The Pattern of Location of Cerebral Metastatic Tumors*

GLEN W. KINDT, M.D.

Department of Surgery, Section of Neurosurgery, University of Michigan Medical Center, Ann Arbor, Michigan

This study concerns the pattern of location of metastatic tumors within the cerebrum, excluding structures of the cerebellum and brain stem. Some consideration also will be given as to the reasons why emboli of tumor, as well as other emboli, have a tendency to lodge repeatedly in a certain area of the brain.

One of the most extensive studies of metastatic brain tumors was made by Courville, who used a series of 40,000 autopsies at the Los Angeles County Hospital. A total of 221 cases of metastatic brain tumors were reviewed post mortem by him in that series. The parieto-occipital area was described as the region of highest incidence where such metastatic tumors occurred. Previous reports relative to the site of predilection of cerebral metastatic tumors have been confined as a rule to the specific lobes of the brain involved.4

Materials and Methods

A new method was used in this study. It consisted of plotting the centers and the outlines of the tumors as accurately as possible on a drawing of the brain. Excellent localization of these tumors was made possible by use of the radioactive mercury203 brain scan.1 Operative findings and autopsy reports were reviewed whenever possible as a further check on the site and the size of the tumors.

Fig. 1 shows a radioactive mercury203 brain scan with the skull traced in position from the routine roentgenogram of the skull. The outline of the metastatic tumor demonstrates itself quite clearly. Fig. 2 constitutes a tracing of the outline and the center of the tumor in a drawing of the skull and brain, as well as it could be shown from the scan and from operative findings.

Thirty-two consecutive cases of metastatic cerebral tumors encountered from December 1960 to March 1963 were taken as a sample. The centers of these metastatic lesions as projected directly lateralward on a drawing of the brain are shown in Fig. 3.

Twenty-seven consecutive cases of glioblastoma multiforme, which occurred over the same period of time, were also taken for comparison. The centers of these primary tumors were plotted in Fig. 4.†

Another method then was used to show further the predilection of metastatic tumors for a certain area of the brain. The procedure

† Only the locations of the tumors as projected on a single left lateral view of the brain were considered for this study. However, the locations were also plotted on a frontal view of the brain when developing the data. Of the metastatic tumors 20 were located in the right hemisphere and 12 in the left hemisphere. Fourteen of the primary tumors were located in the right hemisphere and 13 in the left hemisphere.

Fig. 1. Radioactive mercury (Hg203) brain scan of a patient with a single metastatic cerebral tumor. The outline of the skull is obtained from the routine roentgenograms of the skull.

Received for publication June 7, 1963.

* Presented at meeting of the Society of Neurological Surgeons, Detroit, Michigan, April 17, 1963.
used by meteorologists to plot charts of thickness for use in weather forecasting was borrowed and applied here. The outlines of all 32 metastatic tumors then were traced carefully on a single drawing of the brain. Lines then were drawn through the intersections of the outlines of the tumors to make a chart of thickness or a map of contours. This is shown in Fig. 5, and indicates the per cent of the tumors that overlapped certain areas of the brain. The area of the brain within the inner line of contour was involved by over 50 per cent of the metastatic tumors in this series.

Results

The results of this study as seen from the diagrams indicate a definite predilection for metastatic cerebral tumors to locate along the posterior aspect of the Sylvian fissure in the region of the junction of the temporal, parietal, and occipital lobes. The primary brain tumors showed no such tendency, and these tumors appeared to be distributed more evenly with respect to volume of brain.

The area of the brain with the highest incidence of involvement by metastatic tumor as shown by the overlap method is found in the region deep to area 39 of Brodmann. This region of the brain receives its blood supply from the angular branch of the middle cerebral artery. All the metastatic tumors within this series were found to be located within the distribution of the middle cerebral artery.

Comment

It is interesting to speculate as to why one region of the cerebrum, more than another, should demonstrate an increased involvement with metastatic tumors. We believe this can be explained on the basis of principles of arterial blood flow.

Coman et al. showed by injecting tumor cells into the left side of the heart of experimental animals that the relative number of tumors arising in various tissues depended upon the actual number of emboli lodging in the capillaries of such tissues. With metastatic cerebral tumors, relatively more neoplastic emboli apparently are arriving in the capillary bed just posterior to the Sylvian fissure than in other regions of the brain. This is the region supplied by the terminal branches of the middle cerebral artery.