SUBDURAL COLLECTIONS OF FLUID IN INFANTS AND CHILDREN

II. STUDY WITH RADIOACTIVE SODIUM PHOSPHATE (P-32)*

R. M. N. CROSBY, M.D.,† AND ROBERT E. BAUER, M.D.‡

Department of Surgery, Division of Neurosurgery, Department of Pediatrics, and Department of Medicine, Division of Radioisotopes, University of Maryland School of Medicine, Baltimore, Maryland

(Received for publication October 10, 1955)

In the management of subdural collections of fluid in infants and children, multiple surgical intervention is often necessary. At least one of these operative procedures is performed to determine the presence of encapsulation of the subdural fluid, because removal of the capsule is necessary to effect a cure. Therefore, a nonsurgical method was sought to study the formation of the fluid and its encapsulation in relation to cause and duration of the process.

Previous studies by one of us (R. E. B.)† have shown that radioactive phosphorus (P-32) concentrates in significantly different amounts in pleural and peritoneal effusions. The rate of accumulation and final concentration of P-32 was closely related to the metabolic activity of the effusive process. On this basis it was thought that P-32 could be used to differentiate between subdural collections of fluid caused by various etiologies and possibly indicate the presence of encapsulation.

MATERIAL AND METHODS

The patients were unselected. The only factors governing inclusion in this series were the presence of an open fontanelle to allow needle aspiration of the subdural fluid and the reaccumulation of sufficient subdural fluid after diagnostic aspirations were made.

The plan of treatment used in this clinic is repeated aspiration of the fluid. If fluid persists after three or more aspirations, trephination is done to inspect for encapsulation. Capsules are removed by craniotomy. Trephination is performed only after 10 days of aspiration and craniotomy is performed at least 1 week after trephination if fluid is no longer accumulating or if the amount removed by each aspiration is decreasing. If bilateral, operative removals of the capsules are separated by at least 10 days.

The radioactive phosphorus study was done between the 2nd and 6th fontanelle tap and always before trephination.

* These studies were supported in part by funds obtained from the Atomic Energy Commission (AT(30-1)(1031)) and the Bressler Research Fund. Technical assistance by Mrs. D. P. De Santis.
† 11 East Chase Street, Baltimore 2, Maryland.
‡ Now on leave to the U. S. Navy.
One to 200 microcuries of radioactive phosphorus (P-32) as sodium phosphate in a volume of 1 to 2 ml. was injected intravenously. Samples of subdural fluid and blood were obtained 3 hours later. Whole blood was mixed with ammonium and potassium oxalate and the plasma was separated. Subdural fluid was centrifuged. Duplicate 1 ml. aliquots of plasma and subdural supernate were placed in 2 ml. glass planchets. The planchets were brought to volume by the addition of water and then dried in the air for 24 to 48 hours. Each sample was counted in a shielded lead holder with a background of 30 to 45 CPM. Individual planchet counting rates ranged from 400 to 3000 CPM (values from 9 to 100 times background). The activity in each instance was measured with Geiger counters using thin end window mica tubes (Tracerlab TCC-2).

The activity of the subdural fluid was expressed as a number obtained from the following equation:

\[
\text{Subdural activity} = \frac{\text{CPM/ml subdural fluid}}{\text{CPM/ml plasma}} \times 100.
\]

RESULTS

In many of the cases studied, erythrocyte and leukocyte counts were made on the subdural fluid obtained for the measurement of the radioactive content. There was no obvious relationship between subdural P-32 activity and the several cell counts. In several cases in which the subdural fluid was very bloody, samples were also prepared without centrifugation. When compared to the standard centrifuged sample, the P-32 activity was increased a maximum of 3 per cent by the presence of the erythrocytes.

In the early studies samples were taken at frequent intervals. The maximum concentration of P-32 in the subdural fluid occurred at approximately 3 hours after the injection of the radioactive substance. This was confirmed in one patient in whom a catheter was inserted into the subdural space for continuous drainage. Samples of subdural fluid were obtained every 15 minutes. The activity in the various samples of subdural fluid, cerebrospinal fluid and plasma are plotted in Fig. 1. It may be seen from this graph that the peak of P-32 activity in the subdural fluid occurs 3 hours after the intravenous injection of the radioactive substance.

The results of 35 trials in 29 cases are shown in Table 1. Only 5 of these cases have not been checked by direct inspection through trephine openings and these 5 have been followed carefully for 8 months or more. Those results that are in boldface type were obtained from cases in which encapsulation was proven at operation; those in italics were obtained from patients found at operation to have a thin layer of reactive material on the under surface of the dura mater, but not to have organized capsules necessitating surgical removal.

The level of radioactivity in subdural fluid indicating encapsulation varied, depending on the etiology. As seen in Table 1 those subdural collections of fluid associated with malnutrition become encapsulated and have a