Neurological Differences between Attention Deficit Hyperactivity Disorder and Childhood Bipolar Disorder

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ABSTRACT

The difficulty of differentially diagnosing attention deficit/hyperactivity disorder (ADHD) and childhood bipolar disorder is discussed from the standpoint of neurological assessment and abnormalities. Research has not addressed this problem. However, studies on each individual disorder are examined. Use of tools such as EEGs, MRIs, fMRIs, and SPECT are discussed.

Introduction

Diagnosis of childhood disorders is an intricate and challenging process. One reason is many disorders have symptoms overlapping to a significant degree those characterizing other disorders. For example, attention deficit/hyperactivity disorder (ADHD) has many of the same symptoms as childhood bipolar disorder (Fewell &

Deutscher, 2002). Misdiagnosing ADHD when the child is actually suffering from childhood bipolar disorder can result. The diagnosis of ADHD would suggest treatment with a stimulant such as Ritalin, Dexedrine, or Benzedrine. However, the administration of such a drug might only serve to induce mania in the child with bipolar disorder. Through the lens of the ADHD label, this increase in hyperactivity might even result in increased dosages of the stimulant, thus exacerbating the mania further. Development of an objective and precise method for accurate differentiation between these two disorders is important. One promising direction may lie in the neurological differences between the two maladies.

Purpose of the Article

The purpose of this article is to discuss differential diagnosing of attention deficit/hyperactivity disorder (ADHD) and childhood bipolar disorder from the standpoint of neurological assessment and abnormalities.

Symptoms

Before examining the neurological differences between ADHD and childhood bipolar disorder, symptoms associated with each will be identified. ADHD involves five categories of symptoms that the client must match before diagnosis, according to the *DSM-IV-TR* (APA, 2000). The first category consists of two groups. The first group is associated with inattention that has been evident for a minimum of six months and interferes with the individual's functioning. Examples include losing objects, failing to finish projects or tasks, inability to stay on task, and inability to listen to others. The second group consists of hyperactivity-impulsivity behaviors that interfere with overall functioning. Examples are inability to remain still, difficulty remaining seated, problems with turn taking, and interrupting frequently. Symptoms must have manifested before the age of seven. The disorder must be demonstrated in two different locations, e.g. school and home. "There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning" (p. 93). Lastly, diagnosis requires that the symptoms not appear associated with other difficulties such as mood, anxiety, or dissociative disorders.

Many children with ADHD may also present with symptoms derived from their experiences as sufferers of the disorder. For example, it is not unusual for ADHD children to have a history of accidents such as broken bones, falls, and other accidents. Impulsivity may render the child inattentive to safety measures. The child might also suffer from low self-esteem and subsequent depression related to having been teased and experiencing other difficulties with social interactions.

Bipolar disorder is somewhat difficult to diagnose in children simply because this problem is seen more often in the adult population. In fact, the *DSM-IV-TR* (APA, 2000) reports that bipolar conditions are often first seen during the twenties rather than earlier in life. Various types and levels of bipolar disorder have been described. Basically, however, the disorder involves periods of mania and depression occurring sequentially or simultaneously. Symptoms of depression in children might include irritable mood, crying, anhedonia, less than expected weight gain for growing children, sleep difficulties, psychomotor agitation, low self-esteem, feelings of guilt, deficits in thinking, and possibly thoughts of suicide. Symptoms of mania for children include high self-esteem, finding sleep unnecessary, talkative periods, racing thoughts, and distractibility.

When comparing these symptoms to those of ADHD, considerable overlap is evident. Consequently, children presenting with such symptoms are more likely diagnosed with the disorder considered the most common in children – ADHD. However, crying, anhedonia, failure to make developmentally appropriate weight gains, suicidal thoughts, and high self-esteem do not seem to be associated with ADHD. Thus, further evaluation is warranted when children present with the latter set of characteristics as well as ADHD symptoms.

In summary, it appears that the child with ADHD may present with greater attention problems than the child who has bipolar disorder. The child with bipolar may demonstrate greater or more intense emotional reactions or difficulties. However, this dichotomy is not a perfect one and would not necessarily be sufficient for differential diagnosis of these two disorders. In extreme examples of both maladies, differentiation might be more readily accomplished. In the majority of cases, which involve more moderate symptoms, the distinction is more difficult.

Etiology

When etiology is explored as a possible differentiation tool, the most prominent theory involves genetics (Fletcher-Janzen & Reynolds, 2003). Since both disorders seem to have familial associations, examination of family histories may aid differential diagnosis. Children with ADHD and those with bipolar disorder are more likely to have relatives with “matching” diagnoses. However, effectiveness of this tool may be limited because relatives might have been misdiagnosed as well.

Accurate diagnosis is critical. “Among adolescents diagnosed with BAD [Bipolar Affective Disorder], around 20% make serious suicide attempts” (Fletcher-Janzen & Reynolds, 2003, p. 87). Additionally, both the bipolar and the ADHD adolescent are likely to engage in criminal behaviors if they are untreated. Manic states and impulsive behaviors increase risk- taking and consequent injury or arrest.

Some theories regarding the etiology of ADHD suggest that this disorder results from minimal brain damage. “Brain damage as a result of infection, trauma, and complications during pregnancy or at the time of delivery has been postulated as potential causes [sic] of ADHD; however, routine neurological examination of children with

ADHD is generally normal" (Fletcher-Janzen & Reynolds, 2003, p. 74).

Masi and associates (2003) determined that many children and adolescents diagnosed with ADHD are subsequently diagnosed with bipolar disorder. They suggest that the two difficulties are comorbid but do not consider the possibility that ADHD is a misdiagnosis of bipolar disorder that has not yet completely manifested itself. In other words, the early stages of bipolar disorder may be erroneously identified as ADHD.

Neurological Deficits Associated with ADHD

Brain damage is not always detectable through analysis of scans or wave recordings, but such damage may be assumed on the basis on neurological test results. For example, Temple and Sanfilippo (2003) believe that ADHD is associated with impairments in the executive functions, which might develop from frontal lobe damage. Many ADHD children have a history of injuries such as broken bones. Perhaps their first injury involved frontal closed-head trauma, resulting in increased injury-proneness and deficits in areas of attention. Unfortunately, a child who has bipolar disorder might also exhibit attention deficiencies, especially when she or he experiences depression with associated concentration difficulties.

Support for the hypothesis that ADHD results from brain injury is found in the fact that many ADHD children have seizure disorders, which can also originate from brain trauma (Schubert, 2005). This relationship may render it difficult to determine whether an individual's ADHD behavior is due to inattention or subclinical seizures, an important distinction given the differential treatment indicated for these two circumstances. The question can be resolved through the use of EEGs because this method can distinguish whether an individual is experiencing a particular type of seizure or is simply not attending. The EEG will also provide evidence of the frequency of subclinical spiking, which may affect the ability to attend as well as other cognitive functions. Consequently, EEGs may lead to relatively simple ways of diagnosing ADHD.

Interestingly, some experts believe that ADHD treatment can be enhanced due to the plasticity of the brain (Ito, 2004). In other words, the child's brain could be retrained so that she or he could focus and sustain attention within the normal range of functioning. Training in attention maintenance, particularly utilizing treatment protocols involving CBT methods, seems helpful in alleviating some problems for ADHD children.

In an attempt to use brain scans to predict development of ADHD, Wang and Kuo (2003) used gray-scale transfrontal sonography to detect abnormalities in the arteries supplying blood to the basal ganglia. Vasculopathy was detected in infants who later developed ADHD, tics, or obsessive-compulsive behaviors. Whether these abnormalities can be detected beyond infancy has not been established.

Sowell and associates (2003) were able to find peculiarities in the brains of individuals with ADHD by using high resolution MRIs. The findings of their research indicated:

> Abnormal morphology was noted in the frontal cortices of patients with attention-deficit hyperactivity disorder, with reduced regional brain size localized mainly to inferior portions of dorsal prefrontal cortices bilaterally. Brain size was also reduced in anterior temporal cortices bilaterally. Prominent increases in grey matter were recorded in large portions of the posterior temporal and inferior parietal cortices bilaterally. (p. 1699)

These researchers' interpretation of results is that all lobes (with the exception of the occipital) are association cortices of the hetermodal type comprising a complex system throughout the nervous system. This becomes the basis of inhibitory responses and attention. Such "identified region-specific anatomical abnormalities in cortical components of attentional systems … may help better account for the symptoms of attention-deficit hyperactivity disorder" (p. 1699).

Use of the Single Photon Emission Computed Tomography (SPECT) also appears helpful in determining whether an individual has ADHD (Vles, Feron, Hendriksen, Jolles, van Kroonenburgh, & Weber, 2003). Vles and associates used SPECT to examine the brain dopamine transporter and receptor activity, finding that abnormalities were present prior to the use of stimulants. After stimulant treatment began, they found a down-regulation of the transporter system of dopamine. Consequently, an examination of the brain dopamine system might be one diagnostic method for ADHD.

Thus, it would seem diagnosis of ADHD might be supported by certain neurological assessments. The first would involve neurological examinations that directly assess attention. However, childhood attention tests that could differentiate between ADHD and attention problems resulting from mood disorders would be ideal. A neurological examination that consists of EEGs that would detect seizure activity would also be important, since subclinical seizure activity might underlie ADHD. Additional use of MRIs and SPECTs would also assist in the diagnosis of ADHD. These assessments might aid the clinician in ruling out bipolar disorder. However, it is crucial that further research be conducted with specific reference to these two disorders in order to establish valid protocols of assessment.

Neurological Deficits Associated with Childhood Bipolar Disorder

Very little research has been conducted with children diagnosed with pediatric bipolar disorder, especially with regard to neurological deficits. Hence, the majority if not all of the research presented is based on adult subjects unless otherwise stated. Considerable investigation is needed with adequate data analysis related to the neurological deficits and difficulties of this particular population. Whether or not research on adults can be extrapolated to children has not been determined.

Frey and associates (2005) studied neurometabolites in the dorsolateral prefrontal cortex. They found that the phosphoinositide-signaling pathway was not operating

normally for individuals in the manic phase of bipolar disorder. The researchers noted that further investigation with regard to manic and depressive states is necessary to determine how this abnormality impacts the bipolar individual.

Ahn and other researchers (2004) note abnormal differences between white matter in individuals without bipolar disorder and those with bipolar disorder. By taking slices of magnetic resonance images of white matter, the researchers were able to examine them for prevalence and severity of hyperintensities. Individuals with bipolar had an abnormal number of white matter hyperintensities. Other researchers have found similar results in studies that investigated white matter hyperintensities in bipolar patients. Craven, James, and Murphey (2002) noted that when individuals have cerebral palsy, the probability is high that bipolar disorder is present as well. They report finding an association with white matter lesions in these two disorders in adolescents. However, it should be noted that others believe that white matter hyperintensities might be due to treatment with lithium (Breeze, Hesdorffer, Hong, Frazier, & Reshaw, 2003). Thus, the medication generally considered the treatment of choice might produce abnormalities within the brain, and these abnormalities could be misinterpreted as resulting from the disorder itself.

One of the primary difficulties in studying bipolar disorder is that there are different types of bipolar, such as bipolar I and bipolar II. McGrath and associates (2004) reviewed the literature regarding comparisons of neurobiological differences between the two types and found that few studies examined this difference. Those in evidence yielded inconclusive results. The authors noted that research on genetic differences implied dissimilarities between the two types.

The functional MRI is recognized as the most useful tool for detecting abnormalities in the brain structure of individuals with bipolar disorder (Malhi, Lagopoulos, Owen, & Yatham, 2004). Malhi and associates drew this conclusion after reviewing the literature related to analysis of neurological abnormalities in bipolar patients. They noted that the majority of studies reporting differences used the fMRI. Specifically, they suggest, “the patterns of fMRI activation are different to those found in healthy subjects and patients with major depression. FMRI studies are likely to provide valuable insights into the pathophysiology of bipolar disorder” (p. 46).

In summary, it does appear that neurological differences provide indicators that bipolar disorder is present. Whether or not these differences are present in children is unknown. It would seem that the fMRI is the most widely used assessment tool in investigating bipolar disorder. Using fMRI in examining children with bipolar disorder would be an important step toward understanding the neurological differences such children exhibit.

Concluding Remarks

Assessment of the limbic system is one area of neurological investigation with great promise for differentiation between children with ADHD and children with bipolar disorder. Malhi, Lagopoulos, Ward, Kumari, Mitchell, Parker, Ivanovski, and Sachdev

(2004) report that fMRIs successfully differentiated between bipolar and normal individuals who were presented with positive and negative captioned pictures. They "conclude that bipolar depressed patients perhaps recruit additional subcortical limbic systems for emotional evaluation and this may reflect state-related or trait-related dysfunction. The differential patterns of activation inform us about bipolar depression and have potential diagnostic and therapeutic significance" (p. 741).

One difficulty in comparing neurological research conducted with ADHD subjects and with bipolar subjects is that different tools are likely to be used in assessing the two disorders. Functional MRIs are typically utilized when the research involves bipolar individuals. ADHD individuals are typically investigated with EEGs, MRIs, and SPECT. This makes it difficult to make comparisons between the two disorders in terms of abnormalities. It does seem that both difficulties involve the prefrontal lobe of the cortex. The limbic system is also involved in the neurological pathology of the bipolar patient, but it does not appear to be an aspect of ADHD. Thus, this area is most likely to generate the best differential diagnosis in adults when ADHD must be ruled out. Whether it is effective with children has not been explored. Little is known about limbic system development in the maturing child. Thus, identification of abnormalities in the immature limbic system might not allow the degree of specificity needed for diagnostic purposes, especially for ruling out a specific disorder.

Diagnosing children accurately and with specificity is especially important given their position on the developmental timeline. In other words, failure to keep a child on the "road" to normal development might have a long-term impact on her or his life as an adult. For example, children with untreated ADHD might develop academic problems that eventually lead to dropping out of school or development of conduct disorder. Children with untreated bipolar disorder might ultimately become suicidal. Appropriate treatment for correctly identified childhood disorders could assist the child in continuing to develop normally. Thus, further research in this area is necessary before any conclusions can be drawn regarding differential diagnosis of ADHD and bipolar children.

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