

# Complex obsessive compulsive and impulsive symptoms in Tourette's syndrome

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**Abstract:** Obsessive compulsive and impulsive symptoms are prevalent in patients with Tourette's Syndrome (TS) and well recognized as part of the TS spectrum. However, some complex obsessive compulsive and impulsive behaviors may be mistaken for other symptoms, such as complex tics or psychotic behavior. In addition, the overlap between tics, compulsions, and impulsive actions can make them impossible to discern from each other. Yet, the proper recognition of these symptoms is critical in optimizing treatment outcome in TS patients. This paper will review complex obsessive compulsive and impulsive behaviors that may occur in patients with TS and discuss implications for diagnosis and treatment.

**Keywords:** obsessions, compulsions, tics, psychosis, Tourette's syndrome

## Introduction

Impulsive behavior is common in patients with the chronic tic disorder Tourette's syndrome (TS), usually associated with comorbid attention deficit hyperactivity disorder (ADHD). About half of patients with TS have associated obsessive compulsive features (Comings et al 1985). Obsessions are persistent ideas, thoughts, impulses or images that are intrusive and inappropriate and cause anxiety and distress. Compulsions are repetitive behaviors or mental acts that are carried out to prevent or reduce anxiety (Hollander 1993). Common obsessions and compulsions are listed in Table 1. The obsessive compulsive symptoms associated with TS more frequently involve symmetry, ordering, aggression, religion and sex and less often contamination compared to those of primary obsessive compulsive disorder (George et al 1993; Holzer et al 1994; Miguel et al 1997; Cath et al 2001). In addition to the typical obsessions, compulsions and impulsive behaviors, in caring for a large population of TS patients we have observed a variety of more complex forms that have overlapping clinical phenomenology and have caused diagnostic and therapeutic confusion. This paper will review these complex obsessive compulsive and impulsive symptoms.

## Compulsive tics

Complex motor tics consist of coordinated movements that often resemble voluntary actions. Some complex motor tics like clapping, touching, rubbing, tapping and knocking can be the identical motor action as a compulsion. The action is generally considered a compulsion if it has certain characteristics: (1) it is performed according to specific rules (ie, it is ritualistic) such as a certain number of times, in a certain order or at a certain time of day (eg, bedtime rituals), (2) it is performed in response to an obsession, or (3) it is performed to reduce anxiety, distress or discomfort or to ward off future harm or a dreaded event. Unlike compulsions, motor tics are often preceded by focal uncomfortable somatic sensations ("sensory tics") that are temporarily relieved by the tics (Kurlan et al 1989). Response to drug therapy may help distinguish complex motor tics and compulsions. Tics generally improve with the use of an

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**Table 1** Common obsessions and compulsions

	Common obsessions	Common compulsions
<b>OCD</b>	Contamination	Washing
	Repeated doubts	Cleaning
	Need for order or symmetry	Counting
	Aggressive/violent obsessions	Checking
	Sexual imagery	Ordering
		Demanding reassurances
		Repetitive actions
<b>TS</b>	Mental play	Touching
	Perfectionism	Self-injurious behavior
	Aggressive/violent obsessions	Need for order or symmetry

**References:** (Cath et al 2001; George et al 1993; Holzer et al 1994).

alpha-adrenergic agonist or antipsychotic medications while compulsions usually respond to selective serotonin reuptake inhibitors (SSRIs). Cognitive behavioral therapy may also reduce compulsions.

We have encountered many TS patients in whom these distinctions are not readily applicable. For example, some TS patients describe their premonitory sensations as being more generalized, psychic and distressing (Kurlan et al 1996) and report that the tics are performed to relieve this discomfort. Many TS patients must repeat tics in a rule-like fashion described as “until I feel just right.” We have seen many instances in which TS patients have individual repetitive behaviors that include focal and generalized premonitory sensations, “just right” phenomena and specific rules. Thus, there are repetitive behaviors in TS patients that are virtually impossible to classify as a tic or a compulsion and have features of both. We call these “compulsive tics” or “compultics”. Examples are listed in Table 2. While SSRI’s are an effective pharmacologic treatment for OCD, there is a substantial subgroup of OCD patients who derive no benefit from this treatment (McDougle et al 2000; Miguel et al 2003). Some studies suggest that the presence of tics is associated with a poorer treatment response to SSRI’s and the addition of a neuroleptic drug is an effective treatment strategy (McDougle et al 1990; McDougle et al 1994; McDougle et al 1995). In our experience, the patients with “compultics” fall into this category and optimal therapy involves the combination of anti-obsessional and tic-suppressing treatments. The following case illustrates “compultics” occurring during reading in a young girl.

C. presented for evaluation at age 7 years due to motor and vocal tics. She was the product of a normal pregnancy, labor and delivery and had normal developmental milestones. At 4 years of age she developed repetitive eye blinking lasting approximately 6 weeks. At age 6, eye blinking recurred and

was accompanied by facial and sniffing tics. Other complaints included excessive slowness in reading and in getting dressed each morning. C. reported that when attempting to read she experienced an irresistible urge to always hold 3 additional pages of the book in her right hand and to jerk her eyes up and down the page that she was reading in a multiple of 3. The number of multiples was determined by the number of paragraphs on the page. If she mistakenly jerked her eyes an extra time, she would have to repeat the process. Dressing was also associated with rituals. For example, she would only wear the third outfit that she tried on and she had to smell each item of clothing 3 times before trying it on. Other obsessive-compulsive symptoms included a bedtime ritual (ie, both parents had to kiss her 3 times before going to bed) and the need for symmetry and “evening-up” behavior (eg, both sides of her body had to “feel” the same, such as the tightness of fit of her shoes). She was observed to have eye blinking and other facial tics and sniffing tics, all considered to be mild in severity. Modest improvement in her rituals occurred following cognitive behavioral therapy but those associated with reading persisted, causing significant problems in school and with homework. The counting aspect of the reading ritual resolved following treatment with escitalopram 10 mg/day, but eye tics continued to interfere with reading. These resolved after risperidone 0.5 mg/day was added. C. has remained stable on this medication combination for two years.

## Impulsive and impulsive-compulsive tics

Impulsive behaviors are performed with little forethought and without regards to consequences, driven by the desire to obtain pleasure, gratification or arousal (Hollander et al 2000). They are considered manifestations of impaired impulse control. This is in contrast to compulsions, which are repetitive behaviors or mental acts that are carried out to prevent or reduce anxiety. Patients with TS often experience impulsiveness as part of commonly associated attention deficit hyperactivity disorder (ADHD). Some complex motor tics like poking, hitting, pushing, touching, coprolalic insults and other socially inappropriate comments and actions (Kurlan 1988) are directed at others, and have aggressive and impulsive qualities. We refer to these as “impulsive tics” or “impultics” (see Table 2). Some of these tics also have a compulsive quality, such as needing to be done a certain number of times or until the patient feels “just right”. Thus, some tics take on both impulsive and compulsive qualities (“impulsive-compulsive tics”). Optimum therapy may

**Table 2** Complex motor tics, compulsive tics, impulsive tics, impulsive-compulsive tics and schizo-obsessive symptoms

	<b>Complex motor tics</b>	<b>Compulsive tics</b>	<b>Impulsive tics</b>	<b>Impulsive-compulsive tics</b>	<b>Schizo-obsessive symptoms</b>
<b>Definition</b>	Coordinated, purposeless involuntary movements that can resemble voluntary activity	Repetitive movements performed according to rules (ie, ritualistic), in response to an obsession or to reduce tension	Repetitive movements performed without forethought and without regard to consequences. Often socially unacceptable	Repetitive movements with qualities of both compulsive and impulsive tics	Repetitive thoughts or beliefs that appear psychotic in nature
<b>Examples</b>	Skipping, hopping, rubbing, jumping, smelling	Touching a door a certain number of times; smelling fingers to check for contamination	Touching self or others; touching a hot stove; stepping into traffic	Hitting someone a certain number of times; Pushing someone after they cough to avoid contamination	Thoughts that a "voice" in the patient's "head" is telling him/her what to do; imaginary friends
<b>Treatments</b>	Alpha-adrenergic agonists, antipsychotics	SSRI's, antipsychotics, cognitive-behavioral therapy	Antipsychotics, alpha-adrenergic agonists, mood stabilizers, stimulants	Antipsychotics, alpha-adrenergic agonists, SSRI's, mood stabilizers, stimulants, cognitive-behavioral therapy	Antipsychotics, SSRI's, cognitive-behavioral therapy (CBT)

require targeting tics, obsessive-compulsive behavior and impulse control dysfunction. Treatments that may improve impulse control problems include antipsychotic medication, mood stabilizing drugs, stimulants and cognitive-behavioral therapy.

Some impulsive behaviors become repetitive and compulsive (eg, kleptomania, pathological gambling) (Table 3). Hollander (2000) considers these to be disorders of impulse control but also part of the obsessive compulsive spectrum, characterized by the inability to inhibit or delay repetitive behaviors (Hollander et al 1995). These disorders can be viewed along a continuum with an over-exaggerated sense of harm at the obsessive-compulsive end and an underestimated sense of harm at the impulsive end (Hollander et al 2000). Common types of these behaviors are listed in Table 3.

We find that many young TS patients who experience intermittent explosive disorder (rage attacks) (Budman et al 2000) have OCD and that the attacks are triggered by interference with a compulsive ritual or by unexpected events that are poorly tolerated in the setting of a rigid, inflexible, perfectionistic obsessive-compulsive thought pattern. The rages are often triggered when a compulsive ritual is interfered with, thus disrupting the completion of the ritual. The patient, fearing something terrible will happen if the compulsion is not completed, responds with rage and

anger at that which caused the disruption. However, it often appears to others that there has been no trigger for the rage since the actual trigger is an internal experience of the patient rather than an external, observable stimulus. Thus, these explosions can appear to either have no precipitant, or a precipitant that does not warrant the outcome. In this regard, the angry outbursts may seem totally irrational. In these cases, the optimal treatment of the rage attacks involves therapy directed at reducing obsessive-compulsiveness, impulsivity and aggression. The case presented here illustrates impulsive-compulsive behavior:

J. is an 18 year old male high school graduate, diagnosed with TS, OCD and ADHD at age 9. Family history is positive for ADHD in his father and OCD in his mother. J.'s younger brother also has TS, OCD and ADHD. Following diagnosis, J. was treated with a low dose atypical anti-psychotic to diminish tics, an SSRI for OCD, and methylphenidate for ADHD. He received cognitive behavioral therapy for OCD. While most symptoms were under relatively good control, a few persisted despite medication changes. Tics consisted mainly of head and neck jerks, eye blinking and grunting. They waxed and waned as expected, but were generally mild in severity. OCD symptoms also waxed and waned and were primarily focused on germs, cleanliness and fear of contamination. This led to an avoidance of touching

**Table 3** Common impulsive compulsions

<b>Males</b>	Pathological gambling
	Sexual addictions
	Pyromania
	Intermittent explosive disorder
<b>Females</b>	Kleptomania
	Trichotillomania
	Binge eating
	Shopping/buying
	Self-injurious behavior

**Reference:** (Hollander et al 2000).

things and fear of being touched, especially unexpectedly. Obsessive ruminations about germs resulted in the belief that he could be contaminated simply by being touched by someone he did not know. When he entered middle school, this information was conveyed to the school, with a request for special accommodations to help avoid a negative reaction to being touched by other students while switching classrooms between periods (eg, being allowed to leave classes before the other students), but this request was denied. Within two weeks of starting school, he was unexpectedly and accidentally pushed from behind by a female student. He then had a rage attack and physically assaulted the girl, resulting in the school calling the police and his subsequent arrest. He was later transferred to a small, private school for children with neurodevelopmental syndromes. Since then, he has learned to better control his impulsivity and OCD symptoms have lessened. Guanfacine was added to his treatment regimen to help dampen impulsive behavior. Since then, no similar incident has recurred.

### Schizo-obsessive symptoms

Many TS patients have obsessive thoughts that may resemble psychosis. In patients with OCD, it may be that certain obsessions such as religious preoccupations and fear of harming self or others are more highly associated with psychotic features (Tolin et al 2001). Although the development of schizophrenia in patients with OCD is relatively uncommon (Eisen et al 1999), OCD can result in symptoms that overlap with psychotic phenomena and can be difficult to separate, diagnose and treat (Hwang et al 2000). It is not uncommon for patients with OCD to develop delusions during the course of their illness but they tend to be transient and do not necessarily reflect a schizophrenia-spectrum disorder (Razali 2000). The following case presentation illustrates this symptom type:

D. is a 14 year old girl who was referred to the TS clinic for evaluation of vocal and motor tics, obsessive compulsive

behavior and attentional disturbance. The patient was adopted during infancy, so biological family history is not known. Birth history was unremarkable and she met all developmental milestones normally. However, D. was hyperactive, impulsive and had low frustration tolerance. Temper tantrums were problematic by age 3. Behavior continued to be disruptive and by age 6 she was notably aggressive. For example, in kindergarten she threatened to “cut off a boy’s penis”. Inability to pay attention and concentrate was also observed, but she was able to hyperfocus when reading. At age 7 she was seen by a psychiatrist for an evaluation of ADHD and started on methylphenidate (MPH). She responded well to this medication with significant reduction of ADHD and behavioral problems. However, she developed facial grimacing and throat clearing. She was taken off MPH and started on amphetamine salts, also with good control of her ADHD symptoms. Her academic performance was excellent with no behavioral problems. Tics abated. At age 12, D. decided she no longer wanted to take her medication and was allowed to stop. Significant behavioral and academic decline resulted. She was placed on sertraline following evidence of low mood, threats of self-harm and oppositional and defiant behavior, with little impact. Suicidal threats were made and the medication dosage was increased. During this time, regressive behaviors (eg, thumb sucking) developed. She also developed obsessive-compulsive symptoms including perfectionism, the need for orderliness and symmetry and excessive cleanliness. She became preoccupied with certain topics, such as methods of torture and fairies, and developed invisible friends, to which she gave names and interacted with on a daily basis. These invisible friends persisted; indeed, she responded to them as if they were real friends. When asked at age 14 if she thought these invisible friends and fairies really exist, she replied “yes”. Despite this, she had many actual friends and enjoyed socializing, playing sports, painting, drawing, singing and acting. Over the years, she saw several counselors and therapists to help with her behaviors. Facial and nose tics reappeared around age 13. At that time, she again developed facial and nose twitches. She reported being taunted at school, called “Tourette’s girl!” and the frequency of her tics increased to up to 30 per minute according to teachers and parents. At this time she was referred to our clinic.

D.’s examination was significant for low mood and the presence of mild vocal and motor tics, most notably facial tics and eye blinking. The following diagnoses were made: Tourette syndrome, ADHD-Combined Type, OCD with delusional features and dysthymia. In her case, the ADHD

and OCD were considered the most disabling features and targeted for treatment. Amphetamine salts were restarted with resultant improvement in ADHD symptoms and no significant worsening of tics. In fact, tics lessened over time without having to introduce a tic-suppressing agent. Mood stabilized with ongoing use of sertraline and obsessive compulsive symptoms became non-disabling. Within a few months, D.'s academic performance was again excellent. Her imaginary friends "disappeared" and she reportedly "felt sad losing them". Currently, at age 14, she frequently draws pictures of fairies and continues her belief in their existence. No new psychotic-like features have emerged and she remains stable.

While non-psychotic children have been reported to have hallucinations, mainly auditory (Schreier 1999; Yoshizumi et al 2004), some children with TS have been described as having "intense inner auditory or visual eidetic thought (which) may approximate hallucinations" (Kerbeshian et al 1987). Yet, the occurrence of psychotic-like obsessive symptoms in patients with TS has received little attention (Sverd et al 1993). Our own community epidemiologic study involving about 1600 school children found that 19.2% of children with tics obtained abnormal scores on the "Thought Disorder" index of the Achenbach Child Behavior Checklist (CBCL) compared to 8.6% of children without tics (Kurlan et al 2002). This index includes symptoms such as suspiciousness, having strange ideas, and hearing things that aren't there (Achenbach 1991). Uncharacteristic of OCD and TS, however, are negative symptoms associated with schizophrenia, such as anhedonia, flat affect and avolition. The presence of these symptoms, especially with onset signaling a significant change from baseline personality, may help differentiate a schizophrenic process from OCD and TS.

An association between OCD and psychosis has long been discussed in the literature. One of the first case descriptions was Freud's "Rat Man" who experienced obsessional fears that something terrible would happen to his father and fiancé and had delusions that his parents could read his mind (Freud 1955). It has been reported that certain obsessions, such as fear of harming self or others and religious preoccupations, are more highly associated with psychosis (Tolin et al 2001). In a study of patients with OCD and psychosis, 77% showed significant improvement when treated with a combination of an antipsychotic and an anti-obsessional medication (Ganesan et al 2001). A subgroup of schizophrenia patients have severe and persistent OCD and some clinicians have suggested that they represent a specific subtype of schizophrenia ("schizo-obsessive" or "obsessive compulsive

schizophrenia") based on a distinct clinical profile (Khullar et al 2001), neuropsychological pattern (Berman et al 1998; Lysaker et al 2000), course (Hwang et al 2000) and treatment response (Reznik et al 2000).

## Pathogenetic considerations

It is probably not surprising to see complex obsessive compulsive or impulsive symptoms, sometimes mixed with tics or psychotic features in patients with TS based on shared neuroanatomic sites of dysfunction. Disturbances of frontal cortical-basal ganglia and limbic pathways have been implicated in TS, OCD and schizophrenia by a variety of neuroimaging approaches (Eliez et al 2000), neuropsychological studies (Berman et al 1998; Cavallaro et al 2003) and neurophysiological studies (Sweeney et al 1992). Additionally, we have seen that virtually any pathological process that disrupts normal basal ganglia development can result in a similar complex clinical syndrome of tics and multiple psychiatric symptoms ("developmental basal ganglia syndrome") (Palumbo et al 1997). Neurosurgical (Montoya et al 2002) and clinical studies (Kurlan et al 1990; Gray 1994; Kim et al 2001; Amo et al 2004) have indicated the involvement of limbic structures in OCD and schizophrenia. A dysfunction of neural circuits interconnecting the orbitofrontal cortex, basal ganglia, limbic system and thalamus has been proposed as serving a critical role in the expression of OCD (Modell et al 1989). There is some evidence that the central dopaminergic system is involved in the pathophysiology of TS in which either excess dopamine or a hypersensitivity of D2 receptors is present (Dion et al 2002). Combined disturbances of dopamine and serotonin neurotransmission have also been linked to TS, OCD and schizophrenia (Kapur et al 1996; Sallee et al 1996; Segawa 2003; Yang et al 2004) and may characterize disorders manifested chiefly by the inability to properly delay or inhibit repetitive thoughts or behaviors (Hollander 1993). OCD symptoms tend to respond well to SSRI's, which block serotonin (5HT) reuptake (Zohar et al 2000) and traditional neuroleptic dopamine receptor antagonists have been shown to suppress tics (Scahill et al 2003). Therefore, atypical antipsychotic medications that target both dopamine and serotonin receptors have efficacy for TS, OCD and schizophrenia (Sallee et al 2003; Lynch 1997; Borison et al 1992). Unlike traditional neuroleptics which block D2 receptors only, atypical agents block both D2 and 5-HT2 receptors, and have a lower tendency to cause extrapyramidal symptoms (Mandoki 1995), thus making them a particularly useful treatment option for patients with complex tic-compulsive-psychotic features.

## Conclusion

Complex obsessions, compulsions and impulsive behaviors in TS patients are not uncommon and can overlap with other clinical phenomena, such as tics and psychosis, causing diagnostic and therapeutic confusion. Recognition of these complex behaviors in TS is critical in optimizing treatment (see Table 2). Often, patients with these problems will require combination treatment directed at alleviating tics, OCD, impulsivity and/or psychosis.

While the current information is observational, future research aimed at clarifying and quantifying the defining features of these complex symptoms is clearly an important area of study. Whether scores on formal rating scales can define and separate these TS subtypes is unknown. Quantifying symptom characteristics of tics and other comorbid conditions may also be important to better understand and treat these clinical problems.

## References

- Achenbach TM. 1991. Manual for The Child Behavior Checklist/4-18 and 1991 profile, Department of Psychiatry, University of Vermont, Burlington, VT.
- Amo C, Quesney LF, Ortiz T, et al. 2004. Limbic paroxysmal magnetoencephalographic activity in 12 obsessive-compulsive disorder patients: a new diagnostic finding. *J Clin Psychiatry*, 65:156–62.
- Berman I, Merson A, Viegner B, et al. 1998. Obsessions and compulsions as a distinct cluster of symptoms in schizophrenia: A neuropsychological study. *J Nerv Mental Dis*, 186:150–6.
- Borison R, Pathiraja AP, Diamond BI, et al. 1992. Risperidone: clinical safety and efficacy in schizophrenia. *Psychopharm Bull*, 28:213–18.
- Budman C, Bruun RD, Park K, et al. 2000. Explosive outbursts in children with Tourette's disorder. *J Am Acad Child Adolesc Psychiatry*, 39:1270–6.
- Cath DC, Spinhoven P, Van Woerkom T, et al. 2001. Gilles de la Tourette's syndrome with and without obsessive-compulsive disorder compared with obsessive-compulsive disorder without tics: which symptoms discriminate. *J of Nerv and Mental Dis*, 189:219–28.
- Cavallaro R, Cavedini P, Mistretta PB, T, et al. 2003. Basal-cortico-frontal circuits in schizophrenia and obsessive-compulsive disorder: a controlled, double dissociation study. *Biol Psychiatry*, 54:437–43.
- Comings D, Comings B. 1985. Tourette syndrome: clinical and psychological aspects of 250 cases. *Am J Hum Genet*, 37:435–50.
- Dion Y, Annabele L, Sandor P, et al. 2002. Risperidone in the treatment of Tourette syndrome: a double-blind, placebo-controlled trial. *J Clin Psychopharm*, 22:31–9.
- Eisen JL, Goodman WK, Keller MB, et al. 1999. Patterns of remission and relapse in obsessive-compulsive disorder: a 2-year prospective study. *J Clin Psychiatry*, 60:346–51.
- Eliez S, Reiss AL. 2000. Annotation: MRI neuroimaging of childhood psychiatric disorders: a selective review. *J Child Psychol Psychiat*, 41:679–94.
- Freud S. 1955. Complete psychological works. Vol 10. London: Hogarth Press.
- Ganesan V, Kumar TC, Khanna S. 2001. Obsessive-compulsive disorder and psychosis. *Can J Psychiatry*, 46:750–4.
- George MS, Trimble MR, Ring HA, et al. 1993. Obsessions in obsessive-compulsive disorder with and without Gilles de la Tourette's syndrome. *Am J Psychiatry*, 150:93–7.
- Gray JA. 1994. A general model of the limbic system and basal ganglia: applications to schizophrenia and compulsive behavior of the obsessive type. *Rev Neurol (Paris)*, 150:605–13.
- Hollander E. 1993. Obsessive-compulsive spectrum disorders: an overview. *Psychol Ann*, 23:355–8.
- Hollander E, Rosen J. 2000. Impulsivity [review]. *J Psychopharmacology*, 14:S39–44.
- Hollander E, Wong C. 1995. Obsessive-compulsive spectrum disorders. *J Clin Psychiatry*, 56:3–6.
- Holzer JC, Goodman WK, McDougle CJ, et al. 1994. Obsessive compulsive disorder with and without a chronic tic disorder: a comparison of symptoms in 70 patients. *Br J Psychiatry*, 64:496–73.
- Hwang NY, Morgan JE, Losconzcy MF. 2000. Clinical and neuropsychological profiles of obsessive-compulsive schizophrenia: a pilot study. *J Neuropsychiatry Clin Neurosci*, 13:115–16.
- Kapur S, Remington G. 1996. Serotonin-dopamine interaction and its relevance to schizophrenia. *Am J Psychiatry*, 153:466–76.
- Kerbeshian J, Burd L. 1987. Are schizophreniform symptoms present in attenuated form in children with Tourette disorder and other developmental disorders? *Can J Psychiatry*, 32:123–35.
- Khullar A, Chue P, Tibbo P. 2001. Quetiapine and obsessive-compulsive symptoms (OCS): case report and review of atypical antipsychotic-induced OCS. *J Psychiatry Neurosci*, 26:55–9.
- Kim MC, Lee TK, Son BC, et al. 2001. Regional cerebral blood flow changes in patients with intractable obsessive compulsive disorders treated by limbic leukotomy. *Stereotactic and Functional Neurosurgery*, 76:249–55.
- Kurlan R. 1988. What is the spectrum of Tourette's syndrome? *Curr Opinion Neurol Neurosurg*, 1:294–8.
- Kurlan R, Como PG, Miller B, et al. 2002. The behavioral spectrum of tic disorders: a community-based study. *Neurology*, 59:414–20.
- Kurlan R, Daragjati C, McDermott MP, et al. 1996. Complex socially inappropriate behavior in Tourette's syndrome. *J Neuropsych Clin Neurosciences*, 8:311–17.
- Kurlan R, Kersun J, Ballantine HT, et al. 1990. Neurosurgical treatment of severe obsessive-compulsive disorder associated with Tourette's syndrome. *Mov Disord*, 5:152–5.
- Kurlan R, Lichter D, Hewitt D. 1989. Sensory tics in Tourette's syndrome. *Neurology*, 39:731–4.
- Lynch MR. 1997. Selective effects of prefrontal cortex serotonin by dopamine D3 receptor agonism: interaction with low-dose haloperidol. *Progress in Neuropsychopharmacology and Biological Psychiatry*, 21:1141–53.
- Lysaker PH, Marks KA, Picone JB, et al. 2000. Obsessive and compulsive symptoms in schizophrenia: clinical and neurocognitive correlates. *Journal of Nervous and Mental Disease*, 188:78–83.
- Mandoki MW. 1995. Risperidone in the treatment of children and adolescents with Tourette's disorder. *Biol Psychiatry*, 37:618.
- McDougle CJ, Epperson CN, Pelton GH, et al. 2000. A double-blind, placebo-controlled study of risperidone addition in serotonin reuptake inhibitor-refractory obsessive-compulsive disorder. *Arch Gen Psychiatry*, 57:794–801.
- McDougle CJ, Goodman WK, Price LH, et al. 1990. Neuroleptic addition in fluvoxamine-refractory obsessive-compulsive disorder. *Am J Psychiatry*, 147:652–4.
- McDougle CJ, Goodman WK, Price LH. 1994. Dopamine agonists in tic-related and psychotic spectrum obsessive compulsive disorder. *J Clin Psychiatry*, 55:24–31.
- McDougle D, Fleischmann R, Epperson C, et al. 1995. Risperidone addition in fluvoxamine-refractory obsessive compulsive disorder: three cases. *J Clin Psychiatry*, 56:526–8.
- Miguel EC, Baer L, Coffey BJ, et al. 1997. Phenomenological differences appearing with repetitive behaviors in obsessive-compulsive disorder and Gilles de la Tourette's syndrome. *Br J Psychiatry*, 170:140–5.
- Miguel EC, Shavitt RG, Ferrao YA, et al. 2003. How to treat OCD in patients with Tourette syndrome. *J Psychosom Res*, 55:49–57.

- Modell JG, Mountz JM, Curtis GC, et al. 1989. Neurophysiologic dysfunction in basal ganglia/limbic striatal and thalamocortical circuits as a pathogenetic mechanism of obsessive-compulsive disorder. *J Neuropsych Clin Neurosci*, 1:27–36.
- Montoya A, Weiss AP, Price BH, et al. 2002. Magnetic resonance imaging-guided stereotactic limbic leukotomy for treatment of intractable psychiatric disease. *Neurosurgery*, 50:1043–52.
- Palumbo D, Maughan A, Kurlan R. 1997. Hypothesis III: Tourette's syndrome is only one of several causes of a developmental basal ganglia syndrome. *Arch Neurology*, 54:475–83.
- Razali SM. 2000. Obsessive-compulsive psychosis. *Aust N Z J Psychiatry*, 34:530–1.
- Reznik I, Sirota P. 2000. Obsessive and compulsive symptoms in schizophrenia: a randomized controlled trial with fluvoxamine and neuroleptics. *J Clin Psychopharmacol*, 20:410–16.
- Sallee FR, Gilbert DL, Vinks AA, et al. 2003. Pharmacodynamics of ziprasidone in children and adolescents: impact on dopamine transmission. *J Am Acad Child Adolesc Psychiatry*, 42:90907.
- Sallee FR, Richman H, Beach K, et al. 1996. Platelet serotonin transporter in children and adolescents with obsessive compulsive disorder or Tourette's syndrome. *J Am Acad Child Adolesc Psychiatry*, 35:1647–56.
- Scahill L, Leckman JF, Schultz RT, et al. 2003. A placebo-controlled trial of risperidone in Tourette syndrome. *Neurology*, 69:1130–5.
- Schreier HA. 1999. Hallucinations in nonpsychotic children: more common than we think? *J Child Adolesc Psychiatry*, 38:623–5.
- Segawa M. 2003. Neurophysiology of Tourette's syndrome: pathophysiological considerations. *Brain and Development*, 25:S62–9.
- Sverd J, Montero G, Gurevich N. 1993. Brief report: cases for an association between Tourette syndrome, autistic behavior, and schizophrenia-like disorder. *J Autism Dev Disord*, 23:407–13.
- Sweeney J, Palumbo D, Halper J, et al. 1992. Pursuit eye movement dysfunction in obsessive-compulsive disorder. *Psychiatry Res*, June:1–10.
- Tolin DF, Abramowitz JS, Kozak MJ, et al. 2001. Fixity of belief, perceptual aberration, and magical ideation in obsessive-compulsive disorder. *J Anxiety Disord*, 15:501–10.
- Yang YK, Yu L, Yeh TL, et al. 2004. Associated alterations of striatal dopamine D2/D3 receptor and transporter binding in drug-naive patients with schizophrenia: a dual-isotope SPECT study. *Am J Psychiatry*, 161:1496–8.
- Yoshizumi T, Hurawe S, Honjo S, et al. 2004. Hallucinatory experiences in a community sample of Japanese children. *J Child Adolesc Psychiatry*, 43:1030–6.
- Zohar J, Chopra M, Sasson Y, et al. 2000. Obsessive compulsive disorder: serotonin and beyond. *Am J Psychiatry*, 155:92–100.

