Neurosurgical Classic—VII

ROBERT H. WILKINS, M.D.
National Cancer Institute, Bethesda, Maryland

Since their introduction by Dr. Walter Dandy in 1918 and 1919,7–10 pneumoventriculography and pneumoencephalography have become routine techniques for the diagnosis of various neurological diseases. The importance of these innovations has been stressed frequently, and many consider them to be the most important of Dandy’s various outstanding contributions to neurosurgery.1,4–6,12,15,16,18–21

Prior to the introduction of these techniques, a few isolated cases of cranioencebral trauma had been described in which intracranial and intraventricular air was visualized by roentgen ray.5,12 The best known of these cases was reported in 1913.17

On November 24, 1912, “...a middle-aged man was admitted with a head injury to a New York hospital under the care of Dr. W. H. Luckett. He was x-rayed by Dr. W. H. Stewart, who detected a fracture in the posterior wall of the frontal sinus. The patient was treated conservatively and discharged from hospital, but returned some three weeks later having suffered a relapse. On December 14 a further radiographic examination of the skull was undertaken by Dr. Stewart. He reported that these x-rays showed the ventricles enormously dilated by what was probably air or gas. As a result of these findings Dr. Luckett operated and during the course of the operation tapped one of the ventricles and noticed that air or gas was released. The patient died three days later and at autopsy the fracture in the posterior wall of the frontal sinus was confirmed and part of the bone was found to be depressed about one centimeter. The brain was removed in toto and placed under water. Bubbles emerged through a laceration in the base of the frontal lobe and this laceration was shown to communicate with the anterior horn of the ventricle. The fluid in the ventricle at the time of the operation was examined bacteriologically and found to be sterile. It was therefore assumed that air, not gas, was present.”15

However, despite this accidental visualization of the ventricular system, the diagnostic potentials of this phenomenon were not appreciated until about 5 years later. On January 3, 1917, a patient of Dr. Dandy’s, “...whose abdomen he was about to explore for intestinal perforation chanced to have a chest x-ray taken on the way to the operating room... Air was clearly visible under the diaphragm. Operation confirmed the presence of intraperitoneal air, as well as the perforated typhoid ulcer through which it had escaped. The usefulness of this discovery has been amply confirmed on hundreds of subsequent occasions.

“It is of interest that this was the very roentgenogram that originally suggested to Dandy the use of air to outline the cerebral ventricles!”18

“Because brain tumors were so infrequently revealed by roentgenograms of the skull Dandy searched for a technique by which he might visualize the cerebral ventricles, for the latter were usually displaced or distorted by an intracranial neoplasm.”20

After unsuccessful attempts with the various media used in pyelography, “...Dandy substituted air for ventricular fluid and obtained a clear outline of the ventricular system. Thus ventriculography was born in 1918.”20

In 1919, Dandy “...demonstrated that the cerebral structures might be visualized if the air were injected into the lumbar subarachnoid space. Within two years Bingel3 in Germany, Jacobaeus15 and Widerøe22 in Norway, unaware of Dandy's work, independently injected air into the lumbar subarachnoid space to demonstrate roentgenologically, tumors of the spinal cord. Bingel gave the procedure the name of pneumoencephalography or encephalography.”30

“Dandy favored ventriculography and most of his studies were with that technique, whereas in Europe, especially Germany, encephalography became popular. The procedures were not uncritically received by the
medical profession. In America, a few early fatalities, which occurred before surgeons realized that, in the case of brain tumors, the air study must be followed by craniotomy, led to a reserved skepticism of the new practice for several years . . . ."²⁰

"It seems obvious that ventriculography was not always an innocuous procedure, for Dandy advised, in comatose patients, ventricular estimation, a procedure he devised in 1923 and which he considered better tolerated than ventriculography."¹¹ The usual occipital perforations were made. The upper ventricle was tapped, the fluid aspirated and measured. The lower one was similarly treated. A disparity in the amounts of fluid removed was thought to indicate a tumor on the side having less fluid. If a ventricle contained more than 25 cc. of fluid, it was considered obstructed. If communication between the ventricles was questioned 1 cc. of a neutral suspension of indigo carmine was injected into one ventricle and the other aspirated in search of the dye. To differentiate between a tumor obstructing the aqueduct and pseudotumor, a spinal puncture was advocated twenty minutes after the dye had been injected in the ventricle.

"Ventricular estimation never gained popularity but the dye test, originally used to determine whether a hydrocephalus was obstructive or communicating, became a routine procedure."²⁰

Since their introduction, ventriculography and encephalography have been modified frequently by changes in positions, contrast media, and roentgen-ray techniques.²⁰ The basic ideas, however, have remained unchanged for almost half a century, a fitting tribute to their inherent worth. Dandy’s classical 1918 paper on ventriculography is reprinted below and his 1919 paper on encephalography will be reprinted in a forthcoming issue of the Journal of Neurosurgery.

References