

Presented in part at the Thirtieth National Meeting of the Child Neurology Society, Victoria BC, Oct 17-20, 2001

Neuropsychology: Adaptation for a Busy Pediatric Neurology Clinic in a Managed Care Setting

By Peter F Carey, PhD; Richard J Konkol, MD, PhD

Abstract

Background: Neuropsychologic testing in neurology clinics is often necessary to document cognitive and general intellectual abilities in children with acquired or inborn forms of encephalopathy. Availability of testing is limited, however, because of expense, length of time to complete testing, and difficulty of using long reports in a busy clinic. Our protocol addressed these limitations by contracting with an out-of-plan psychologist to perform selected complementary standardized psychometric tests as an extension of the neurologic evaluation.

Methods: Sixty-nine children were referred from primary care clinics because of diagnostic uncertainty or treatment failure. Children received complete neurologic assessment, after which a neuropsychology battery of tests was administered to screen aspects of cognitive functioning. Psychosocial questionnaires also were administered to collect input from parents, teachers, and the children themselves. Findings were presented in a tabular format organizing specific test scores with standard deviations, followed by a brief narrative conclusion. A synthesis of findings was provided to parents at a follow-up visit with the neurologist and psychologist. Differences in viewpoints were reconciled before a treatment plan was given.

Results: Of undiagnosed children, 70% were found to have attention difficulties, 58% had unrecognized learning disorders, and 17% had major mood disturbance. A postvisit survey of parents reflected satisfaction with the protocol, and 80% of parents expressed relief that the child's problems were objectively defined. Costs were about 30% to 40% of alternative types of independent, nonintegrated neuropsychologic assessment.

Discussion: This service lessened demands in the primary care clinics because parents were motivated and were specifically directed to pursue specific medical and support services. This plan could be adapted to other specialty clinics, such as psychiatry or developmental pediatrics.

need and cost is frequently highlighted in the pediatric neurology clinic, where many children have encephalopathic conditions that result in associated learning disabilities, behavioral problems, and mood problems. In addition, medical personnel often do not have the skills or the time to perform age-normative standardized testing of cognitive and behavioral measures in the clinic that adequately answer clinical questions. The customary method of evaluating these cognitive and behavioral issues consists of referral for a complete neuropsychologic assessment; as an alternative, children may be referred to their school for testing. However, school districts vary in assessment capability and are being pressed to provide more services despite shrinking resources. This situation leads to service omissions, especially for children with nondisruptive neurologic and cognitive deficits.

Even with a comprehensive neuropsychologic report, a neurologist may encounter difficulty that limits the usefulness of consultation: The patient may have to wait for an extended period to obtain an appointment, and then the psychologist's report may be

Introduction

The Problem: Cost and Complexity of Pediatric Neuropsychological Evaluation

Although most children can be diagnosed and treated for attention deficit hyperactivity disorder (ADHD) and mood disorders, learning problems are more difficult to define in primary care clinics. Furthermore, children with clearly defined primary encephalopathic conditions of-

ten have secondary comorbid disorders impacting mood, learning, and central processing, even with stable primary conditions such as cerebral palsy, seizures, or developmental delay. For instance, an anxious, moody, misbehaving child with well-controlled complex partial seizures may appear to be depressed. However, emergence of these symptoms only during the week and not on weekends or holidays points to the possibility of a specific learning dis-

ability or central processing problem and indicates the need for neuropsychologic assessment.

However, feasibility of traditional neuropsychologic assessment has been questioned by managed care administrators because these full evaluations are costly.^{1,2} Cost containment is a constraint that leads to an artificial division between medical and psychologic services because of the high cost of all but the most urgent neuropsychologic referrals. Such conflict between



Peter F Carey, PhD, (left), is a psychologist who contracts with KPNW to provide neuropsychological assessments. He is currently working with the Providence Neurodevelopmental Team in Portland, OR and has a private practice in McMinnville, OR. E-mail: pjetscarey@aol.com.

Richard J Konkol, MD, PhD, (right), has been Chief of Pediatric Neurology at NWP for the past four years. Previously, he was Chief of Pediatric Neurology at Medical College of Wisconsin and Oregon Health Sciences University.

delayed for two months or more; these reports often exceed 15 or 20 pages and do not necessarily discuss problems that the neurologist must address in the limited time available in the clinic; in addition, this psychologic assessment is costly, sometimes two to three thousand dollars each. Families whose children are evaluated frequently do not understand what was discovered with the neuropsychological testing and are unable to relate the results to school and family life or to the medical diagnosis.

New KP Approach to Effective, Efficient Pediatric Neuropsychologic Evaluation

To overcome these limitations, a neuropsychologic screening assessment battery was developed and implemented in the pediatric neurology clinics of Kaiser Permanente Northwest. This screening was structured to complement the neurologic examination and was initiated after a pediatric neurologist or a developmental pediatrician determined the need for this assessment by identifying specific areas of functional concern. Children referred for assessment were frequently failing in school, were considered ineligible for special educational services, or had disruptive behavior that interfered with family and social functioning. Moreover, these children frequently completed standard learning disability assessment through their school district as well as nondiagnostic screening for ADHD or other behavioral disorders through a primary care clinic before being referred to the pediatric neurology clinic.

The purpose of this project was to develop an economical, efficient neuropsychologic screening process that could be integrated into a busy clinical setting ...

The purpose of this project was to develop an economical, efficient neuropsychologic screening process that could be integrated into a busy clinical setting to develop a more sophisticated and effective neurologic examination and treatment plan. In our protocol, the neuropsychologic assessment period was limited to a half-day clinic and was adapted to each patient on the basis of the neurologist's assessment. Neuro-

psychologic evaluation with a limited focus was made possible by integration with neurologic assessment, especially the mental status examinations. Selection of psychometric tests was designed to highlight specific areas of weakness while confirming areas of strength or normal function. The children referred often had complex clinical findings that required further testing to more clearly define their functioning.

In addition, we surveyed parents to determine whether they found the evaluation valuable. This report describes evaluation measures and procedures, summarizes outcomes for the first 69 patients evaluated, and presents results of the parental feedback survey.

Methods

Two levels of screening in the primary care and neurology clinics led to selection of subjects who had mood disruption and school failure and whose parents were frustrated with the child's behavior. Medical evaluation consisted in obtaining the medical history, administering physical examination, reviewing the semistructured psychologic narrative, and administering tests of neurologic and mental status. Neurologic evaluation was done during a routinely scheduled clinic visit.

Sixty-nine patients aged 4 years to 20 years (mean age, 12 years) were evaluated by either a pediatric neurologist or a developmental pediatrician who formulated a specific hypothesis regarding areas of suspected cognitive deficits, behavioral problems, or mood disturbance. A neuropsychologist performed a screening evaluation within the next two weeks to identify specific areas of problems or deficits and to confirm other areas of normal function and skills. The neuropsychologist was an outside consultant paid by KP at a contracted rate for each evaluation. This service also included brief follow-up discussion with both the family and the neurologist.

The screening examination used standardized age-normative measures, lasted approximately 3.5 hours, and included tests of dominant-hemisphere (language) and nondominant (perceptual and constructional) abilities and memory. Frontal lobe function was correlated with tests of executive function; attention and information processing speed were assessed independently. Psychosocial and mood problems

Table 1. Neuropsychologic tests administered to 69 referred pediatric patients participating in evaluation protocol

General cognitive functioning	Wechsler Adult Intelligence Scale Wechsler Intelligence Scale for Children, Third Ed Wechsler Abbreviated Scale of Intelligence
Dominant hemisphere functioning	Vocabulary Similarities Story memory Sentence memory Verbal learning Boston Naming Test
Nondominant hemisphere functioning	Block design Matrix reasoning Rey-Osterrieth Complex Figure Test Judgment of line orientation Raven's Coloured Progressive Matrices
Information processing	Coding Symbol search Continuous Performance Test Digit span Trailmaking Test, Form A
Executive functioning	Wisconsin Card Sorting Test Tower of London Trailmaking Test, Form B Stroop Test, Facial Recognition Controlled Oral Word Fluency
Psychosocial functioning	Connors' Parent Rating Scale Parenting Stress Index Stress Index for Parents of Adolescents Beck Depression Inventory Beck Youth Inventories Interview

were identified from responses to standardized questionnaires and from structured interviews.

For most patients, three or four neuropsychologic tests were administered to review cognitive ability specific to a domain; additional testing was administered to identify problem areas (Table 1). Measures of dominant-hemisphere functioning included tests of expressive language, verbal memory (both short-term and long-term), verbal learning, and anomia/naming. Measures of nondominant hemisphere functioning included visual-spatial reasoning, basic perception,

complex perception, and visual construction as well as visual memory. Attentional abilities were documented through measures of processing speed and attention. Executive functioning was evaluated using tests of problem-solving and mental flexibility, fluency, inhibition, and simultaneous processing. Psychosocial functioning was characterized by interviews and by parental responses to standardized questionnaires. All measures were recorded as age-normative standard scores with standard deviations.

Results were summarized in tabular and narrative formats. A

table of results using Microsoft® Excel was organized (Table 2) that compares the patient's standard scores (and standard deviation) with population mean scores. The table was followed by a brief narrative summary of results describing implications for life at school and in the family. An example of the table is shown (Table 2). The psychologist and the neurologist met briefly with each family to present results and to answer questions. The impact of this assessment was estimated through direct feedback as well as from responses to a questionnaire.

Results

Most of the 69 referred children were found to have clinically significant, neuropsychologically defined problems in addition to the primary neurologic diagnoses or school assessment findings: 70% had abnormalities of attention, 58% had learning disabilities unrecognized by their school, and 17% had major symptoms of mood disorder. The neuropsychologic findings led to major reorientation in educational, medical, and supportive approaches not otherwise considered previously for these children.

The brief report format worked effectively in the clinic: Within fully scheduled clinics, the neurologist could access all pertinent, specific information from the table and one-page narrative and could quickly apply this information to formulating the diagnosis and planning treatment. When medical and psychologic viewpoints apparently conflicted, these were easily resolved in a discussion with the parents, the neurologist, and the psychologist at a follow-up clinic visit. Calculated on the basis of local billing rates, cost of the evaluation service was approximately a third of comparable independent lowest-cost, noncontract referral consultations.

Many families were greatly relieved that a child's dysfunction was recognized and explained in terms of anatomic and physiologic principles instead of being ignored or causing the child to be considered untreatable. This response to the children's dysfunction also removed both the suggestion of willful misconduct by the

Table 2. Tabular format of sample summarized data obtained for children receiving neuropsychological screening evaluation

Name	Health record number	Date of birth			Date of visit		
		Raw score	Standard score	SD percentile	Mean	SD	Age-dependent interpretation
Area of functioning	Test						
Cognitive functioning	Wechsler Abbreviated Scale of Intelligence						
	Verbal IQ Equivalent				100	15	
	Performance IQ Equivalent				100	15	
	Full-Scale IQ Equivalent				100	15	
Dominant hemisphere	Vocabulary		T		50	10	
	Similarities		T		50	10	
	Story Memory				10	03	
	Boston Naming Test						
	Sentence Memory				10	03	
Nondominant hemisphere	Block Design		T		50	10	
	Matrix Reasoning		T		50	10	
	Rey-Osterreith Complex Figure Test			Percentile			
	Judgment of Line Orientation Test						
Information processing							
	Continuous Performance Test		Index				
	Processing Speed/WISC-III				100	15	
Executive functioning	Wisconsin Card Sorting Test						
	Tower of London						
	Time to Completion						
	Trailmaking Test, Form B						
	Controlled Oral Word Fluency						
	Stroop Test						
Academic achievement	Wide Range Achievement Test						
Psychosocial functioning	Connors Rating Scales						

child and any parental feeling of shame; instead, parents were shown a more realistic view of the child's weaknesses and strengths. Parents felt more encouraged to take a more positive approach in helping their children.

Feedback from parents and participating neurologists indicated high levels of satisfaction with the program. Parents coming into the clinic often reported that their child was not well understood and was struggling in the school system as well as socially. Of the parents who completed the survey, 80% rated the service as highly satisfactory; 82% reported that the evaluation complemented their consultation with the physician; and 74% indicated that they had learned new information about their child's strengths and weaknesses. The survey report showed that 80% found the evaluation useful for understanding their child and enabled them to be more effective advocates when seeking specific accommodation and services for the child.

Case Example

An example of the unique integrated assessment used in the project was encountered in the case of a teenager who was thought to have dyslexia and attention problems because she could not read well or finish her school or homework tasks on time. Because of both her inability to make adequate progress and the numerous hours she was spending on homework, she became increasingly frustrated in her first year of high school. Her reluctant verbalization tended to be simple or reflexive, even though school testing found a relatively high verbal reasoning ability. Inadequate compensatory tech-

niques (eg, arguing and avoidance strategies) as well as frequently irritable mood also were observed. On the basis of these symptoms, school-based testing resulted in two diagnoses: oppositional defiant disorder and attention deficit disorder. Additional school testing showed no deficit in decoding or reading single words and showed above-average general intellectual ability with no delay in academic achievement.

Neurologic examination showed that she had poor reading fluency and an upper motor pattern of weakness affecting the left deltoid, triceps, iliopsoas, and hamstring muscles. She also had sensory perceptual deficit in recognizing numbers traced on the left palm while her eyes were closed. The appendicular upper motor pattern of weakness and sensory perception deficit was consistent with dysfunction of the right parietal and frontal areas.

Neuropsychologic screening assessment showed good performance in the dominant hemisphere tasks of naming, decoding, and verbal learning. Testing of the nondominant hemisphere showed average basic perceptual skills as documented on the line orientation task, but relatively weak results were seen for the higher-order drawing recall task as measured using the Rey–Osterrieth Complex figure. This task required higher-order integration of spatial organizational skills.^{3,4}

Neuropsychologic evaluation showed also that although the patient had good basic language skills, her ability to synthesize thematic elements and develop new ideas was much weaker than her ability to define words and comprehend spoken language. For example, although she could de-

fine words well, she had difficulty with the Similarities Subtest from the *Wechsler Abbreviated Scale of Intelligence*,⁵ which provided a measure of conceptual reasoning. A key piece to this puzzle was the patient's difficulty completing the recall components on the complex figure test. Although she ac-

Parents felt more encouraged to take a more positive approach in helping their children.

curately recalled details of the complex figure, the limitations she experienced reflected a lack of organization or schema by which she could accurately organize the complex figure.

These findings were consistent with the patient's mother's observation that the patient could not process words in the context of a paragraph or page of text, even though she could perform well with lists of isolated words. This deficit is consistent with a right frontoparietal lesion: The right hemisphere is uniquely specialized for spatial, perceptual, and constructional comprehension and for overall organization of behavior output and perception. The deficit is also consistent with modern functional neuroimaging studies, which show an important role of the right hemisphere in language processing.^{6,7} Integration of the information obtained from both neuropsychologic and neurologic examination provided a more complete picture of brain functioning than either discipline could have achieved by itself.

Discussion

We have outlined a modified, multidisciplinary, economically efficient process for evaluating selected children with diagnostic or treatment failure. This approach is unique because it is integrated into the workflow of a fully scheduled clinic but costs about two-thirds less than non-integrated neuropsychologic evaluation. Our process also offers another unique feature: incorporation of a feedback mechanism to resolve contradictory data and inappropriate conclusions. The neurology clinic seemed an appropriate setting for this approach because neurologic brain involvement has a high probability of affecting learning, central processing, and mood regulation. This model could also be used in other clinics (eg, psychiatry or developmental medicine) if support is provided and if access-related issues are well managed.

This project showed the utility of neuropsychologic screening evaluation on several levels: The evaluation identified neuropsychologic problems previously undiscovered by other testing; the brief report format worked effectively in the clinic; conflicting medical and psychological viewpoints were easily resolved at a follow-up clinic visit; and the evaluation service was much less costly than other, noncontract referral consultations.

Our interdisciplinary approach yielded a more complete picture of brain and behavioral interrelationships without having the disadvantages of major expense, delay, or misunderstanding—disadvantages to be expected in creating a multidisciplinary clinic with multiple clinicians evaluating only two or three patients per

day or sending children to an outside clinic for testing. The essential component of this economy (ie, focused integration of medical and psychologic viewpoints during evaluation and during summation of test results) departs from the typical psychologic model (an extended standardized battery of tests), where the process of gathering information does not target a specific set of symptoms. Our model provides patients and their families with integrated information.

This multidisciplinary approach has many other conceivable applications in a medical practice. Any medical or accidental intervention that can produce an encephalopathic condition could be an appropriate subject for this assessment. For instance, children with head injury may have subtle changes in behavior, attention, mood, and learning. Specific standardized neuropsychologic testing linked to neurologic findings could not only confirm the primary diagnosis but may also be useful in therapeutic decisions

This model could also be used in other clinics ... if support is provided and if access-related issues are well managed.

and prognosis. In other instances, drugs such as anti-epileptic agents can affect nonictal brain functioning, and these effects must be distinguished from seizures by means of integrated neuropsychologic-neurologic analysis. Clear definition of these

issues can further redirect the care plan, which, if correctly determined, can improve effects of treatment. This result, in turn, decreases utilization of medical services in a patient population that makes heavy demands on the time of clinic staff;⁸ and this reduced utilization subsequently improves a patient's quality of life. This approach is specifically applicable to a specialty clinic and may, with modification, have limited use in a primary care clinic.

The perception that neuropsychologic testing is a time-consuming, costly, inefficient service for most neurology patients represented a prominent challenge to development of this program. Because of the importance of obtaining functional information, a concerted effort has been made to develop brief assessment that leads directly to treatment plans.⁹ Strong emphasis on the interview to determine the clinical intervention—as opposed to using the full battery of available psychologic tests—led to de-emphasizing psychologic assessment.¹ This project addressed this limitation by developing a more focused role for limited, selected standardized assessment.

Our protocol was designed to meet criteria commonly defined by the medical model of consultation. In the medical consultative model, clinicians receive brief highlights relevant to the referral question.¹⁰ The utility of developing brief consultative reports to specialists is well established and frequently used; however, the literature on efficacy and cost of brief versus extended modification of the neuropsychologic battery is limited.¹¹

Moreover, few reports of pro-

Practice Tips
Seek an interdisciplinary approach of physician and psychologist to produce a more complete picture of brain and behavioral interrelationships.
Use a neuropsychological screening evaluation when it is a limited, selected standardized assessment based on a specific set of symptoms.
Characterize psychosocial functioning through interviews and parental responses to standardized questionnaires.
Integrate the medical and psychological viewpoints during evaluation and during summation of test results for patients and parents.
Reconcile differences in viewpoints before giving a treatment plan.

ocols in a managed care setting have compared brief psychologic assessment correlated with neurologic examination. Future development of this form of assessment will require further validation of our modification and will focus on integrating use of standardized neuropsychologic, electrophysiologic, and imaging studies to understand the links between brain function and structure. ♦

Acknowledgment

The authors express their thanks to Dr Robert Butler for advice in the development of this program.

References

1. Stout CE, Cook LP. New areas for psychological assessment in general health care settings: what to do today to prepare for tomorrow. *J Clin Psychol* 1999 Jul;55(7):797-812.
2. Slaughter J, Johnstone G, Petroski G, Flax J. The usefulness of the Brief Symptom Inventory in the neuropsychological evaluation of traumatic brain injury. *Brain Inj* 1999 Feb;13(2):125-30.
3. Lezak MD. *Neuropsychological assessment*. 3rd ed. New York: Oxford University Press; 1995.
4. Spreen O, Strauss E. *A compendium of neuropsychological tests:*
- administration, norms, and commentary. 2nd ed. New York: Oxford University Press; 1998.
5. Psychological Corporation. *Wechsler Abbreviated Scale of Intelligence*. San Antonio (TX): The Psychological Corporation; 1999.
6. Watkins KE, Vargha-Khadem F, Ashburner J, et al. MRI analysis of an inherited speech and language disorder: structural brain abnormalities. *Brain* 2002 Mar;125(Pt 3):465-78.
7. Caplan R, Dapretto M. Making sense during conversation: an fMRI study. *Neuroreport* 2001 Nov 16;12(16):3625-32.
8. Berman B. The academic children's hospital primary care clinic: responding to the challenges of a changing health care environment. *Clin Pediatr (Phila)* 2000 Aug;39(8):473-8.
9. Kubiszyn TW, Meyer GJ, Finn SE, et al. Empirical support for psychological assessment in clinical health care settings. *Prof Psychol* 2000 Apr;31(2):119-30.
10. Armengol CG, Kaplan E, Moes EJ, editors. *The consumer-oriented neuropsychological report*. Lutz (FL): Psychological Assessment Resources; 2001.
11. Piotrowski C. Assessment practices in the era of managed care: current status and future directions. *J Clin Psychol* 1999 Jul;55(7):787-96.