Neuropsychological Factors Associated With Borderline Pathology in Children

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ABSTRACT

Objective: To determine whether children with borderline pathology have a specific pattern of neuropsychological risk factors. Method: The subjects were 94 school-age children in day treatment, divided into borderline (n = 41) and nonborderline (n = 53) groups according to results of the Child version of the Diagnostic Interview for Borderlines. All children were assessed with the Child Behavior Checklist, the Schedule for Affective Disorders and Schizophrenia for School-Age Children, and a neuropsychological battery. Results: Children with borderline pathology had abnormal scores on the Wisconsin Card Sorting Test and on the Continuous Performance Test, both of which suggested problems with executive function. Although borderline pathology was highly comorbid with conduct disorder, most results were independent of this comorbidity. Conclusions: Borderline pathology in children has a unique pattern of neuropsychological risk factors that may reflect a diathesis for this syndrome. J. Am. Acad. Child Adolesc. Psychiatry, 1999, 38(6):770–774. Key Words: borderline pathology, children at risk, neuropsychological testing.

Borderline pathology in children is a syndrome characterized by a combination of externalizing and internalizing symptoms, accompanied by cognitive deficits (Bemporad et al., 1987; Kernberg, 1997). Although these symptoms resemble adult borderline personality, it is not clear whether they represent a unique disorder or a heterogeneous group better described by other diagnoses (Petti and Vela, 1990). However, a long-term follow-up study (Lofgren et al., 1991) has shown that borderline pathology in children is a precursor of adult personality disorders.

One way to understand this form of pathology is through a stress-diathesis model, in which psychosocial stressors uncover a biological vulnerability. In 2 previous reports (Guzder et al., 1996, 1999), we found that borderline children have a distinct profile of psychosocial risk factors associated with sexual abuse, neglect, and parental psychopathology. We hypothesize that these environmental risks interact with biological diatheses in shaping clinical symptoms. An assessment of neuropsychological deficits could be used as a measure of these vulnerabilities.

Cohen et al. (1987) have described this population of children as suffering from a “multiple complex developmental disorder.” This construct suggests that children with borderline pathology suffer from organic deficits, so that neuropsychological abnormalities could underlie their problems in mood, thought, and behavior. However, there has been little research on the neuropsychological profile of this population. A few studies have suggested that borderline patients can show “soft” signs of organicity, such as learning disabilities, attention deficit disorder, and abnormal EEG patterns (Petti and Vela, 1990). However, most of this research is limited by its use of unclear definitions of borderline pathology, as well as by a failure to use standardized neuropsychological measures. Thus far, the best-documented finding involves impairments in auditory processing (Lincoln et al., 1998).
The neuropsychological deficits in children with borderline pathology might also parallel those found in adult patients with borderline personality disorder. Borderline adults have been shown to have deficits in frontal lobe functioning, as indicated by measures of increased impulsivity, cognitive inflexibility, poor self-monitoring, and perseveration (Judd and Rugg, 1993; O'Leary et al., 1991; O'Leary and Cowdry, 1994; van Reekum et al., 1993, 1996). It would therefore be of interest to apply some of these same measures to a population of children presenting with similar symptoms.

This study was therefore designed to assess the neuropsychological profile of children with and without borderline pathology, using measures that can pick up the deficits in executive function that one might expect to find in a population with impulsive and cognitive dysfunction. The study was also designed to determine the specificity of these profiles by comparing borderline children with a nonborderline group who have comparably severe levels of psychopathology.

**METHOD**

**Sample**

The subjects were 89 patients (76 boys and 13 girls), with a mean age of 9.8 years (range 7–12 years), who were consecutively referred for admission to a child psychiatry day treatment center at an urban teaching hospital and were evaluated over a period of 24 months.

All subjects were administered the Schedule for Affective Disorders and Schizophrenia for School-Age Children—Epidemiologic version (K-SADS-E) (Ambrosini et al., 1989). The most frequent K-SADS diagnoses in this sample were conduct disorder (52%), oppositional defiant disorder (32%), attention-deficit hyperactivity disorder (ADHD) (59%), major depressive disorder (23%), and oppositional disorder (25%).

To determine overall functioning, all subjects were also administered the Child Behavior Checklist (CBCL) (Achenbach and McConaughy, 1997), as well as the Teacher's Report Form (TRF) of the CBCL (Achenbach and McConaughy, 1997). Means on total problems (69.0 for the CBCL and 70.9 for the TRF) were well outside the range of population norms.

**Measures**

**Diagnosis.** The Child Version of the Retrospective Diagnostic Interview for Borderlines (C-DIB-R) (Greenman et al., 1986) is an adaptation for children of a widely researched semistructured interview (Gunderson and Kolb, 1978; Zanarini et al., 1989) that has been shown to be a specific and sensitive diagnostic tool for borderline pathology in adults. The C-DIB-R includes 24 items which yield 5 subscales, each scored 0 to 2: Social Adaptation, Impulsivity, Affect, Psychosis, and Interpersonal Relations. A score of 7 or more on the C-DIB-R is the cutoff point for a diagnosis of borderline pathology in children. We established good interrater reliability for this measure ($k = 0.72$) in our chart review study (Guzder et al., 1996). In the current study, scoring was done by a child psychologist (EZ), from review of the assessment interview recorded in the medical chart, who had previously established reliability on this instrument (Guzder et al., 1996).

The results of the C-DIB-R were used to divide the sample into borderline ($n = 38$; 30 males and 8 females) and nonborderline ($n = 51$; 47 males and 4 females) groups. The 2 groups were not significantly different in age, but they differed in gender (Fisher exact test; $p < 0.05$).

**Neuropsychological Measures.** The WISC-III, a standard instrument, was used to assess IQ and its subscales.

The Quick Neurological Screening Test-Revised (QNST) (Muti et al., 1978) was used to document neurological soft signs such as poor coordination, abnormal reflexes, and mirror movements. This test, which includes 15 tasks such as eye tracking, figure recognition and production, finger to nose, and rapidly reversing repetitive hand movements, has been found to discriminate between children with and without learning disabilities. Test-retest reliability is adequate, with values of approximately 0.80. On the basis of QNST scores, children are classified into "normal," "suspicous," or "abnormal" groups.

The Rey-Osterrieth Complex Figure Test (RCFT) (Wabe and Holmes, 1986) is designed to assess visuospatial constructional ability and visual memory. It also provides information on planning and organizational skills and problem-solving strategies. The subject is presented with a complex geometric design to copy and then, 20 minutes later, without prior warming, is asked to reproduce it from memory. Patients with frontal lobe lesions tend to have difficulty planning their approach to copying the figure. Kolb and Whishaw (1985) provide normative data for children aged 6 to 15 years. When strict scoring criteria are used, interrater reliability is greater than 0.95 (Strauss and Spreen, 1990). In this study, we established a comparable reliability (0.91 for copy score and 0.97 for recall score) between 2 trained raters. For the recall trial, raw scores are transformed into $T$ scores with a mean of 50 and an SD of 10. For the standardization sample, copy trial scores were skewed, and scores above the 16th percentile are considered to be in the normal range.

The Wisconsin Card Sorting Test (WCST) (Heaton, 1981) assesses the ability to form abstract concepts and to shift and maintain a set. The test requires subjects to sort cards depicting colored geometric shapes according to color, form, and number. This measure has been found to discriminate patients with frontal lobe lesions from those with other lesions, and it has been shown to be useful in assessing cognition dysfunction in patients with ADHD (Stern et al., 1997) and in adult schizophrenia (Haut et al., 1996). Norms are available for school-age children (Chelune and Baer, 1986). The WCST yields subscales measuring number of trials, total correct responses, total errors, perseverative responses, perseverative errors, nonperseverative errors, and conceptual-level response. Raw scores are transformed into standard scores, with a mean of 100 and an SD of 15.

The Continuous Performance Test (CPT) (Connors, 1993) is a computer-assisted assessment of vigilance and sustained attention. The subject is asked to press the computer spacebar immediately after the presentation of specific letters on-screen. The CPT yields subscales measuring omission errors, reaction time, inconsistent response, change in attention over time, inability to discriminate targets, commission errors, impulsive response, and risk-taking. Raw scores are transformed into $T$ scores, with a mean of 50 and an SD of 10.

**RESULTS**

There were no gender differences, as measured by analysis of variance or $\chi^2$, on any of the neuropsychological measures. Mean IQ was 103 in the borderline group and 101 in the nonborderline group, with no significant differences between the groups on any of the subscales of the WISC.
TABLE 1
Scores for Borderline and Nonborderline Children on the Wisconsin Card Sorting Test

<table>
<thead>
<tr>
<th></th>
<th>Borderline (n = 38)</th>
<th>Nonborderline (n = 51)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Categories Achieved (% in normal range)</td>
<td>61</td>
<td>80</td>
<td>$\chi^2 = 4.3, p &lt; .05$</td>
</tr>
<tr>
<td>Learning to Learn (% in normal range)</td>
<td>61</td>
<td>86</td>
<td>$\chi^2 = 6.7, p &lt; .01$</td>
</tr>
<tr>
<td>Mean no. of trials</td>
<td>123</td>
<td>117</td>
<td>$F_{1,88} = 5.0, p &lt; .05$ (Dx)</td>
</tr>
<tr>
<td>Total errors*</td>
<td>87.9</td>
<td>94.9</td>
<td>$F_{1,88} = 9.7, p &lt; .01$ (Dx)</td>
</tr>
<tr>
<td>Perseverative responses*</td>
<td>91.9</td>
<td>97.0</td>
<td>$F_{1,88} = 4.1, p &lt; .05$ (Dx)</td>
</tr>
<tr>
<td>Perseverative errors*</td>
<td>91.0</td>
<td>96.2</td>
<td>$F_{1,88} = 9.3, p &lt; .01$ (IQ)</td>
</tr>
<tr>
<td>Nonperseverative errors*</td>
<td>88.2</td>
<td>95.2</td>
<td>$F_{1,88} = 4.5, p &lt; .05$ (Dx)</td>
</tr>
<tr>
<td>Conceptual-level responses*</td>
<td>88.7</td>
<td>94.6</td>
<td>$F_{1,88} = 10.4, p &lt; .01$ (IQ)</td>
</tr>
</tbody>
</table>

Note: $\chi^2$ analyses and analyses of covariance controlling for gender and IQ. Dx = diagnosis; IQ = score on the WISC.

* Standardized score.

There were also no significant differences between the groups on total score of the QNST. However, it is notable that 40% of borderline and 39% of nonborderline children fell in the suspicious range, while 7.9% of borderline and 9.9% of nonborderline children fell in the abnormal range.

There were no significant differences between the groups on the RCFT copy score, but 66% of the borderline group and 75% of the nonborderline group fell in the abnormal range. There were also no significant differences between the groups on the RCFT recall score. Again, the mean scores (35.7 for the borderline group and 37.1 for the nonborderline group) fell approximately 1.5 SD from normative means.

There were significant differences between the diagnostic groups on all scales of the WCST. These results are summarized in Table 1. For the 2 categorical scales (Number of Categories Achieved and Learning to Learn), $\chi^2$ tests were used to compare the borderline and nonborderline groups. On both of these scales, fewer borderline children were placed in the normal range. For continuous scales, analyses of covariance (ANCOVAs) were conducted with diagnostic grouping as a factor, while controlling for IQ (significantly correlated with the WCST scales). On these measures, borderline children required more trials to complete the test, had more perseverative responses, made more errors (perseverative and nonperseverative), and had fewer conceptual-level responses.

Because conduct disorder, as measured by the K-SADS, was highly comorbid with borderline pathology, we also conducted ANCOVAs with borderline pathology and conduct disorder as factors and IQ as a covariate, and with the WCST scales as dependent variables. The results, summarized in Table 2, did not remain significant for all scores, but show that conduct disorder has no significant main effects on any of the WCST scales, whereas borderline pathology retains a significant relationship to total errors, to nonperseverative errors, and to conceptual-level responses.

There were significant differences between the groups on 4 of the subscales of the CPT. These results are sum-

TABLE 2
Scores for Borderline and Nonborderline Children on the Wisconsin Card Sorting Test

<table>
<thead>
<tr>
<th></th>
<th>Borderline No CD</th>
<th>Borderline CD</th>
<th>Nonborderline No CD</th>
<th>Nonborderline CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean no. of trials*</td>
<td>120.3</td>
<td>123.9</td>
<td>115.4</td>
<td>118.5</td>
</tr>
<tr>
<td>Total errors*</td>
<td>91.9</td>
<td>98.5</td>
<td>97.6</td>
<td>92.3</td>
</tr>
<tr>
<td>Perseverative responses*</td>
<td>94.6</td>
<td>90.4</td>
<td>100.7</td>
<td>93.0</td>
</tr>
<tr>
<td>Perseverative errors*</td>
<td>92.8</td>
<td>90.0</td>
<td>99.6</td>
<td>93.4</td>
</tr>
<tr>
<td>Nonperseverative errors*</td>
<td>91.5</td>
<td>86.5</td>
<td>96.8</td>
<td>92.8</td>
</tr>
<tr>
<td>Conceptual-level responses*</td>
<td>93.3</td>
<td>86.3</td>
<td>96.1</td>
<td>93.3</td>
</tr>
</tbody>
</table>

Note: Significant differences on analyses of covariance, controlling for IQ, subgroups with and without conduct disorder (CD).

* $F = 10.3, p < .01$ (IQ).

* $F = 19.3, p < .001$ (IQ); $F = 5.6, p < .05$ (borderline).

* $F = 9.0, p < .01$ (IQ).

* $F = 9.5, p < .01$ (IQ).

* $F = 11.2, p < .001$ (IQ); $F = 4.4, p < .01$ (borderline).

* $F = 16.1, p < .01$ (IQ); $F = 4.6, p < .01$ (borderline).
marized in Table 3. Inasmuch as CPT scores might be related to comorbid diagnoses, we conducted parallel ANCOVAs, first using conduct disorder as the diagnostic factor and then using ADHD as the diagnostic factor. These analyses showed that neither CD nor ADHD was related to any of the CPT scales.

DISCUSSION

The results showed no significant differences between the groups in intelligence, as measured by the WISC, or in soft neurological signs, as measured by the QNST. Moreover, there were no group differences in visual-motor coordination, visual memory, or visual planning, as measured by the RCFT.

All these results have to be seen in the context of our study design, which aimed to determine whether or not any neuropsychological findings are relatively specific to borderline children. Because the sample was drawn from a very dysfunctional population, it is not surprising that many measures were equally abnormal in both the borderline and nonborderline groups. Thus, although mean IQ was normal in both groups, scores on both the QNST and RCFT tended to fall in abnormal ranges that suggest neuropsychological dysfunction. As shown by Pine et al. (1997), neurological soft signs can be associated with many forms of psychopathology, including both externalizing and internalizing symptoms.

The most striking differences between the 2 groups emerged on the WCST. This measure has been widely used to assess cognitive deficits in psychiatric populations and is considered a measure of frontal lobe and executive function, as well as of working memory (Gold et al., 1997). In the current study, although both groups had highly abnormal scores in relation to norms, the borderline children performed more poorly on every subscale of the WCST. Thus, the borderline children had more difficulty completing tasks, made more errors, failed to learn from these errors, and were unable to achieve an overall conceptualization of the tasks set by the test.

All these findings point to problems in executive function. Moreover, these observations indicate difficulties in planning and a lack of flexibility which parallel the clinical phenomena seen in this group, which is known to be characterized by both externalizing and cognitive symptomatology. These findings were most apparent on the WCST, which is specifically designed to measure executive function, whereas the RCFT is primarily a measure of visual-motor coordination and visual memory. Finally, as shown by the ANCOVAs, the differences on the WCST were not accounted for by comorbidity with conduct disorder. Thus, although some research (e.g., Seguin et al., 1995) suggests that deficits in executive function can be associated with aggression, our finding that these problems are independent of conduct disorder in borderline children suggests they could have a broader significance.

The differences between the groups on the CPT can largely be accounted for by inattentiveness in the borderline children, although they were not explained by comorbidity with ADHD. Thus, children with borderline pathology demonstrated relatively poor orientation to the task, as well as slow reaction times and inconsistent responses over the course of testing, all of which suggest a low level of attention.

In summary, all these findings support our hypothesis that borderline children have a biological diathesis underlying their symptoms. Moreover, it is notable that this population shows a neuropsychological profile similar to that of adults with borderline personality disorder (van Reekum et al., 1996).

These results also provide some support for the use of the construct of borderline pathology in childhood, as well as for the measure we used, the C-DIB-R. We are not proposing, however, that borderline pathology in childhood is a category with greater validity than most of the common diagnoses used in child populations, such as conduct disorder or ADHD. Rather, our results can be interpreted as supporting the principle that psychopathology in severely disturbed children reflects multiple interacting dimensions. In this context, as has been suggested by Cohen et al. (1987), borderline pathology may be a clinically useful way to describe a group of chil-

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**TABLE 3**

Proportions of Borderline and Nonborderline Children With Abnormal Scores on the Continuous Performance Test

<table>
<thead>
<tr>
<th></th>
<th>% With Abnormal Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Borderline (n = 38)</td>
</tr>
<tr>
<td>Omission errors*</td>
<td>49</td>
</tr>
<tr>
<td>Slow reaction time</td>
<td>20</td>
</tr>
<tr>
<td>Inconsistent responses</td>
<td>73</td>
</tr>
<tr>
<td>Risk-taking*</td>
<td>66</td>
</tr>
</tbody>
</table>

*Note: Significant differences on $\chi^2$ tests, controlling for gender and IQ.

$^a \chi^2 = 6.0, p < .05$.

$^b \chi^2 = 4.4, p < .05$.

$^c \chi^2 = 4.8, p < .05$.

$^d \chi^2 = 11.9, p < .001$. 

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children who are impaired on several of these dimensions. This type of description may have utility for both assessment and treatment of children who exhibit this particular pattern of symptoms.

Finally, our results support those of Lincoln et al. (1998), who assessed deficits in auditory processing in a very similar population. Our study and that of Lincoln et al. have complementary findings in showing problems in cognitive flexibility and planning. Moreover, the use of more specific measures, such as the WCST and CPT, demonstrated additional differences between children with borderline pathology and the comparison group that are not apparent on global measures such as the WISC. In summary, there is now a body of research suggesting that children with borderline pathology have an identifiable profile on neuropsychological testing. Since all of our results can be understood as reflecting deficits in executive function, and since these types of deficits may be linked to frontal lobe function (Welsh and Pennington, 1988), these observations might be further explored in research using neurobiological measures and imaging techniques.

The main limitation of this study is the small number of females in the sample, which could explain the lack of gender differences on any of the neuropsychological measures. Since borderline pathology in girls could be a precursor of adult borderline pathology, which is more common in women, and since the girls in this sample with borderline pathology did not have conduct disorder, it would have been illuminating if we had had sufficient power to analyze our data separately by gender.

Clinical Implications

The findings presented here could also have clinical relevance. As suggested by Lincoln et al. (1998), traditional forms of therapy may have limited usefulness in children with borderline pathology. Neuropsychological findings might be used as a guide for developing new forms of cognitive therapy or psychoeducation, to ameliorate or remediate the deficits found in this population.

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