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Surgical indications for infantile subdural effusion

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Abstract. Thirty-four cases of infantile subdural effusion (ISE) were reviewed in relation to surgical treatment and its prognosis during an average of 4 years of extended follow-up. The surgical indications were determined mainly by the size of the ISE on computed tomography (CT) scan and by metrizamide CT cisternography (MCTC). Consequently, 18 cases were categorized as type A according to MCTC, including 11 cases (61.1%) of ISE CT grade 1. All type A cases were closely observed. This nontreatment regimen yielded excellent results in 15 cases (83.3%). For 10 cases categorized as type B according to MCTC, including 5 cases (50%) of ISE CT grade 3, surgical treatment was indicated and excellent results were obtained in 8 cases (80%). For 6 cases categorized as type C according to MCTC and as ISE CT grade 3, surgery yielded excellent results in 4 cases (66.7%). Antiepileptic drugs have been given to three (27.3%) of the 11 patients who had convulsive attacks. In conclusion, the surgical indications for ISE were based mainly on MCTC in addition to the clinical course, and it is emphasized that, in the early stages, surgery on ISE cases categorized as MCTC types B and C is necessary.

Key words: CT cisternography – Infants – Subdural effusion – Subdural, peritoneal shunt – Surgical indication

The definition, diagnosis, and treatment of infantile subdural effusion (ISE) remains unclear and controversial. The purpose of this study is to report the results of an analysis carried out on a series of 34 cases of ISE and to elucidate the operative indications.

Patients and methods

The case histories of 34 patients with ISE, treated over the past 7 years were reviewed. Cases with histories of antecedent head injury, birth trauma, intracranial infection, craniotomy, or primary central nervour system disorders were excluded. Our series was characterized as follows: (1) the ages of the patients ranged from 4 to 11 months (mean age 6 months); (2) there were 22 boys and 12 girls; (3) the initial symptoms were a large head in 23 cases and convulsive attacks in 11 cases; (4) the follow-up term was between 9 months and 11 years with a mean of 4 years; (5) serial head circumference measurements were evaluated according to the method of Nellhaus [10].

ISE was assessed by means of computed tomography (CT) scans and metrizamide CT cisternography (MCTC). Furthermore, mental and physical development was checked sequentially.

Using the axial view of CT scans (Fig. 1), the size of the ISE was graded as follows: grade 1: maximum thickness of ISE (ISE t) is equivalent to or less than that of the corresponding frontal skull (front t); grade 2: ISE t is 1–2 times that of the front t; grade 3: ISE t is more than two times that of the front t.

On the other hand, MCTC was classified as follows: type A: influx into ISE 3 to 24 h after intrathecal metrizamide injection; type B: slow influx (more than 24 h) or scant influx; type C: similar dynamics to type B, but complicated with subdural hematoma.

Case reports

Case 1

Case 1 (Fig. 2) is a typical group A case.

A 5-month-old boy was admitted because of a large head measuring 45 cm. He had been delivered normally on 17 June 1988, after a normal gestation period. His body weight at birth had been 3630 g and his head circumference had measured 35 cm. On admission, this

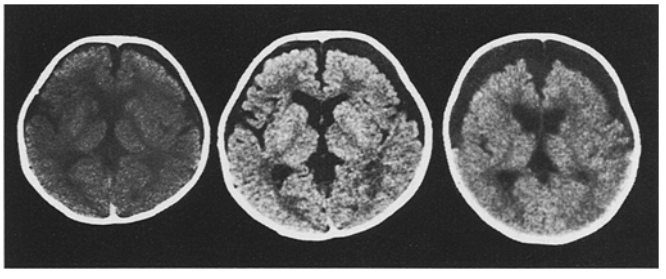

Fig. 1. Typical CT scans demonstrating ISE CT grading: grade 1 ≤ one time (*left*), grade 2 ≤ 2 times (*middle*), grade 3 > 3 times (*right*). For details, see text

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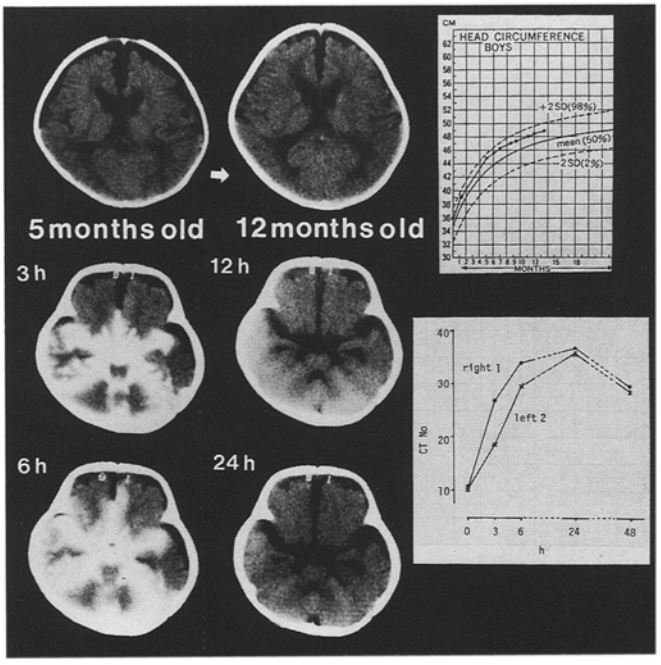

Fig. 2. A typical group A case (male patient, birth 17 June 1988). This case resulted in excellent development with clinical observation only. Photograph, showing the first CT scan of initial diagnosis (*upper left*), follow-up CT scan (7 months later, *upper center*), MCTC (*middle and lower CT scans*), head circumference measurements (*upper right*), and CT number changes of ISE in MCTC (*lower right*)

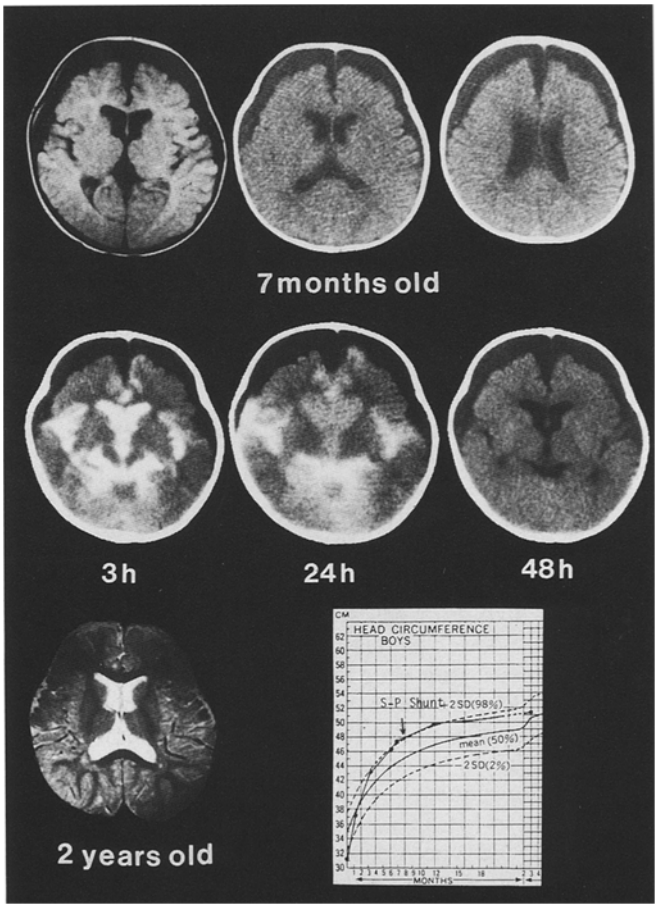

Fig. 3. A typical group B case (male patient, birth 16 July 1986). This case received a subdural peritoneal shunt. Thereafter, the serial head circumference measurements normalized, as shown in the lower right. Photograph showing the first CT scans at the time of initial diagnosis (*upper row*), MCTC (*middle row*), and follow-up magnetic resonance (MR) imaging at 2 years of age (*lower left*) in which ISE was no longer detected

ISE case belonged to CT grade 1 (upper left), and had a type A MCTC (3, 6, 12 and 24 h). CT numbers of the ISE in the MCTC were plotted as seen in Curves 1 and 2 in the lower right-hand corner of Fig. 2. In this case, clinical observation alone was chosen as the course of treatment. The case resulted in normal development 7 months after the initial diagnosis.

Patients in group B had a type B MCTC, and this group consisted of ten cases. The age ranged from 4 to 7 months with a mean of 5.2 months. There were six boys and four girls. The initial symptoms were macrocephaly in all 10 cases and convulsive attacks in five cases. On admission, the head circumference was larger than the mean value in all 10 cases. The five cases with convulsions demonstrated a head circumference larger than 2SD. According to ISE CT, five cases were grade 2 and the remaining five were grade 3. All patients in group B received surgical treatment; Ommaya reservoirs were installed in three cases and subdural peritoneal shunts were inserted in seven cases.

The follow-up term after surgery ranged from 3 to 11 years with a mean of 5.5 years. The time to ISE reduction ranged from 3 to 8 months (mean 7 months). Subsequently, the result was normal development in eight patients (80%) and mental retardation in two patients (20%), one of whom died due to status epilepticus 3 years postoperatively.

Case 2

Case 2 (Fig. 3) is a typical group B case.

A 7-month-old boy with a head circumference of 47 cm was admitted for evaluation. The history of delivery on 16 July 1986 was normal. The head circumference at birth was 32 cm. On admission, the ISE showed a CT of grade 3 (upper row) and type B MCTC (3, 24, and 48 h). For this case, a subdural peritoneal shunt was inserted. The head circumference after shunting normalized gradually (lower right), and there was no presence of behavioral or mental deficits. Also, magnetic resonance (MR) imaging at 2 years of age revealed complete regression of the ISE.

The six patients in group C had a type C MCTC. The age ranged from 5 to 11 months, with a mean of 7 months. There were five boys and one girl. Three patients demonstrated both macrocephaly and convulsive attacks as initial symptoms. On admission, the head circumference measurement was more than the mean + 2DS in four cases (66.7%), while in two cases it was within a normal range (33.3%). One of the three cases with convulsions demonstrated a head larger than 2SD. The ISE CT grade of all cases was grade 3. Surgery was performed in all cases. In five cases removal and irrigation of the effusions were carried out, followed by the insertion of Ommaya reservoirs. One of these cases was thereafter provided with a subdural peritoneal shunt, and in another case the effusion capsule was removed via a craniotomy because of recurrence. In the remaining case, removal of effusion, together with the capsule, by a craniotomy and installation of subdural, peritoneal shunt were carried out simultaneously. The follow-up term after surgery was 1 to 3 years with a mean of 2.3 years. The time to ISE reduction ranged from 5 to 12 months (mean 8.6 months). Subsequently, in these cases, normal development was attained in four cases (66.7%), including one with a slight gait disturbance, and intellectual retardation in the remaining two cases (33.3%).

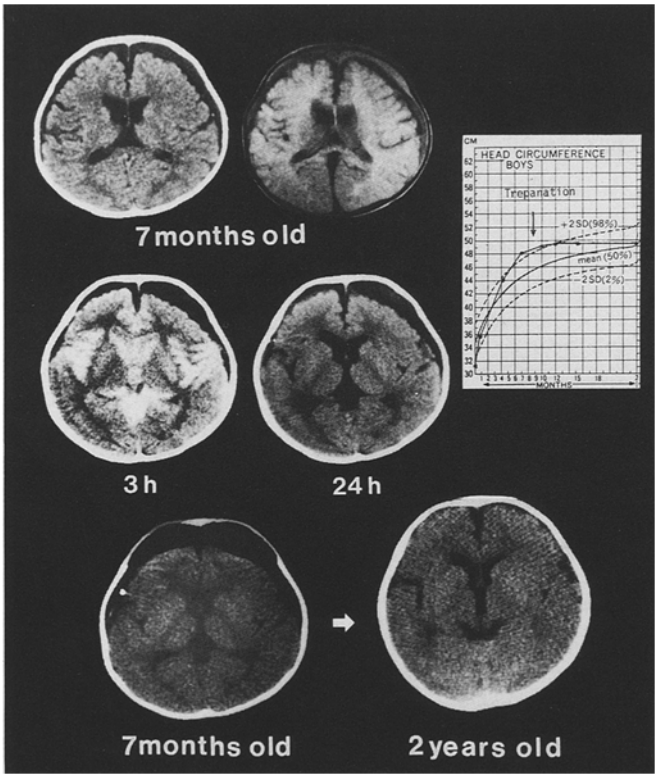

Fig. 4. A typical group C case (male patient, birth 24 June 1987). This case had an ISE CT grade of 3 (*upper left*), in which the ISE was more evidently distinguished from the subdural hematoma by MR imaging (*upper right*). The hematoma was removed by trepanation, and then an Ommaya reservoir was installed (*lower left*). Follow-up CT scan at the age of 2 years was within normal range (*lower right*), and so were his head circumference measurements (*upper right*)

Case 3

Case 3 (Fig. 4) represents a typical group C case.

A 7-month-old boy was admitted because his head was 48 cm in circumference. There was no abnormal history at birth on 24 June 1987. The head circumference at birth was 33 cm. On admission, the ISE was classified according to CT as grade 3 with a type C MCTC (3 and 24 h). MR imaging more clearly detected ISE and a hematoma (upper right). Removal of the hematoma was performed with trepanations, and then an Ommaya reservoir was inserted. The developmental status when the patient was 2 years old was excellent, and the head circumference had also normalized gradually.

Overall, the results of the long-term follow-up study are as follows: 25 cases were excellent, 6 cases were good, 2 cases were fair, and 1 patient died. Also, antiepileptic drugs were given to 3 of 11 cases with convulsive attacks at the beginning of treatment.

Results

All cases were classified according to groups A, B, and C, based on the results of MCTC. Subsequently, the prognosis of each group was analyzed. Patients in group A had a type A MCTC. This group consisted of 18 cases. The ages ranged from 3 to 11 months with a mean of 6.2 months. There were 11 boys and 7 girls. Initial symptoms were macrocephaly in all cases and convulsive attacks in 3 cases (16.7%). On admission, the head circumference measurement was more than the mean + 2SD in 4 cases (22.2%), and less than the mean + 2SD in 14 cases (77.8%). The three patients with convulsive attacks had heads larger than the mean + 2SD. The ISE CT grade distribution was as follows: 11 cases (61.1%) were grade 1, 5 cases (27.8%) were grade 2, and 2 cases (11.1%) were grade 3. All group A patients were closely observed, but were not surgically treated. The follow-up term after the initial diagnosis was 9 months to 11 years with a mean of 3.8 years. The time before ISE reduction was observed, was 1 to 8 months (mean 5.9 months). Subsequently, normal development was observed in 15 cases (83.3%), and mild retardation in speech, behavior, or intelligence in the three patients (16.7%) who demonstrated head circumference >2SD and convulsions as initial symptoms.

Discussion

In the current infant subdural fluid collections studies, the description, "benign subdural collections of infancy" was proposed by Robertson et al. [12] and Briner and Bodensteiner [2], "benign extra-axial collections of infancy" was proposed by Carolan et al. [3], and "external hydrocephalus in infants" was suggested by Andersson et al. [1]. However, there is no widely accepted explanation of the etiology. ISE is characterized clinically by the onset of symptoms during the 1st year of life [1, 5, 7–9 12], even if there are no ISE inducing factors such as head trauma [6], or infection [4, 14]. The initial symptoms in our series of ISE, were, in most cases, a large head, and in some cases convulsive attacks. ISE was detected on CT scan as a crescent configuration in the frontal area axially.

The evolutional mechanism of ISE remains unknown, but we suspect that there is craniocerebral disproportion during the process of development in early life [9]. In fact, many cases of ISE seem to develop normally without medical intervention; their serial CT scans show ISE regression [1, 8, 13]. However, some cases of ISE are complicated involving a rapidly enlarging head circumference beyond the critical level, sometimes accompanied by vomiting or repeated convulsion during the clinical course. For such clinical manifestations, there is not any significant understanding except that the disorder is caused by abnormal cerebrospinal fluid (CSF) dynamics [15, 17]. Accordingly, we believe that MCTC, as one of the CSF dynamics examinations, is a very reliable procedure for the diagnosis and determination of surgical treatment in ISE [16].

According to our retrospective analysis, most cases having a rapidly enlarging head circumference beyond the critical value plus 2SD or repeated convulsive attacks showed abnormal dynamics of the fluid within the ISE itself, such as type B MCTC of our criteria. Moreover, surgical treatment of such cases yielded better results with minimum morbidity [11] in comparison to the series of McLaurin et al. [7]. Surgical treatment of ISE, i.e., draining or shunting, of infantile subdural effusion may be

Table 1. Summary of treatment of infantile subdural effusion (ISE). CT, Computed tomography; MCTC, metrizamide CT cisternography; SP, subdural peritoneal

CT grade / MCTC	1	2	3
Type A	Observed	Closely observed[a]	More closely observed[a]
Type B	Observed	Observed[a] or SP shunt	SP shunt
Type C	Observed (for 1 to 2 months)	Trepanation (or closely observed[a])	Trepanation ↓ (SP shunt, craniotomy)

[a] Surgical treatment is indicated if head circumference increases more than the mean + 2SD, or if development retards

more effective in facilitating development of cerebral structures and the subarachnoid spaces for CSF absorption.

The effect of a temporary subdural, peritoneal shunt in ISE cases was reported by Tsubokawa et al. [15], who speculated that subdural, semiclosed cavity formation caused by laceration of arachnoid membrane was involved in the evolutional mechanism of ISE.

Among ISE cases, there are some with a complicated subdural hematoma. Their clinical course is characterized by abrupt relapse and a higher morbidity in contrast to chronic subdural hematoma in adults. Accordingly, it seems that removal of hematomas by trepanation or craniotomy is indicated within about 1 month after the onset of clinical signs. In addition, when the hematoma recurs repeatedly, extirpation of the hematoma capsule is recommended.

In conclusion, our treatment of ISE is summarized in Table 1. Additionally, during close observation of ISE cases, in which the head circumference increases by more than the critical level plus 2SD and/or developmental impairment is noticed, we emphasize that the treatment of choice is surgical in the early stages, because surgery minimizes the ISE morbidity and leads to normal physical and social development with a satisfactory quality of life.

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