SUBDURAL HEMATOMA OCCURRING IN SURGICALLY TREATED HYDROCEPHALIC CHILDREN

WITH A NOTE ON A METHOD OF HANDLING PERSISTENT ACCUMULATIONS

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While in recent years subarachnoid-peritoneal anastomoses have been performed, the majority of patients with congenital hydrocephalus have been treated in this clinic by choroid plexectomy. Our technique for the operation has been reported in detail elsewhere. In order to maintain the integrity of the cranial vault when cerebrospinal fluid is withdrawn from the ventricle, a plaster cast is applied preoperatively in the form of a ring encompassing the forehead and occiput. Following excision or coagulation of the plexus, Ringer’s solution is instilled into the ventricle in sufficient quantity to prevent the brain, which has been supported during the course of the operation with retractors, from collapsing. If the head is so positioned that the opening in the skull is uppermost, the fluid can be replaced almost completely. However, it is very difficult to expand the brain so as entirely to obliterate the subdural space, and some separation between cortex and dura mater may persist. This space is traversed by a variable number of stretched veins, which may conceivably rupture and produce a hematoma.

Surgical procedures for the treatment of hydrocephalus other than choroid plexectomy, designed to reduce intracranial pressure by shunting cerebrospinal fluid into extraneural channels, pose a similar threat. A sudden diminution of pressure within the ventricles resulting from withdrawal of cerebrospinal fluid may also possibly bring about a collapse of the brain which, in turn, may lead to rupture of a vein and bleeding into the subdural space.

Though mentioned in a paper by Voris, to our knowledge there is only Anderson’s report in the literature dealing primarily with subdural hematoma as a complication of the surgical treatment of hydrocephalus. The latter has described 3 such cases occurring in a group of 24 treated infants. In all 3 symptoms referable to the hematoma became manifest early in the postoperative course. The hematoma developed after a spino-ureteral anastomosis in 1 case, following choroid plexectomy in a 2nd and subsequent to the removal of an intraventricular cyst containing choroid plexus in a 3rd patient.

In view of the paucity of information available on this subject, we are reporting 3 additional cases. Incidentally a method of dealing with chronic recurrent subdural accumulations of fluid in a head much enlarged by pre-
ceeding hydrocephalus will be briefly described. Our experience is based on 85 surgically treated hydrocephalic children on whom 134 operations were performed.

CASE REPORTS

Case 1. B.I.H. #245005. R.B., hydrocephalic male. Bilateral choroid plexectomy at 3\frac{1}{2} months. After 2 years, trauma to head; left subdural hematoma disclosed. Reaccumulation of subdural fluid after classical treatment. Control after subdural-cisternal anastomosis.

History. A 3\frac{1}{2}-month-old male infant was referred to this clinic on Feb. 23, 1948 because of excessive enlargement of the head. He was a first-born child delivered by forceps after a normal full-term pregnancy. A scalp laceration in the left frontal region was incurred at the time of delivery.

Examination. The pertinent findings were limited to the head. It measured 48.5 cm. in circumference. The anterior fontanelle was dilated (6 X 6 cm.) and bulged moderately.

Course. Subdural punctures failed to disclose the presence of a hematoma. Accordingly a ventricular estimation was performed using a small quantity of gas (40 cc.). An extreme degree of ventricular dilatation was revealed.

1st and 2nd Operations. Under local anesthesia a small right parietotemporo-occipital flap was reflected and a choroid plexectomy was performed on Feb. 26, 1948. Twelve days later a similar procedure was done on the left side.

Course. The child withstood the operations well and at the time of discharge from the hospital on Mar. 16, 1948, his head circumference measured 49 cm.

For about 1\frac{1}{2} years, he appeared to be making satisfactory progress. His fontanelle closed, he began to walk and his mental development was seemingly reasonably good. At the age of 8 months an internal squint of the left eye became manifest. Some enlargement of the head continued to take place, its circumference in September, 1949 being 53.5 cm.

In January, 1950, following a fall, the child became irritable, drowsy and vomited occasionally. In addition to these symptoms, episodes occurred during which he would suddenly retract his head.

Readmission, Jan. 11, 1950. Examination at this time disclosed no gross neurologic abnormalities. Lumbar puncture revealed xanthochromic CSF containing 1822 mg. per cent total protein. EEG indicated an absence of all electrical activity over the left hemisphere. The presence of a subdural hematoma was suspected.

3rd Operation. Bilateral trephination was performed on Jan. 15, 1950. A large subdural clot overlying the left cerebrum was evacuated.

Course. Considerable improvement followed.

4th Operation. Removal of the inner membrane of the subdural hematoma was subsequently accomplished by means of a craniotomy. Fluid similar in character to that present in the subdural space was found within the ventricle, leading to the conclusion that the subdural space and ventricle communicated through the opening of the cortex originally created for the purpose of gaining access to the choroid plexus.

Course. Right-sided seizures developed, but otherwise the child's course was not remarkable. Except for occasional vomiting, his condition during the next 8 months was reasonably satisfactory. An EEG in March, 1951 was reported to be within normal limits.
In June, 1951 hospitalization was again necessary because of recurrence of seizures. Again no definite neurologic abnormalities were detected. His behavior, however, was such as to indicate that in all probability he was mentally retarded. The circumference of his head measured 54 cm. A pneumoencephalogram attempted by way of the lumbar route was unsuccessful. The CSF was xanthochromic and contained 168 mg. per cent total protein. A subdural puncture on the left side yielded brown fluid demonstrating a persistence of the hematoma. The subdural space on the right side was inspected through a trephine opening and found free of clot.

5th Operation. On July 10, 1951, utilizing the principle of the Torkildsen procedure, a connection was established by means of a polyethylene tube between the subdural space on the left side and the cisterna magna for the purpose of draining the chronic subdural accumulation.

Subsequent Course. During the time that has elapsed since the last operation, the circumference of the child's head has increased only 1 cm. At varying times he has vomited and occasionally complained of headache. Since August, 1951 he has been free of major seizures. His intelligence has continued below par.


History. A female child, aged 3, was first seen in October, 1950 because of an unusually large head, present since birth. As the child grew older, the head had continued to enlarge disproportionate to the size of her body. Except for some unsteadiness of gait, her mental and physical development were said to have been normal.

Examination. The patient appeared to be a remarkably bright child, active, friendly and talkative. Her head was considerably enlarged, measuring 60 cm. in circumference. The anterior fontanelle was still partly open. On percussion a cracked pot sound was audible. She exhibited a slightly spastic gait with a tendency towards adduction of the lower extremities and inversion of the feet. Roentgenograms of the skull disclosed separation of the sutures.

Course. Communication between the lateral ventricle and lumbar subarachnoid space was demonstrated by means of the tilt test.

1st Operation. On Nov. 7, 1950 a lumbar laminectomy was performed and a subarachnoid-peritoneal anastomosis was established by means of a polyethylene tube.

Course. An electrical amplitude diminution, which had been noted preoperatively over the right frontal and parietal and the left temporal regions, was still discernible following this procedure. However, whereas 2–5 per sec. waves were observed posteriorly in the record prior to operation, their frequency had increased to 4–8 per sec. postoperatively.

About a month after operation seizures involving the left half of the body developed, which resulted in a transient left hemiparesis. Following the administration of anticonvulsant medication, the convulsions did not recur.

In January, 1951 she began to complain of headache and pain in the neck and soon thereafter vomited and became drowsy. EEG now revealed a severe depression of amplitude over the entire right side, and a focus of slow activity in the occipital and temporal regions on the left side. The existence of a subdural hematoma was considered.

2nd Operation. On Jan. 30, 1951 bilateral trephination was performed. Hemato-
mas were disclosed on both sides, the one on the left being devoid of a membrane. The ventricle on the right side contained yellow fluid similar in appearance to that present in the subdural space.

Course. Following evacuation of the hematomas, the child did not improve. She frequently complained of pain in the neck, vomited and often became exceedingly drowsy. Relief usually followed withdrawal of fluid from one or the other subdural spaces.

3rd Operation. On Feb. 20, 1951 a right lateral craniotomy was performed under local anesthesia. The subdural space was emptied and the inner membrane was largely removed. The brain, however, failed to expand so that the size of the subdural cavity remained unaltered.

Course. The child recovered from the operation but her condition thereafter deteriorated rapidly. She was comatose on the 3rd postoperative day, and continuous drainage of the subdural space by catheter was instituted for 3 days. Thereafter her condition improved and she continued to gain ground.

Early in April, 1951 her symptoms returned. She again experienced pain in the neck, vomited and became irritable and drowsy. Examination revealed a bulging bone flap and bilateral extensor plantar responses. To afford her relief, it was necessary to withdraw fluid from the subdural space on one or the other side by aspiration at frequent intervals.

4th Operation. On June 3, 1951, for the purpose of allowing the subdural fluid to drain into the cisterna magna, a communication was established on the right side by means of a polyethylene tube. Over the left cerebrum, no subdural fluid was encountered, but a needle inserted through the cortex yielded yellow fluid, presumably from the ventricle. A pathway from this ventricle into the cisterna magna was created, utilizing a rubber catheter. Inspection of the region of the foramen magnum disclosed no evidence of an Arnold-Chiari malformation.

Subsequent Course. Since the last operation the child has remained remarkably well. There have occurred no manifestations of increased intracranial pressure and the circumference of the head has remained unchanged (60 cm.).

Case 3. B.I.H. #260068. P.A.M., hydrocephalic female. Right and left choroid plexectomy at 4 and 10 weeks of age. Well for 3 years. Then fall from bed and in 2 months, right subdural hematoma. Failure of classical operations. Control of subdural fluid by subdural-cisternal anastomosis. Continued symptoms because of block of foramen of Monro, probably by tumor.

History. A female infant aged 4 weeks was referred to this clinic on Jan. 12, 1949 from another hospital where a diagnosis of hydrocephalus had been established. The baby, the first-born child of her parents, was delivered by forceps following a normal pregnancy and after an otherwise uncomplicated labor. Soon after birth she began to vomit and it was noted that her head appeared unusually large. Its circumference measured 38 cm. Bilateral subdural punctures disclosed no hematoma. Ventriculography revealed dilated ventricles.

Examination. The findings of note involved the head. It was enlarged, measuring 42 cm, in circumference. The anterior fontanelle was considerably dilated (8×8 cm.), bulging and tense. There were no other abnormalities.

1st Operation. On Jan. 17, 1949 a right parietotemporo-occipital flap was made under local anesthesia and a choroid plexectomy was performed.

Course. The child tolerated the operation well and was kept under observation
thereafter for a period of about 6 weeks. Continued enlargement of the head necessitated further treatment.

2nd Operation. On March 11, 1949, choroid plexectomy was carried out on the left side.

Course. Following the 2nd operation, the child's condition was extremely satisfactory and continued so for a little over 3 years. Thus, in March, 1950 at the age of 15 months, she was able to walk and to say a few words. Her head circumference measured 53 cm. and the anterior fontanelle, though still open, was markedly scaphoid.

In April, 1951, and again a year later, her parents reported excellent progress, physically and mentally.

Some time about March, 1952 the child fell from her bed and struck her head. She was not rendered unconscious and examination disclosed no evidence of any serious injury. About 2 months later, she became listless and began to vomit and to complain of headache. When seen in August, 1952 she appeared apathetic and drowsy and examination revealed low-grade papilledema. X-rays of the skull showed separation of the sutures, thus confirming the presence of increased intracranial pressure. EEG disclosed a large amount of diffuse high voltage delta activity on the left side, as well as an asymmetry of amplitude, waves of low voltage being consistently recorded on the right.

3rd and 4th Operations. On Aug. 6, 1952, bilateral trephination was performed and the presence of a subdural hematoma was demonstrated on the right side. Two days later the clot and membranes were removed by means of a craniotomy. It was observed that the hematoma extended practically over the entire convexity of the right cerebrum.

Course. The child improved considerably immediately following the evacuation of the subdural hematoma, and the papilledema disappeared. However, about a month after operation she again became lethargic and a left hemiparesis rapidly developed. Aspiration through the right burr hole yielded dark brown fluid at a depth of about 3 cm. Roentgenograms taken after gas had been injected into this cavity made it appear that the fluid was contained within the ventricle itself.

5th Operation. On Sept. 17, 1952, a Torkildsen operation was performed, fluid from the right lateral ventricle being led into the cisterna magna through a polyethylene tube. The absence of a recurrent subdural hematoma was confirmed and the presence of clear, colorless CSF within the cisterna magna was observed. The existence of a lesion obstructing the right lateral ventricle thus appeared to have been demonstrated.

Course. Despite this procedure, however, the child's condition did not materially improve. The bone flap began to bulge and repeated lumbar punctures were necessary to lower the intracranial pressure.

6th Operation. On the assumption that absorption of CSF was defective, a subarachnoid-peritoneal anastomosis was accomplished on Oct. 14, 1952.

Course. Still the course of events was not favorably influenced. Ventriculography was performed which revealed dilated lateral ventricles blocked at the foramen of Monro.

7th Operation. On Nov. 5, 1952, through a transfrontal craniotomy, the right lateral ventricle was entered and the region of the foramen was explored. It was completely occluded seemingly by neoplastic tissue.

Subsequent Course. Following operation the child became alert, but continued to
remain hemiplegic. A course of radiation therapy was administered. To date her condition remains unchanged.

COMMENT

The relatively long interval of time that elapsed between the operations for hydrocephalus and the development of symptoms attributable to the subdural hematoma in Cases 1 and 3 may raise some doubt as to a direct causal relationship. Moreover, there was a history of trauma during the interim in each case, and the possibility that the hematomas were attributable to the trauma cannot be entirely ignored. Finally in our Case 2, as well as in 1 of Anderson’s cases, a subdural hematoma developed after anastomotic procedures, without preceding craniotomy. We are inclined to believe, however, that the original operative procedures in all probability were indirectly, if not directly, the responsible factors in that they all had in common the sudden release of increased intracranial pressure in the presence of enlarged heads containing distended cerebral ventricles. It is well known that subdural hematomas may make their presence manifest after varying periods of time and, in the case of a hydrocephalic child, because of the increased capacity of the skull, this interval might be lengthened considerably. It is assumed, of course, that the hydrocephalus has been arrested since otherwise the patients would not have been asymptomatic in the intervals. It is entirely conceivable that under such circumstances a subdural hematoma might expand to a considerable size before giving rise to clinical symptoms and that the time element would be correspondingly prolonged.

The symptoms produced by the subdural hematoma in the 3 cases reported were essentially those of increased intracranial pressure. Focal seizures developed in one patient and papilledema was observed in another.

In Anderson’s cases symptoms referable to the hematoma appeared much sooner following operation. Evidence of recurrent intracranial hypertension was manifested by a bulging fontanelle 10 days after a spino-ureteral anastomosis in 1 case and 3 days following removal of an intraventricular cyst in another; in the 3rd case the hematoma was accidentally encountered at a 2nd-stage operation 6 weeks after choroid plexectomy on the opposite side.

In arriving at a diagnosis various etiologic possibilities were considered. The background of hydrocephalus invariably raised the question of reactivation of the original process. Such conditions as the Arnold-Chiari malformation and aqueduct stenosis were given consideration in the differential diagnosis. The evidence that in all 3 instances suggested the possibility of a subdural hematoma was the EEG pattern. A diminution in amplitude of electrical activity over the involved hemisphere was demonstrated in each case. In the single patient with bilateral subdural hematomas the amplitude depression was recorded on the side of the more extensive lesion, while a slow wave focus was present over the opposite hemisphere. The usefulness of the EEG in providing a clue to the diagnosis in these cases cannot be overemphasized.
HEMATOMA AFTER SURGERY FOR HYDROCEPHALUS

Difficulties were encountered in the treatment of this condition. Therapy was instituted in accordance with the plan usually adopted in infants and children. A craniotomy was eventually performed in each case, the hematoma was evacuated and the inner and outer membranes were largely excised. Persistent recurrence of the subdural accumulation in 2 patients presented a desperate therapeutic problem. Some means of providing constant internal drainage had to be devised so as to eliminate the subdural pocket of fluid, or at least annul its compressive effect. Utilizing the principle of the Torkildsen operation, the contents of the subdural space were permitted to empty into the cisterna magna through a polyethylene tube. Judging from the clinical response, this method of treatment appears to have been successful.

To minimize the likelihood of occurrence of a subdural hematoma following the surgical treatment of hydrocephalus, Anderson advised that, insofar as possible, precipitous lowering of intraventricular pressure be avoided. While undoubtedly desirable, this is not altogether feasible. A shunting operation, such as a subarachnoid-ureteral or subarachnoid-peritoneal anastomosis, would appear to be preferable to choroid plexectomy in this respect, but, judging from Anderson’s as well as our own experience, obviously offers no guarantee against postoperative bleeding. Anderson further suggested that following operation the patient be kept horizontal or in the Trendelenburg position and that an adequate fluid intake be maintained.

SUMMARY

Subdural hematoma may occur as a delayed complication of the surgical treatment of congenital hydrocephalus. Three such cases are described. The importance of electroencephalography as a diagnostic aid is emphasized. Chronic recurrent subdural hematomas may be treated by internal drainage into the cisterna magna.

REFERENCES