



Pediatric Brain Injury Rehabilitation: The New Standard of Care

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Overview

- **Pediatric Brain Injuries**
- **Current Outpatient Standard of Care**
- **A Revised Treatment Standard**
- **Results of a Nation-wide Phase III Clinical Trial**
- **Where to Next?**

Oncology

- **Brain tumors**
- **Leukemias (ALL)**

Neuropathology of Brain Irradiation

Demyelination

Gliosis

Vascular Necrosis

Focal Necrosis

Calcification

White
Matter
Disease



FIG. 12. An histologic section from the lesion illustrated in Fig. 11.11 shows the darkly stained, unresorbed calcified tissue as well as pale-staining areas of gliosis and cyst formation. Although delayed radiation necrosis is located predominantly in the white matter, there is often a loss of the deeper cortical lamina to produce a thinning of the cortical ribbon. This is best seen in the orbital surface of the lobe. (H&E/LFB.) Compare this chronic lesion with radiation necrosis in the acute phase as illustrated in Fig. 11.4.

Neuropathology of Intrathecal Methotrexate

Gliosis

Demyelination

Vascular Necrosis



White

Matter

Disease

Effects of Brain Irradiation/MTX on Neuropsychological Functions

- Declines in intelligence
- Attention/concentration disturbances
- Reduced processing speed
- Memory problems
- Visual-spatial deficits
- Visual-motor integration problems
- Executive functions deficits
- Arithmetic difficulties

Neuropsychological Impairment Mediators and Moderators

- **Vigilance attention**
- **Reduced processing speed**
- **Working memory**

CNS Insult

Neurological/Biological Factors

- Severity
- Pre-existing
- Genetics

Developmental Factors

- Age
- Gender
- Intelligence

Time Since Onset

- Acute
- Chronic
- Trajectory



Mitigation

- Rehabilitation
- Reserve capacity
- Family/Resources





**Neuropsychological/
Behavioral Outcome**

After Dennis (2000)

Clinical Brain injury Rehabilitation Assumptions

- **Functional reorganization
proximal/distal**
- **Training facilitates biological repair**
- **Learning occurs**

Brain Injury Habilitation/Rehabilitation

Adult	Childhood
Established functions	Emerging/developing
Work	School
More mature coping/language	Less mature coping/language
Spontaneous recovery	Growth into deficits
Spouse/children	Caregivers/siblings
Less tolerance	More tolerance

Drill Oriented Remediation (Physical Therapy Model)

- **Tutorial/repetition**
- **Guided practice/assistance**
 - **Model**
 - **Prompt**
 - **Check**
- **Direct instruction**
- **Frequent review**
- **Independent work**

Standard of Care (Special Education)

- **504 Plan**
- **Individualized education plan**
- **Speech/language therapy services**
- **Occupational therapy services**
- **Special classroom**
- **Medication**

New Standard of Care

**Brief/Focused Outpatient
Rehabilitation**

+

Educational Intervention

Cognitive Remediation Program (CRP) Tripartite Model

- **Brain injury rehabilitation**
- **Educational psychology – Special Education**
- **Clinical psychology (CBT)**

CRP Approach

- Individual
- Short term (4-5 months)
- 20 two-hour sessions (40 treatment hours)
- Team orientation
- Psychotherapy

Traditional Remediation and Memory Restoration

- **Practice drills (Alternating/50-80%)**
- **Mnemonic strategies**
 - **Visual imagery**
 - **Acronyms**
 - **Chunking**

Metacognitive Strategies

- Preparation
- On-Task
- Post-Task

Task Preparation Strategies

- Magic/special words
- Soup breath
- Game face
- World record
- Warm up my brain

On Task Strategies

- Talk to myself
- Mark my place
- Look for shortcuts
- Time out/start again
- Look at the floor

Post Task Strategies

- Check my work
- Ask for feedback
- Reward myself
- Learn from my mistakes
- Try it again

Child Clinical Psychology

- **Cognitive-Behavioral interventions**
- **Psychotherapeutic environment**
- **Programmatic/Individualized**

A Multi-Center, Randomized Clinical Trial of a Cognitive Remediation Program for Childhood Survivors of a Pediatric Malignancy

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Diane Fairclough, Colorado Health Sciences Center, Denver, CO

Raymond K. Mulhern, St. Jude Children's Hospital, Memphis, TN

Ernest Katz, Children's Hospital Los Angeles, Los Angeles, CA

Anne E. Kazak, The Children's Hospital of Philadelphia, Philadelphia, PA

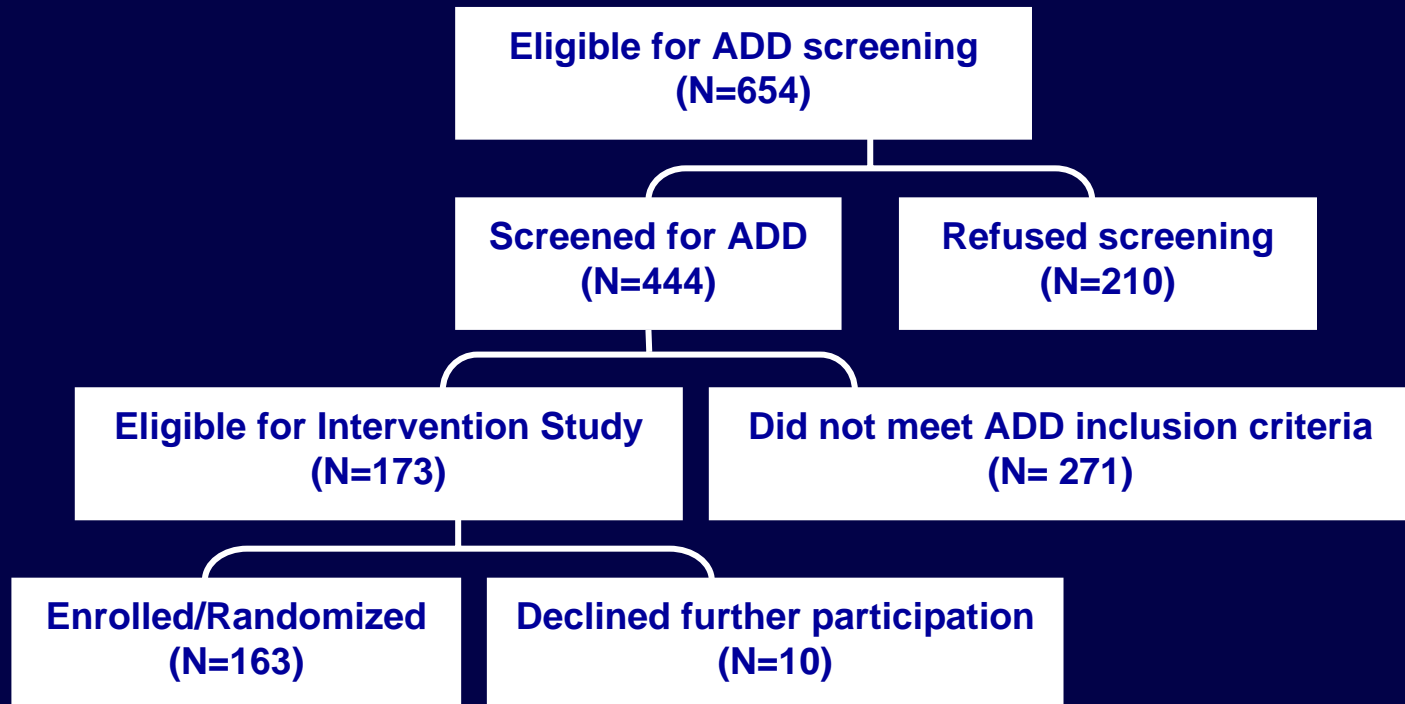
Robert Knoll, Children's Hospital of Pittsburgh, Pittsburgh, PA

Olle J. Sahler, University of Rochester Medical Center, Rochester, NY

Participants (70-30)

- 161 Pediatric cancer survivors (1 yr)
- Age 6-17
- 7 Nationwide sites
- No pre-diagnosis involvement
- Documented attentional disturbance
- IQ \geq 50
- Intact language/sensorium

Consort Flow



N= 161 based on Immediate Declines

Sample (n=161)

Comparisons of Group Characteristics

Characteristic	Group	Number of Subjects	Mean	Standard Deviation	p-value
Age	CRP	108	10.8	3.4	0.49
	Control	53	11.1	3.1	
Grade	CRP	103	5.0	3.3	0.26
	Control	53	5.6	3.3	
SES	CRP	99	3.2	1.0	0.99
	Control	49	3.2	1.1	
Age at DX	CRP	108	4.9	3.3	0.25
	Control	53	5.6	3.4	
Time since DX	CRP	108	5.8	2.8	0.60
	Control	53	5.6	3.2	
Male	CRP	67	n/a	n/a	n/a
	Control	37			

Demographics

Race	$p = 0.67$	
American	CRP	2.8
	Control	1.9
Asian	CRP	3.7
	Control	0.0
Black	CRP	10.2
	Control	11.5
Caucasian	CRP	63.9
	Control	67.3
Hispanic	CRP	17.6
	Control	19.2
Other	CRP	1.9
	Control	0.0

Cognitive/Behavioral Status At T1

Full Scale IQ

WASI	CRP	107	89.2	15.9	0.10
	Control	52	93.8	16.6	

Verbal IQ

WASI	CRP	107	92.0	16.3	0.48
	Control	52	94.0	17.9	

Performance IQ

WASI	CRP	107	88.5	15.6	0.02
	Control	52	94.5	15.7	

CPT-II

Clinical Confidence
Index

	CRP	106	71.6	16.2	0.77
	Control	53	70.8	14.4	

Omission Errors

	CRP	106	62.7	18.4	0.30
	Control	53	59.5	16.5	

CPRS

Cognitive Problems/Inattention	CRP	106	68.9	11.2	0.40
	Control	51	67.2	11.7	

Inattention Scale

	CRP	106	67.4	11.7	0.76
	Control	51	66.8	12.9	

Construction of Indices

Indices (Alpha)	Measures (correlation with total)	
A: Academic Achievement (0.93)	<i>WRAT-III</i>	
	Reading	0.81
	Spelling	0.79
	Arithmetic	0.85
	<i>PIAT-R</i>	
	Reading	0.74
	<i>W-J:R</i>	
	Calculations	0.77
	Applied Problems	0.82
	<i>WISC-III</i>	
	Arithmetic	0.76

Construction of Indices

Indices (Alpha)	Measures (correlation with total)	
B: Brief Focused Attention (0.72)	<i>WISC-III</i>	
	Digits forward	0.46
	<i>WRAML</i>	
	Sentence Memory	0.70
	<i>CMS</i>	
	Stories Immediate	0.46
	<i>RAVLT</i>	
	Trial 1	0.44

Construction of Indices

Indices (Alpha)	Measures (correlation with total)	
C: Working Memory (0.62)	<i>WISC-III</i>	
	Digits backward	0.45
	<i>STROOP</i>	
	Trial 3	0.30
	<i>TRAILS</i>	
	B	0.37
	<i>BTA</i>	
	Sum Score	0.51

Construction of Indices

Indices (Alpha)	Measures (correlation with total)	
D: Memory Recall (0.70)	<i>CMS</i>	
	Stories Delay	0.49
	<i>ROCF</i>	
	Delay	0.48
	<i>RAVLT</i>	
	Delay	0.56
E: Vigilance (0.77)	<i>CPT-II</i>	
	Omissions	0.65
	Hit RT	0.53
	Variability	0.69

Statistical Significance (Interactions)

A. Academic Achievement

$t=3.05, p=0.003, ES=0.53$

B. Brief Focused Attention

$t=0.15, p=0.9, ES=0.02$

C. Working Memory

$t=1.30, p=0.20$ (Stroop $p<0.05$), $ES=0.15$

D. Memory Recall

$t=-0.90, p=0.37, ES=-0.11$

E. Vigilance

$t=0.76, p=0.45, ES=0.10$

Separate Measures

- Parent Rating (Inattention)
- Teacher Rating (Inattention)
- Teacher Rating (ADHD)
- Self Report (CFSEI)

Statistical Significance (Other/Self Report)

1. Parent Inattention

$t=-3.61, p<0.001, ES=-0.48$

2. Teacher Inattention

$t=-1.00, p=0.32, ES=-0.21$

3. Teacher ADHD

$t=-0.42, p=0.76, ES=-0.11$

4. Total CFSEI

$t=0.76, p=0.45, ES=0.10$

Individual CRP Analyses

- Achievement T1-T3
- Focused Attention T1-T3
- Working Memory T1-T2
- Learning T1-T3
- Teacher Inattention T1-T2
- Self Esteem T1-T3

$p \leq 0.05$

Compliance

- Older Age/African American:
↓ 18 sessions $p < 0.03$
- Gender/SES/Time Since Dx
(N.S.)
- Older Age:
↓ T2 $p = 0.04$

Conclusions

- CRP did have a significant effect on critical areas of functioning.
- Generalization occurred
- Effect sizes are modest
- Compliance is an issue
- Individual variables remain unclear

But....

Conditions Most Likely to Increase Effectiveness of Cognitive Remediation

- Team approach/knowledge
- Increased compliance
- High functioning family/decreased family stress
- Promotion of generalization

Second Generation CRP

- **Problem Solving Skills Training (6-8 sessions)**
 - **Increase treatment compliance**
 - **Educate caregivers about education system**
 - **Reduce family chaos**

Second Generation CRP

- Ecological intervention
 - Sleep
 - Nutrition
 - Exercise
- School interventions
 - ?



*This program
makes me feel happy.*

Travis

