annulate lamellae are common in the epithelial cells. The small blood vessels are fenestrated, and the endothelial cells contain tubular bodies, membrane-bounded vacuoles containing dense fluid and occasional tubules, arrays of tubules within the nuclear envelope and rough endoplasmic reticulum, and a markedly irregular luminal surface. Dense, lamellated structures are present in the widened, collagen-containing perivascular spaces.

Key words: Annulate Lamellae — Fenestrae — Germinoma — Tubular Array — Tubular Bodies.

Introduction

The origin of intracranial germinoma is still not clear but most workers seem to agree that, contrary to earlier opinions, these tumors are unrelated to the parenchymal cells of the pineal gland (Russel and Rubinstein, 1971). Even before electron microscopy, pathologists had recognized the similarity between intracranial germinomas and those found within the ovary and the seminomas of the testis. The electron microscope has tended to confirm the light microscopic observations and the cytology of the tumor has been characterized (Ramsey, 1965; Tabuchi *et al.*, 1973; Cravioto and Dart, 1973; Tani *et al.*, 1974).

Intracranial germinomas, like their apparent counterparts in the ovary and the seminomas of the testis, consist of 2 types of cells. One is a large, polygonal cell and the other a small, lymphocyte-like cell. We have studied a case of intracranial germinoma and have come across several observations which have either been overlooked previously or to which we would like to add a new interpretation.

Materials and Methods

The tumor was removed during surgery from the suprasellar region in a 9 year old girl. A diagnosis of germinoma was made by conventional neuropathological techniques and a portion of the biopsy specimen was reserved for electron microscopic study.

This fragment was fixed in 5% glutaraldehyde in 1/15 M phosphate buffer, pH 7.4, post-fixed in chrome-osmium, dehydrated in ethanol and embedded in Epon after 2 changes in propylene oxide. Thin sections were prepared, stained in uranyl and lead salts and examined in the electron microscope.

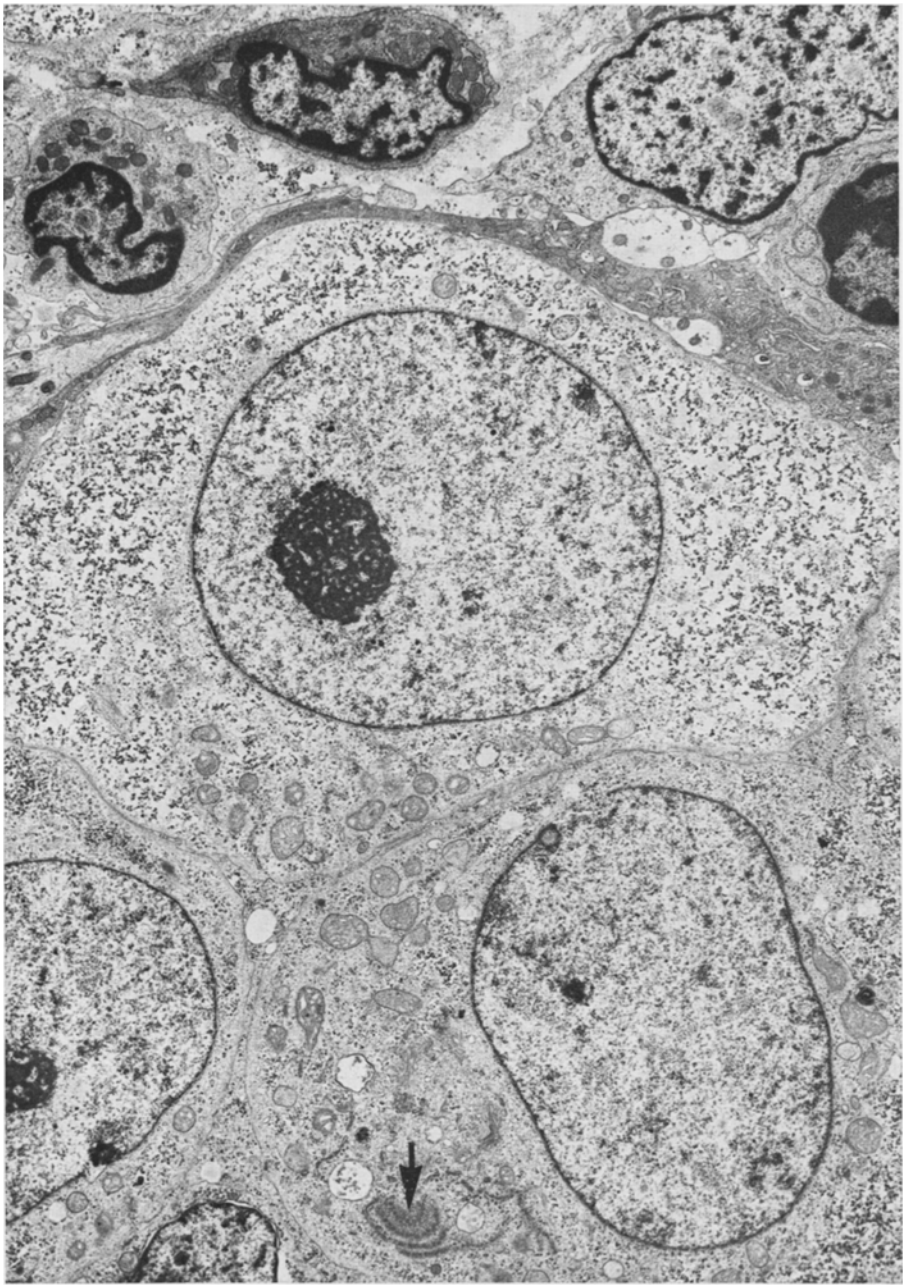

Fig. 1. A section through the germinoma showing the large, polygonal cells and small lymphocyte-like components. Annulate lamellae (arrow) are present in one of the large, polygonal cells. ×6600

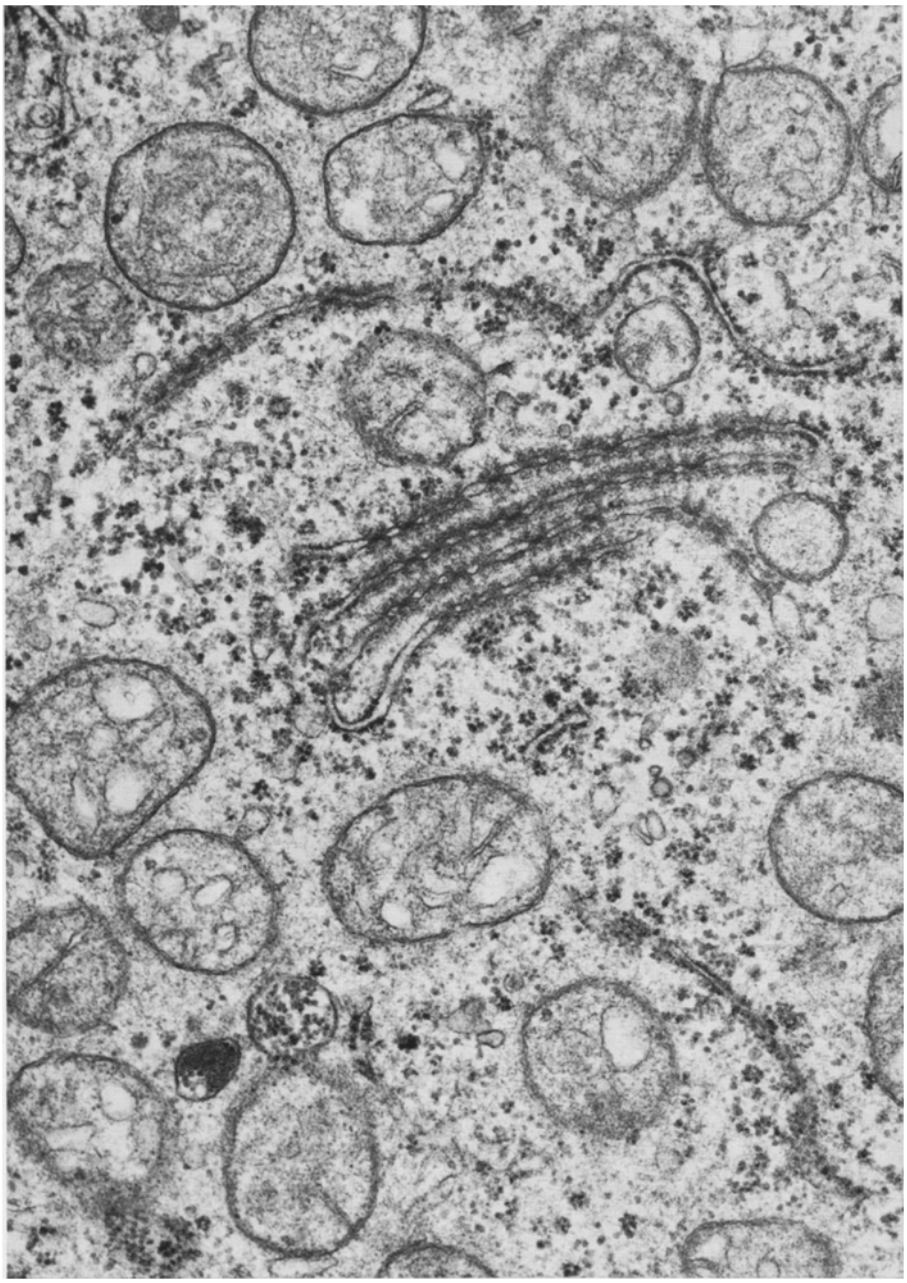

Fig. 2. A formation of annulate lamellae within a large, polygonal cell. ×30000

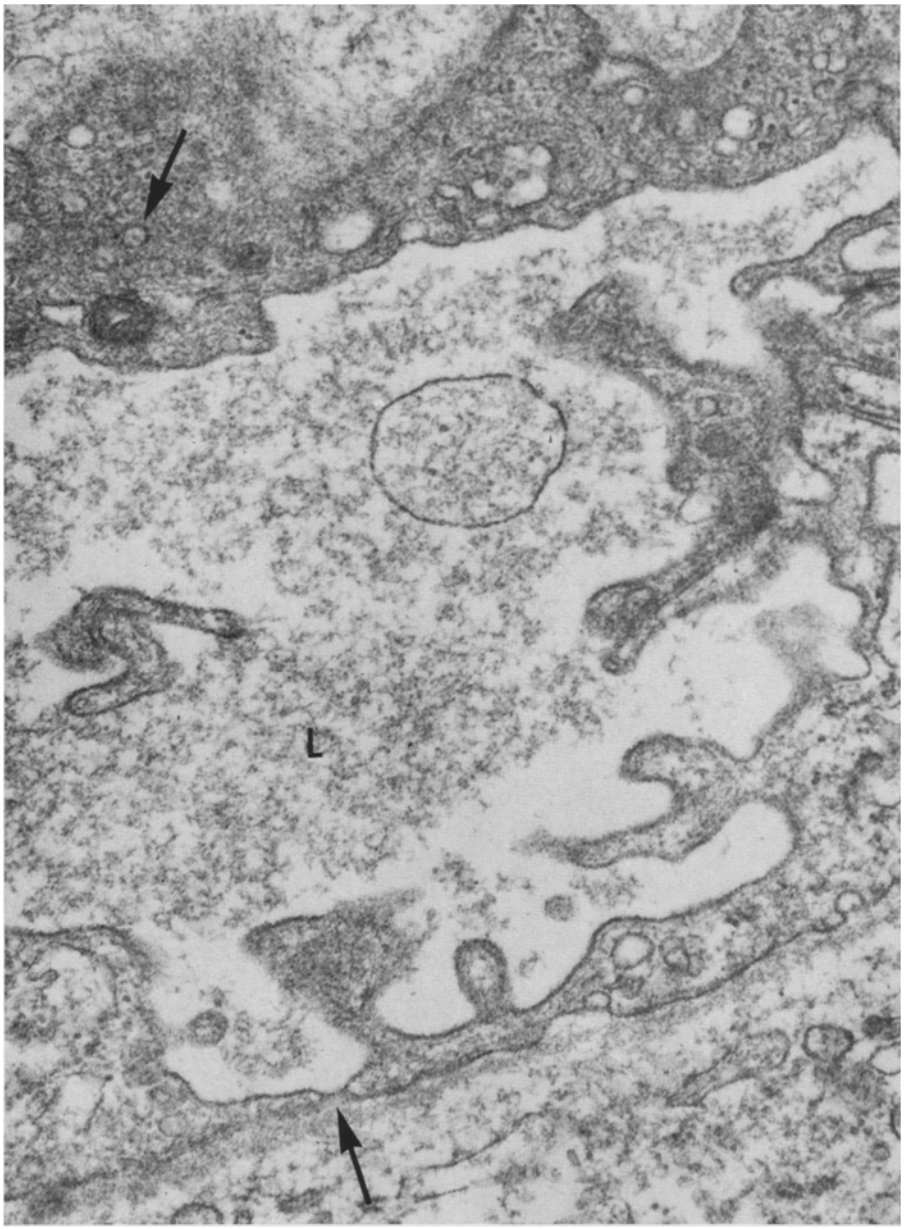

Fig. 3. A blood vessel within the germinoma showing fenestrae (arrow). The endothelial cells show markedly irregular surface undulations projecting into the lumen (*L*). ×36000

Results

As reported by others, the overall cytoarchitecture of the tumor consisted of a mixture of 2 cell types (Fig. 1). One was a large, polygonal cell with a prominent nucleus and nucleolus as well as significant amounts of glycogen in the cytoplasm

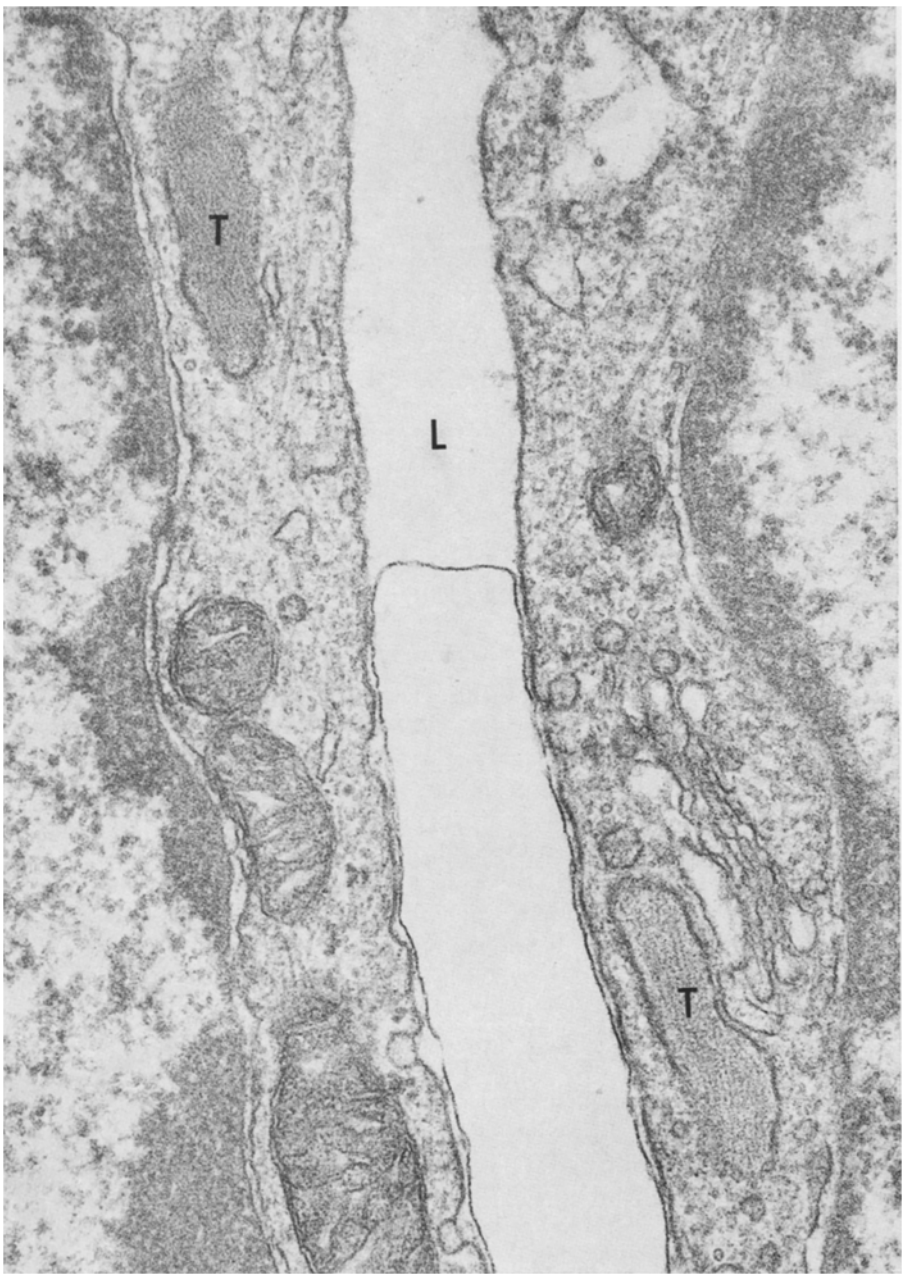

Fig. 4. Tubular bodies (*T*) are present in endothelial cells on either side of the lumen (*L*). ×54000

(Ramsey, 1965; Tabuchi *et al.*, 1973). Frequently, these cells were connected by junctional devices (Tabuchi *et al.*, 1973; Tani, 1974); usually punctate adhesions. In addition to the usual organelles, the polygonal component of the tumor often

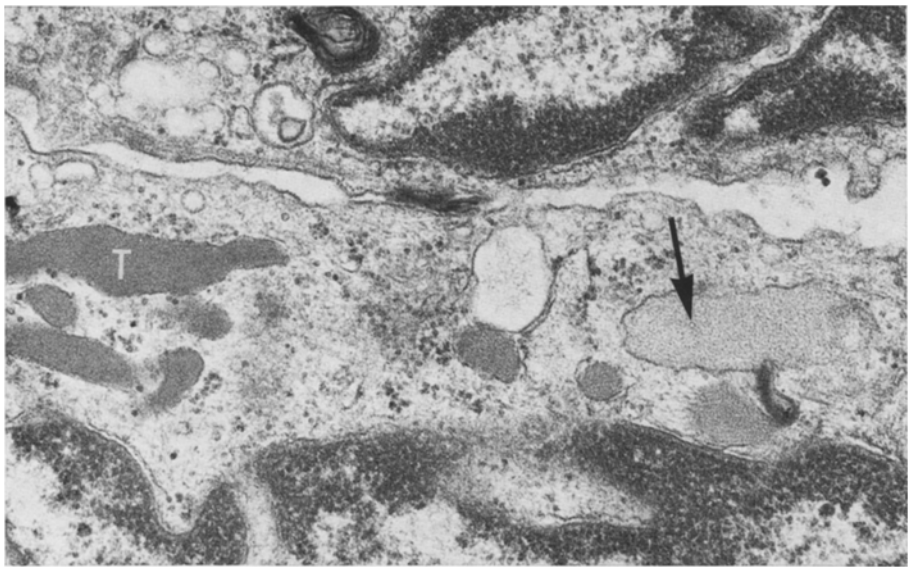

Fig. 5. An endothelial cell containing both a tubular body (*T*) and a membrane-bounded vacuole filled with a dense fluid and occasional tubules (arrow). ×33000

contained a well known variant of the rough endoplasmic reticulum known as annulate lamellae (Fig. 2). These consist of adjacent elements in which the membranes lining a single cistern fuse, forming a regular series of constrictions.

The other cellular component of the tumor (Fig. 1) is significantly smaller than the large, polygonal cell and is indistinguishable from a lymphocyte. Not infrequently, plasma cells, phagocytes and other leukocytes are also seen. In addition, occasional elongated cellular processes, closely adherent to other cells, are present. The origin of these processes is unknown.

We paid special attention to the vasculature of the tumor. The small vessels were fenestrated (Fig. 3), and the endothelial cells showed numerous pinocytotic vesicles and undulation of the luminal surface. The endothelial cells also contained prominent tubular bodies (Fig. 5) which were often found in the vicinity of the Golgi apparatus and were of variable density. In addition, some endothelial cells contained membrane-bounded vacuoles with accumulations of moderately dense fluid and occasional tubules about 150—200 Å in diameter (Fig. 5). These structures sometimes assumed great proportions and were always in the neighborhood of tubular bodies.

The nuclei of the endothelial cells often showed a collection of tubules within the nuclear envelope (Fig. 6). Similar arrays were observed within cisternae of the rough endoplasmic reticulum (Fig. 7).

The perivascular spaces within the tumor were large. The endothelial basement-membrane was often multilayered and collagen fibers were frequently abundant. In addition, we observed an unusual dense precipitate in the perivascular space which displayed a striking fingerprint-like pattern of dense lamellae (Fig. 8). The regularly arranged lamellae showed a periodicity of approximately 200—250 Å.

Fig. 6. An endothelial cell with an array of tubules within the nuclear envelope. ×40000

Discussion

In general, our results confirm those already described by others (Ramsey, 1965; Tabuchi *et al.*, 1973; Cravioto and Dart, 1973). Basically, the tumor consists of both a large polygonal and small lymphocyte-like cell. On the basis of the

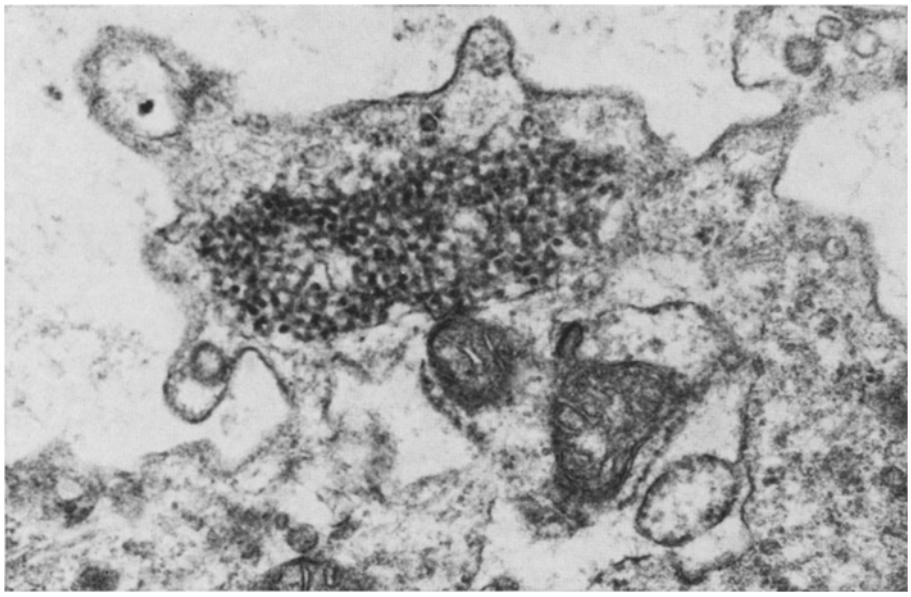

Fig. 7. A tubular array within a cistern of the endoplasmic reticulum in an endothelial cell. ×36000

overall histological pattern, we agree with most workers who have suggested that intracranial germinomas are probably unrelated to the pineal gland and, instead, are identical to germinomas of the ovary (Lynn *et al.*, 1967; Overbeck and Philip, 1969; Kay *et al.*, 1972; Hou-Jensen and Kempson, 1974), and to seminomas in man (Levine, 1973).

The latter conclusion is strengthened by our observation of the high frequency of annulate lamellae within the large polygonal cell components. Annulate lamellae are normal components of oocytes (Rhodin, 1974) and are common features of ovarian germinomas (Lynn *et al.*, 1967; Overbeck and Philip, 1969; Hou-Jensen and Kempson, 1974). These structures have been reported previously in intracranial germinomas by Ramsey (1965) and by Tabuchi *et al.* (1973) but, in our opinion, were never emphasized properly. Annulate lamellae are known to occur in a number of tumors (Rhodin, 1974) but, in our case, they were much more common than in any other intracranial neoplasm with which we are familiar. On this basis, it seems reasonable to consider them a characteristic feature of the tumor.

Some of our observations of the vasculature of this tumor are noteworthy. The capillaries were fenestrated as illustrated by Tabuchi *et al.* (1973, Fig. 8), unlike most areas of the brain and this, too, seems to be a characteristic feature of intracranial germinomas. It is difficult to tell whether the fenestrae were the results of the influence of the tumor tissue as seems to be the case in metastatic carcinoma (Hirano and Zimmerman, 1972) or are simply due to the fact that the vessels originated from the fenestrated vessels known to be present in specific areas of the suprasellar region, i.e. the median eminence of the hypothalamus, the

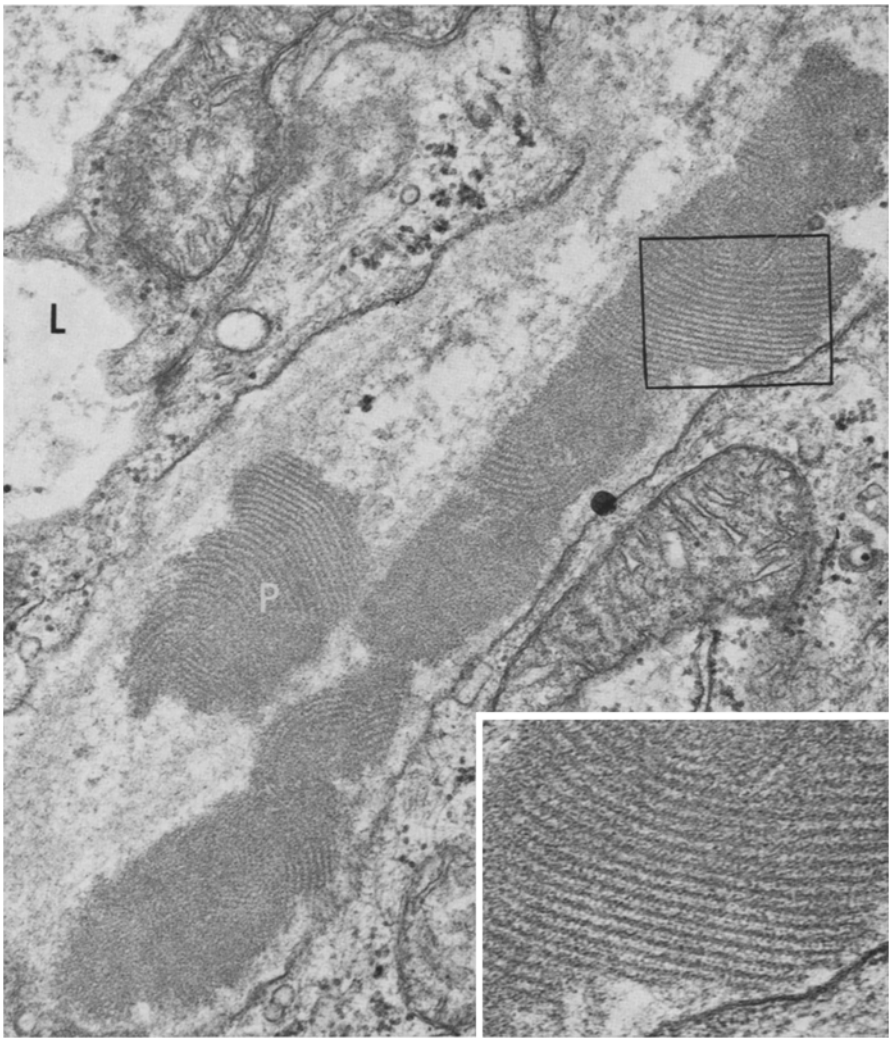

Fig. 8. Dense-fingerprint-like precipitates (*P*) within the perivascular space. The lumen (*L*) is seen in the upper left portion of the micrograph. ×33000, inset ×66000

infundibulum and the pituitary gland (Hirano *et al.*, 1972, 1973; Miki and Hirano, 1975). Unfortunately, the presence of fenestrae does not help us with regard to the origin of the tumor since both the ovary and the pineal gland are supplied by fenestrated vessels (Yamada and Ishikawa, 1960; Majno, 1965; Anderson, 1965). Previous reports of ovarian germinomas do not describe the blood vessels (Lynn *et al.*, 1967; Overbeck and Philip, 1969; Hou-Jenson and Kempson, 1974).

Other features of the endothelial cells were also seen which are not at all common in normal brain vasculature although they have been seen in various intracranial neoplasms (Hirano and Matsui, 1975). These include the tubular bodies

(Weibel and Palade, 1964), which are seen in both normal (Herrlinger *et al.*, 1974) and neoplastic (Hirano, 1974) conditions, the membrane-bounded vacuoles containing tubules (Kawamura *et al.*, 1974) and the tubular arrays within the nuclear envelope and rough endoplasmic reticulum (Uzman *et al.*, 1971; Barlinger and Swoveland, 1972). It is intriguing to speculate regarding the possible interrelationships of these three structures but no evidence concerning this matter is available and we shall have to await further data before reasonable conclusions can be drawn. Furthermore, these structures were not reported in other descriptions of germinomas so that at least some of them may be a peculiar feature of the present case and not characteristic of germinomas in general.

The increased frequency of pinocytotic vesicles, the presence of pores, and the pronounced surface undulations seen in the endothelium are all probably related to increased vascular permeability (see Hirano, 1974). As a result, we are not surprised to find increased perivascular spaces. This may also explain the presence of the dense precipitate in the enlarged perivascular space. It seems likely that these lamellated structures represent fibrin (Hirano, 1969) which has for some reason taken on an unusually well organized structure.

Acknowledgement. The authors are grateful to Dr. H. M. Dembitzer for his valuable criticism and essential advice in the preparation of this manuscript.

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