Panic Disorder in Children and Adolescents: A Review

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Objective: Panic disorder has been considered an adulthood disorder that does not occur in children or adolescents. The authors' goals were to critically review the available evidence for panic attacks and/or panic disorder in children and adolescents, to review the limited data on the biological basis of panic disorder as it has been studied in children and adolescents, to discuss the possible treatment approaches for panic disorder in children, and to suggest potential opportunities for further research on panic disorder in children. Data Collection: Sixty-three articles pertaining to panic disorder in children and adolescents were critically reviewed. These articles included retrospective histories of adults with panic disorder, clinical case reports of children and adolescents with panic disorder, studies of psychiatrically referred children and adolescents, reports from epidemiologic community and school samples of children and adolescents, studies of children and adolescents at risk for psychiatric disorder, reports of panic-like symptoms in pediatric patients, family studies of panic, studies of the biological basis of panic in adults, and studies of treatment for panic. Findings: There is strong evidence that panic disorder occurs in children and adolescents and that its clinical presentation in this population is similar to that found in adults. Conclusions: Extending the many adult studies of panic disorder to children and adolescents would be extremely fruitful. Like adults with panic disorder, many children and adolescents are brought to emergency and medical clinics for the physical symptoms of unrecognized panic disorder.

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Although anxiety symptoms are common in children of all ages and both sexes (1), only three anxiety disorders (overanxious disorder, separation anxiety disorder, and avoidant disorder) are classified specifically as disorders of childhood. Family studies and retrospective reports of childhood symptoms by adults with anxiety disorders suggest a continuity between childhood and adult anxiety disorders. Early childhood histories of separation anxiety disorders in adults with panic disorder have been reported (2). Other studies have linked an early history of separation anxiety disorder to several other adult anxiety disorders such as generalized anxiety disorder and agoraphobia (3, 4) as well as a predisposition to other types of psychopathology (5). Panic disorder, however, has been considered a disorder of adulthood that does not occur in children or adolescents. There is now evidence supporting the occurrence of childhood panic attacks with symptoms that are qualitatively distinct from those of separation anxiety disorder.

Isolated panic attacks occur in about 10% of adults, and recurrent panic attacks not meeting full diagnostic criteria occur in about 3.6% of adults (5). The rate of full-blown panic disorder is smaller (1.6%). There is increasing evidence that panic attacks and panic disorder are seriously disabling conditions with high morbidity (6–8). Moreover, a childhood onset of these disorders may be especially impairing. A report from the National Institute of Mental Health (NIMH) Epidemiologic Catchment Area (ECA) study (8) indicated that panic disorder with first onset at age 17 or younger was associated with greater risk of alcohol abuse, suicidal thoughts, suicide attempts, and use of emergency rooms than onset at age 18 or older.

Several retrospective reports from adults of their age at onset of panic attacks (9–12) have appeared, suggesting that panic attacks begin in childhood. However, before 1987 there were no published cases of panic attacks or panic disorder based on direct studies of children. In 1987, Casat et al. (13) reported the case of a 12-year-old girl with separation anxiety disorder and mitral valve prolapse. The girl reported symptoms suggestive of adult panic disorder, including tachycardia, sweating, dyspnea, generalized weakness, and “butter-
flies” in her stomach accompanied by school refusal. She later developed fears of crowds, heights, strangers, and being alone. Casat et al. suggested that some children with separation anxiety disorder may develop agoraphobia and panic attacks in adulthood. In 1989, three separate reports of panic attacks and/or panic disorder in a total of 24 children appeared (14–16).

In addition to retrospective reports of adults with panic disorder and clinical case reports of children and adolescents with panic, further evidence that panic attacks and/or panic disorder occur in children and adolescents can be found in clinical case reports of treatment of panic in children and adolescents, in assessments of psychiatrically referred children and adolescents based on structured diagnostic interviews and DSM-III criteria, in reports from epidemiologic community and school samples of children and adolescents, in studies of children and adolescents at risk for psychiatric disorders by virtue of their parents’ psychiatric disorder, and in reports of panic-like symptoms in children and adolescents seen in pediatric services.

The purposes of this paper are 1) to critically review the available evidence for panic attacks and/or panic disorder in children and adolescents, 2) to review the limited data on the biological basis of panic disorder as it has been studied in children and adolescents, 3) to discuss the possible treatment approaches for panic disorder in this population, and, finally, 4) to suggest potential opportunities for further research on panic disorder in children and adolescents.

REVIEW OF THE LITERATURE

Retrospective Reports of Adults With Panic Disorder

In several studies of adults with panic disorder (9–12), the subjects retrospectively reported that their panic disorder began in childhood or early adolescence (figure 1). These reports have received little attention. Sheehan et al. (9) studied 100 patients 19–61 years old who had DSM-III panic disorder with agoraphobia. The range of age at onset of panic was 5–58 years; the mean age at onset was 24.1 years. Twenty-six patients reported experiencing symptoms before the age of 20 years: 12 were between 15 and 19 years old, 10 were between 10 and 14 years old, and four were younger than 9 years old. Of interest and concern is the fact that the mean time from onset of symptoms to treatment for the total sample was 12.7 years.

Breier et al. (11) reported on age at onset of panic disorder in 60 adults with agoraphobia, mixed phobia, and/or panic disorder diagnosed according to Research Diagnostic Criteria (RDC). Seventeen (28%) of these patients reported that their panic disorder began before they were 20 years old. Eleven patients (18% of the sample) reported that their first panic attack occurred between the ages of 10 and 17, three (5%) reported that their first panic attack was at age 18, and another three (5%) reported that their first attack was at age 19.

On the basis of a retrospective chart review of 62 adults with DSM-III panic disorder without agoraphobia whose mean age at onset was 26.6 years (range=5–51), Thyer et al. (12) reported that 38% of the patients experienced symptoms before the age of 20 and 11% experienced symptoms before the age of 10. Thyer et al. obtained similar results in 95 adult patients diagnosed with panic disorder and agoraphobia.

The NIMH ECA study (17), which included a probability sample of more than 18,000 subjects 18 years old and older living in five U.S. communities, found a peak onset of panic disorder between the ages of 15 and 19. More than 18% of the adults in this study reported experiencing panic before they were 10 years old, and an additional 7% reported experiencing panic between the ages of 10 and 15.

Klein et al. (18) reexamined their data on childhood panic attacks and panic disorder in two study groups: 343 consecutive admissions to an adult anxiety disorders clinic and 560 first-degree relatives of patients admitted to an anxiety disorders clinic. Using the data from structured diagnostic interviews administered by trained clinicians, they determined that nine (1%) of the 904 subjects reported experiencing spontaneous panic attacks before they were 13 years old. Klein et al. reviewed the narrative summaries of these nine subjects and concluded that only three of them gave reports consistent with four-symptom spontaneous panic attacks occurring in childhood. They pointed out the inherent problems in the validity of retrospective reports of panic and suggested that the definition of spontaneous panic “is best done in the context of a series of such attacks.”

Although these reports suggest that panic disorder occurs in children and adolescents, retrospective reports of their childhood by adults are subject to problems of recall such as distortion and revision in addition to the validity issue raised by Klein et al. (18). In addition, prepubertal status at the time of onset of panic in
the subjects who retrospectively reported childhood onset was not established in these studies. Therefore, direct assessment of children and adolescents with panic disorder is critical to further our understanding of this disorder in this population.

**Case Reports of Children and Adolescents**

There are case reports of panic disorder in 22 children and adolescents that support adults’ retrospective reports of their age at onset of panic disorder (14, 19–23) (table 1). Because many children with panic come from families with panic, the recognition of the child’s disorder may represent a selection bias because parents with panic disorder may be more likely to recognize the symptoms in their children. Even though most of these studies did not use a structured diagnostic interview and cannot provide rates because of sampling problems, they are of interest because the diagnoses were made by experienced clinicians who provided details of the clinical phenomena.

These preliminary reports provide directions for future research based on sound methodology: use of structured diagnostic interviews, direct interviews with the child and the parent, and assessment of referred as well as nonreferred populations.

Vitiello et al. (19) made the first such report in a letter to the editor in 1987. They diagnosed DSM-III panic disorder in two prepubertal boys, one inpatient and one outpatient, using a structured diagnostic interview. The boys had been referred for separation anxiety. Their symptoms included shortness of breath, palpitations, chest pain, paresthesia, and trembling. Both boys had developed agoraphobia and school refusal. A family history of panic disorder was found in both children.

Biederman (20) reported panic disorder in three prepubertal children, two boys and one girl. Symptoms included restlessness, muscle tension, palpitations, sweating, and dry mouth in one boy; multiple autonomic symptoms in the girl; and symptoms of fear and shaking in the other boy. Two of the children refused to attend school, and the mothers of two of the children had a history of agoraphobia. Clonazepam was used successfully in all three children to reduce anxiety, and the children’s functioning returned to normal.

Ballenger et al. (14) reported on three children, two girls and one boy, who had DSM-III panic disorder with agoraphobia, all of whom responded to alprazolam and imipramine. Symptom complexes varied for each child but included dizziness, tingling, trembling, shortness of breath, palpitations, and a cold and clammy feeling. A family history of panic was reported in one child.

Black and Robbins (21) described six adolescents with panic disorder, two boys and four girls. Only one of these adolescents reported prepubertal onset of panic disorder. Symptoms included hyperventilation, flushing, sweating, shortness of breath, dizziness, tachycardia, and paresthesia in most of the subjects and isolated symptoms of shaking, headaches, faintness, and palpitations in all of the subjects. All six subjects reported a history of depression. A family history of panic disorder with agoraphobia was reported in one adolescent. Four of the children responded favorably to desipramine with agoraphobia.

Vitiello et al. (22) also reported DSM-III-R panic disorder in six prepubertal children, five boys and one girl, referred to an academic child psychiatry service. All but one of the children were outpatients. All of these children had heart pounding, weakness, trembling or shaking, and feelings of dying or going crazy. Five children had shortness of breath, lightheadedness or dizziness, and chest tightness or pain. Four children had tingling of fingers or face, feelings of choking or smothering, and sweating. None of the children reported hot or cold flashes or blurred vision. School avoidance was diagnosed in three of the children. The diagnoses of separation anxiety disorder and school avoidance were independent of panic disorder. The mean interval between first panic attack and diagnosis was 3 years. A family history of panic disorder was found in all six children.

In a letter to the editor, Black et al. (23) reported on two additional prepubertal girls with panic disorder and agoraphobia. The diagnosis in both children was based on a structured diagnostic interview of the child and the parent. The 8-year-old girl had mild depressive symptoms and developed separation anxiety disorder subsequent to her panic disorder. Her father had a history of panic disorder with agoraphobia. She described sudden onset of fear accompanied by sweating, a “funny feeling in my throat,” a “funny smell,” trembling, nausea, feeling hot, her “heart feeling funny,” and fear of loss of control. The 12-year-old girl reported onset of panic at age 9. Her attacks were char-

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**TABLE 1. Case Reports of Panic Disorder in Children and Adolescents**

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Subjects With Panic Disorder</th>
<th>Age Range (years)</th>
<th>Subjects With Coexisting Disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitiello et al. (19)</td>
<td>1987</td>
<td>2</td>
<td>8-10</td>
<td>Separation Anxiety</td>
</tr>
<tr>
<td>Biederman (20)</td>
<td>1987</td>
<td>3</td>
<td>8-11</td>
<td>Mitral Valve Prolapse</td>
</tr>
<tr>
<td>Ballenger et al. (14)</td>
<td>1989</td>
<td>3</td>
<td>8-13</td>
<td></td>
</tr>
<tr>
<td>Black and Robbins (21)</td>
<td>1990</td>
<td>6</td>
<td>14-28</td>
<td></td>
</tr>
<tr>
<td>Vitiello et al. (22)</td>
<td>1990</td>
<td>6</td>
<td>8-12</td>
<td></td>
</tr>
<tr>
<td>Black et al. (23)</td>
<td>1990</td>
<td>2</td>
<td>8-12</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 2. Reports of Panic Disorder in Psychiatrically Referred Children and Adolescents

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Sample</th>
<th>N</th>
<th>Age Range (years)</th>
<th>Subjects With Panic</th>
<th>Subjects With Coexisting Separation Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>% At Time of Report</td>
<td>% At Onset</td>
<td>% Boy:Girl Ratio</td>
</tr>
<tr>
<td>Alessi et al. (24)</td>
<td>1987</td>
<td>61 inpatients</td>
<td>10</td>
<td>16</td>
<td>14-17</td>
<td>12-15</td>
</tr>
<tr>
<td>Alessi and Magen (25)</td>
<td>1988</td>
<td>136 inpatients</td>
<td>7</td>
<td>5</td>
<td>7-12</td>
<td>3-12</td>
</tr>
<tr>
<td>Last and Strauss (26)</td>
<td>1989</td>
<td>177 outpatients</td>
<td>17</td>
<td>10</td>
<td>14-18</td>
<td>9-18</td>
</tr>
</tbody>
</table>

characterized by “sudden onset of extreme fearfulness, crying, breathlessness, dizziness, flushing, sweating, tachycardia, palpitations, tremulousness, feeling that she may lose control, nausea, headache, feeling a lump in the throat, and pleading with her parents to take her away from whatever situation they were in.” There was no significant morbidity or family history of anxiety disorder. Both children were reported to respond favorably to tricyclic therapy. Despite the presence of a “funny smell” in the list of symptoms for one of these children, the authors did not consider the possibility of temporal lobe epilepsy. However, this girl’s positive response to tricyclic therapy favors the diagnosis of panic.

Although these reports are of interest because of their clear clinical descriptions of panic in children, they suffer from sample bias and lack of structured or semistructured diagnostic interviews. In addition, in the absence of data from placebo-controlled trials, these reports of treatment efficacy must be considered tentative.

Assessment of Psychiatrically Referred Children and Adolescents

Diagnoses of panic disorder have been made in studies of psychiatrically referred children and adolescents using the Schedule for Affective Disorders and Schizophrenia—Childhood Version and DSM-III criteria (24–26) (table 2). The subjects were referred for psychiatric treatment for multiple reasons, not necessarily panic symptoms, and thus provide some limited data on the frequency of panic in psychiatrically referred children and adolescents.

Alessi et al. (24) found that 10 of 61 adolescents on an adolescent psychiatric inpatient unit had panic disorder according to RDC and that another 15 had possible panic disorder. All but one of the 10 patients with definite panic disorder had a comorbid depressive disorder. The mean age at onset of panic was 13.9 years, and no prepubertal onsets were reported. More than half of the adolescents with definite panic disorder reported symptoms of sweating, trembling, palpitations, and feelings of faintness. Trembling was reported by nine of the adolescents with panic disorder.

Alessi and Magen (25) diagnosed panic disorder in seven of 136 children consecutively admitted to a child diagnostic and research inpatient unit. Four of the children with panic disorder were boys and three were girls. The most common referral symptoms were school refusal and aggression, followed by depression and somatic complaints. Trembling or shaking, dyspnea, palpitations, and dizziness were reported by five of the children with panic disorder, and chest pain, choking, faintness, fear of dying, hot and cold flashes, and sweating were reported by three. Paresthesias were reported in one child. Depressive disorders were diagnosed in four of the children.

Last and Strauss (26) reported that 10% of 177 consecutive referrals to an outpatient pediatric anxiety clinic had DSM-III-R panic disorder. Only one prepubertal child had panic attacks, and only one adolescent reported a prepubertal onset of panic. Panic symptoms resembled those found in the adult disorder. Palpitations/tachycardia, trembling, and flushes or chills were each reported in 94% of the patients with panic disorder, shortness of breath and sweating by 82% and dizziness/faintness by 75%. All other panic attack symptoms, except choking, were present in more than half of the children with panic disorder. Comorbidity was found in approximately half of the children, most commonly another anxiety disorder. Of interest is the fact that 33% of the mothers met DSM-III-R criteria for a lifetime diagnosis of panic disorder.

Again, the issue of prepubertal status was not specifically addressed in these studies. The age range of the children and adolescents (7–18 years), however, suggests that at least some of these children were prepubertal at the time of their panic.

Epidemiologic Community and School Surveys of Children and Adolescents

There have been no large, multisite epidemiologic surveys of children and adolescents using current psychiatric diagnostic criteria comparable to the ECA data on adults. Three small epidemiologic studies have reported on panic disorder (16, 27, 28) (table 3).

Hayward et al. (16) reported that the lifetime prevalence rate of at least one four-symptom panic attack in 95 ninth-grade students whose mean age was 14.5 years was almost 12%. Eight girls and three boys had panic disorder. Three other boys reported limited symptom panic attacks.

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Macaulay and Kleinknecht (27) surveyed 660 children and adolescents 13–18 years old. They found severe panic with symptoms similar to adult panic disorder in 30 of the subjects and moderate panic in 58 of the subjects. Severe panic included symptoms of distress and seriousness, but moderate panic referred to either distress or seriousness. There was no significant difference in frequency of attacks between subjects with severe and moderate panic. Girls outnumbered boys by about three to one. The median age at onset of panic was 13 years.

In a two-stage epidemiologic survey of a New Jersey community, Whitaker et al. (28) initially screened 5,000 students 14–17 years old for multiple psychiatric symptoms, including panic symptoms. During the second stage of the study, 356 students were interviewed with a semistructured interview yielding DSM-III diagnoses. The interviews were conducted by individuals who were blind to the results of the first stage of the study. A diagnosis of panic disorder was made on the basis of results from the Columbia Clinical Interview (29). The lifetime prevalence rate of panic disorder reported—0.6%—is similar to that reported in persons with onset at age 17 or younger in the ECA. Fewer than half of the students with panic disorder in the study of Whitaker et al. had received treatment for their symptoms.

The Whitaker et al. study used semistructured interviews, albeit before the development of validated semistructured DSM-III interview protocols suitable for use with children and adolescents. The other two studies used self-report questionnaires, and only Hayward et al. (16) had the diagnosis confirmed by a child psychiatrist using DSM-III-R criteria. DSM-III-R criteria were used to make a diagnosis of panic attacks, but the frequency of attacks was not reported so the diagnosis of panic disorder could not be confirmed. Despite these limitations, these data clearly support the occurrence of panic attacks in children and adolescents and support the high probability of such attacks meeting DSM-III-R criteria for panic disorder.

### Studies of Children and Adolescents at Risk for Psychiatric Disorder

We reported on the occurrence of panic disorder in children at risk for psychiatric disorder by virtue of depression in one or more parents (15). Six (2.7%) of the 220 children in this study met DSM-III criteria for panic disorder. A seventh child, who was 9 years old, reported panic attacks that did not meet the frequency criteria for DSM-III panic disorder. Diagnoses were made by a child psychiatrist and were based on all available information, including structured diagnostic interview of child and mother. The range in age at onset of panic disorder in this study was 5–18 years. Two of the six children with panic disorder were clearly prepubertal (they were 5 and 6 years old) at onset of panic. The prepubertal status at onset of panic of three of the children, who were 10, 12, and 13 years old, was not determined. Comorbid illnesses were common among the six children, particularly major depression and separation anxiety disorder. The symptom pattern of the panic attacks resembled that of the adult disorder. All six children reported shortness of breath, and five children reported palpitations. Chest pain, choking, dizziness, sweating, trembling, fear of death, faintness, and feelings of unreality were found in three of the children. Two children experienced tingling, and one child described hot and cold flashes. The parents of four of the children had panic disorder in addition to major depression.

### Reports of Panic-Like Symptoms in Children and Adolescents Seen in Pediatric Services

Children with depressive disorders have been shown to have frequent somatic complaints (30, 31). Although there are many reports in the literature on childhood hyperventilation, the relationship of hyperventilation to panic attacks is unknown (32). Four studies in the pediatric medical literature (33–36) suggest the occurrence of panic attacks in children and adolescents (table 4).

Herman et al. (33) examined Mayo Clinic records over a 25-year period and found 34 children diagnosed with hyperventilation syndrome whose symptoms were suggestive of panic attacks. When these children were contacted for follow-up information, many reported chronic anxiety. van Winter and Stickler (34) reported panic disorder in six children at the Mayo Clinic. Herskowitz (35) reported on four children with panic attacks who were brought to pediatric services with neurological symptoms.

In a retrospective chart review of all cases seen between 1984 and 1988 by the psychiatric consultation-liaison service at a tertiary referral pediatric hospital, Garland and Smith (36) diagnosed four cases of DSM-
III-R panic disorder. Three children were referred to psychiatry during the first months of medical workups yielding no organic etiology for somatic complaints. Substantial complications in the children's school and family functioning were noted. The authors suggested that children with the somatic complaints of panic disorder may be brought to pediatric services. If confirmed, this would be comparable to the situation for adults with panic disorder, who often seek medical rather than psychiatric treatment (37).

The Nature of Panic in Children and Adolescents

Some investigators question whether the nature of panic is similar in children and adults. Acute, sudden onset of physiological symptoms and the attribution of such sensations to losing control or going crazy seem to be necessary for a diagnosis of panic attacks. Nelles and Barlow (32), on the basis of Piaget's theory of cognitive development, expressed doubts as to whether children have the cognitive capacity to make such an attribution. The studies reviewed here (13-16, 18-28, 34-36) suggest that children experience the same physiological symptoms of panic as adults and also, like adults, attach fearful or catastrophic significance to these physical sensations. These fears and physical sensations do not seem to be invariably associated with or brought on by separation from a major attachment figure. Therefore, they appear to be distinct from separation anxiety disorder, which, in any event, is characterized by somatic complaints, not physiological symptoms suggestive of autonomic hyperactivity. Further detailed clinical study of the symptom pattern of children with panic disorder is needed.

Family Studies of Panic

Several studies have examined rates of anxiety disorders in the relatives of adults with anxiety disorder (38-41). Other studies have examined the rates of these illnesses in the relatives of children with anxiety disorders (42). A review of these and other studies in progress supports the familial nature of panic disorder (43).

To our knowledge, only one study has reported on the rates of anxiety disorders in the relatives of children with a diagnosis of DSM-III-R panic disorder. Last et al. (44) compared the rates of anxiety disorders in the first- and second-degree relatives of children 5-18 years old who had anxiety disorders (including panic disorder) with rates of anxiety disorders in the first- and second-degree relatives of children who had attention deficit disorder and were never psychiatrically ill. Diagnoses of anxiety disorders were made in 94 children on the basis of results obtained from the Schedule for Affective Disorders and Schizophrenia for School-Age Children (KIDDIE-SADS) (modified for DSM-III-R) administered to the child and the parent. Adult relatives of 94 children with anxiety disorders, nine of whom had a primary diagnosis of panic disorder, were given the Structured Clinical Interview for DSM-III-R and the childhood disorders sections (separation anxiety disorder, overanxious disorder, attention deficit disorder, avoidant disorder) of the modified KIDDIE-SADS. The child relatives of the children with anxiety disorders were given the complete modified KIDDIE-SADS. First-degree relatives of children with anxiety disorders had higher rates of anxiety disorder than first-degree relatives of two control groups. More specifically, the relatives of children with overanxious disorder had higher rates of panic disorder than the relatives of children with separation anxiety disorder and other anxiety disorders. There was a trend for relatives of children with panic disorder to have higher rates of panic disorder than relatives of children with other anxiety disorders. The small number of family studies that included children limit conclusions and suggest a potentially interesting area for further research.

Data on the Biological Basis of Panic in Children and Adolescents

There have been considerable research efforts in adults to identify potential biological markers for panic. Catecholamine levels, frequency of mitral valve prolapse, and agents that produce laboratory models of panic attacks have been studied. The latter include lactate infusion, carbon dioxide inhalation, isoprotenerol hydrochloride, yohimbine hydrochloride, and caffeine, which can produce panic attacks in laboratory subjects with a history of panic disorder. These invasive challenge tests are used in research studies exploring the biological differences among anxiety disorders and the physiological basis of panic attacks (45). Therefore, their use in children for research purposes has been necessarily limited.

There has been some suggestion of an association between mitral valve prolapse and panic attacks in adults.
Both disorders can present with similar symptoms mediated by hyperactivity of the autonomic nervous system. The diagnosis of mitral valve prolapse is made by cardiac auscultation, which reveals a characteristic mid- to late-systolic click and/or late systolic murmur, and by echocardiogram. The prevalence of mitral valve prolapse in the general population is 3% to 4% (46). Women are more commonly affected than men. Age appears to affect the prevalence of mitral valve prolapse; children have rates of 1% and adolescents show rates approaching those found in adults (46). Mitral valve prolapse diagnosed by echocardiogram has been associated with panic disorder in adults in several studies (47–50) but not in others (51–53).

The literature on a possible association between mitral valve prolapse and anxiety in children is sparse. In a study of 813 children 9–14 years old, Arkken et al. (54) found that the prevalence of mitral valve prolapse diagnosed by cardiac auscultation was 4.2%. These authors found no difference in anxiety scores between a group of children with mitral valve prolapse and a group of children without mitral valve prolapse. In an unpublished study Gorman and Klein (personal communication) found that mitral valve prolapse was diagnosed by echocardiogram in three out of 16 children with anxiety disorders, the majority of whom had separation anxiety disorder. The possible co-occurrence of mitral valve prolapse and panic disorder in children warrants further exploration based on these findings. We are currently conducting such a study at our institution.

Only one published study has examined biological markers in children at risk for panic disorder by virtue of panic disorder in their parents (55). Thirty-nine children, 7–17 years old, were examined for mitral valve prolapse by cardiac auscultation and echocardiogram, lactate levels after maximal exercise, 24-hour urinary catecholamine levels, and platelet monoamine oxidase (MAO) activity. Although a trend toward higher 24-hour catecholamine levels and greater MAO activity were found in the high-risk children than in normal control subjects, there were no statistically significant differences between children of patients with panic disorder and normal control subjects on any of the tests.

TREATMENT FOR PANIC ATTACKS: BEHAVIORAL AND PHARMACOLOGICAL APPROACHES

Behavioral and cognitive therapy as well as pharmacotherapy have been systematically tested in adults but not in children or adolescents with panic disorder. Clinical trials in adults have shown that exposure (56) and medications such as tricyclic antidepressants (57), fluoxetine (58), alprazolam (59), lorazepam (60), and clonazepam (61) are effective in reducing the symptoms of panic. The use of cognitive and behavioral treatment in children with anxiety, particularly fears and phobias, has been reported in open trials and clinical practice (62), but there are no controlled clinical trials of these treatments with children. Pharmacological studies in children with anxiety disorders in general have been extremely limited and include neuroleptics, psychostimulants, antihistamines, and anxiety and antidepressant medications. The data so far are inclusive and limited. Therefore, there is no scientific basis yet to support the use of these medications in children with anxiety disorders, with the possible exceptions of tricyclic antidepressants for separation anxiety disorder and obsessive-compulsive disorder (63). Pharmacological treatments that are efficacious in adults with panic disorder have been used in clinical practice for children with panic (14, 20, 21), but clinical trials are absent.

IMPLICATIONS FOR FUTURE RESEARCH AND CASE FINDING

Our review suggests a number of potential directions for future research on panic attacks and/or panic disorder in children and adolescents. Information that is emerging from the studies of adults with panic disorder could fruitfully be extended. This could include studies of the natural history and clinical course of children whose panic disorder and symptoms were systematically diagnosed and assessed and who were followed longitudinally, family-genetic studies of children with panic to attempt to replicate the familial aggregation findings found in adults, studies of the biological markers of panic in children, and controlled clinical trials of behavioral and pharmacological approaches for the treatment of panic in children.

Thorough diagnostic evaluations using structured diagnostic interviews and DSM-III-R criteria could be conducted in children with panic disorder. These children could be followed longitudinally to determine the evolution of symptoms as well as the natural history and course of childhood-onset panic disorder. Do children with panic disorder continue to have panic when they reach adulthood?

Biological studies that have proved fruitful in adult patients with panic and that pose no psychological or physical threat to the child (examples include echocardiograms and determining catecholamine levels) could be conducted to determine the prevalence of mitral valve prolapse in children with panic disorder and in children with other anxiety disorders or with no anxiety disorders. Do children with panic have higher mean 24-hour catecholamine levels than children with other anxiety disorders or children with no anxiety disorders?

Finally, research methods and designs used to study behavior therapy and pharmacological therapy in adult patients with panic disorder could be applied to the study of children with panic disorder. It would be important to compare differences and similarities among children, adolescents, and adults with panic disorders to determine if and how age affects treatment response. In terms of case finding, children with panic disorder, like adults with the disorder, probably are brought to emergency and medical clinics for physical symptoms.
(i.e., hyperventilation, dizziness, palpitations), and their diagnosis may go unrecognized. Therefore, pediatric and neurology clinics and pediatric emergency rooms may be important areas for case finding. In addition, there is reasonable evidence that children of parents with panic and anxiety disorders are at greater risk for having panic, so some of the cases may be found in these families.

Our review suggests that panic disorder occurs in adolescents and, less frequently, in prepubertal children. The field is ripe for a host of studies developed in adults to be extended to children. These studies must, of course, take into account the specific needs of and precautions for this younger age group.

REFERENCES


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