Complications Related to Delayed Hemorrhage After Hemispherectomy*

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Hemispherectomy to relieve epilepsy and behavioral disturbance in patients with infantile hemiplegia has been an accepted procedure for over 20 years. Although techniques have differed in detail, the end-point of the operation is the virtual emptying of one half of the cranium. Early postoperative complications such as obstructive hydrocephalus and herniation of the remaining hemisphere have been fully described, but the long-term fate of the large hemicranial deadspace and the remaining hemisphere is mostly unknown.

In 1966, Oppenheimer and Griffith reported a syndrome of delayed hemorrhage into the intracranial cavity characterized by the following sequence of events:

1. An infantile hemiplegia with epilepsy treated in childhood by hemispherectomy.
2. A trouble-free period with seizure relief lasting for some years.
3. A period of insidious deterioration, often extending over several years, and ending in death. During this period, there is evidence of bleeding within the cerebrospinal fluid pathways, and later of obstructive hydrocephalus.
4. At postmortem examination the findings are those of superficial hemosiderosis of the brain and spinal cord with a membrane, indistinguishable from that of a subdural hematoma, lining the cerebral cavity, the walls of the remaining ventricles, and the spinal cord.

Oppenheimer and Griffith reported this sequence in three out of 18 patients (16%) who had undergone the operation at Oxford several years earlier. They postulated repeated minor head injuries as a possible cause. Their cases all ended fatally, but they cited one of us (M.A.F.) as saying that the condition can be treated surgically. Our own experience of this particular complication now includes four cases, of which three were relieved by further surgery. Two of these three, however, suffered later the additional complication of loculation of the temporal horn in the remaining cerebral hemisphere, a complication of hemispherectomy which has not previously been described.

Review of Literature

There are, of course, other complications, both immediate and late, which have been reported. White reviewed 269 published cases of hemispherectomy for infantile hemiplegia with epilepsy and behavioral disorder, but only 150 of these had been reported in sufficient detail for analysis. The average period of follow-up was 16 months, although a few patients were followed for as long as 9 years. Mortality during the recorded follow-up period was 6.6%. Dehydration and intracranial hemorrhage were mentioned as early complications, and wound infection and hydrocephalus as late ones, but no incidence was reported.

Gros and Vlahovitch in their monograph based upon 11 cases of hemispherectomy did not discuss operative or late complications, but the period of follow-up in their 10 surviving patients was only between 3 weeks and 3 years. Matera and Castro did not report any complications during an 8-year follow-up of their five patients. Wertheimer, et al., reported 23 cases of hemispherectomy with a high mortality (12 deaths within 2 years of operation including several operative deaths), but among the 11 survivors followed for up to 8 years, there were no late complications and 10 remained free of epilepsy.

Laine, et al., followed 20 survivors of their series of 22 hemispherectomies for be-
tween 1 and 13 years. Two patients with excellent initial results died long after operation following ostensibly minor head injuries, but in neither instance was autopsy performed. Their were also three patients briefly mentioned who suffered a delayed complication labelled as “intracranial hypotension.” This was characterized by severe headache, vomiting, hyperthermia, mental clouding, and (in one) “coma vigil;” recovery followed bed-rest, adequate hydration, and salt supplementation. Laine and his colleagues were anxious about the vulnerability of the residual hemisphere (“l'inquiétante fragilité de nos opérés vis-à-vis de traumatismes craniens”). They discussed the possibility of stereotaxic ablations which would leave the diseased hemisphere functionally disconnected but anatomically in situ, and remarked that “le rôle de remplissage n’est peut-être pas tout à fait inutile.”

In 1967, Griffith reviewed the Oxford series of 18 hemispherectomies initiated in 1950 by Cairns and Davidson and continued until 1961 by Pennybacker and Lewin. The average follow-up period was over 10 years. Two patients had early complications, namely, meningitis and hydrocephalus respectively. Five late deaths occurred, one from progression of tuberous sclerosis, one from spinal tuberculosis, and three from delayed intracranial hemorrhage. It was regrettable that all three latter deaths were in patients with a previously good clinical result. Among the 13 survivors, 12 remained well and free of epilepsy and the remaining one was untraceable. Griffith adduced an argument for replacing the standard hemispherectomy by some lesser procedure or procedures, as earlier suggested by Laine, et al.

In a series of 45 hemispherectomies performed by McKissock in London between 1949 and 1964, hemorrhagic complications were proven at reoperation or autopsy, or were strongly indicated by clinical investigation, in 11 patients (25%). In three cases the intra-cavitary hemorrhage occurred within 1 year of operation, while in the remaining eight patients it occurred between 15 months and 10 years after operation, an average interval of 43 years. Three of these patients recovered after surgical treatment of the hemorrhage.

In an unreported series of five hemispherectomies performed by Till in London between 1960 and 1962 there were three proven cases of delayed intracranial hemorrhage and obstructive hydrocephalus, two of them fatal. The third was symptomatically relieved for over 3 years by a valved shunt between the operative cavity and the right atrium, but episodic headaches and vomiting then returned.

Ulrich, et al., have reported one patient who died some 8 years after hemispherectomy, in whom the necropsy findings of hydrocephalus and hemosiderosis were identical to those described by Griffith and Oppenheimer, but in whom by contrast the clinical episodes of hemorrhage began in the immediate postoperative period. There was no lengthy span of well-being, and there was the added complication of purulent meningitis (following ventriculocisternostomy) early in the evolution of the syndrome.

**Case Material**

Between 1952 and 1966, at this unit, 18 patients underwent hemispherectomy for epilepsy and behavioral disturbance associated with infantile hemiplegia of varying etiology (Fig. 1). The cases with Sturge-Weber disease have already been reported. Nine patients were operated on the left side and nine on the right. Their ages at operation ranged between 3 and 26 years, average age 10 years. Eight were male and 10 female. The particular technique employed in all these patients whereby the affected cerebral hemisphere was resected in one piece and the choroid plexus of the removed hemisphere destroyed, has already been described.

Three patients have died; one was found dead in her bed at home 1 month after operation, but an autopsy disclosed no obvious cause of death (Case 18). The second died 8 years after hemispherectomy; death was ascribed to intercurrent infection, although autopsy was not performed (Case 9). The third died 9 years after hemispherectomy, from delayed intracranial hemorrhage (Case 10).

The remaining patients have been followed for periods up to 15 years, although two cases could not be traced after the 8th postoperative year. All but three have remained seizure-free during the recorded fol-