

of pain, which continued for the three or four months that the patient was under my observation.

In summary, my personal experience suggests that the burning pain described by Dr. Davis and Dr. Martin is the result of irritation of the proximal stump and can be relieved in the majority of cases by a properly performed cordotomy.

JOHN MARTIN: I would like to make one more reference to cordotomy. Some patients come to us with cordotomies already having been performed, for the most part while they were in Army hospitals. So far as the dissection of the scar is concerned, the scar being considered the source of pain on either the proximal or distal stump of the cord, we have resected that scar in some instances with a resultant gap as long as 2½ cm. This fresh clean section, however, left the pain just the same as before operation. One might believe that the open injuries of warfare might make military patients differ from civilian patients in the consideration of their pain but we have frequently observed pain in the military type of patient with closed fracture and injuries of the cord with the same anatomical defects as we see occurring in civilian patients, but in our civilian patients we have rarely had to deal with the problem of pain.

ONE HUNDRED CASES OF CHILDHOOD SCHIZOPHRENIA TREATED WITH ELECTRIC SHOCK

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For a five year period or since July 1942 electric shock therapy has been used in the treatment and follow-up study of more than 100 children with schizophrenia and other allied conditions on the Children's Ward of the Psychiatric Division of Bellevue Hospital. The present report attempts to evaluate the effect of electric shock on 98 schizophrenic children under the age of 12 years.

The study of these schizophrenic children has already led to the definition of schizophrenia in childhood as a clinical entity indicative of an encephalopathy expressing itself at different points in the developmental curve before the age of 12 years, and revealing pathology in behavior at every level and in every area of integration or patterning within the functioning of the central nervous system be it vegetative, motor, perceptual, intellectual, emotional and social. The configuration of the behavior pathology is characteristic in childhood schizophrenia and shows mixed tendencies to regression and exaceration, inhibitions and expansions in each area of function. A reactive anxiety and secondary symptom formation is an integral part of the picture.

In our observation and treatment program the schizophrenic child is included in our hospital ward and school room set-up which is planned for 35 to 50 pre-adolescent problem children of all types. They are usually hospitalized for about two months on the first admission and are frequently re-admitted. The children subjected to electric shock have in

addition to the usual routine, more extensive psychological studies, electroencephalograms, pediatric consultations, including spine x-rays, and more extensive psychiatric and neurological examinations. Besides the group and school room activities many of the schizophrenic children receive remedial tutoring and individual psychotherapy according to their needs and our facilities. Many of the parents have taken part in group discussions especially planned for them, and individual therapy for parents was arranged in some instances.

The electric shock treatment was performed with a Raum machine with 95 to 130 volts for 1/10 or 2/10 of a second until a grand mal convulsion was produced. Sub-convulsive reactions were avoided as they disturbed the children. Twenty daily convulsive shocks represented a full course of treatment. Six children had fewer than 20 and 9 children had 2 or more courses of treatment, up to 40 convulsive shocks. Following treatment we have attempted to repeat all examinations and to return the children to their home and as normal environment as possible. Repeated follow-up contacts have been made and many children have been repeatedly re-admitted to the hospital and institutional care arrangement indicated. We have recently visited the children in the institutions and many have returned to the hospital for follow-up electroencephalograms and psychometric studies.

In this group of 98 children there are 70 boys and 28 girls. Their age range from 4-3 to 11-10 at the time they received the shock treatment. Ten children were 5 years of age, 20 were 6 and 7 years of age; the remainder were evenly distributed in each year through 11. At the time of this report the age range is from 5-2 to 15-2. The estimated age of onset shows 4 peaks for childhood. Thirty-four had an onset within the infantile period or the first two years. Twenty-seven had an onset with regressive signs between 3 and 5 years. Fifteen had an apparent onset at 6 and 7 but it was thought probable that in many of these cases, the onset was earlier but not observed until the child attended school. Fifteen had an onset at 9-10 years presenting the special syndrome of late pre-adolescence. The duration of the illness was less than one year in 11 children while all the others had been ill for a period of 2 to 10 years.

Extensive psychometric examinations have been performed before shock, immediately following shock, and at intervals thereafter whenever possible. Fifty-four cases received psychometric tests before and after shock; these had an I.Q. range of 44 to 146 with an average of 83. After shock the range was 44 to 153 with an average of 84.5. Thirty-six showed no deviation in the two tests beyond a plus or minus of 5 points. Nine showed an increased I.Q. and 9 showed a diminished I.Q. The psychological tests are further characterized by lack of any evidence for a lasting effect on the intellectual functioning and development of the child

as a result of the electric shock, although 5 children showed some interference in function immediately after treatment.

Sixty-eight of these children had pre-shock electroencephalograms. Seventy-two percent showed abnormal records as compared to 15% abnormal which is the figure usually given for electroencephalograms of normal children of this age. The children's electroencephalograms as shown by this series were very labile and usually much more easily altered by shock than adults. They returned to normal more quickly also. In 23 cases there were repeat electroencephalograms six months or longer after the end of shock therapy. In one record there was an increase in petit-mal seizure patterns in the after-shock record but this was in a child who had had petit-mal seizures preceding shock but none following. No other record has shown complete distortion; none has shown a true epileptic pattern; 8 of the group have in contrast shown an improved record apparently greater than might be expected as the result of changes caused by age factor alone. Eight of the 10 children with the most normal electroencephalograms had an onset of schizophrenia within the year before treatment while 9 of the 10 children with the most disturbed electroencephalograms had had the schizophrenia from 2½ to 10 years.

Complications resulting from electric shock treatment in these children were minimal; there was one fractured vertebra in a large obese boy age 11-9 which was symptom free in 10 days. One child had recurring grand-mal convulsions following several months after treatment but there was a history of one convulsion at 1½ years, before the onset of the schizophrenic picture. Four children had an organic-type mental disturbance with excitement and confusion and interference in psychometric testing, which completely disappeared within two weeks after shock.

There was very little anxiety in relation to the treatment though this varied from group to group. Some children in near puberty showed pre-occupation with the meaning of the shock experience. Girls clearly related it to sexual intercourse and fantasy. Boys concerned themselves with aggressive implications as with the possibility that it was punishment or that they might not recover consciousness. Children in or near puberty showed the most marked anxiety. Some of the youngest mute children were negativistic and resistive sometimes to the point of panic. However, most of the children would lend themselves passively and actively to the treatment both physically and psychologically.

In all but 2 or 3 of the children a positive change in behavior following treatment has been observed. Remissions such as are seen in adults occurred in only a few children near 12 years of age who were probably in puberty. Careful re-examination of the children for those characteristic disturbances in patterned behavior which are specific for childhood schizophrenia such as the motility disturbances, vegetative lability,

disturbances in thought and language symbol formation and preceptual motor patternings show that these have been no modification as a result of shock treatment. Nevertheless it is the opinion of all observers in the hospital, in the school rooms, of the parents and other guardians that the children were always somewhat improved by the treatment inasmuch as they were less disturbed, less excitable, less withdrawn, and less anxious. They were better controlled, seemed better integrated and more mature and were better able to meet social situations in a realistic fashion. They were more composed, happier, and were better able to accept teaching or psychotherapy in groups or individually.

Recent follow-up shows that the present disposition of the 98 children is as follows: 48 are at home. Of these 26 were children treated before 1946 (and reported by Dr. Neubauer) 7 of these have been in hospitals for the mentally sick and have returned home again. Seven others are not going to school and their adjustment is poor. Forty are in school; some are adjusting at a lower level than would be expected and are recognized for their difficulties, while many are doing quite well and are not recognized by their companions and school authorities as special problems. Thirty-five are in hospital for the mentally sick and 13 are in a school for mental defectives. Therefore, about $\frac{1}{2}$ are in institutions and $\frac{1}{2}$ are at home. Some of those at home may soon enter institutions and some in institutions may go home again.

The conclusions from 5 years experience with the use of electric shock treatments to the extent of 20 grand mal convulsions on 98 schizophrenic children under the age of 12 years are that: first, the essential schizophrenic process does not appear to be modified. Second, the child nevertheless benefits by improving in his capacity to deal with problems which are secondary to the schizophrenic process especially anxiety and secondary symptom formations. Third, there is no interference in the intellectual functioning and development and the I.Q. remains remarkably stable. Fourth, the electroencephalogram shows no lasting effect and tends to mature normally. In some cases abnormal patterns are improved more than would be anticipated through maturation alone. Fifth, complications are minimal. Sixth, the prognosis of schizophrenic children seems to be better with electric shock treatments as part of the treatment program, though a longer continued study of these children and comparative studies of other schizophrenic children is necessary to prove this point. Seven, finally children can tolerate electric shock better than adults and the post-shock modification in behavior and clinical course of schizophrenic children appears to be a positive one.

DISCUSSION

LOTHAR B. KALINOWSKY: I do not want to discuss the psychiatric implication of this extremely interesting study of Dr. Bender's, except perhaps the fact that child

schizophrenia appears to be prognostically less hopeless than was frequently claimed. The statement that onset in early age is serious, is valid for the adolescent group in which hebephrenics predominate but does not seem to include onset in childhood.

The paper contains a number of interesting implications for the neurologist. One is that children obviously are less confused and show fewer signs of organic damage than adults; this is in accordance with the experience that older patients with presumably arteriosclerotic or senile brain changes get much more confused than younger people.

The main importance of such a paper in this group, I think, is the challenge which the new somatic treatments all together give to the neurologist. In convulsive treatment, we elicit a clear-cut neurological manifestation. In insulin treatment we produce hypoglycemia bringing the patient into various stages of coma, the depth of which we diagnose according to different neurological manifestations of these stages. The new electronarcosis treatment which is actually no narcosis but a modified convulsion followed by signs of decerebrate rigidity, is neurologically of particular interest. If we add to this enumeration the neurosurgical approach of prefrontal lobotomy it becomes obvious how strongly neurological problems are involved in modern treatments of psychiatric illness. This should be a challenge to neurologists, and I noticed with great interest that Dr. Bender, in spite of her analytical background defined schizophrenia as an encephalopathy.

SUBCORTICAL CHANGES IN CEREBRAL CONCUSSION

ELECTROENCEPHALOGRAPHIC AND HISTOPATHOLOGIC FINDINGS

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A number of symptoms of cerebral concussion and of post-concussional disturbances suggest that not only the cerebral cortex, but also subcortical areas, particularly the diencephalon and mesencephalon are affected. Impairment of consciousness, the appearance of vegetative disorders, such as changes of the body temperature and hyperglycemia, and the loss or impairment of labyrinthine and body righting reflexes point in this direction.

Electrical discharges of the cerebral cortex and of various subcortical areas (chiefly hypothalamus, midbrain tegmentum and cerebellum) were studied in 17 cats. The potentials of the cerebral cortex, and in some cases also those from the cerebellar cortex were lead off by means of phonograph needles (Hoagland) inserted into the skull. The discharges of subcortical areas were picked up by means of special wire electrodes inserted by a stereotaxic instrument in the base of the skull, the wire being insulated completely, except a small point corresponding to the area to be studied. Acceleration concussion was produced in awake