A new tool for Neuropsychological Evaluation in brain tumors and irradiated leukemias

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Objective: In children with brain tumors, early interventions to diminish sequelae are crucial, above all, neuropsychological deficits that worsen their social, academic achievements and quality of life. We propose to study neuropsychological deficits in a quantitative, reproducible and prospective manner with a battery of neuropsychological tests (table 1). The final aim of our study was to develop a tool to be applied in neuropsychological rehabilitation programs.
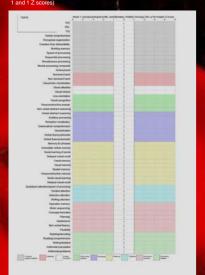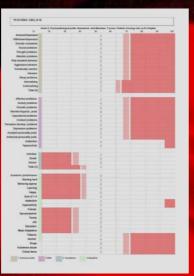
Patients and methods: Patients with brain tumor and irradiated leukemia (either survivors or in treatment) were evaluated during last year (2004). A battery of cognitive and behavioral tests were applied according to age, quantified by z-measures and transformed in two individual cognitive and behavioral profiles. A control group of healthy children was also studied. Statistical analysis was carried out by SPSS 12.0 (contingency tables, cluster and ANOVA).

Table 1: Tests applied according to age	
General	WPPSI, WISC-R and WAIS-III. Computer analysis.
	K-ABC Kaufman assessment battery for children
	Cumanin Neuropsychological maturity questionnaire
	K-BIT, Kaufman Brief Intelligence test
	Woodcock-Muñoz tests of cognitive abilities
	Woodcock Muñoz tests of achievement
Specific	Grooved Pegboard Test
	Benton judgment of line orientation
	Benton facial recognition
	Benton Visual Retention Test
	Rey complex figure performance
	Token test for children
	Peabody picture vocabulary test
	Phonetic and semantic fluency
	TOMAL memory and learning test
	Stroop colours and words test
	Five-point Test
	RFFT Ruff Figural Fluency Test
	Trail-making test
	Continuous Performance Test. CPT-II / K-CPT Conners
	TEA-Ch Test of Everyday Attention for Children
Behavior	Achenbach system of empirically based assessment (CBCL, C-TRF, CBCL 6-18, TRF, YSR, ABCL, ASR)
	Interview

Results: Forty children were evaluated (7 healthy, 8 leukemia, 18 brain and 7 intracranial non-brain tumors). Median age at evaluation was 9,5 years (range: 4-23 y).

Compared with healthy children, children with brain tumors and leukemia had deficits in general cognitive skills, memory, attention, executive functions and academic skills.

ANOVA (between groups)	Sum of squares	df	Mean square	F	Sig.
Verbal comprehension	10.612	2	5.306	7.932	.002
Perceptual Organization	6.010	2	3.005	1.902	.172
Freedom From Distractibility	1.552	2	.776	.952	.405
Working Memory	1.613	1	1.613	2.145	.217
Speed Of Processing	.003	1	.003	.002	.969
Verbal IQ	16.719	2	8.360	8.027	.002
Performance IQ	10.723	2	5.361	3.908	.031
Total IQ	17.141	2	8.570	6.387	.005
Cognitive general abilities	7.832	2	3.916	4.841	.015
Motricity	3.083	2	1.542	.934	.404
Perception	3.009	2	1.505	1.418	.258
Nonverbal abilities	.243	2	.121	.123	.885
Language	3.143	2	1.572	2.494	.100
Memory	3.162	2	1.581	4.161	.025
Attention	5.822	2	2.911	4.156	.026
Executive functions	6.313	2	3.157	4.958	.014
Academic abilities	9.911	2	4.956	6.434	.005

Assessed children with leukemia had lower means in verbal comprehension, working memory and verbal IQ.

Intelligence Wechsler scores									
Diagnosis		Verbal comprehension	Perceptual Organization	Freedom from distractibility	Working memory	Speed of processing	Verbal IQ	Performance IQ	Total IQ
CNS tumor	Mean	-.7512	-.3705	-1.2833	-1.1000	-.9500	-.9704	-.7444	-.9778
	N	14	14	10	4	4	18	18	18
	Standard Deviation	.89963	1.41168	.91884	.98808	1.61967	1.09550	1.26744	1.24994
Leukemia	Mean	-1.6044	-.3256	-1.2000	-2.2000	-.9000	-1.5037	-.8148	-1.3185
	N	6	6	4	2	2	9	9	9
	Standard Deviation	.69078	1.32618	.50626	.28284	.23570	1.07088	1.25112	1.23368
Total	Mean	-1.0072	-.3570	-1.2595	-1.4667	-.9333	-1.1481	-.7679	-1.0914
	N	20	20	14	6	6	27	27	27
	Standard Deviation	.91666	1.35159	.80322	.96148	1.25928	1.09690	1.23819	1.23152

We performed cluster analysis from 2 to 7 using the means of the area scores to try to identify profiles in this sample. Cluster analysis showed 6 different cognitive profiles, from minimal to severe damage. Cognitive skills followed by academic skills, motor, executive functions, language and attention were important to classify patients into one of the profiles.

	Cluster					
	1	2	3	4	5	6
n	7	1	2	9	9	5
General cognitive abilities	-.37	-2.87	-2.11	.53	-1.47	-.57
Motricity	-.03	-5.10	-3.01	.06	-.70	.31
Perception	.00	-2.50	-2.25	.67	-.49	-.50
Non-verbal abilities	.19	-2.22	-.63	.56	-.72	-.79
Language	-.26	-2.75	-.19	.38	-1.14	-.61
Memory	-.61	-1.46	-1.07	.25	-.71	-.02
Attention	-.73	-3.00	-1.99	.03	-1.45	-.16
Executive functions	-.44	-2.44	-1.91	.41	-1.18	-.62
Academic abilities	.06	-2.92	-.84	.48	-1.56	-.43

Profile 1: different diseases, low scores in attention and memory, normal academic achievement.
Profile 2: 1 case with the worst cognitive deficit.
Profile 3: two cases of long-term survivors with serious cognitive deficit.
Profile 4: healthy or patients at diagnosis. There is no cognitive deficit.
Profile 5: moderate generalized deterioration.
Profile 6: light cognitive deterioration: perception, non-verbal abilities, language, executive functions and academic abilities.

Psychopathology	% Total pathologic
Affective problems	65.22
Anxiety problems	53.85
Somatic concerns	36.00
Attention Deficit/Hyperactivity	42.31
Oppositional behavior	21.74
Conduct problems	27.27
Attention Deficit	31.82
Hyperactivity	9.09
Generalized developmental disorders	0
Depressive problems	33.33
Personality problems: avoidant	66.67
Personality problems: antisocial	33.33

The most frequent psychopathologies in this population with brain tumors and leukemia were: 43% of patients had affective troubles and 32% anxiety. These percentages show clinically significant psychopathology with DSM-IV criteria.

We observed the presence of Attention Deficit/Hyperactivity Disorder (ADHD) in 42.31% of our patients: 31.82% present Inattentive subtype, 9% hyperactive subtype.

Neuropsychological profile. Z scores. Coloured areas represent different neuropsychological areas. The white strap represent normality (between -1 and 1 Z scores)

Psychopathological profile. Achenbach Syndrome and DSM-IV scoring in one template. Red areas represent clinically pathological score.

Conclusions:

1. We have improved and validated a powerful tool to study neuropsychological status in a quantitative and reproducible manner to be used in patients with CNS damage.
2. Although most of the deficits have been already described, we have confirmed them in our population (as IQ below the mean in more than 50% of our patients, linguistic processes more affected in leukemia patients)
3. Most common psychopathologies were anxiety and affective problems. Almost half of patients presented ADHD (42,31%, 31,82% Inattentive subtype).
4. This was our first step to validate this protocol in our country: healthy children obtained normal profiles.
5. It will be incorporated to evaluate the efficacy of our neuropsychological rehabilitation programs.