

Analysis of WISC-R subtests across different child brain diseases

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INTRODUCTION

Wechsler IQ scales have been routinely used as standard measure for evaluation of neurocognitive functions in different diseases. Being able to predict the nature and depth of damage by analyzing the subtests results could give the professionals tools to evaluate and advise patients and families.

OBJECTIVES

To find out differences among clinical variables in order to analyze the implication of brain structures in cognitive functioning in different types of diseases: neurological, oncological and learning difficulties. Besides that, we tried to find out the relationship among different clinical variables and damage location (posterior or anterior), and the effect of different treatments (surgery, chemotherapy, radiotherapy, megatherapy) in brain and leukemia groups.

PATIENTS AND METHODS

Patients diagnosed and treated in our Units were evaluated. Wechsler scales were applied according to age: WPPSI, WISC-R, WAIS-III.

Although patients were initially divided into 5 disease groups (leukemias, brain tumors, epilepsy, traumatism, degenerative disorders and learning difficulties) only brain tumors (benign and malignant) and leukemias were included in this analysis. The other groups were too heterogeneous, and therefore did not show consistent results as a group. Clinical variables were disease group, gender, neurofibromatosis, location, imaging sequelae, hydrocephalus, type of treatment, age at diagnosis and evaluation, and time between end of treatment and evaluation date.

Discriminate analysis was performed using the Wechsler scale subtest and Verbal and Performance IQ (as independent variables) to obtain a differential multivariate profile between groups (both disease and clinical variables).

The complementary subtests digits and mazes were not used, as these were patients without these score.

Statistical analysis was carried out by using SPSS package. Discriminate analysis.

RESULTS

107 patients were studied. Median age was 11 (range: 3-24). There were 61 malignant tumors, 36 benign and 10 leukemias. Discriminate analysis identified 69% of malignant tumors, benign tumors and leukemias; 80% of left and right hemisphere; 79.7% of chemotherapy and non-chemotherapy groups; 80% of holocranial and nonholocranial RT.

The following figure shows the variables and groups that have been better identified by discriminant analysis. The centroids of that groups are non-relevant on the discriminant function.

The subtests have a mark according to their relevance in the discriminant function. Subtests with a significant decrease are indicated showing the weak points in the intellectual profile of the children

* <0.5, ** 0.5-1, *** >1

Variable	- CNS malign - CNS Benign - Leukemia	- Supratentorial - Infratentorial - Brainstem - Others	- Oncological - CNS Benign	Cranial RT Yes/no	Chemotherapy Yes/no	- Cranial - Local - No
Group	CNS malign tumor	Leukemia	Infratentorial	Oncological	C-RT yes	Chemotherapy
Information						
Similarities						
Arithmetic	*	*		**	**	
Vocabulary		***		**	**	***
Comprehension						
Picture completion						**
Picture arrangement						
Block design		*				
Object assembly	***			***	**	***
Coding	*			*	**	**
Verbal IQ				**	**	*
Performance IQ		**		*	**	**

ONCOLOGICAL

The results offer a function that allows us to identify oncological and non-oncological patients. The former shows lower scores in verbal components (arithmetic and vocabulary) and performance components (object assembly and coding). These data connect the findings of leukemias (major verbal component) and malignant CNS tumors (major performance component)

Classification results			Functions at the group centroids	
ON_NE_DE	% Predicted group	Total	ON_NE_DE	Function
Yes	Oncological	Benign	Oncological	1
No	CNS	CNS	Benign	2
Oncological	74.5	26.5	100.0	-436
Benign CNS	32.1	67.9	100.0	-704
Non grouped	50.0	50.0	100.0	

72.2% of the original cases correctly classified.

Standardized coefficients of the canonical discriminant functions	
Function	1
Information	-472
Similarities	-140
Arithmetic	-541
Vocabulary	-568
Comprehension	-157
Pic. completion	-454
Pic. arrangement	-270
Block design	-984
Object assembly	1306
Coding	-303

CRANIAL RT YES/NO

Cranial RT as treatment employed for leukemias as much as for malignant tumors, affects both verbal and performance components.

Classification results			Functions at the group centroids	
Cranial RT	% Predicted group	Total	Cranial RT	Function
Yes	Yes	No	Yes	1
No	Yes	No	No	2
Yes	73.9	26.1	100.0	-985
No	16.7	83.3	100.0	-539
Non grouped	38.5	61.5	100.0	

80.0% of the original cases correctly classified.

Standardized coefficients of the canonical discriminant functions	
Function	1
Information	-988
Similarities	-174
Arithmetic	-301
Vocabulary	-550
Comprehension	-224
Pic. completion	-351
Pic. arrangement	-539
Block design	-513
Object assembly	-748
Coding	806

CHEMOTHERAPY

CT affects verbal (vocabulary and arithmetic) and performance (object assembly) components, although the principal deterioration is in linguistic processes.

Classification results			Functions at the group centroids	
Chemotherapy	% Predicted group	Total	Chemotherapy	Function
Yes / No	Yes	No	Yes/No	1
Yes	Yes	No	No	2
Yes	52.4	17.6	100.0	-797
No	22.9	77.1	100.0	-774
Non grouped	44.4	55.6	100.0	

79.7% of the original cases correctly classified.

Standardized coefficients of the canonical discriminant functions	
Function	1
Information	-1105
Similarities	-442
Arithmetic	-323
Vocabulary	1092
Comprehension	-041
Pic. completion	-213
Pic. arrangement	-515
Block design	-1375
Object assembly	1516
Coding	050

TYPE OF RT

Another analysis differentiating cranial RT, local and non-RT groups was performed. In previous works no difference between local RT and non-RT was found in IQ.

In the discriminant analysis a clear separation of these groups is found. Patients with cranial RT have both verbal and performance difficulties.

However, in the discriminant analysis with the subtests, only performance (picture completion, object assembly and coding) are relevant, the vocabulary subtest then disappearing. The explanation for this result could show the RT effect on white matter. Processes associated with the right hemisphere are more dependent on white matter than the left ones. (these are more encapsulated) Likewise a white matter injury affects general processes such as processing speed and such processes are especially (dependent) relevant on WISC-R perceptive-performance tasks.

Classification results			Functions at the group centroids	
Type of RT	% Predicted group	Total	Type of RT	Function
Local	Cranial	Local	Cranial	1
No	Local	No	Local	2
Cranial	94.7	23.5	11.8	100.0
Local	11.1	68.7	22.2	100.0
No	20.0	26.7	53.3	100.0
Non grouped	33.3	48.1	18.5	100.0

58.9% of the original cases correctly classified.

Standardized coefficients of the canonical discriminant functions	
Function	1
Information	-548
Similarities	-132
Arithmetic	-213
Vocabulary	-048
Comprehension	028
Pic. completion	505
Pic. arrangement	-272
Block design	-463
Object assembly	525
Coding	-771

DIAGNOSES

The first variable in the Table (Diagnoses) shows the characteristics of the malignant CNS tumors and leukemia subgroups.

In leukemias, the low points in verbal subtests are in concordance with published data about a major weakness in language procedures in this disease, a selective deterioration of linguistic processes in children treated for this pathology.

In malignant tumors we observe lower scores in arithmetic and coding, both have an attentional component. We also observe lower scores in object assembly, which needs good visual memory support. These facts are consistent with those reported in the literature (weaker attention and memory); these processes are more sensitive to deterioration in children with malignant CNS tumors.

Classification results				Functions at the group centroids	
	% Predicted group	Total	Function	1	2
	Malignant CNS tumors	Benign CNS tumors	Leuke mia	1	2
Malignant CNS tumors	68.7	19.4	19.9	100.0	
Benign CNS tumors	19.2	57.7	23.1	100.0	
Leukemia	22.2	0	77.8	100.0	
Non grouped	28.6	57.1	14.3	100.0	

64.8% of the original cases correctly classified.

Standardized coefficients of the canonical discriminant functions	
Function	1
Information	-280
Similarities	-012
Arithmetic	-416
Vocabulary	-264
Comprehension	-158
Pic. completion	-066
Pic. arrangement	-376
Block design	-1249
Object assembly	1445
Coding	-411

LOCATION

Infratentorial location affects PIQ exclusively; we have not found a significant discriminant function from the subtests.

The most common infratentorial location is cerebellum, which produces motor and sensorial deficits affecting PIQ more than in other locations.

Classification results			Functions at the group centroids	
Location	% Predicted group	Total	Location	Function
Infratentorial / Cerebellum	Others		1	2
Infratentorial / Cerebellum	52.5	10.0	100.0	0.057
Others	0	66.7	100.0	-0.054
Non grouped	45.5	22.7	100.0	

38.6% of the original cases correctly classified.

Standardized coefficients of the canonical discriminant functions	
Function	1
Verbal IQ	1.169
Performance IQ	0.873

CONCLUSIONS:

These results are an approach of some characteristics of subjects with CNS tumors and leukemias in intelligence Wechsler scales. There are difficulties to analyze the effects in an independent way, because cases share different variables and it is difficult to separate the effects of only one.

For a more complex multivariate approach it is necessary to have better homogeneous groups, larger samples to determine the effects of protocols, drugs, image sequelae, location, etc.

Data point to different types of deterioration in diseases affecting cognitive functioning and posterior quality of life.

We wish to emphasize the importance of exploring more accurately the treatment and disease effects with complete follow-up assessments in order to clearly diagnose the difficulties to help in patient rehabilitation