We've all been wrong about Provisional Tic Disorder

Amanda L. Arbuckle (ORCiD)

Emily C. Bihun (ORCiD)

Sarah C. Grossen

Jonathan M. Koller (ORCiD)

Keisuke Ueda (ORCiD)

David Y. Song (ORCiD)

Angela Reiersen (ORCiD)

Bradley L. Schlaggar (ORCiD)

Deanna J. Greene (ORCiD)

Kevin J. Black (ORCiD)

Correspondence to Dr. Black at kevin@wustl.edu or
Washington University School of Medicine
MSC 8134-70-2205
660 S. Euclid Avenue
St. Louis, Missouri 63110-1010

Abstract

Background: Provisional Tic Disorder (PTD)—current tics, less than a year since onset—is a common childhood neuropsychiatric disorder. The received wisdom among clinicians is that PTD is short-lived and mild, with one or at most a few tics, and rarely includes complex tics, premonitory phenomena or comorbid illnesses. However, such conclusions come from clinical experience, with biased ascertainment and limited follow-up.

Methods: Prospective study of 89 children with tics starting 0-9 months ago (median 4 months), fewer than half from clinical sources. Follow-up at 12 (± 24, 36, 48) months after the first tic.

Results: Most had ADHD (39), an anxiety disorder (27), OCD (9) or enuresis (26). Autism spectrum symptom scores were not elevated. Initial history revealed a past-week tic in only 49 of 59 children, but after video observation of the child seated alone, all had at least two current tics, with a lifetime total of 6.7 motor and 2.2 phonic tics (mean). Forty-one had had a complex tic, and 69 could suppress some tics. Total tic score was > 13 in 62/89, YGTSS impairment score was ≥ 20 in 14/88, and 53/62 had recent or planned doctor visits for the tics. At 12 months, 80 returned, and 79 still had tics. However, most (58/70) had no current plans to see a doctor for tics. Most who returned at 2-4 years still had tics known to the child and family, but medical impact was low.

Conclusions: Our results do not contradict previous observations, but overturn clinical lore.

Introduction

Tourette's disorder (Tourette syndrome, TS) is defined by tics—brief, repetitive unwanted movements or vocalizations—that develop in childhood and have persisted for at least a year (American Psychiatric Association, 2013). About 1 in 200 children age 5-14 have TS (Alves and Quagliato, 2014, Hornsey *et al.*, 2001, Khalifa and von Knorring, 2003, Mason *et al.*, 1998, Robertson, 2008). However, tics are much more common, affecting at least 20%, and arguably most children over time (Bihun *et al.*, 2023, Black *et al.*, 2016), which has led to the conclusion that tics usually disappear after a few months. When tics have lasted for less than a year, Provisional Tic Disorder (PTD) can be diagnosed. A major concern of parents is whether the recent onset of tics heralds a transient or a chronic tic disorder.

The received wisdom among clinicians has been that PTD is generally short-lived and mild, includes few tics, and rarely includes complex tics, premonitory phenomena, or comorbid illnesses (reviewed in Black *et al.*, 2016). However, such conclusions come from clinical experience. Unfortunately, clinical experience is biased. Many tics go unnoticed or are attributed to allergies, hyperactivity, or other problems. Parents are less likely to take children with mild tics to the doctor. Additionally, symptoms other than tics are quite frequent in these children. The most common of these are ADHD and OCD, but other anxiety disorders are also quite common (Hirschtritt *et al.*, 2015). Half of children with ADHD have tics at some point (Black, 2023), yet many fewer are diagnosed with tics. As Khalifa and von Knorring (2005) stated, "the majority of patients do not seek help for the tics but rather for other problems." Thus many children with tics are not diagnosed within the first year after tic onset. Therefore, the conclusions clinicians draw from their experience treating patients at specialty clinics are strongly affected by sampling bias. Similarly, clinical follow-up is biased; "these patients, characteristically, do not return for follow-up contacts" (Bruun, 1984). Tics may improve, or parents may become accustomed to the tics and no longer feel anxious about them. Thus, clinicians may erroneously assume a full remission even when tics persist.

Therefore, only a prospective study can accurately describe the features of PTD, a study that records tic severity and distribution, and comorbidities, both near tic onset and over an extended period of time, with special attention to persistence and remission. We therefore conducted the New Tics study (Black *et al.*, 2020), enrolling children whose tics had begun 0-9 months before a screening visit at which several clinical, psychological, and biological measures were collected. We then followed these children for several years. For comparison, we enrolled participants of the same age who had already had tics for at least a year, and children with no tics. We have previously reported some of the findings at screening and at 1 year after tic onset (Greene *et al.*, 2015, Kim *et al.*, 2020, Kim *et al.*, 2019a, Kim *et al.*, 2019b). However, over time several additional clinical observations surprised us, and we now have data from follow-up visits 2-4 years after tic onset. Here, we report novel, clinically-focused analyses from the New Tics study that we believe will

be of substantial practical interest to clinicians.

Methods

Subjects

The New Tics study was conducted at Washington University School of Medicine, St. Louis, Missouri, USA, and used a longitudinal design to investigate recent-onset tics. We actively recruited using physician referrals, flyers, school district e-flyers to parents, electronic medical records search, search engine advertising, and word of mouth. These methods were designed to recruit children with recent onset of tic disorder, many of whom do not seek immediate medical intervention for their tics. We enrolled children aged 5-10 years into one of three groups: (1) the NewTics group: children with tic onset 0-9 months before the first study visit;[1] (2) the TS/CTD group: children experiencing tics for at least one year who met criteria for either Tourette's Disorder or Persistent Tic Disorder; (3) the tic-free control (TFC) group: children who, through parent assessment, clinical examination, audiovisual observation, and self-reported history, had no tics or immediate family member with tics. Though not an aspect of the original study design, we additionally started to track a fourth group, (4) the LaterPTD group: children whose tic onset fell between 9 to 11.5 months before the baseline visit, since these individuals also have PTD. The study was approved by the Washington University Human Research Protection Office (IRB), protocol numbers 201109157 and 201707059. Each child assented and a parent (guardian) gave informed consent.

Protocol

A detailed description of the methods used can be found in (Black *et al.*, 2020), and the study protocol was registered (https://osf.io/cdx3n; 03 Oct 2016). Here we cover only the highlights.

All participants completed a baseline visit. For participants in the NewTics group, baseline visits occurred within 9 months of tic onset. These participants returned for a 12-month follow-up visit at the 1-year anniversary of their first tic (as nearly as possible). The NewTics participants were also invited to complete follow-up visits at the 2-year, 3-year, and 4-year anniversaries of their tic onset. Some of these later follow-up visits were prevented by public health measures for the COVID-19 pandemic.

The TS/CTD group completed a screening visit with the same procedures as the NewTics group and a follow-up visit at the 12-month anniversary of the tic onset of the NewTics participant they were matched to in terms of age, sex, and handedness.

The TFC group completed a screening visit and a 12-month follow-up visit that coincided

[1] A few NewTics children enrolled early in the study were age 11-14.

with the 12-month anniversary of the tic onset of the NewTics participant they were matched to in terms of age, sex, and handedness. Additionally, parents of the TFC participants were invited to complete an annual online survey (up to 4 years) that included follow-up questions regarding the development of tics or any other new conditions.

The LaterPTD group, with tic onset between 9 to 11.5 months before the screening visit, returned for a follow-up visit 3 months after screening. They were also invited to complete follow-up visits at the 2-year, 3 year, and 4-year anniversaries of their tic onset.

Assessments

Screening visit

Demographic information was collected including medical and surgical history, maternal and birth history, socioeconomic status, family history of tics, ADHD, and OCD, and descriptions of both current and past symptoms experienced by the participant. Study data were collected and managed using REDCap electronic data capture tools hosted at Washington University in St. Louis (Harris *et al.*, 2019, Harris *et al.*, 2009). Surveys completed by the parent or guardian through REDCap, with a recommendation to involve the child, included the Edinburgh Handedness Inventory (Oldfield, 1971), the Barratt Simplified Measure of Social Status (Barratt, 2012), parent-rated adaptations of the Yale Global Tic Severity Scale (YGTSS) and CY-BOCS (current and worst ever) (Findley *et al.*, 1999), ADHD Rating Scale (Conners *et al.*, 1998) rated for the time in the child's life when ADHD symptoms were most severe ("lifetime worst"), Social Responsiveness Scale (SRS) (Constantino *et al.*, 2003), Child Sensory Questionnaire (adapted from the Adult Sensory Questionnaire) (Kinnealey and Oliver, 2002), the American Psychiatric Association DSM-5 Parent/Guardian-Rated Level 1 Cross-Cutting Symptom Measure, Pediatric Quality of Life Inventory™ (PedsQL) (Varni *et al.*, 1999), Child Behavior Checklist (CBCL) ages 6 through 18 (or Y-CBCL Age 5) (Achenbach, 1991), and the Premonitory Uge Tics Scale (PUTS) (Woods *et al.*, 2005).

A standard tic suppression protocol (TSP) (Woods and Himle, 2004) was performed with clinician observation by remote video of the child seated alone in a room under several conditions, each 5 minutes in duration: no instruction to suppress tics (tic freely), verbal request not to tic (verbal), immediate reward for every disjoint 10-second period without a tic (Differential Reinforcement of Other behavior, DRO), and, in some participants, a non-contingent response (NCR) condition that presented the same number and timing of rewards as occurred in the DRO condition regardless of tic occurrence during the NCR session. Further details appear in (Greene *et al.*, 2015).

Other assessments administered by staff at baseline included the PANESS (Denckla, 1985), K-SADS-PL, a semi-standardized diagnostic interview with separate child and

parent interviews (Kaufman *et al.*, 1997), Purdue Pegboard test (Bloch *et al.*, 2006, Tiffin, 1968), Kaufman Brief Intelligence Test Second Edition (KBIT-2) (Kaufman and Kaufman, 2004), The Conners Continuous Performance Test II (CPT-II) (Conners and MHS Staff, 2000), and a weather prediction task of probabilistic classification, (Marsh *et al.*, 2004). The investigator (author KJB, for > 95% of study visits) performed a brief neurological exam and completed the following measures: Diagnostic Confidence Index (DCI) (Robertson *et al.*, 1999), YGTSS (for later subjects rated both before and after the TSP) (Leckman *et al.*, 1989), ADHD Rating Scale, CY-BOCS (Scahill *et al.*, 1997), and a clinician outcome data report form. For participants who had a post-TSP YGTSS rating, those scores were used for analysis of outcomes; earlier participants had only one YGTSS rating at each visit.

We invested substantial effort into determining as accurately as possible the date of tic onset (Greene *et al.*, 2015). We sought information on tic start date in semi-standardized interviews with the child and parent separately. We specifically asked them to consider major life events, birthdays, and holidays, we asked them to look up the date of doctor visits, and we asked whether teachers had observed tics. We asked the parents to examine any home videos. When this information led to a range of possible onset dates, such as "after Thanksgiving, but before New Year's," the investigator entered the beginning and end dates ("confidence range") and chose a most likely start date within that range.

Diagnoses for ADHD, OCD, and tic disorders were determined by two methods. In addition to the K-SADS-PL, author KJB recorded a clinical diagnosis based on all data collected prior to and during the visit.

Follow-up visits

Measures and assessments administered at most follow-up visits included the PedsQL, CBCL, Premonitory Uge Tics Scale, parent-rated CY-BOCS, medical history since the previous visit, a brief neurological exam, YGTSS (before and after the TSP), standard CY-BOCS, ARS, DCI, and the TSP.

After several participants had enrolled, we added questions about clinically relevant tic outcomes, such as "Are you planning to take your child to the doctor now or in the near future because of tics?" (counted as positive if there was a recent such visit). We defined tics as "clinically meaningful" at a given visit if any of the following criteria were true: YGTSS total tic score (TTS) > 13, YGTSS impairment score ≥ 20, parent planning to take child to the doctor because of his or her tics, or clinician judgment that in the week prior to the visit, tics impaired function in a life role or caused marked distress.

Late in the study, follow-up visits were shortened due to pandemic safety restrictions, and thereafter included only the PedsQL, PUTS, parent-rated CY-BOCS and ARS, medical history, DCI, outcome data, a single 5-minute remote observation of the child sitting

alone in the room (free to tic), and YGTSS ratings both before and after that 5-minute session. The clinician also reviewed psychiatric history since the previous visit and updated diagnoses as needed.

Diagnosis

Tic diagnosis and group assignment was by the investigator (author KJB) based on all information known by the end of the screening visit. Children with tics due to a medication, substance or general medical condition were excluded. Prior to mid-2017, tic diagnosis was by DSM-IV-TR criteria, and potential participants discovered to have tic onset > 6 months prior to screening were excluded unless their prior tic history consisted only of a single possible tic, over a year prior, lasting for no more than 2 months. After that point, NT participants had to have DSM-5 PTD with tic onset ≤ 9 months prior to screening.

Statistical analyses

Descriptive statistics and other analyses were conducted using Excel (version 2016) or R Studio (R version 3.6.1, 2019-07-05).

Results

Eighty-nine NT participants enrolled in the study, a median of 4 months after tic onset, and 79 of these returned at 12 months (Figure 1). Two of the 89 were initially scheduled as TFC (*i.e.,* on a brief screening telephone call, parents knew of no current or past tics), but were moved to the NT group when tics were observed at the screening visit. Nineteen participants were scheduled as NT, but a longer tic history was identified at the screening visit. Similarly, 3 were transferred from TFC to TS/CTD, and 1 from TS/CTD to LaterPTD.

Table 1 summarizes participant characteristics. In the NT group, the mean days since tic onset was 118.3 days (median= 111.0, range=22-268). The mean confidence range around tic duration was 22.9 days (median=14.0, range=0-123); *i.e.*, for half of participants, the onset date was felt to be accurate within one week. Most had ADHD (39), an anxiety disorder (27), OCD (9) or enuresis (26). On average, ASD symptom scores were perfectly normal (SRS T-score 50.4 ± 10.0).

Tables 2 and 3 report the tic features present at the baseline and follow-up visits. In 10 of 59 cases, child and parent initially denied the presence of tics in the past week, but after thoroughly reviewing the YGTSS symptom checklist and the K-SADS interview findings with child and parent, a tic in the past week was reported for 60 of 62 children. After observing the child during history and physical exam, the PI was confident of a past-week tic in only 49 of 59 NT participants. However, often tics became obvious when the child was observed by remote video monitoring while seated alone in a room (during the TSP). Thus, by the end of the visit, all NT participants had at least 2 lifetime tics identified, and over 80% had at least one phonic tic prior to or at the baseline visit. The number of tics

known by the end of the screening visit tended to correlate with the 12-month TTS (p = 0.078) while controlling for the screening TTS. Controlling for the TTS at screening may have reduced the significance of this correlation somewhat, since the YGTSS TTS includes items for number of motor and phonic tics, and hence is not completely independent of the number of tics observed. On average, the TTS increased by almost 2 points from before to after the TSP.

Most participants still had tics at their 24, 36, and 48-month follow-up visits. These tics were, in most cases, apparent to both the parent and the clinician (see Table 3). In some participants, however, tics were observed only on the TSP, when the child was observed by video while seated alone (7 of 33 at 2 years, 8 of 34 at 3 years, 6 of 24 at 4 years). By 2-4 years after initial tic onset, YGTSS scores were low for most participants: 42-65% had a TTS score > 13, the inclusion criterion for one of the largest TS behavior therapy studies (Piacentini *et al.*, 2010), and only 15-20% had impairment scores of 20 ("mild") or higher. Many parents no longer viewed tics as a major concern; only 8-12% were planning on taking their child to the doctor because of the tics.

An additional 10 children with DSM-5 PTD but with tics beginning 9-11.5 months prior to the first visit (LaterPTD) are described in Tables 4-6. They are similar to the NT group.

Discussion

Results that are NOT surprising

The fraction of children with "clinically meaningful" tics, as we defined it, dropped from 74% at screening to 28% at the 1-year anniversary of the first tic. On average, 12-month total tic scores declined by 29% relative to the screening visit. In other words, on average, the prognosis for PTD at 1 year after tic onset is good, even if at least occasional tics remain in essentially all of the children at follow-up.

We found a M:F sex ratio of about 2.6:1. In Tourette syndrome, this ratio is usually agreed to be closer to 4:1, but previous studies of PTD also found a lower sex ratio, with values ranging from 1.2 to 4.0 (Corbett *et al.*, 1969, Lanzi *et al.*, 2004, Lapouse and Monk, 1964, Nomoto and Machiyama, 1990, Snider *et al.*, 2002). Among several possible explanations for this difference, we hypothesize that girls are more likely than commonly thought to have a first tic (*i.e.*, to develop PTD), but that earlier maturation of inhibitory pathways and better attention to social feedback allows their tics, to improve earlier, especially in the presence of others, in spite of greater mean anxiety.

Results that are surprising

The typical impression of Provisional Tic Disorder is well reflected in this comment by Dr. David Comings: "Transient tic disorder … is usually a mild condition. I don't recall ever seeing a case of transient tic disorder that 'caused marked distress or significant impairment on social, occupational, or other important areas of functioning.' First, they

don't persist long enough to cause significant impairment, and second, in my experience, when the tics are that severe, they eventually become chronic" (Comings, 1995)[2].

Results from this prospective study reveal a somewhat different picture. We echo the experience of Bennett and colleagues in their open behavior therapy trial in young children with tics: "Some of our initial assumptions were challenged by this study. We assumed that a younger sample would present with fewer or less severe tics, but the number, frequency, and severity of tics in this younger sample were similar to those of the larger randomized controlled trial with older patients. We also assumed young children would be unable to engage in HRT due to limited awareness of tics and urges, which also proved to be somewhat inaccurate. The majority of these youth showed awareness of tics and tic urges in a manner that was facilitative of treatment with HRT" (Bennett *et al.*, 2020). Almost all adults with tics report premonitory urges or sensations (Crossley and Cavanna, 2013), but the prevalence of premonitory urges in children with tics has been reported as 20-40% (Openneer *et al.*, 2020) and 34.8% (Sambrani *et al.*, 2016) in children under age 8. By age 8-10, the prevalence of premonitory urges in children with tics has been reported as 24%, >50% and 61.8% (Banaschewski *et al.*, 2003, Openneer *et al.*, 2020, Sambrani *et al.*, 2016) (their Table II), but is lower in children under age 8 (20-40% (Openneer *et al.*, 2020) and 34.8% (Sambrani *et al.*, 2016)). By contrast, in our sample of children ages 5-10, 65% had premonitory urges at the initial visit.

PTD has traditionally been thought to involve only one or a few tics. For instance, in a consecutive sample of 60 children with TS, 60% recalled that their first "tic episode" included only a single motor tic (Orazem Mrak *et al.*, 2017). By contrast, in our study, by the end of the screening visit, the mean number of current or past tics identified was 8.9. Fewer tics may possibly predict a better outcome: in one report, 6 of 11 cases of spontaneously remitting tics had only a single tic identified (Remschmidt and Remschmidt, 1974), and in an epidemiological study set in an elementary school, multiple tics were thought to portend a worse prognosis (Wang and Kuo, 2003). Although logically one tic must appear first, our observations suggest that within weeks of onset, children almost always have experienced multiple tics, and more tics may predict worse outcome ($0.05 < p < 0.10$). Thus PTD includes multiple tics much more commonly than previously thought.

Comorbidities were also surprisingly common, including a high prevalence of anxiety disorders and (past or current) enuresis (Table 1). Anxiety is common in children with tics (Comings and Comings, 1987a, Vermilion *et al.*, 2021), and tics generally worsen with anxiety (Iverson and Black, 2022). In our sample, an anxiety disorder predicted more

[2] Dr. Comings was apparently excluding in his comment PTD patients whose tics later persisted past 1 year, but this was a widespread misunderstanding of the DSM–III through DSM–IV–TR diagnostic criteria for Transient Tic Disorder (Black et al., 2016).

severe tics at 12 months (Kim *et al.*, 2019a). We hypothesize that in part, the association of tic outcome with anxiety is explained by the fact that anxiety comes with stronger development of negative reinforcement learning. Negative reinforcement (specifically, the temporary alleviation of the urge to tic when a tic occurs) has been hypothesized to be a key construct in explaining the persistence of tics over time and the mechanism of Comprehensive Behavioral Interventions for Tics (CBIT). Enuresis has been noted previously to be common in TS, and more common than in TFC (Champion *et al.*, 1988, Comings and Comings, 1987b, Jiménez-Jiménez *et al.*, 2020), but we feel clinicians may underappreciate this point.

Thirty-three of our 89 PTD participants (37%) had a first-degree relative with tics, of whom 18 (20%) had a parent with tics; one child had tics in both parents. Of course, these fractions are immensely higher than the rate of tics in the general adult population, but within the range of family history positivity rates reported in chronic tic disorders. A family history of chronic tics, of tics persisting into adulthood, and of tics in both parents have been proposed to be possible predictors of worse outcome for PTD (McMahon *et al.*, 2003, Torup, 1962).

Data that bear on controversies

Our data shed light on the one-year duration criterion for chronic tic disorders including TS. The number of tics the child had experienced did increase over time (Figure 3), and the DCI score increased from the initial visit to the 12-month visit and again to subsequent follow-up visits (Table 2). These increases are expected, since typically new tics and other features of TS develop over the course of TS. However, otherwise, as noted in the previous section, the PTD patients have very similar clinical features as do children with TS/CTD. Clinical features, psychological testing, follow-up and family history are more similar than different, suggesting that PTD and TS/CTD are the same condition, rather than two distinct illnesses (Robins and Guze, 1970).

Another controversy was summarized recently by He and colleagues: "Some have argued that because not all individuals with TS experience premonitory urges, tics cannot be caused by premonitory urges. … However, by adulthood, up to 98% individuals with TS report experiencing premonitory urges, suggesting that low estimates of premonitory urges experienced in TS may be partially because of difficulties describing premonitory urges in early childhood and adolescence" (He *et al.*, 2022, Jackson *et al.*, 2011). In favor of the latter interpretation—urges may cause tics—two thirds of our participants endorsed premonitory urges within months of tic disorder onset and at only 5-10 years of age.

Data we don't have

Anecdotally, most of these children on follow-up visits showed zero to few tics during a 40-60 min interview with the PI talking about their tics, but then had numerous tics within moments of closing the door on them for remote observation. Unfortunately, we

did not record participants for similar quantification of tic frequency or severity during the interview and physical examination. An available proxy for the desired data is that 0 of 63 children had tics observed during the history and exam but none during the TSP. We hypothesize that this phenomenon (tics decrease during observation by others), which is so typical that its opposite (tics much worse when observed by others) has been identified as a diagnostic feature of functional tic-like symptoms (Arbuckle *et al.*, 2023), is partially responsible for the improvement seen over the first year of a tic disorder. This "social tic suppression" ability would be expected to improve more in children with fewer autism-spectrum-like characteristics, and that is what we observed (Kim *et al.*, 2019a).

Limitations

As we wrote previously, "The primary limitation of our work is that our sample was not a purely representative epidemiological sample. Such a sample would be extremely difficult to study, since a relatively large number of children would need to be thoroughly screened, and most would be asymptomatic, limiting child and parent enthusiasm for participation. The most obvious concern related to representativeness is that we may be likely to oversample children with severe tics or from families better positioned to access medical care. However, we feel that our sample is representative. Tic severity was fairly low at study entry, with a mean TTS < 20; about a third of the children came from families experienced with tics (positive family history or a physician parent); and disadvantaged minorities are represented at or above the frequency predicted from regional demographics" (Black *et al.*, 2020).

Judging tic onset retrospectively is a challenge. However, we sought information on tic start date in semi-standardized interviews with the child and parent separately, and probed extensively (see Methods). This additional information often clarified and firmed up the onset date. Quite often, volunteers arrived thinking tic onset was 2-3 months ago and on further probing, several were found to have had tics for more than 6 months or even more than a year. Also, the median "confidence range" for onset date was only 14 days.

Possibly we missed the expected quickly remitting (transient) tics because we enrolled children who still have tics at an average of 4 months after the tics begin. In other words, we could be coming to the fire scene too late. Our data do not support this hypothesis: if this were the case, we would expect to see remissions in children examined shortly after tic onset, and we see none. Conceivably the tic disorders that remit do so only in the first 3 weeks after onset, as we have reasonable data from 3 weeks to 3 months after onset (N=4 from 21-28 days, N=25 from 21-91 days; see Figure 2). This view was reflected in older Diagnostic and Statistical Manual editions that required a 4-week duration to diagnose Transient Tic Disorder. On the other hand, DSM-5 removed that criterion, since no data supported a minimum duration threshold (Walkup *et al.*, 2010). Alternatively, we might at least see clearly lower 12-month YGTSS total tic scores (TTS) in children examined

immediately after tic onset, but in our data, the 12-month TTS was nontrivial in the 4 children screened in the first 4 weeks after tic onset (mean = 14, median = 8), and increased only slightly when graphed against the number of days from tic onset to the screening visit ($0.05 < p < 0.10$ for a linear trend; Figure 2).

Finally, could tic outcome in this study be less favorable than expected because of study participation; specifically, could all the questions about tics have worsened tics by drawing the child's attention to them? This is extremely unlikely. First of all, though talking about tics can worsen tic severity *during the conversation* (Woods *et al.*, 2001), "these effects quickly disappear once the topic of conversation shifts away from tics," and self-monitoring of tics may even decrease tic severity slightly (Capriotti *et al.*, 2014). Much stronger evidence comes from controlled trials of CBIT, in which attending to and talking about the tics are essential components; CBIT on average substantially improves tics (Capriotti *et al.*, 2014). Second, we also spent hours talking about tics with children in the TFC group, and observed them for at least 10 minutes by video while they sat alone in a room. At the follow-up visit, 2 of 23 TFC children had probable subtle tics unnoticed by child or parent; in both cases the investigator was ambivalent about their presence. This rate is consistent with the incidence of tics in the general population and lower than the incidence in ADHD; for instance, 22% of children with ADHD but no tics at baseline developed tics over the course of one year on placebo (Law and Schachar, 1999).

Conclusion

Provisional Tic Disorder does generally have a favorable prognosis. However, phenomenologically it resembles Tourette's Disorder much more than previously recognized.

Acknowledgments

We gratefully thank the children and parents who participated in this study.

Funding

Research reported in this publication was supported by National Institutes of Health under award number K24MH087913 to K.J.B.; K01MH104592 to D.J.G.; R01MH104030 to K.J.B. and B.L.S.; National institute of Neurological Disorders and Stroke R21NS091635 to B.L.S. and K.J.B.; the Washington University Institute of Clinical and Translational Sciences grants UL1RR024992 and UL1TR000448; Siteman Comprehensive Cancer Center and NCI Cancer Center Support Grant P30 CA091842; the Eunice Kennedy Shriver National Institute of Child Health and Human Development under Award Number U54HD087011 to the Intellectual and Developmental Disabilities Research Center at

Washington University, and K23DC006638 to J.E.C. Lieu. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Conflicts of interest

No relevant conflicts.

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Tables

Table 1. Non-tic participant characteristics for the NT participants over time.

Children with tics for 0-9 months at screening. Values indicate number or mean ± SD unless indicated otherwise.

Characteristic	**Baseline**	**Baseline (returned at 12 months)**	**12-month follow-up**	**24-month follow-up**	**36-month follow-up**	**48-month follow-up**
N	89	79	80	34	35	31
Age	7.42 ± 2.04	7.30 ± 1.96	7.73 ± 1.63	8.42 ± 1.41	9.78 ± 1.64	11.05 ± 1.40
Sex (M:F)	64:25	54:25	54:25	26:8	25:10	25:6
Handedness (R:non-R)	77:12	69:11	68:12	28:6	27:8	26:5
Non-white	15 (N=87)	13 (N=77)	13 (N=78)	5	5	3
Barratt SES	51.57 ± 9.92	51.68 ± 10.10	-	-	-	-
IQ estimate (K-BIT)	108.36 ± 12.50 (N=88)	108.34 ± 12.01	-	-	-	-
Family history of OCD	14	13	-	-	-	-
Family history of ADHD	25	23	-	-	-	-
ADHD, K-SADS (current)	45	39	-	-	-	-
ADHD, K-SADS (past)	2	2	-	-	-	-
ADHD, clinician	39	32	36	12	13	7
ADHD Severity	14.82 ± 12.41	14.26 ± 12.36	15.61 ± 11.45	15.90 ± 14.32 (N=30)	14 ± 12.46 (N=27)	10.7 ± 10.88 (N=10)
OCD, K-SADS (current)	27	22	-	-	-	-
OCD, K-SADS (past)	0	0	-	-	-	-
OCD, clinician	9	7	13	1	1	1
OCD severity (CY-BOCS)	4.06 ± 6.48 (N=87)	3.71 ± 6.30 (N=77)	6.18 ± 8.09	4.45± 6.92 (N=31)	6.36 ± 7.58 (N=28)	5.27 ± 8.76 (N=11)
Anxiety disorder, K-SADS, lifetime [3]	27	26	-	-	-	-
Enuresis (current), K-SADS	26	25	-	-	-	-
Enuresis (past), K-SADS	12	12	-	-	-	-
DMDD, K-SADS [4]	2 (1 current, 1 past)	2	-	-	-	-
ODD, K-SADS [5]	12 (11 current, 1 past)	12	-	-	-	-
Brain-active medications	24	21	25	9	11	5
SRS total T scores	50.35 ± 10.02	50.46 ± 10.10	-	-	-	-
Number of comorbid psychiatric diagnosis classes (Mataix-Cols *et al.*, in press)	1.24 ± 0.95	1.19 ± 0.97	-	-	-	-

[3] Does not include OCD

[4] Disruptive mood dysregulation disorder

[5] Oppositional-defiant disorder

Table 2. Tic characteristics for the NT participants over time.

Children with tics for 0-9 months at screening. Values indicate number or mean ± SD unless indicated otherwise.

Characteristic	**Baseline**	**Baseline (Returned at 12 months)**	**12-month follow-up**	**24-month follow-up**	**36-month follow-up**	**48-month follow-up**
N	89	79	80	34	35	31
Enrollment (in months) after tic onset	3.90 ±1.83	4.00 ± 1.87	4.00 ± 1.87	4.30 ± 2.06	4.30 ± 2.18	4.30 ± 1.77
DSM-IV TS or CTD	0	0	62 TS, 6 CTD	23 TS, 5 CTD	22 TS, 4 CTD	15 TS, 1 CTD
DSM-IV-TR TS or CTD	0	0	65 TS, 6 CTD	24 TS, 5 CTD	24 TS, 5 CTD	16 TS, 3 CTD
DSM-5 TS or CTD	0	0	70 TS, 7 CTD, 1 Other (Black, 2020)	26 TS, 5 CTD, 1 other	27 TS, 3 CTD, 1 other	18 TS, 1 CTD, 1 no tics
Mean days since tic onset	118.3 ± 55.80	120.2 ± 57.00	383.63 ± 44.34	747.85 ± 25.57	1109.35 ± 64.15	1492.23 ± 90.42
Median days since tic onset	111.0	111.0	370.0	738.0	1110.5	1467.0
Range of days since tic onset	22-268	22-268	346-663	715-833	959-1351	1359-1854
Total number of lifetime tics known by end of screening visit	8.92 ± 4.38	9.06 ± 4.43	9.99 ± 5.23	15.79 ± 8.38	18.06 ± 10.55	16.40 ± 8.44
Number of lifetime motor tics known by end of visit	6.70 ± 4.15	6.73 ± 4.21	7.46 ± 4.51	15.76 ± 8.26	13.41 ± 7.65	12.30 ± 6.74
Number of lifetime phonic tics known by end of visit	2.22 ± 1.71	2.33 ± 1.72	2.53 ± 2.07	3.85 ± 3.22	4.90 ± 4.11	4.10 ± 2.65
YGTSS motor tic number score (0-5)	2.35 ± 0.11 (N=66)	2.39 ± 0.11	1.80 ± 1.15	2.15 ± 1.20	2.26 ± 1.46	2.08 ± 1.47
Medication for tics [6]	4	4	3-4	0-1	2-3	0
YGTSS phonic tic number score	1.44 ± 0.11	1.48 ± 0.11	0.98 ± 1.02	0.94 ± 1.17	1.03 ± 1.17	0.96 ± 1.24
YGTSS motor tic intensity (pre-TSP)	2.28 ± 0.97	2.25 ± 0.11	1.85 ± 1.10	2.15 ± 1.80	2.12 ± 1.17	2.20 ± 1.19
YGTSS motor tic intensity (post-TSP)	2.55 ± 0.90	2.52 ± 0.12	2.28 ± 0.85	2.45 ± 0.85	2.23 ± 1.00	2.22 ± 0.94
YGTSS phonic tic intensity (pre-TSP)	1.69 ± 1.23	1.80 ± 0.14	1.33 ± 1.25	1.15 ± 0.23	1.34 ± 0.23	1.43 ± 0.31
YGTSS phonic tic intensity (post-TSP)	1.88 ± 1.20	1.93 ± 0.15	1.31 ± 1.23	1.42 ± 0.24	1.79 ± 0.25	1.21 ± 0.38
YGTSS motor tic interference (pre-TSP)	0.95 ± 1.07	1.01 ± 0.12	0.84 ± 0.97	0.73 ± 0.16	1.16 ± 0.21	1.00 ± 0.28
YGTSS motor tic	0.91 ± 1.02	0.98 ± 0.13	0.83 ± 0.10	0.77 ± 0.17	1.14 ±	1.00 ± 0.38

[6] In 3 cases, at a follow-up visit it was not clear whether a medication was for tics or for another purpose.

Characteristic	Baseline	Baseline (Returned at 12 months)	12-month follow-up	24-month follow-up	36-month follow-up	48-month follow-up
interference (post-TSP)					0.23	
YGTSS phonic tic interference (pre-TSP)	0.58 ± 0.94	0.62 ± 0.11	0.50± 0.97	0.48 ± 0.17	0.53 ± 0.17	0.62 ± 0.19
YGTSS phonic tic interference (post-TSP)	0.61 ± 0.97	0.66 ± 0.13	0.49 ± 0.95	0.45 ± 0.17	0.50 ± 0.17	0.57 ± 0.23
At least 1 phonic tic	72	66	53	19	21	13
Number of different tics in the last week	1.46 ± 1.21	3.78 ± 2.58	4.24 ± 3.33	4.73 ± 4.73	5.06 ± 4.84	0.48 ± 1.44 (N=29)
Number of new tic types seen on TSP	1.62 ± 1.97	1.70 ± 2.00	0.92 ± 2.14	0.79 ± 1.02	1.00 ± 1.20	0.15 ± 0.37
First tic motor, phonic, same age	32, 9, 20 (N=60)	23, 8, 19 (N=50)				
Current complex tic	41	37	36	18	19	11
Current motor tic	39	35	34	18	18	11
Current phonic tic	9	8	8	3	6	3
Ever had a complex tic	42	41	52	22	26	17
Ever had a complex motor tic	35	30	47	20	25	17
Ever had a complex phonic tic	13	11	17	8	10	7
Tics began above the shoulders	79	71	70	30	29	19
Multiple motor tic body locations	46	42	56	24	24	16
PUTS Score	14.01 ± 4.97 (N=82)	13.85 ± 4.80 (N=75)	15.44 ± 5.94 (N=75)	13.29 ± 4.96 (N=32)	15.4 ± 5.72	15.6 ± 5.2 (N=20)
DCI score	33.4 ± 13.1	32.6 ± 12.1	43.74 ± 14.73 (N=78)	48.97 ± 16.19	52.44 ± 16.45	55.71 ± 18.06
Premonitory Urge	58	50	62	25	27	19
Participants with tics first seen on TSP	59	54	25	18	16 (N=29)	4
Pre-TSP YGTSS Total Tic Score	15.34 ± 5.72 (N=88)	15.33 ± 5.45 (N=78)	13.57 ± 7.54 (N=71)	13.76 ± 9.19	15.53 ± 9.37	13.57 ± 9.93
Pre-TSP YGTSS Impairment	7.38 ± 8.02	7.30 ± 7.88	3.39 ± 6.55	5.61 ± 9.33	7.34 ± 10.16	5.24 ± 11.67
Pre-TSP TTS, post-TSP score recorded	15.31 ± 5.78	15.69 ± 5.72	11.72 ± 7.93	13.87 ± 8.80	15.03 ± 9.68	11.61 ± 9.19
Post-TSP YGTSS TTS	17.22 ± 5.56	17.64 ± 5.47	13.83 ± 7.54	15.45 ± 7.75	16.47 ± 9.00	13.22 ± 8.71
Post-TSP YGTSS Impairment	7.46 ± 8.30	7.75 ± 8.46	4.15 ± 6.55	5.83 ± 9.66	8.5 ± 11.08	6.11 ± 11.57
Δ in TTS from pre- to	1.90 ± 2.12	1.94 ± 2.13	2.11± 2.85	1.53 ± 2.76	1.42 ±	1.40 ± 2.21

Characteristic	Baseline	Baseline (Returned at 12 months)	12-month follow-up	24-month follow-up	36-month follow-up	48-month follow-up
post-TSP	(N=63)	(N=53)	(N=71)	(N=32)	2.36 (N=31)	(N=52)
Children whose TTS increased after TSP	47 of 63	44 of 53	42 of 71	14 of 32	14 of 31	10 of 52
Tics suppressible	69	63 of 79	70 of 79	30 of 33	34 of 34	24 of 25

Table 3. How tics were detected in the NT participants.

Children with tics for 0-9 months at screening. Values indicate number or mean ± SD (Range) unless indicated otherwise. Several items were added partway through the study, so N is given in each cell if it differs from the overall N for that column.

Measures	**Baseline**	**Baseline (Returned at 12 months)**	**12-month Follow-up**	**24-Month Follow-Up**	**36-Month Follow-Up**	**48-Month Follow-Up**
N	89	79	80	34	35	31
Parent or child reported any tics in past three months?	61 of 62	55 of 55	68 of 71	30 of 33	32 of 35	22 of 26
Positive history after clinical interview	60 of 62	55 of 55	59	29 of 33	31 of 34	21 of 24
Positive exam (before TSP)	54 of 61	48 of 54	48 of 69	23 of 32	25 of 33	15 of 24
Tics observed on TSP	56 of 56	50 of 50	59 of 63	30 of 30	26 of 29	18 of 19
No positive history or positive exam, but tics were observed on TSP	1 of 56	0 of 49	6 of 62	2 of 31	1 of 30	2 of 22
# of lifetime tics known before TSP	6.66 ± 3.93	6.75 ± 4.08	10.56 ± 6.36	14.79 ± 8.27	18.31 ± 10.91	17.00 ± 8.26
# of tics first observed during TSP	1.62 ± 1.97	1.70 ± 2.00	1.21 ± 1.54	0.65 ± 1.01	1.03 ± 1.26	0.88 ± 2.16
# of tics known previously, but before TSP thought not to have happened in past week	0.12 ± 0.90	0.14 ± 0.96	0.36 ± 0.96	0.06 ± 0.24	0.16 ± 0.51	0.23 ± 0.43
P.I. confident they had tics before the TSP	49 of 59	43 of 52	37 of 57	26 of 33	26 of 34	18 of 19
Tics observed in a parent [7]	0	0	3	2	4	0

[7] Data collected only in the last 5 years of the study. In most cases, only one parent was present at the visit.

Table 4. Impact of tics over time for the NT participants.

Children with tics for 0-9 months at screening. Values indicate number or mean ± SD (Range) unless indicated otherwise.

Measures	**Baseline**	**Baseline (Returned at 12 months)**	**12-month Follow-up**	**24-Month Follow-Up**	**36-Month Follow-Up**	**48-Month Follow-Up**
N	89	79	80	34	35	31
Planning to see doctor because of tics	53 of 62	47 of 54	12 of 70	4 of 33	3 of 34	2 of 24
YGTSS Impairment ≥20	14	14	7	5 of 33	7 of 34	5 of 25
YGTSS TTS >13	62	58	37	14 of 33	22 of 34	12 of 25
Impairment or marked distress (past week)?	7 of 62	7 of 55	3 of 70	4 of 33	9 of 34	5 of 24
Clinically meaningful tics	65	59 of 79	22	12	16 True, 20 False	10 True, 21 False

Table 5. How tics were detected for the LaterPTD participants.

These children had tics for 9-11.5 months at the screening visit, and were followed up 3 months after the screening visit, rather than at 12 months after tic onset. Values indicate number or mean ± SD (Range) unless indicated otherwise.

Measures	**Baseline**	**Baseline, participants returning 3 months later**	**Follow-up 3 months later**	**24-Month Follow-Up**	**36-Month Follow-Up**	**48-Month Follow-Up**
N	10	10	10	9	7	3
Parent or child reported any tics in past three months?	10	10	10	8	6 of 6	3
Positive history after clinical interview	10	10	10	7 of 8	6 of 6	2 of 2
Positive exam (PI saw tics before TSP)	8	8	7	8 of 8	5 of 6	1 of 2
Tics observed on TSP	10	10	9 of 9	8 of 8	4 of 5	2 of 2
No positive history or positive exam, but tics were observed on TSP	0	0	0	1	0	0
# of lifetime tics known before TSP	8.3 ± 2.71	8.3 ± 2.71	12.78 ± 3.03	17.56 ± 2.60	21.29 ± 4.92	20.25 ± 1.72
# of tics first observed during TSP	1.3 ± 1.42	1.3 ± 1.42	1.22 ± 0.67	0.78 ± 0.83	0.29 ± 0.49	0.25 ± 0.50
# of tics known previously, but before TSP thought not to have happened in past week	0	0	0.4 ± 1.27	0.22 ± 0.67	0.43 ± 1.13	1.00 ± 0.00
P.I. confident they had tics before the TSP	9	9	8	8 of 8	6 of 6	2 of 2
Tics observed in a parent	1 of 1	1 of 1	0 of 2	0 of 6	1 of 6	0 of 1

Table 6. Impact of tics over time for the LaterPTD participants.

These children had tics for 9-11.5 months at the screening visit, and were followed up 3 months after the screening visit, rather than at 12 months after tic onset. Values indicate number or mean ± SD (Range) unless indicated otherwise.

Measures	**Baseline**	**Baseline, participants returning 3 months later**	**Follow-up 3 months later**	**24-Month Follow-Up**	**36-Month Follow-Up**	**48-Month Follow-Up**
N	10	10	10	10	7	3
Planning to see doctor because of tics	8	8	4	2 of 8	2 of 6	1 of 1
YGTSS Impairment ≥20	1	1	1	0 of 8	1	1 of 1
YGTSS Total tic score (>13)	8	8	6	6 of 8	3	1 of 1
Tics cause distress (past week)	1	1	1	0 of 8	1 of 6	1 of 1
ADHD Diagnosis (clinician)	6	6	6	5 of 9	5	1 of 1
ADHD Severity	19.70 ± 14.77	19.70 ± 14.77	17.22 ± 11.88 (N=9)	18.75 ± 13.91 (N=9)	18.25 ± 9.57 (N=4)	N/A
OCD Diagnosis (clinician)	0	0	0	0 of 9	2	0 of 1
OCD Severity (CY-BOCS)	2.80 ± 4.61	2.80 ± 4.61	3.56 ± 6.54	2.25 ± 4.20	9.00 ± 11.83	N/A
Clinically meaningful Tics	8	8	6	5	5	1

Figures

Figure 1. Tic duration at study entry and follow-up visits.

Shows only the NT (#1-79) and LaterPTD participants (#80-89) who returned for follow-up. The horizontal axis shows time since the first tic. Each participant is shown as a horizontal line, with an open circle for the first study visit and a filled circle for the follow-up visit. The solid red line marks the mean duration at screening (median is somewhat earlier), the dashed red line marks the original 6-month enrollment cutoff, the thick black line marks the 9-month cutoff, and the thin black vertical line marks 1 year after the first tic.

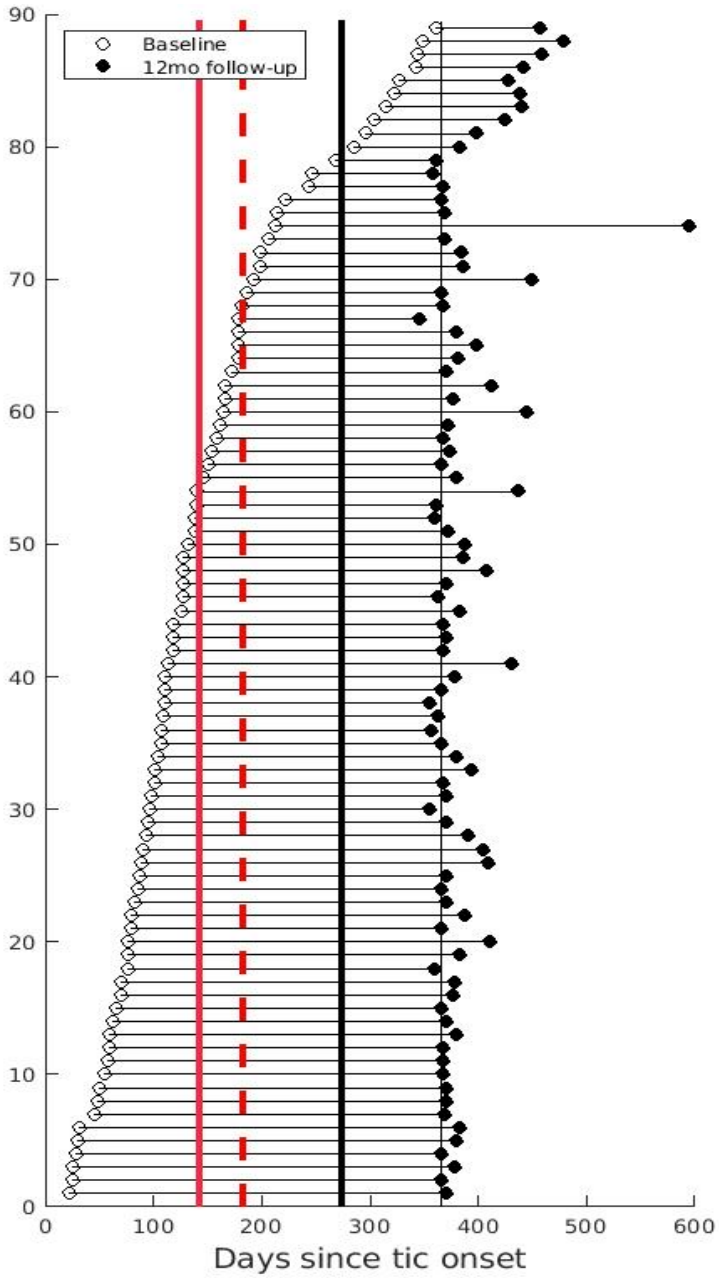

Figure 2. YGTSS Total Tic Score (TTS) at 12 months, by time since tic onset at screening.
TTS at the 12-month follow-up visit was not significantly greater in children whose tics had lasted longer at the initial screening visit.

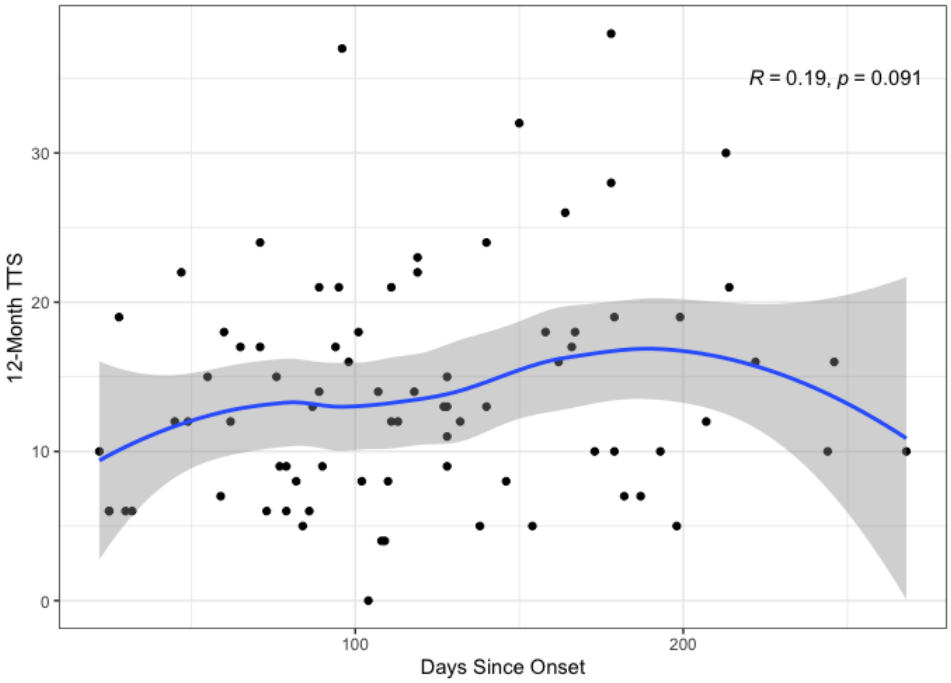

Figure 3. Number of tics known at the screening visit, by time since tic onset.
More tics were identified in children who had had tics longer.