The Radiographic Demonstration of Cysts and Abscesses of the Brain
Use of Micropaque Barium in Suspension

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SINCE the invention of the roentgen ray, the advantage of making permanently visible the walls of certain cysts and abscesses of the brain has been evident to neurological surgeons. The instillation of air has been helpful in the immediate determination of the size of a cerebral cavity, but to ascertain the degree of shrinkage or expansion of the cavity, a substance that can be incorporated into the wall of the cyst or abscess is desirable.

Thorotrast (colloidal thorium dioxide in dextran) has been used widely and satisfactorily, since small amounts of it are taken up readily by the phagocytes in the walls of cysts and abscesses. But this material is mildly radioactive and it has been suggested that in certain general uses long-standing deposits of Thorotrast in the body may be carcinogenic. Furthermore, its persistent radioactivity has led to the increase of cica-tricial tissue, such as that seen in the neck in carotid arteriograms where small amounts of this substance have been deposited in the tissues around arteries. The extremely undesirable properties of this colloidal suspension when it is introduced into the ventricles or the subarachnoid space of the central nervous system have been documented thoroughly in the classical works of Reeves and Stuck.4,7

Whitcomb and Scoville8 have utilized tantalum powder which can be insufflated into the cavity of a cyst and it becomes incorporated permanently into the wall of the cavity. Tantalum is not available readily however, and it has not been used widely.

Pantopaque has been used also but it is not taken up readily by the phagocytes and usually does not give permanent visualization.

In the field of general radiology, a micropulverized barium sulfate (micropaque barium) recently has become available and has been used in gastrointestinal roentgenograms. Micropaque barium also is supplied in small 5-cc. ampules of sterile micropaque barium called Steripaque.*

The possible use of micropulverized barium sulfate became apparent more than 10 years ago in studies of antibiotic dusts for inhalation therapy. A dry-grinding process reduces the number of large particles of barium in the 5 to 20μ range and increases the concentration of small particles in the 0.04 to 0.10μ range. In the suspension supplied by the manufacturer, most of the particles are 0.1 to 1.0μ in size. Reduction in the size of the particles has been accomplished more effectively by wet grinding for several days in a ball mill.

With respect to inhalation studies, Adolph and Taplin felt that there was a correlation between size of particles and toxicity—the smaller the particle, the more potentially toxic. In the intestinal tract, however, insoluble particles of barium would be likely to enter through the lymphatic system, not through the blood stream. They concluded that this finely particulated barium would not be toxic in the uses to which it would be put ordinarily in the intestinal tract. They found no immediate or delayed toxic reaction in 10 rabbits following the intravenous injection of aqueous suspension of barium sulfate


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in a dosage of 0.5 gm. per kg. of body weight. In 60 examinations of the lower, and 35 of the upper intestinal tract, there was no toxic reaction of any kind. There were, they thought, significant advantages in the minute radiopacity of the medium in investigating the pattern of the intestinal tract because of the tendency of the micropulverized material to adhere to the wall of the bowel and to show persistent shadows after normal evacuation.

Likewise, Roylance\(^6\) made over 1,000 barium-meal examinations in humans using micropaque barium without complications from the material.

A few experimental studies have been reported. The use of this material in non-sterile form in the intestinal tract of dogs has been described by Nelson et al.\(^3\) In addition to giving superior contrast and showing the point of experimental obstruction better than other substances, it was harmless to the animals as well.

Steggerda,\(^6\) reporting on studies done for the United States Air Force, attempted to make various organs of the body permanently opaque to roentgen rays by the injection of certain materials into the walls of these organs. He used Thorotrast in some animals and finely divided barium sulfate suspension (micropaque) in others. With both substances the radiopacity was satisfactory, numerous histologic studies were done, and no harmful effects were noted up to the 10-month length of the experiments. Small amounts were injected into the walls of different organs, including the gallbladder, kidney, stomach, colon and diaphragm. Although Thorotrast was more miscible with body fluids, it was absorbed when injected into the walls of the stomach and diaphragm. Micropaque barium seemed to remain without being absorbed in such positions. The reaction to these 2 media was about the same—a pronounced infiltration of macrophages which engulf the foreign materials. The reaction was considered to be that usually seen as the result of the presence of any foreign body.

Clarke et al.\(^2\) reported the use of sterile micropaque barium in 8 cases in which the suspension was injected into cavities of cerebral abscesses in amounts of about 1.5 cc., together with suitable solutions of antibiotics. The micropaque was taken up quickly by the walls of the abscesses and continued to give a satisfactory radiopaque image thereafter. In 1 instance the cavity communicated with the lateral ventricle and micropaque barium was visible throughout the ventricular system. The patient died about 6 months later from bronchopneumonia. At autopsy the barium was found lying within phagocytes; around the main deposit of barium in the cavity of the abscess was a well defined fibrous-tissue reaction. In the wall of the ventricle, barium sulfate was seen within phagocytes just deep to the ependymal lining. Around them was "only a very slight fibrous tissue reaction and no sign of astrocytic response."

Case Reports

Case 1. A 44-year-old man was found to have a large cystic astrocytoma of the right frontoparietal region. The patient demonstrated only equivocal neurologic deficit preoperatively and it was considered inadvisable to attempt a complete removal of the tumor. Steripaque (1.25 cc.) was injected into the cyst before closure of the wound at the operation on Jan. 4, 1963. Subsequent roentgenograms showed clear opacity of the entire wall of the cyst, which revealed progressive shrinkage on later films (Fig. 1).

Case 2. A 26-year-old ministerial student had severe pansinusitis and left frontal osteomyelitis. Cranectomy was performed and an epidural abscess was removed. Although the local infection cleared, the patient failed to improve and he was found to have a large left frontal abscess. On Nov. 30, 1962, following aspiration of the abscess through the scalp, Steripaque (3 cc.) was inserted into the cavity. Follow-up films showed progressive shrinkage of the cavity of the abscess, which had been treated with local instillations of antibiotics together with systemic antibiotic therapy (Fig. 2). The patient made an uneventful recovery.

Summary

1. Micropulverized barium sulfate, 0.1 to 1.0\(\mu\) in suspension, is taken up quickly by phagocytes in the wall of a brain abscess or
Fig. 1. (Left) Anteroposterior film of skull with 1.25 cc. of Steripaque in cystic cavity originally containing 40 cc. of fluid. (Right) Anteroposterior film of skull 6 months later.
cyst, rendering it permanently radiopaque.

2. The material is used easily with antibiotic solutions, is not removed from the wall of the cavity by later irrigation, is not radioactive, and is well tolerated.

3. Two cases in which this material has been utilized satisfactorily are reported and illustrated.

References

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Fig. 2. Anteroposterior and lateral films of skull showing progressive shrinkage of abscess cavity of left frontal region. Three cc. of Steripaque with 2 cc. of air injected originally (left); cavity irrigated repeatedly on successive days thereafter. Films represent shrinkage of abscess cavity (center) at 2 months and (right) at 6 months.