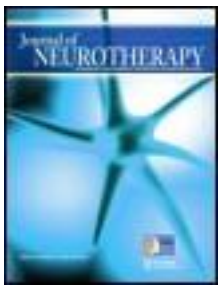

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Daniel G. Amen M.D. & Blake Carmichael B.A.

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Oppositional Children Similar To OCD on SPECT: Implications for Treatment

Daniel G. Amen, M.D. and Blake Carmichael, B.A.

Sixty-four children and adolescents with Oppositional Defiant Disorder by DSM-IIIR criteria were evaluated with brain SPECT imaging. A control group of 20 patients matched for age, sex, and other psychiatric diagnoses were also studied. Children with Obsessive-Compulsive Disorder and Conduct Disorder were excluded from the sample. The brain SPECT studies were read blind to the diagnoses. The brain SPECT patterns of the group with Oppositional Defiant Disorder showed qualitatively increased activity in the anterior medial aspects of the frontal lobes compared to the rest of the brain and when compared to the control group. No other significant SPECT differences were noted between the groups. This is a finding similar to that reported in adults with Obsessive Compulsive Disorder. These findings indicate there may be an underlying biologic simi - larity between Oppositional Defiant Disorder and Obsessive-Compulsive Disorder. Implications for treatment are discussed, including the potential usefulness of behavior therapy, EEG biofeedback, and SSRI medication.

Key Words: oppositional defiant disorder, brain SPECT studies, hyperfrontality.

Brain SPECT (single photon emission computed tomography) imaging is a nuclear medicine study, utilizing minute doses of radioactive isotopes bound to neurospecific pharmaceuticals to study cerebral perfusion and thus indirectly brain metabolic activity (Holman, 1992). It has been used in the research of neurological and psychiatric disorders for the past several years, in conjunction with PET (positron emission tomography) scanning which is a direct measure of metabolic activity and/or receptor distribution. With continued improvement in technology brain SPECT image resolution is within the same realm as PET (Reba, 1993) at considerably less cost. SPECT scans are clinically easier to perform and they are more widely available.

In studying psychiatric patients with brain SPECT imaging, researchers have found distinct cerebral perfusion patterns for many different psychiatric conditions (George, 1991). Chiron (1992) recently reported normative data for children demonstrating that the brain of a two- to three-year-old child shows the same relative cerebral blood flow pattern as the adult brain. There are several studies on the use of SPECT in psychiatric conditions in children and adolescents. Lou (1984) found decreased blood flow in the frontal lobes of ADHD children, which increased after the children received Ritalin. This finding was replicated in an expanded study (Lou, 1990) which also found decreased blood flow in the basal ganglia.

In my experience as a board certified child psychiatrist and a physician licensed in nuclear brain imaging with experience with over 2,000 cases, I find that brain SPECT imaging in children can be a particularly useful tool, especially to evaluate non-responsive behavior problems. In performing SPECT for medical indications, it was noticed that many children with comorbid Oppositional Defiant Disorder (ODD) showed the same SPECT pattern described for patients with Obsessive-Compulsive Disorder (OCD), increased activity in the anterior-medial aspects of the

frontal lobes. Since on the surface ODD and OCD are such divergent disorders I found this a curious finding. Yet, children and adolescents who have ODD often get stuck on saying "no" to authority figures even when it is clearly in their best interest to say "yes." This repetitive negative behavior pattern leads them to be ineffective in school and in their relationships with peers and adults. It is this pattern of "getting stuck" on certain thoughts ("No, I won't do it") and behaviors (refusing to follow rules, argumentativeness) that led me to postulate that there may be a correlation between ODD and OCD.

Increased metabolic activity bilaterally in the anterior medial portions of the frontal lobes in comparison to the rest of the brain has been reported as a PET and SPECT finding in patients with OCD (Hollander, 1992; Machlin, 1991; Nordahl, 1989; Swedo, 1989). Mirsky (1990) postulated that one's ability to "shift attention" is localized in this area of the frontal lobes. When this area is diseased or overactive, a person may have difficulty shifting his or her attention onto different things and end up "stuck" on certain thoughts or behaviors. With this in mind, we hypothesized children who had ODD would show increased activity in the anterior medial portions of their frontal lobes compared to the rest of their brain and in comparison to other psychiatric diagnoses in children.

In this paper we will report our experience with children and adolescents who meet the DSM-IIIR criteria for ODD.

Method

Sixty-four medication-free children and adolescents who met the DSM-IIIR criteria for ODD and who had a brain SPECT study referred by their outpatient psychiatrist were studied. Children with OCD and Conduct Disorder were excluded from the sample. These patients were compared to 20 medication-free children and teenagers who were matched for age, sex, and other diagnoses, who were also referred by their outpatient psychiatrist, did not meet the criteria for ODD or OCD, and also had a brain SPECT study as part of their psychiatric evaluation (see Table 1). In the initial evaluation of these patients, the parents or guardians were specifically asked the DSM-IIIR criteria questions for ODD and OCD. Diagnoses were also made in the entire group utilizing clinical interviews with both the parents and child or teenager by a board certified child psychiatrist (DA) and a commercially available computerized DSM-IIIR structured interview (Decisionbase). Patients were referred from a number of different sources, including pediatricians, neurologists, school systems, and parents. Informed consent of the parents was obtained for the SPECT studies. These studies were performed primarily in these patients to rule out organic dysfunction.

The SPECT studies were done in the following manner. Intravenous access was obtained via small gauge butterfly. The patient was then placed in a quiet, dimly lit room in the supine position with his or her eyes closed for approximately 15 minutes. Ceretec (99m Tc hexamethylpropylene amine oxime) was injected at approximately the twelfth minute. A tomographic brain study was performed approximately 60 minutes later using a Picker Prism 3000 gamma camera with fan beam collimators. Data were acquired in 128 x 128 matrices. One hundred twenty images with 3 degrees separation spanning 360 degrees rotation were obtained. The data were prefiltered using a Ramp filter with a high cutoff. Attenuation correction was performed using a linear method. Coronal, sagittal, and transaxial tomographs were reconstructed with a slice thickness of approximately 9 mm. The transaxial tomographs were parallel to the orbitalmeatal line. The tomographs were displayed using a standardized color scale.

The brain SPECT studies were then read by the nuclear medicine physician who was blind to diagnoses. The studies were read by visual inspection evaluating relative activity in each brain area listed in Table 2.

Each area was qualitatively assessed relative to other areas of the brain and assigned a value on a scale of 0-4 (0 equaled normal activity, 1+ mild increased activity, 2+ moderate increased activity, 3+ moderate-to-marked increased activity, and 4+ marked increased activity). The clinical utility for this procedure is well chronicled by many other studies (2, 12, 13). Comparisons between the ODD and non-ODD groups were made using the Fisher's Exact Test. Two sided p-values are reported. Negative numbers were used to describe decreased activity. Only values of 2+ and above, or 2- and below were considered significant.

Results

Fifty-two out of sixty-four patients (81%) who met the DSM-IIIR criteria for ODD showed qualitatively increased uptake bilaterally in the anterior medial portions of the frontal lobes. Three out of 20 patients (15%) who did not meet the DSM-IIIR criteria for ODD showed increased uptake bilaterally in the medial portions of the frontal lobes. This difference is highly statistically significant ($p < 0.0001$). No other significant differences were noted between the groups.

Table 1
Age and Sex Distribution

	OPPOSITIONAL	NON OPPOSITIONAL
n	64	20
male (%)	48 (75)	15 (75)
age		
mean	11	10
range	6-17	6-17
Other Diagnoses		
ODD only	6	
ADHD	24	8
Undifferentiated ADD	9	2
Major Depression	15	6
Depressive Disorder NOS	3	2
Overanxious Disorder	7	2

Table 2: Results by Specific Brain Region
(abnormalities listed in each area are of increased perfusion unless otherwise specified)

SPECT Findings (listed by number of patients, percentage in parentheses)	64 Oppositional.	20 Non Oppositional
Frontal Lobes		
Anterior Medial Aspects	52 (81)	3 (15)
Prefrontal Cortices		
Suppressed	11 (17)	4 (20)
Frontal Dorsal Cortex		
L	6 (9)	3 (15)
R	8 (13)	2 (10)
Parietal Lobes		
L	3 (5)	1 (5)
R	4 (6)	2 (10)
Occipital Lobes		
L	0	0
R	0	0
Temporal Lobe		
L	17 (27)	6 (30)
R	21 (32)	8 (40)
Limbic System		
Diffuse Limbic Findings	15 (23)	6 (30)
Focal Limbic Findings		
L	7 (11)	3 (15)
R	4 (6)	2 (10)
Basal Ganglia		
Diffuse Basal Ganglia	9 (14)	2 (10)
Focal Basal Ganglia		
L	6 (10)	4 (20)
R	8 (13)	2 (10)

Stress Often Increases Activity in the Anterior Medial Aspects of the Frontal Lobes

In 8 of 19 ODD cases where we obtained both rest and concentration (performed while the patients performed random math problems) SPECT studies with ODD children and teens, we saw a further increased activity in the anterior medial aspects of the frontal lobes during the concentration task (for example, the hyperemia went from 2+ to 4+). This finding did not occur at all in the 8 children in the control group who had both a rest and concentration study. No other significant changes were noted in other brain regions. Clinically, we suspect that this finding might correlate with ODD children and teens who get worse ("more stuck") under pressure or when they are pushed to comply with certain requests. We have seen this occur frequently on an adolescent treatment unit where some of these teens would become so "stuck" that they would refuse to comply with the staff requests and end up on restriction or even, in some cases, restraints because they could not shift their attention to more effective behavior.

Before and After Treatment Case Study

It has been observed that the brain SPECT abnormalities in the anterior medial portions of the frontal lobes normalize with SSRI medication treatments for OCD (Hoehn-Saric, 1991; Hollander, 1992). This does not appear to be intertest variability, as Chiron (1992) has shown that without intervening in some way the brain SPECT patterns vary little from test to test. In a case of ODD where follow up SPECT data were obtained, normalization of the anterior medial aspects of the frontal lobes was demonstrated.

J. O., age 9, was evaluated for significant oppositional behavior. He was suspended from school five times in second grade for refusing to do what he was told and being openly defiant with his teacher. His parents were told not to bring him back to school until they sought professional help. His clinical evaluation was also consistent with a diagnosis of ODD. His brain SPECT study revealed bilateral qualitatively increased in the anterior medial portions of his frontal lobes. When he improved only minimally with behavioral interventions, he was placed on clomipramine (100 milligrams). Within two weeks he showed clinical improvement. After two months his brain SPECT study was repeated and revealed essentially normal activity in the medial portions of his frontal lobes. The following year J. O. was not suspended once from school and his teacher that year could not understand why the other teachers had warned her about him.

Discussion

In this study brain SPECT imaging in children and adolescents with ODD demonstrated a cerebral perfusion pattern similar to that reported with OCD. This fits with the clinical observation that many of these children become "stuck" on certain negative thought or behavior patterns. OCD is most often categorized with internalizing anxiety disorders while ODD is categorized with externalizing behavior disorders. Perhaps genetic or environmental patterns play a significant role in the different expression of similar cerebral perfusion patterns.

As noted in the case example above, the use of SSRIs may enhance the treatment of patients with ODD. Of note however, Baxter (1992) reported that with successful behavior therapy in patients with OCD there was also a significant reduction in hyperfrontality found by PET studies. So even though there is an underlying biological pattern to ODD it does not imply that medication is the primary treatment, although in severe or retractable cases a trial of an SSRI might be considered.

Given this finding, EEG biofeedback, which has also been termed neurotherapy and neurofeedback, might also play a role in the treatment of ODD. EEG biofeedback has reported positive benefits for children with ADHD (Rossiter & LaVaque, 1995; Lubar, 1991). With the specific information of over-

activity in the anterior medial aspects of the frontal lobes, it is possible to place electrodes over C3 and C4, and train this area to become less active with either SMR or alpha rhythm. Beta training over this area is likely to make the problems worse. It is interesting to note that Sternman (personal communication, 1997) has demonstrated that training the SMR rhythm over C3-C4 is shown to have positive effects on behaviorally disordered children.

Given that children and teens with ODD tend to get cognitively "locked up" when they are pushed to comply, we have found using behavioral techniques such as giving options and distraction more effective in obtaining compliance. When you give an oppositional child or teen an option as to when they might do something, they tend to be less likely to get stuck on "No, I won't do it." When they are stuck on a negative thought or behavior, we have found it helpful to distract them for a bit and then come back to the issue at hand later.

Conclusion

Brain SPECT imaging may be a useful tool in the assessment and treatment of refractory cases of ODD. It points to a clinically useful insight into the relationship between ODD and OCD. Our finding of increased anterior medial frontal perfusion in patients with ODD is consistent with the hypothesis of frontal lobe involvement in this disorder.

These findings should be considered preliminary and need to be replicated. One criticism of our work is that the brain SPECT studies were read by visual inspection as opposed to quantitatively measuring activity in each area of the brain. We believe that in a clinical setting the majority of SPECT studies are read visually, comparing the brain perfusion pattern to itself and that reporting these results in this way will provide the most useful clinical data.

It must be emphasized that brain SPECT imaging in most clinical settings is still considered a research tool. In order to utilize the technology effectively it is important to have a sophisticated camera (we used a triple-headed camera, most SPECT cameras are still single headed and provide less resolution), a nuclear medicine physician skilled in reading brain studies for psychiatric or functional reasons, and a psychiatrist who understands how to properly utilize the technology.

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