This article deals with the study of 22 consecutive cases of cerebrospinal fluid examinations in which the referring physician requested that the fluid be examined for tumor cells. Tumor cells were identified in 5 cases. In 17 cases no tumor cells were found and in only 1 of these was the presence of an intracranial tumor (acoustic neuroma) later proved. In 2 others there are reasonable grounds for suspecting that a tumor may have been present but this, subsequently, has not been demonstrated. In the remaining 14 cases the existence of brain tumor has been ruled out. The technic used for the smear preparations was centrifugation, smearing of the sediment on previously albuminized slides, fixation, and staining by the Papanicolaou method.

The 5 cases in which tumor cells were identified in the cerebrospinal fluid are presented in the following reports.

**CASE REPORTS**

*Case 1.* C.S.D., a 61-year-old male, was admitted on Nov. 27, 1950 with fibrillary twitchings of the muscles of both hands and unilateral vocal cord paralysis. The CSF contained numerous tumor cells. Roentgenograms of the chest showed no abnormalities, and examination of the sputum for tumor cells gave negative findings. Ventriculography revealed an internal hydrocephalus with dilatation of the lateral and 3rd ventricles.

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Because of his critical condition no intracranial surgery was attempted and he expired Dec. 1, 1950.

Necropsy disclosed a small primary bronchogenic carcinoma in the upper lobe of the right lung with metastases to the brain and meninges.

Case 2. H.R., a 58-year-old male, was admitted March 19, 1951 with complaints of double vision and numbness of the right arm and right side of the face. Positive neurological findings were choked discs, paralysis of the left side of the soft palate, and impairment of pain recognition over the entire right half of the body. The CSF contained numerous large tumor cells suggestive of a metastatic origin (Fig. 1). Ventriculography disclosed a space-occupying mass in the brain stem above the 4th ventricle.

A polythene catheter was inserted between the right lateral ventricle and the cisterna magna to relieve the hydrocephalus. Temporary clinical improvement followed. A thorough search for the primary tumor was unsuccessful. Deep X-ray therapy to the head was ineffective and he expired on April 14, 1951.

Necropsy revealed a small highly malignant primary adenocarcinoma in the head of the pancreas with retroperitoneal and posterior mediastinal lymph node metastases. There was a solitary cerebral metastasis involving the dorsum of the pons and occluding the aqueduct of Sylvius.

Case 3. T.C., a 60-year-old man, was first admitted Dec. 28, 1951, when he presented signs and symptoms of a herniated lumbar nucleus pulposus which was excised with subsequent relief of symptoms. One month later he complained of severe headache, and bilateral choked discs were discovered. Roentgenograms of the chest showed mediastinal widening but no primary lung tumor. Cerebral angiograms revealed a left frontal tumor. Two CSF specimens were negative for tumor cells but a third specimen obtained after agitation of the lumbar subarachnoid fluid by repeated aspiration and injection contained numerous large bizarre tumor cells (Fig. 2).

Fig. 2. Many bizarre tumor cells.
Necropsy on Feb. 28, 1952 disclosed a tiny primary oat cell bronchogenic carcinoma in the upper lobe of the right lung with large mediastinal metastases. The brain contained numerous nodules of metastatic tumor, one of which had extended into the subarachnoid space.

Case 4. M.B., a 60-year-old woman, was admitted Jan. 22, 1952 with partial left hemiplegia and bilateral choked discs. Cerebral angiography revealed a mass in the right hemisphere. The CSF contained spindle-shaped cells suggestive of glioma.

A Grade III glioma (astroblastoma) was surgically excised.

Two months later she was apparently in good health, with no gross evidence of neurological defects.

Case 5. L.R., a 40-year-old male, was admitted Jan. 26, 1952 with a history of severe headaches for the past year. The only positive finding neurologically was a left homolateral hemianopsia. Cerebral angiography outlined a tumor in the right posterior parietal region. The CSF contained numerous tumor cells which were identified as being glial in origin (Fig. 3).

A Grade II glioma (astrocytoma) was surgically removed. After angiography and before the surgical procedure he suddenly stopped breathing and went into shock. Respiration resumed spontaneously after the skull was opened. Later complete anuria developed, and he expired on the 9th hospital day.

Autopsy findings included severe hemoglobinuric nephrosis, a recent Cushing's duodenal ulcer, and terminal pulmonary edema and pneumonia. There was some residual tumor about the edges of the operative site.

DISCUSSION

The propensity of certain malignant primary and metastatic tumors of the central nervous system to seed the meninges and ependyma has been well established. This type of case was first reported in 1907 by Spiller'.
who described diffuse meningeal implants from an ependymoma of the 4th ventricle. Since this time there have been numerous reports of implants from various types of malignant gliomas as well as in cases of metastatic tumor, retinoblastoma, pinealoma, sarcomatosis of the meninges, and even of meningiomas with sarcomatous transition.\(^1\) The percentage of malignant gliomas with meningeal involvement varies from 47.6 per cent in the medullo-blastoma group to 7.1 per cent in the cases of more adult astrocytomas.\(^3\) These implants may often be present in the meninges of the spinal cord, as observed by Svien, Gates, and Kernohan\(^5\) in 31.5 per cent of their cases of ependymoma. The seeding is probably a direct result of exfoliation of the tumor cells into the cerebrospinal fluid with transplantation of these viable cells to other portions of the meninges. Any tumor capable of exfoliation can lead to the finding of tumor cells in the spinal fluid if either the ependyma of the ventricles or the leptomeninges are involved. The action of gravity explains the presence of these exfoliated cells in the lumbar spinal fluid and, in the absence of a block in the cerebrospinal fluid circulation, they should be expected to be most numerous in this dependent fluid. Agitation of the lumbar subarachnoid fluid by repeated aspiration and reinjection may yield tumor cells in cases in which aspiration alone has been unsuccessful. Fluid aspirated from cerebral cysts may also contain tumor cells.\(^2\) In some cases it may be possible to determine from the appearance of the tumor cells whether they arise from a primary or metastatic neoplasm. Finally, it has been reported by Willis\(^6\) that disseminated carcinomatosis of the spinal meninges can occur without any grossly demonstrable metastatic neoplasm in the central nervous system. This may result from minute, undiscovered, blood-borne metastases in the ependyma or meninges, or from meningeal infiltration by way of nerve sheath, nerve root, or perineural lymphatic extension.

**SUMMARY**

1. The results of spinal fluid examination for the presence of tumor cells in 22 consecutive requests for this procedure have been presented.
2. In 5 instances the fluids were reported as containing tumor cells: 3 from metastatic carcinoma, and 2 from primary glioma.
3. In 1 instance the tumor cytology was considered diagnostic of metastatic carcinoma rather than a primary central nervous system tumor.
4. In 1 patient two spinal fluids were negative for tumor cells but a third specimen obtained after agitation of the lumbar subarachnoid fluid contained numerous bizarre tumor cells.
5. In the remaining 17 spinal fluids which were reported as negative for tumor cells there was 1 case of proved acoustic neuroma, which would not be expected to exfoliate, and 2 cases in which tumor was strongly suspected but not definitely proved.
6. In our opinion spinal fluid examination is a useful adjunct in the differential diagnosis of intracranial neoplasm from other lesions of the central nervous system.
REFERENCES


