Objective: Despite the high prevalence and significant morbidity associated with posttraumatic stress disorder (PTSD) in children and adolescents, there are limited and conflicting data to guide psychopharmacologic interventions. With these considerations in mind, we sought to summarize the current evidence for psychopharmacologic interventions in youth with PTSD.

Data Sources/Study Selection: We conducted a literature review of the National Library of Medicine to identify publications of pharmacologic treatments for youth with PTSD or posttraumatic stress symptoms. The search was limited to articles written in English and published between 1966 and 2009. In addition, we manually searched each citation for additional references and the following journals: *Journal of the American Academy of Child and Adolescent Psychiatry* and *Journal of Child and Adolescent Psychopharmacology*.

Data Extraction: All articles were manually reviewed and evaluated. Thereafter, each agent or class of medication was categorized by level of evidence.

Data Synthesis: Three double-blind, randomized controlled trials of selective serotonin reuptake inhibitors (SSRIs) and 1 double-blind randomized controlled trial of imipramine in children and adolescents with PTSD or acute stress disorder were identified. Additionally, several open-label studies and case series involving other classes of medications (eg, antiadrenergics, other antidepressants, and second-generation antipsychotics) were reviewed.

Conclusions: The extant data do not support the use of SSRIs as first-line treatments for PTSD in children and adolescents. There is limited evidence that the brief use of antiadrenergic agents, second-generation antipsychotics, and several mood stabilizers may attenuate some PTSD symptoms in youth. However, controlled trials of these agents in children and adolescents with PTSD are needed.

*J Clin Psychiatry*
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DATA SOURCES AND STUDY SELECTION

We conducted a literature review of the National Library of Medicine using the following key words: trauma, posttraumatic stress disorder, posttraumatic stress symptoms, stress, acute stress disorder; child abuse, sertraline, fluoxetine, fluvoxamine, paroxetine, citalopram, escitalopram, venlafaxine, desvenlafaxine, duloxetine, clonidine, guanfacine, prazosin, doxazosin, propranolol, antiepileptics, lithium, valproate, divalproex, carbamazepine, oxcarbazepine, lamotrigine, topiramate, gabapentin, pregabaline, levetiracetam, atypical antipsychotics, risperidone, olanzapine, quetiapine, ziprasidone, aripiprazole, paliperidone, benzodiazepines, alprazolam, clonazepam, lorazepam, diazepam, cyproheptadine to identify pharmacologic treatment reports of these agents in children and adolescents with PTSD or posttraumatic stress symptoms. The search was limited to studies written in English and published between 1966 and 2009. In addition, we manually searched each citation for additional references and searched the following journals: Journal of the American Academy of Child and Adolescent Psychiatry and the Journal of Child and Adolescent Psychopharmacology. All articles were manually reviewed and evaluated. Thereafter, each agent or class of medication was categorized by level of evidence.

RESULTS

Selective Serotonin Reuptake Inhibitors (SSRIs) and Selective Serotonin-Norepinephrine Reuptake Inhibitors

Although SSRIs are considered to be among the first line pharmacologic interventions for adults with PTSD and their use is supported by many but not all studies in adult patients with PTSD, results of clinical trials in children and adolescents have often failed to demonstrate significant advantages compared to placebo.

The first double-blind placebo-controlled trial of SSRIs in pediatric PTSD compared the use of flexibly dosed sertraline (mean dose, 150 mg/d; range, 50–200 mg/d) and placebo as adjunctive treatment to trauma-focused cognitive-behavioral therapy (TF-CBT). Both treatment groups experienced significant improvement in posttraumatic stress symptoms and other clinical outcomes, suggesting minimal benefit to adjunctive sertraline use in TF-CBT. In a subsequent multisite placebo-controlled trial of flexibly dosed sertraline (50–200 mg/d), Robb and colleagues examined 131 children and adolescents with PTSD over 10 weeks and noted no differences in primary outcome (change in University of California at Los Angeles Posttraumatic Stress Disorder Reaction Index 17-item total score) between sertraline-treated patients and those receiving placebo though sertraline was noted to be generally well tolerated.

Finally, one very recent study found no difference among fluoxetine (5 mg/d for children < 40 kg, 10 mg/d for those weighing 40–60 kg, and 20 mg/d for children weighing > 60 kg), imipramine (1 mg/kg), and placebo for the treatment of acute stress disorder symptoms in children with thermal burns; however, the duration of treatment was only 1 week and thus would have been unlikely to have shown clinical benefit.

In addition to these double-blind placebo-controlled trials, a number of case reports and open-label studies have examined the utility of SSRIs in pediatric patients with PTSD. For example, Seedat et al treated 24 youth with PTSD with citalopram (20–40 mg/d) for 8 weeks and noted improvements in Clinician-Administered PTSD Scale (CAPS) total and symptom cluster scores as well as the Clinical Global Impressions-Improvement scale (CGI-I) score. In a prior open-label study of citalopram in adolescents with PTSD, Seedat et al treated 8 patients with moderate to severe PTSD with a fixed dose of citalopram (20 mg/d) and found reductions in total CAPS Child and Adolescent Version (CAPS-CA) score (38% decrease from baseline to endpoint) and scores on CAPS-CA subscales for reexperiencing, avoidance, and hyperarousal symptoms. We are unable to locate pediatric treatment trials of escitalopram, fluvoxamine, or paroxetine or the selective serotonin-norepinephrine reuptake inhibitors duloxetine, venlafaxine, or desvenlafaxine.

Other Antidepressant Medications

In a brief (7-day) comparison trial of imipramine and chloral hydrate, Robert and colleagues found that low-dose imipramine provided superior reduction in acute stress disorder symptoms for pediatric burn victims.

Despite several open-label trials of trazadone and nefazadone in adults with PTSD, there are limited data supporting the use of these agents in youth with PTSD. Doman and Anderson noted tolerability of nefazodone in adolescents with PTSD at doses up to 600 mg/d as well as clinical improvement in all 3 symptom clusters as well as anger and aggression. The norepinephrine-dopamine reuptake inhibiting agent bupropion has yield disappointing results in both open-label and double-blind trials of adults with PTSD. At present, we are unable to locate any published reports of using bupropion in youth with PTSD. Finally, many randomized controlled trials of monoamine oxidase inhibitors have supported the use of these compounds in the management of PTSD in adults, although results of these randomized controlled trials have not been universally positive. We are unable to locate any reports of monoamine oxidase inhibitors in the treatment of pediatric PTSD.

Antidrenergic Medications

Supported by adult and pediatric data that have demonstrated noradrenergic hyperactivity in PTSD, clinicians have often utilized antidrenergic agents to treat children and adolescents with PTSD or posttraumatic stress symptoms (Table 1). The dysregulated noradrenergic system observed in patients with PTSD can be pharmacologically modified in a variety of ways by a number of agonists or...
The target dose of 2–4 mg/d is based on the current available pediatric PTSD literature; however, the maximum approved dose of this medication for the management of pediatric hypertension is 15 mg/d. It is likely that such a dose in a normotensive pediatric patient would be poorly tolerated.

**Receptor/Target Drug Initial Pediatric Dose (mg) Target Pediatric Dose (mg)**

<table>
<thead>
<tr>
<th>Receptor/Target</th>
<th>Drug</th>
<th>Initial Pediatric Dose (mg)</th>
<th>Target Pediatric Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>α₁ Antagonist</td>
<td>Prazosin</td>
<td>1 qhs</td>
<td>2–4 reported in the 2–4 qhs</td>
</tr>
<tr>
<td>α₂ Agonist</td>
<td>Clonidine</td>
<td>0.05 qhs (children aged 0.2–0.5 5–10 years)</td>
<td>6–20 8–12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1 qhs (children aged &gt;10 years)</td>
<td></td>
</tr>
<tr>
<td>β₁/β₂</td>
<td>Guanfacine</td>
<td>0.5 bid 1–3 1–3</td>
<td>12–24 13–14</td>
</tr>
<tr>
<td></td>
<td>Propranolol</td>
<td>10 tid 40–80 4–6</td>
<td>4–6 4–6.4</td>
</tr>
</tbody>
</table>

**Common Adverse Effects and Notes**
- Reflex tachycardia, orthostatic hypotension (may have first dose hypotension); lack of energy; nausea
- Use with caution in children <12 years of age
- Dry mouth, dizziness, sedation, bradycardia, rebound hypertension
- Dry mouth, sedation, dizziness, Bradycardia, sedation, thymocytic purpura and bronchospasm

*aSlow titration of these medications is recommended in children and adolescents.
*bThe target dose of 2–4 mg/d is based on the current available pediatric PTSD literature; however, the maximum approved dose of this medication for the management of pediatric hypertension is 15 mg/d. It is likely that such a dose in a normotensive pediatric patient would be poorly tolerated.

**Abbreviations:** bid = twice a day; qhs = every night; t1/2 = half-life; tid = three times a day.

**α₂ Agonists.** In case series of adults with PTSD and at least 2 randomized controlled studies of adult combat-related PTSD, the α₂ antagonist prazosin appears to be efficacious, particularly with regard to intrusive symptoms. At present, there are limited data on the use of these agents in children and adolescents with PTSD, although Brkanac and colleagues reported the successful use of adjunctive prazosin (4 mg every night [qhs]) in an adolescent female with severe PTSD. This patient had been hospitalized in a long-term residential facility and noted improvement in sleep and cessation of nightmares. Similarly, we have recently reported an adolescent female armed robbery victim who was successfully treated with prazosin monotherapy (2 mg qhs) and experienced rapid reduction in intrusive symptoms.

There are limited data regarding the dosing of prazosin in youth though our experience and dosing strategies, which have been extrapolated from adults, suggest that prazosin should be initiated at 1 mg at bedtime and may be increased by 1 mg/wk as tolerated to a maximum dosage of 4 mg/d. However, significantly higher doses are reported in the adult PTSD literature, and this medication is used for the treatment of hypertension in children at doses up to 15 mg/d (400 μg/kg/d).

**Centrally acting α₂ agonists.** The α₂ agonist clonidine appears to be effective in attenuating hyperarousal, hypervigilance, sleep disruption, exaggerated startle responses, and nightmares in open-label trials of adults with war-related PTSD as well as in a double-blind, placebo-controlled trial conducted in adult patients with borderline personality disorder and comorbid PTSD. By contrast, 2 recent double-blind placebo-controlled trials of adults with chronic, combat-related PTSD have failed to detect differences between those treated with the less potent α₁ agonist guanfacine and those treated with placebo.

Despite the frequency with which the α₂ agonists are used by child and adolescent psychiatrists, there are limited data for their use in youth with PTSD. In abused youth, clonidine decreases reenactment symptoms. Similarly, the α₂ agonist guanfacine may reduce nightmares in children with PTSD. At present, there are no double-blind trials of clonidine or guanfacine in pediatric patients with PTSD.

Clonidine is highly bioavailable (75%–95% bioavailability) and has a rapid onset of action (generally within 30–60 minutes). This agent is often initiated at doses of 0.05 or 0.1 mg given initially at bedtime, and doses are increased by 0.05 mg every 3 days; however, multiple doses are often required, given the short half-life of this agent, and doses should not exceed 0.5 mg/d. Also, as with many of the antidrenergic medications, heart rate and blood pressure should be monitored, and the medication should not be discontinued abruptly. Common adverse effects of α₂ agonists include dry mouth and sedation, both of which lessen with time. Compared to adults in whom the half-life is approximately 6–20 hours, the half-life in children is significantly shorter (8–12 hours). The α₂ agonist guanfacine also rapidly penetrates the central nervous system and is actually more rapidly absorbed than clonidine and reaches peak levels in 1–4 hours. In addition, this agent is substantially more selective for the α₂ receptor than clonidine.

**Centrally acting β-blockers.** Adult studies of the long-chain β-blocker propranolol suggest that it may both...
prevention and treatment. A case series (on-off-on design), 11 children with abuse-related PTSD had significantly fewer symptoms when receiving propranolol.

Of particular interest, there are 2 published double-blind controlled trials of propranolol in the secondary prevention of PTSD in adults, although in 1 of these trials the low dose of propranolol may have been inadequate (as evidenced by heart rates between the 2 groups) and thus the 40 mg dose utilized may have been “insufficient to fully attenuate patients’ acute posttraumatic hyperadrenergic states,” which may have accounted for the lack of a significant longer term preventive effect on PTSD development.

One recent pediatric pilot study evaluated propranolol (2.5 mg/kg/d; maximum dose, 40 mg bid; duration of treatment, 12 hours) as a secondary prevention of PTSD in children and adolescents aged 10–18 years. In this study, 29 children were randomized to receive propranolol (or placebo) within 12 hours of accidental traumatization and there were no differences in CAPS-CA scores or in the number of patients meeting criteria for PTSD or subthreshold criteria for PTSD at 6 weeks follow-up.

Propranolol is approximately 30%–40% orally bioavailable (though this may be increased in some conditions, such as Down syndrome) and its onset of action typically occurs within 2 hours. Its half-life in children and adults is similar (4–6 hours) and typical doses are 10–40 mg every 6 hours. Blood pressure and heart rate should be monitored carefully over the course of dose titration, and common adverse events include hypotension, bradycardia, lightheadedness, fatigue, dizziness, nausea, and bronchospasm.

### Second-Generation Antipsychotics

Second-generation antipsychotics have been used extensively for the treatment of children and adolescents with a constellation of severe neuropsychiatric conditions and have generally been well tolerated. In addition, both aripiprazole and risperidone have recently received US Food and Drug Administration (FDA) indications for the treatment of several psychiatric disorders in children and adolescents (eg, bipolar disorder, schizophrenia, aggression associated with autism).

Over the last decade, there have been 7 double-blind placebo controlled trials of second-generation antipsychotic agents (either as monotherapy or as adjunctive therapy) in the treatment of adults with PTSD. A recent meta-analysis of these studies suggests that second-generation antipsychotics may be beneficial in the treatment of PTSD and notes that these agents may be particularly effective in reducing intrusive symptoms of the disorder.

**Risperidone.** Multiple placebo-controlled and open-label trials of risperidone support its use in adults with PTSD. Although some of these trials have examined the usefulness of risperidone monotherapy, most have focused on adjunctive treatment. In addition, Meighen and colleagues recently treated 3 preschool-aged children with serious thermal burns and acute stress disorder and noted that risperidone reduced all symptom clusters of acute stress disorder. We recently reported significant improvement associated with adjunctive risperidone in a 13-year-old boy with severe sexual abuse– and neglect-related PTSD, although his treatment was complicated by transient hyperprolactinemia.

**Quetiapine.** A number of open-label trials and retrospective reviews have noted quetiapine to be effective in reducing symptoms of PTSD in adults, although generally at lower doses than typically employed in the treatment of acute manic or mixed episodes associated with bipolar disorder or in the treatment of schizophrenia. In addition, a 12-week, double-blind, placebo-controlled, randomized, fixed-flexible dose trial of quetiapine monotherapy for the treatment of adults with PTSD is currently underway (clinicaltrials.gov identifier: NCT00237393) as is a randomized placebo-controlled trial of adjunctive quetiapine for adult PTSD (clinicaltrials.gov identifier: NCT00306540). At present, there is 1 study that has examined the efficacy of this agent in youth with PTSD. In this study, adolescents with PTSD (n = 6, aged 15–17 years) were treated with flexibly dosed quetiapine (50–200 mg/d). Improvement in Traumatic Symptom Checklist for Children posttraumatic stress t scores (mean ± SD, 75 ± 5.2 to 54 ± 7.4) and in symptoms of anxiety, depression, and anger were noted over a 6-week treatment period.

**Ziprasidone.** There is 1 small case series91 that describes beneficial effects of ziprasidone in adult patients with PTSD, and a trial of ziprasidone for the treatment of adults with PTSD has been registered (clinicaltrials.gov identifier: NCT00208208); however, the results have not been published and there are no reports of ziprasidone in children or adolescents with PTSD.

**Olanzapine.** At least 1 double-blind placebo controlled trial of adjunctive olanzapine in SSRI-refractory PTSD has demonstrated reasonable improvement in adults with PTSD. However, not all double-blind placebo-controlled trials of olanzapine in adults with PTSD have observed differences between placebo and olanzapine though this may have been attributable to a high placebo response rate. Finally, a number of open-label trials and case reports/series96,97 support the efficacy of olanzapine in the treatment of adults with PTSD. To our knowledge, there are no reports of olanzapine for the treatment of children or adolescents with PTSD.

**Aripiprazole.** Although several studies of adults with PTSD have noted aripiprazole monotherapy98,99 and adjunctive aripiprazole100–102 to be effective in reducing target symptoms, there are no studies of aripiprazole in children or adolescents with PTSD.

The second-generation antipsychotics, though potentially effective and efficacious, may also cause significant side effects in the pediatric population that must be recognized and managed effectively. These side effects include...
extrapyramidal effects, tardive dyskinesia, obesity, hyperlipidemia, increased prolactin levels, and increased QTc interval. Importantly, the long-term sequelae of these adverse effects (eg, hyperprolactinemia, extrapyramidal symptoms/tardive dyskinesia) remain largely unknown. Moreover, the relative liabilities of these agents to precipitate these adverse effects may be different in children as compared to adults.103

Mood Stabilizers

The extant literature supporting the use of antiepileptic drugs (ie, mood stabilizers) in adults with PTSD consists of several double-blind placebo-controlled trials (lamotrigine, divalproex, topiramate, and tiagabine) as well as a number of open-label trials of divalproex,104,105 carbamazepine,106 topiramate,107 phenytoin,108 levetiracetam,109 and gabapentin.110 In addition, the new antiepileptic agent pregabalin has been found to be effective in case reports of adults with PTSD112 and has been examined in a controlled, double-blind comparison study as an adjunctive agent for the treatment of in PTSD.113 Mixed effects have been observed in at least 2, if not all 3 of the primary PTSD clusters, and a variety of traumatized populations have been studied (eg, combat, abuse).

Topiramate monotherapy was more effective than placebo in reducing reexperiencing symptoms in adults with PTSD112 and has been examined in a controlled, double-blind comparison study as an adjunctive agent for the treatment of in PTSD.113 Mixed effects have been observed for tiagabine-treated patients in placebo-controlled discontinuation trials114 and other placebo-controlled trials of tiagabine have failed to show benefit.115 Hertzberg and colleagues116 noted the efficacy of flexibly dosed lamotrigine monotherapy (25–500 mg/d) in adults with chronic PTSD.116 Finally, 2 double-blind, placebo-controlled trials of divalproex monotherapy have failed to demonstrate efficacy in reducing CAPS scores in veterans with chronic PTSD.117,118

With regard to trials of mood stabilizers in children and adolescents with PTSD, we were able to locate only 1 open-label trial of carbamazepine in children (aged 8 and 17 years) with sexual abuse–related PTSD119 and 1 trial of divalproex in youth with PTSD.120 In the carbamazepine study,119 after attaining target carbamazepine serum levels of 10–11.5 μg/mL, 22 of the 28 patients were asymptomatic, while the remaining 6 showed improvement as well. In general, carbamazepine was well tolerated, with no adverse events being reported in the study, and all patients were discharged to community outpatient providers on their remission doses of carbamazepine.119 In the trial120 of divalproex, 12 male subjects (mean ± SD age, 16 ± 1 years) with comorbid conduct disorder and PTSD were randomly assigned to receive high- or low-dose divalproex, and those receiving high dose exhibited improvements in CGI score over the course of treatment. In addition, a chart review of 14 patients (aged 6–14 years) who were prescribed oxcarbazepine for mood symptoms and behavior problems associated with anger and irritability showed moderate clinical global improvement 50% of the time; however, the 1 patient in the study who carried the diagnosis of PTSD did not improve but instead was hospitalized due to worsening symptoms.121

Other Agents

Benzodiazepines. There are limited data to support the use of benzodiazepines in adults with PTSD,122 although these medications are often utilized to attenuate anxiety. Benzodiazepines used acutely following traumatization in adults do not produce differences in PTSD diagnosis at 3 or 6 months and do not appear to improve symptoms of dyssomnia or intrusive symptoms in adults with PTSD.123,124 Given the limited role of benzodiazepines in child and adolescent psychiatry and the unique consequences that they may have in youth (eg, disinhibition), it is not surprising that we are unable to locate any reports on the use of benzodiazepines in the management of PTSD in children and adolescents. In general, there are few controlled trials of benzodiazepines in children and adolescents, and many of those that exist are limited by brief duration, dose and high placebo response rates, as well as small sample sizes.125 At present, extrapolation from the available adult studies would suggest that these agents have limited value, although clinicians choosing to use these agents in children and adolescents with PTSD should be aware that benzodiazepines are more rapidly absorbed and metabolized in children as compared to adults.126

Cyproheptadine. Several case reports have examined the efficacy of the antihistamine and 5-HT2 antagonist cyproheptadine in the treatment of adults with PTSD and, in particular, its effect on intrusive symptoms.127–130 In the only pediatric report of which we are aware, Gupta and colleagues131 retrospectively evaluated the efficacy of adjunctive cyproheptadine in youth with PTSD and noted effects ranging from “complete remission to a decrease in the intensity and frequency of nightmares.”131

DISCUSSION

Despite accumulating data that suggest that PTSD in children and adolescents is associated with significant morbidity,132,133 often persists,134 and may worsen the course of other psychiatric comorbidities, there is scant evidence to guide psychopharmacologic treatment of PTSD in children and adolescents.

From the literature reviewed (Table 2), 2 placebo-controlled trials do not support the use of SSRIs in the treatment of children and adolescents with PTSD. However, depressive-spectrum disorders and other anxiety disorders are often comorbid in youth with PTSD, and SSRIs may have
Table 2. Current Psychopharmacologic Treatments for Posttraumatic Stress Disorder in Children and Adolescents

<table>
<thead>
<tr>
<th>Medication</th>
<th>Level of Evidence</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiadrenergics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prazosin</td>
<td>IV</td>
<td>↓ intrusive/hyperarous symptoms</td>
</tr>
<tr>
<td>Clonidine</td>
<td>IV</td>
<td>↓ reenactment symptoms</td>
</tr>
<tr>
<td>Guanfacine</td>
<td>IV</td>
<td>↓ intrusive symptoms</td>
</tr>
<tr>
<td>Propranolol</td>
<td>IV, 1 Negative RCT for secondary prevention</td>
<td>↓ hyperarousal symptoms</td>
</tr>
<tr>
<td>Second-generation antipsychotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quetiapine</td>
<td>IV</td>
<td>↓ TSCC scores and anxiety, depression and anger</td>
</tr>
<tr>
<td>Risperidone</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Antiepileptic drugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Divalproex</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>SSRIs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sertraline</td>
<td>2 Negative RCTs</td>
<td></td>
</tr>
<tr>
<td>Citalopram</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Other agents/classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyproheptadine</td>
<td>IV</td>
<td>↓ intrusive symptoms</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td></td>
<td>No evidence to support use</td>
</tr>
</tbody>
</table>

'Levels of evidence: level I, systematic review or multiple randomized controlled trials; level II, randomized trial; level III, individual case-control studies; level IV, case-series; level V, expert opinion or based on physiology.

Symbol: ↓ decrease.

Abbreviations: RCT = randomized controlled trial, SSRI = selective serotonin reuptake inhibitor, TSCC = Trauma Symptom Checklist for Children.

a treatment role in patients with both conditions. Extrapolation from adult studies and open-label trials in children preliminarily support the use of antiadrenergic agents, particularly with regard to the management of intrusive and hyperarousal symptoms. Available evidence supports the need for a trial of an adjunctive second-generation antipsychotic (eg, quetiapine or risperidone) or the mood stabilizer carbamazepine in youth with PTSD. However, importantly, the extant pediatric data inform child and adolescent psychiatrists that caution must be used when extrapolating findings from adult studies to the treatment of youth with PTSD, as some agents that have been shown to be effective in adult populations have failed to yield such results in children and adolescents. It remains to be determined if the differential efficacy of these agents in pediatric populations relates to pharmacokinetic or pharmacodynamic differences between children and adults or possibly to differences in the PTSD-related pathophysiology (see below).

Accumulating data suggest that the noradrenergic system is hyperactivated in PTSD and specifically that these neurochemical and neuroanatomic changes might be symptom linked, particularly with regard to intrusive and hyperarousal symptoms. Of note, many of the structures, such as the hippocampus and amygdala, that have been pathophysiologically implicated in PTSD in adults and children are coated in α receptors. It is of pharmacologic interest that several of the antipsychotics utilized to treat pediatric (and adult) PTSD (eg, risperidone and quetiapine) are potent antagonists at α receptors. However, at present pediatric data for the use of these agents is limited to case report–level evidence. Thus, double-blind placebo-controlled trials with centrally acting α and β receptor antagonists and α₂ agonists in pediatric PTSD populations are needed.

In addition to the noradrenergic system, a number of other neurochemical systems also have been implicated in the pathophysiology of PTSD in adults, including substance P, hypothalamic-pituitary-axis products (eg, corticotropin-releasing hormone, adrenocorticotropic-releasing hormone, and cortisol), neuropeptide Y, β-endorphin, and orexin-A among others. Although studies are necessary to evaluate the degree to which these systems are similarly dysregulated in children and adolescents with PTSD, early work in this field has implicated adrenocortical dysregulation and noradrenergic hyperactivity. Also dysregulation of cytokine physiology may prove to be both pathophysiologically and therapeutically important in traumatized children. More immediately, substance P antagonists, orexin agonists, and neuropeptide Y antagonists are in various stages of development.

Beyond the increasing understanding of the neurochemical changes in PTSD, advances have been made in identifying neurofunctional and neuroanatomic changes that may similarly serve as therapeutic substrates and targets. For example, functional imaging studies and magnetic spectroscopy have identified metabolic differences in anterior cingulate activity in children with maltreatment-related PTSD and have suggested differences in amygdalar activation, potentially supporting the process termed limbic kindling. Specifically, this putative kindling process has been suggested to occur between the amygdala and hippocampus in a manner similar to the seizure model. Hypothetically, this process could result in primary symptom clusters of PTSD. As functional neuroimaging techniques and probes advance, it is likely that kindling will be better understood and the respective effects of specific antiepileptic agents will be more precisely targeted.

Given that many pediatric patients with PTSD have experienced symptomatic improvement over the course of psychotherapy, studies that address the role of complimentary pharmacotherapy in ameliorating residual symptoms are necessary. It is also of interest that many of the trials of pharmacotherapies, such as of the antiadrenergic agents and some second-generation antipsychotics, suggest that these medications may be preferentially effective in reducing intrusive and hyperarousal symptoms, whereas some modalities of therapy (eg, TF-CBT) may confer particular benefit in reducing avoidant symptoms. Thus, some clinical experience suggests psychotherapy with adjunctive pharmacotherapy while other evidence suggests pharmacotherapy.
with adjunctive psychotherapy. The combination of the modalities appears to be of importance as a future area of study and an option for clinicians treating patients.

With regard to secondary prevention of PTSD (eg, administration of a medication following traumatization), 1 small, negative pilot trial has examined the role of propranolol in this capacity in children and adolescents. Beyond adrenergic targets, it is hoped that additional agents might be explored, such as substance P antagonists, glucocorticoid antagonists, or even high-dose glucocorticoids and corticotropin receptor antagonists. We are unaware of any proposals in children and adolescents.

From a public policy standpoint, the state of evidence for the psychopharmacologic treatment of PTSD in children and adolescents highlights the ubiquitous gap in child psychiatry between how medications are used and the evidence that supports their use. A number of multilevel, but controversial solutions have been proposed to address this gap. Specifically, the pharmaceutical industry might be encouraged to examine available agents in children and adolescents with PTSD and the National Institutes of Health might facilitate “short term trials of medications…where knowledge gaps are greatest, levels of prescribing are highest and potential for toxicities with long-term exposure is most prominent.” Finally, it has been suggested that the FDA implement proposed regulations that mandate studies of new medications in children and adolescents. Given the large numbers of youth exposed to traumatizing experiences through child maltreatment, domestic violence, and community violence, it is imperative to improve the scientific basis for the psychopharmacologic treatment of PTSD and trauma-related symptoms.

Importantly, clinicians must bear in mind that traumatized children often suffer from a variety of psychiatric sequelae that can be comorbid with PTSD symptoms, including depression, ADHD, affective instability, disruptive behaviors, and dysregulated attachment. Clinicians would do well to use psychopharmacologic strategies (as clinically appropriate) to address these symptoms when present in patients with PTSD. While we have focused on psychopharmacologic approaches to the management of PTSD, individual or group psychotherapy should be considered part of comprehensive treatment.

**Drug names**: alprazolam (Xanax, Niravam, and others), aripiprazole (Abilify), bupropion (Wellbutrin, and others), carbamazepine (Carbatrol, Equetro, and others), citalopram (Celexa and others), clonazepam (Klonopin, and others), clonidine (Catapres, and others), divalproex (Depakote and others), duloxetine (Cymbalta), escitalopram (Lexapro and others), fluoxetine (Prozac, Sarafem, and others), fluvoxamine (Luvox and others), gabapentin (Neurontin and others), gabapentin (Gabitril), topiramate (Topamax and others), venlafaxine (Effexor and others), ziprasidone (Geodon).

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**Potential conflicts of interest**: Dr DelBello has received research support from AstraZeneca, Eli Lilly, Johnson & Johnson, Shire, Janssen, Pfizer, Bristol-Myers Squibb, Repligen, Martek, Somerset, National Institute on Drug Abuse, National Institute of Mental Health, National Institute on Alcohol Abuse and Alcoholism, NARSAD, Thresher Foundation, and GlaxoSmithKline; has served on lecture bureaus for Bristol-Myers Squibb, AstraZeneca, and France Foundation; and has served on consulting/advisory boards for or has received honoraria from Schering-Plough, GlaxoSmithKline, Eli Lilly, France Foundation, Kappa Clinical, Pfizer, and Medical Communications Media. Dr Geracioti receives research grants from the US Department of Veterans Affairs, National Institutes of Health, and the US Department of Defense; is a medical consultant to www.WebEMDR.com; and is majority unit holder of RxDino. Drs Strawn, Keeshin, and Putnam report no potential conflicts of interest.

**Funding/support**: None reported.

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