Sensory and physiological dimensions of cold pressor pain in Trichotillomania

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ABSTRACT

Background: Trichotillomania (TTM) is characterized by hair pulling resulting in hair loss. It has long been perceived that people with TTM may have different pain thresholds or pain tolerances than healthy counterparts. This study sought to examine whether TTM was associated with reductions in sensory or physiological components of cold pressor pain.

Method: Adults with TTM were examined on clinical measures including symptom severity and functioning. All participants underwent the cold pressor test. Heart rate, blood pressure, and self-reported pain were compared between TTM participants (N=19) and controls (N=14).

Results: There were no differences in pain tolerance between TTM participants and controls. The TTM group did not show faster recovery time nor exhibit lower pain ratings. Systolic blood pressure was significantly lower in the TTM group before immersion, though differences did not exist at pain tolerance or after the recovery period. TTM participants had a lower heart rate at all time points, but this difference was statistically significant only at 90 s (p=0.046).

Conclusions: In this study, adults with TTM failed to exhibit analgesia to cold pressor pain as compared with healthy controls. No association appears to exist between pain and TTM symptom severity.

1. Introduction

Trichotillomania (TTM), or hair pulling disorder, is characterized by repetitive hair pulling resulting in hair loss (American Psychiatric Association, 2013). Although hair pulling would likely be painful for healthy individuals, those with TTM usually do not report pulling-related pain (Christenson, Mackenzie, & Mitchell, 1991) and may even experience pleasure (Stanley, Swann, Bowers, Davis, & Taylor, 1992). It has therefore long been perceived that people with TTM may have different pain thresholds or pain tolerances than healthy counterparts. In an influential paper, however, Christenson et al. (1994) found that TTM participants exposed to a steadily increasing pressure stimulus to the fingertip failed to show hypoalgesia (Christenson et al., 1994). Likewise, although it has been hypothesized that repeated pulling induces analgesia at pulling sites, TTM volunteers in an experimental hair-pulling task reported levels of physical pain comparable to healthy controls (Diefenbach, Tolin, Meunier, & Worhunsky, 2008). Recent insights into both the neurobiology of pain modulation and the major neurotransmitter systems involved in TTM may shed light on the opaque relationship between pulling-related pain and pleasure in TTM.

Intense pressure and other noxious mechanical stimuli are detected by high-threshold mechanoreceptors and polymodal nociceptors in the skin and transmitted by small myelinated A-delta (Aδ) fibers and unmyelinated C fibers (Basbaum, Bautista, Scherrer, & Julius, 2009). By contrast, noxious cold cutaneous sensations (below ~17 °C) are recognized primarily by the cold-sensitive ion channel TRPM8 before sensory signal transduction (Winchester et al., 2014). Subsequently, highly distributed cortical and subcortical networks (collectively, the “pain matrix”) process incoming nociceptive information and generate the experience of pain (Iannetti & Mouraux, 2010). Although activation of the pain matrix is non-specific for pain (Salomons, Iannetti, Liang, & Wood, 2016), meta-analysis of functional neuroimaging data reveals that, compared with heat applied to the skin, noxious cold stimulation applied to the upper limbs of healthy subjects is associated with preferential activation of the amygdala and subgenual anterior cingulate cortex (Duerden & Albanese, 2013), perhaps reflecting a role for these structures in generating the affective and emotional components of pain (Shackman et al., 2011; Veinante, Yalcin, & Barrot, 2013). In fact, cold water immersion is perceived to be significantly more unpleasant than contact heat or electrical stimuli of equal...
The cold pressor test requires participants to immerse a limb in ice water until the task becomes too uncomfortable to continue. Subjects experience an affective/motivational response to pain (urge to withdraw the limb) and acute stress-induced release of cortisol (Clewett, Schoeke, & Mather, 2013) and endogenous opioids (Ribeiro, Kennedy, Smith, Stohler, & Zubieta, 2005). Notably, availability of the striatal µ-opioid receptor (MOR) at the resting state predicts cold pressor pain threshold (but not pain tolerance) in healthy volunteers, suggesting that individuals with high MOR receptor density take longer to experience experimental cold pain due to more robust MOR-mediated pain suppression (Hagelberg et al., 2012). The cold pressor test has a promising application in TTM because studies support a role for endogenous opioid activity in the reward system, self-injurious behavior (Leknes & Tracey, 2008), and stereotypic behavior in animal models (Presti & Lewis, 2005). Moreover, TTM shows some improvement to treatment with the opioid antagonist naltrexone (Grant, Odlaug, Schreiber, & Kim, 2014).

1.1. Aims of the study

Assuming an abnormal MOR system in trichotillomania, and based on the previous literature, we predicted that participants with TTM would show pain tolerance similar to that of comparison subjects, faster recovery time, and lower scores on a self-report measure of pain intensity. In addition, we hypothesized that decreased pain sensitivity in TTM subjects would be associated with worse hair-pulling symptomatology and longer duration of illness.

2. Material and methods

2.1. Participants

Men and women aged 18–65 with a current primary diagnosis of TTM (n=19), based on DSM-5 criteria and a structured clinical interview with a board-certified psychiatrist (J.E.G.) with expertise in TTM and body-focused repetitive behaviors, were recruited by media advertisements, referrals, and in person at the TLC Foundation for Body Focused Repetitive Behaviors annual conference. Exclusion criteria included: (1) history of Raynaud’s phenomenon; (2) history of cardiovascular disorder; (3) open cuts or sores on the hand to be submersed; (4) history of fainting or seizures; (5) fracture of the limb to be submersed; (6) history of frostbite; and (7) an inability to submerge their hand in the water bath to just above the wrist and were instructed to keep their hand open (rather than in a closed fist position) while it was in the water. Before immersion, participants were told to keep the hand in the water until cold pressor pain became intolerable or until the cutoff time of 3 min was reached. Ambient temperature was recorded before the start of the procedure to control for potential covariates.

During the task, subjects rated their pain at 15-s intervals using an adapted version of the Wong-Baker Faces Pain Rating Scale (al’Absi et al., 2004; Wong & Baker, 1988). Pain was rated on a scale from 0 (not painful at all) to 100 (extremely painful). Intermediate ratings include 25 (somewhat painful), 50 (moderately painful), and 75 (very painful). Pain ratings were displayed on a large poster in a line from 0 to 100. Each intermediate rating included a visual representation of pain associated with that rating. Latency to pain tolerance (when the hand was voluntarily withdrawn) was measured with a stopwatch in seconds. Heart rate and blood pressure were recorded using an automated digital device at four time points, initiated at least 5 min before each CPT trial and immediately after hand removal. Because the CPT may cause physical discomfort or psychological stress, volunteers were free to discontinue the task at any point.

2.2. Procedures

2.2.1. Clinical assessments

A board-certified psychiatrist conducted an initial clinical interview with all subjects to assess psychiatric comorbidity using the Structured Clinical Interview for DSM-IV (First, Spitzer, Gibbon, & Williams, 1997). We also asked about the age at onset of TTM, past treatment for TTM (if any), and which sites were pulled. Other assessments included:

2.2.2. National Institute of Mental Health (NIMH) Trichotillomania severity scale

The five-item, clinician-administered NIMH-TSS was used to assess severity of hair-pulling symptoms during the past week (Swedo et al., 1989). The items assess pulling frequency in minutes per day (both on the previous day and average during the past week), urge intensity and resistance, subjective distress, and interference with daily activities.

2.2.3. Massachusetts general hospital–hairpulling scale

The MGH-HPS is a 7-item, self-report scale that rates hair-pulling urges, actual amount of pulling, perceived control over behavior, and distress associated with hair pulling over the past 7 days, with a severity scale from 0 to 4 for each item. The MGH–HPS has two subscales: (1) Severity (containing 4 items); and (2) Resistance and Control (3 items) (Keuthen et al., 2007).

2.2.4. Clinical global impressions—severity scale

The CGI-S is a 7- item scale used to assess clinical symptom severity (Busner & Targum, 2007). Scoring ranges from 1 (“not ill at all”) to 7 (“among the most extremely ill” patients).

2.2.5. Sheehan disability scale (Leon, Olfon, Portera, Farber, & Sheehan, 1997)

The SDS is a 3-item, self-administered measure of psychosocial functioning in three areas of life: work/school, social or leisure activities (e.g., with other people at parties, socializing, visiting, dating, outings, clubs, and entertaining), and home and family life (Sheehan, 1983).

2.2.6. Cold pressor test

The cold pressor test (CPT) is a reliable and valid pain induction method (Edens & Gil, 1995) that requires participants to submerge their hand in a 85-ounce container filled with ice water at a temperature between 0–4 °C. Participants immersed the non-dominant hand in the water bath to just above the wrist and were instructed to keep their hand open (rather than in a closed fist position) while it was in the water. Before immersion, participants were told to keep the hand in the water until cold pressor pain became intolerable or until the cutoff time of 3 min was reached. Ambient temperature was recorded before the start of the procedure to control for potential covariates.

Within-group correlational analyses (Pearson’s r) examined the relationship between clinical characteristics (e.g., measures of hair pulling...
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