INFANTILE SPASTIC HEMIPLEGIA

III. Intelligence

By Meyer A. Perlstein, M.D.,* and Philip N. Hood, Ph.D.+}

In previous papers14,22,23 the results of a study of 334 patients with infantile spastic hemiplegia were presented with respect to age distribution, race, sex, presence of seizures, side of involvement, and time of onset (whether congenital or postnatally acquired). The present paper describes the manner in which these factors were related to intelligence in the same group.**

MATERIAL AND METHODS

The 334 patients forming the basis of this report were seen by one of us (M.A.P.) during the past 10 years. Approximately 35 per cent were seen in private practice; 30 per cent are from the Cook County Hospital Children's Neurology Clinic; the remaining 35 per cent are from itinerant clinics outside of the Chicago area, scattered throughout the midwest, primarily in Michigan, Indiana, Idaho, Montana, and the Dakotas. The cases in this series are thus fairly heterogeneous with respect to geographic and socio-economic distribution.

The intellectual assessment of all cases was made by referral to qualified psychologists. Although the tests were done by many different clinical psychologists, most (about 80 per cent) were done by 3 of them, and all were well qualified and familiar with the problems of testing the cerebral palsied.

The psychological tests used varied with the age, degree of motor handicap, and intellectual capacity of the child. The 2 most frequently used tests were the Cattell Infant Intelligence Scale7 for children with mental ages under 2 years and the Revised Stanford-Binet27 for children with a mental age above 2 years. In some instances the Wechsler Intelligence Scale for Children28 was used. In approximately 15 per cent of the patients supplemental intelligence tests, such as the Grace Arthur Point Performance Scale,2 the Minnesota Pre-School Scale,12 the Raven Progressive Matrices Test,24 and the Vineland Social Maturity Scale,9 were used. In the relatively few patients where there was disagreement between test scores, the psychologist's impression of the most reasonable score was used for the purposes of this study. Because the motor handicap of the hemiplegic is practically never great enough to vitiate testing procedures, the results of psychologic testing for this group were considered to be valid.

The I.Q. scores were tabulated and treated statistically by 2 techniques: 1) using the Chi-square technique, comparisons were made between the various dichotomies in terms of the proportion of mental defectives versus educable children, and 2) using the t-test of significance, comparisons were made between the mean I.Q. scores of the various dichotomies.

REVIEW OF THE LITERATURE

Reports on the intelligence of the cerebral palsied are somewhat conflicting. Several of the older reports18 indicated that approximately a fourth of the cerebral palsied population fell within the "average" range of intelligence, and approximately a fourth were "mentally defective." Of those remaining, a small percentage were said to be above average in intelligence, and the balance fell somewhere between "average" and "mentally defective." There thus appeared to be downward shift in the trend of...
the intelligence scores in the cerebral palsied population. This same shift was evident when reports covering only the spastics were considered. Some investigators demonstrated that the same skewedness existed when only spastic hemiplegics were studied.\textsuperscript{11, 29, 30} Brockway\textsuperscript{5} substantiated these findings by reporting an average I.Q. for spastics of 79.7 and an average for the spastic hemiplegics of 80.3.

More recent reports, however, suggest that the mental capacity of the cerebral palsied is on the average much more seriously impaired than these earlier reports indicated. The work of Asher and Schonell,\textsuperscript{4} Miller and Rosenfeld,\textsuperscript{19} and of Hohman\textsuperscript{17} indicates that more than 50 per cent of consecutive cases of all types of cerebral palsy have I.Q.'s below 60. It should be pointed out that the present series, like many of those on which older reports are based, is not an unselected one but is drawn from cerebral palsy clinics and from older groups and therefore tends to have more educable patients in it. Many of the mental defectives and more severely involved are institutionalized or die in early life and thus do not find their way into series like the present one. Thus our results, presented in the sections which follow, conform more to the population forming the basis of the earlier reports.

**RESULTS**

The present series of infantile spastic hemiplegics was classified with respect to age, side of involvement, sex, whether congenital or postnatailly acquired, and whether or not seizures were present. In the sections which follow, the intelligence of the spastic hemiplegics of this series will be described with respect to these subdivisions.

**The Total Population.** Of 334 patients observed, sufficient information was available in 270 to permit them to be classified as either mentally defective or educable.\textsuperscript{*} Of these, 75 (28 per cent) were mentally defective. This percentage is significantly lower than the 50 per cent reported recently by Hohman and others and con-

---

**TABLE I**

**The Incidence of Mental Deficiency in the Various Dichotomies**

(270 patients)

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>% Educable</th>
<th>% M.D.\textsuperscript{*}</th>
<th>Criterion</th>
<th>Chi-Square</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>270</td>
<td>72</td>
<td>28</td>
<td>Chance</td>
<td>Significant below .01</td>
<td></td>
</tr>
<tr>
<td>Lefts</td>
<td>120</td>
<td>72</td>
<td>28</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Rights</td>
<td>150</td>
<td>73</td>
<td>27</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>183</td>
<td>74</td>
<td>26</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>117</td>
<td>71</td>
<td>29</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Congenital</td>
<td>104</td>
<td>70</td>
<td>30</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Postnatailly acquired</td>
<td>76</td>
<td>79</td>
<td>21</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Seizures present</td>
<td>116</td>
<td>58</td>
<td>42</td>
<td>Chance</td>
<td>Significant at .01</td>
<td></td>
</tr>
<tr>
<td>Seizures absent</td>
<td>154</td>
<td>88</td>
<td>17</td>
<td>Chance</td>
<td>Significant at .05</td>
<td></td>
</tr>
<tr>
<td>Above 6 years</td>
<td>141</td>
<td>78</td>
<td>22</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
<tr>
<td>Below 6 years</td>
<td>137</td>
<td>67</td>
<td>33</td>
<td>Chance</td>
<td>Not Significant</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{*} An I.Q. of 65 or below was considered mentally defective.

---

\textsuperscript{*} An I.Q. of 65 was empirically chosen as the dividing line between the educable and the mentally defective group.
TABLE II
MEAN INTELLIGENCE QUOTIENT SCORES IN THE VARIOUS DICHOTOMIES
(173 patients)

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean I.Q.</th>
<th>Standard Deviation</th>
<th>Significance Level of the t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>173</td>
<td>77.1</td>
<td>22.8</td>
<td></td>
</tr>
<tr>
<td>Lefts</td>
<td>76</td>
<td>77.8</td>
<td>23.2</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Rights</td>
<td>97</td>
<td>76.6</td>
<td>20.6</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>100</td>
<td>78.9</td>
<td>24.2</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Females</td>
<td>73</td>
<td>74.9</td>
<td>20.6</td>
<td></td>
</tr>
<tr>
<td>Congenital</td>
<td>112</td>
<td>77.2</td>
<td>23.2</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Postnatally acquired</td>
<td>61</td>
<td>77.0</td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>Seizures present</td>
<td>76</td>
<td>70.2</td>
<td>21.8</td>
<td>Significant at .01</td>
</tr>
<tr>
<td>Seizures absent</td>
<td>97</td>
<td>82.5</td>
<td>22.5</td>
<td></td>
</tr>
</tbody>
</table>

considerably higher than the 2.2 per cent of mental deficiency found in the general population. It does not differ significantly, however, from the 25 per cent given in many of the earlier reports on the incidence of mental deficiency in cerebral palsy (see Table I). In a future study based on consecutive cases, we anticipate that our figure will approximate the 50 per cent mental deficiency reported by Hohman and other recent investigators.

The 173 patients on whom I.Q. scores were available yielded a mean I.Q. score of 77.1 with a standard deviation of 22.8, as shown in Table II. This mean is in close agreement with that reported by Brockway of 80.3 for spastic hemiplegics.

LEFT VERSUS RIGHT. The comparison of intelligence in left versus right spastic hemiplegics involves a consideration of cortical dominance and its relation to intelligence. The basis for assuming a difference in the mental capacity of left and right hemiplegics lies in the supposition that in most people the left hemisphere has greater functional capacity than the right with respect to language and fine manual skills. Consequently, it might be assumed that damage to the dominant hemisphere would be more devastating to intelligence than damage to the opposite hemisphere, since both language and motor dexterity may be closely related to intelligence. The further inference, since most individuals are right handed, is that right hemiplegics, who presumably sustain damage to the dominant lobe, should have on the average, greater mental impairment than left hemiplegics. Such, in fact, was the finding of McIntire18 who, in a series of 173 hemiplegics, found a significantly greater number of mental defectives among right hemiplegics.

The present study supports neither these theoretical considerations nor the findings of McIntire. In the 270 hemiplegics in this study, 28 per cent of the 120 left and 27 per cent of the 150 right hemiplegics were mentally defective, a difference which is without statistical significance.

This same condition obtains when mean intelligence scores are compared. In the present series, the mean I.Q. for 76 left hemiplegics was $77.8 \pm 2.9$ as compared with $76.6 \pm 2.1$ for 97 right hemiplegics; the difference between the 2 means is negligible.

The discrepancy between our findings and those of McIntire's might be explained by differences in the psychodiagnostic tests used, the choice of a different empirical dividing point between mental deficiency and normal mentality, or differences in the...
mean age, the relative incidence of seizures, and the relative number of postnatally acquired cases in the two series. In the present study, seizures and postnatally acquired cases are randomly distributed between the left and right hemiplegics; and the mean age of both the left and right groups is identical, approximately 7 years.

If, as postulated, a real difference does exist between the mental capacities of patients with left as compared to right hemisphere damage, then that difference has been obscured by other factors in our study. Perhaps the differences may be too subtle to detect with the psychodiagnostic tests used. It has also been pointed out that in the intellectual process the integrative result of many areas of the brain, functioning simultaneously, may produce a total effect different from a mere summation of the activity of the separate parts. Hence a lesion any place in the brain might depress total intellectual capacity. Then again, although the clinical manifestations of a brain injury may be unilateral, i.e., spastic hemiplegia, mental impairment might be due to bilateral cortical involvement. That such bilateral cortical involvement may exist in hemiplegias is indicated from the finding of bilateral abnormal electroencephalographic foci in over 30 per cent of hemiplegics. Finally, the possibility that cortical dominance may shift if damage occurs early enough in life must also be considered. Our experience has been (unpublished data) that motor aphasia, though not uncommon in the acquired right hemiplegias, is rare in the congenital forms. In comparing left and right congenital infantile spastic hemiplegics, there is of course no accurate way of determining whether a shift has been made; consequently, one has no way of knowing whether he is dealing with a hemisphere which was originally dominant or only secondarily so as a result of damage to the contralateral hemisphere. Whatever the explanation, the present study does not bear out the hypothesis nor McIntire's report that left cortical lesions are more devastating to intelligence than right-sided lesions.

**Male Versus Female.** In the present series, the incidence of mental deficiency was not significantly greater for either sex. When mean I.Q. scores were considered, the same condition obtained. Although the mean I.Q. for the males was 78.9 and that for the females 74.9, the difference is not significant.

**Congenital Versus Postnatally Acquired.** Approximately 30 per cent of the congenital cases and only 21 per cent of the acquired cases were mentally defective. This difference, however, is not statistically significant. The mean I.Q. scores did not differ as much as a single point between the 2 groups, indicating that lesions acquired postnatally were not more devastating to intelligence than those acquired in the prenatal or paranatal period.

**Seizures Present Versus Seizures Absent.** The present series confirms the reported high correlation between the presence of seizures and intellectual impairment. Approximately 42 per cent of the patients with seizures were mentally defective as compared with only 17 per cent of the nonconvulsives, a difference which is statistically significant. Moreover, the mean I.Q. scores of the 2 groups likewise differed significantly. For the convulsives the mean I.Q. was 70.2 as compared with 82.5 for the non-convulsives; the difference of 12.3 points is statistically significant.

Several other areas in the spastic hemiplegic population were explored with respect to intelligence. These comparisons, are summarized in Table III.

**Above Six Years of Age Versus Below Six Years of Age.** The difficulty of testing the cerebral palsied and the fact that some investigators have noted an increase of I.Q. scores with age led us to compare the mean I.Q. scores of children above and below the age of 6. This division point, although somewhat arbitrary, represents the age above which experience
seems to indicate more reliable test scores are likely to result. While the mean I.Q. for children above 6 years was 79.4 and for those below, 73.6, the difference, as shown in Table III, is not statistically significant. We could not, therefore, confirm either the claim for greater reliability of testing or of increasing I.Q.'s with increasing age. When the number of mental defectives in each group was considered, however, it was found that for those above 6 years, 22 per cent were mentally defective, while for those below 6 years the figure was 33 per cent (Table I). This difference is statistically significant. It probably reflects the tendency for the more seriously involved cases to be institutionalized and to have higher death rates before the age of 6 years rather than a true rise in I.Q. scores.

The fact that mean I.Q. scores do not tend to increase with age in this series is further substantiated by the fact that when scores are grouped in 1-year age intervals from 1 to 13, there is no significant difference in any of these year groups. This was also true of the number of mental defectives found in each year level from 1 to 13. Moreover, the patients with seizures in this series showed no significant decrease in I.Q. with age, a finding at variance with other reports.1-6,26

**Infectious Versus Traumatic Etiologies in the Acquired Cases.** For purposes of comparison, the postnatally acquired cerebral palsied were grouped into those resulting from trauma (i.e., skull fracture, contusion, etc.) and those due to infection (i.e., meningitis, encephalitis, etc.). The mean I.Q.'s of the 2 groups differed by scarcely more than 1 I.Q. point (see Table III), indicating no greater predilection of either trauma or infection to cause intellectual damage.

**Toxemia of Pregnancy.** When the children with congenital cerebral palsy born of toxemic mothers are compared to a similar group born of non-toxemic mothers, no significant difference is found either in the mean I.Q. scores or in the number of mental defectives in the 2 groups. Apparently toxemia of pregnancy is no more devastating to intelligence in spastic hemiplegia than are other congenital etiologies.

**CONCLUSIONS**

From this study the following conclusions emerge regarding the relation of intelligence of infantile spastic hemiplegics to various factors.

The spastic hemiplegics of the present series were retarded approximately 20 I.Q. points below normal individuals. The mean I.Q. scores and the incidence of mental retardation were in close agreement with several early reports. The marked difference from the recent reports of Hohman and others reporting consecutive series of cerebral palsied patients is attributed to the
fact that the present study is based upon a selective population. Left and right hemiplegics did not differ significantly either in mean I.Q. scores or in the incidence of mental deficiency. Male and female hemiplegics did not differ significantly either in mean I.Q. scores or in the incidence of mental deficiency. The mean I.Q. scores of the congenital and acquired cases did not differ significantly nor was there a greater incidence of mental deficiency in either of the 2 groups. Mental deficiency was significantly related to the presence of convulsions in this series of spastic hemiplegics; the mean I.Q. score of the convulsives was significantly lower than that for the nonconvulsives by 12 I.Q. points. There was a significantly greater number of mental defectives below the age of 6 than above that age, although the mean I.Q. scores did not differ significantly between the 2 groups. When the subjects were grouped into age levels of 1-year intervals, there was no greater incidence of mental deficiency nor did the mean I.Q. scores differ significantly at any year level. The infectious and traumatic groups of acquired etiologies showed no significant difference in mean I.Q. scores. The toxemia of pregnancy group showed approximately the same incidence of mental deficiency and the same mean I.Q. score as the group composed of all other congenital etiologies of spastic hemiplegia.

REFERENCES
SPANISH ABSTRACT

Hemiplejía Espástica Infantil.

III. Inteligencia

En el presente trabajo los autores estudian en qué forma la edad, raza, presencia de convulsiones, el sexo, lado afectado y época de iniciación de la hemiplejía espástica infantil se pueden relacionar al grado de inteligencia posterior en 334 pacientes seleccionados. Psicólogos experimentados calificaron la valoración intelectual con pruebas según la edad, el grado de trastorno motor y la capacidad intelectual del niño. Los grados de cociente de inteligencia se tabularon y trataron estadísticamente empleando dos técnicas: la Chi-Square para comparar las diversas dicotomías en término de la relación del retardo mental y niños educables, y la prueba de la significancia para comparar los promedios de cociente de inteligencia de las diversas dicotomías.

Aunque recientemente se ha venido insistiendo en que la capacidad mental de los paralíticos cerebrales se afecta mucho más seriamente que lo aceptado en los primeros informes de la materia, los autores creen que sus resultados se adaptan más a la población estudiada en estos primeros informes. Los hemipléjicos espásticos presentaron un retardo aproximado de 20 puntos abajo de los individuos normales; las cifras promedio de C.I. y la incidencia de retardo mental estuvieron así de acuerdo con algunos de los primeros informes de la literatura, siendo las diferencias con los más recientes quizás debidas al tipo de población estudiada.

La comparación del grado de inteligencia entre espásticos hemipléjicos izquierdos y derechos tiene importancia por el supuesto dominio cortical de uno de los hemisferios sobre el grado de inteligencia; se supone que la mayoría de las gentes poseen un hemisferio izquierdo de mucho mayor capacidad funcional que el derecho para el lenguaje y la habilidad manual. En este estudio los datos obtenidos no sostienen estas consideraciones teóricas; en 270 hemipléjicos, 28% de 120 izquierdos y 27% de 150 derechos fueron defectuosos mentales, diferencia que no tiene significación estadística.

Ni el sexo, ni el hecho de que el padecimiento fuera congénito o adquirido determinaron la graduación del cociente de inteligencia o la incidencia de deficiencia mental. Se encontró una relación significativa entre la deficiencia mental y la presencia de convulsiones; el promedio de C.I. de los niños con convulsiones fue francamente inferior en 12 puntos a los niños sin convulsiones. Hubo un número mucho mayor de retardados mentales en niños menores de seis años que los mayores de esta edad, aunque el promedio del C.I. no difirió significativamente entre los dos grupos; reunidos los pacientes en grupos de 12 meses, ningún grupo mostró mayor incidencia de defecto mental ni alteración significativa del promedio del C.I.

Los procesos infecciosos y traumáticos desencadenantes del padecimiento, la toxemia del embarazo y los demás factores etiológicos congénitos de la hemiplejía espástica determinaron aproximadamente la misma incidencia de retardo mental y niveles de C.I.
INFANTILE SPASTIC HEMIPLEGIA: III. Intelligence
Meyer A. Perlstein and Philip N. Hood
Pediatrics 1955;15:676

The online version of this article, along with updated information and services, is located on the World Wide Web at:
/content/15/6/676