Neuropsychiatric Aspects of Impulse Control Disorders

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KEYWORDS

- Attention-deficit/hyperactivity disorder • Impulse control disorders
- Neurodegenerative disorders • Neurodevelopmental disorders • Parkinson disease
- Tourette syndrome

KEY POINTS

- Impulse control disorders (ICDs) are neuropsychiatric conditions characterized by the repeated inability to resist an impulse, drive, or temptation to perform an act that is harmful to the person or others.
- Pathologic gambling, kleptomania, trichotillomania, excoriation (skin picking) disorder, intermittent explosive disorder, pyromania, oppositional defiant, conduct, and antisocial personality disorders are often classified as ICDs, although there is significant variability across classification systems.
- ICDs are relatively common conditions, both as primary disorders and as comorbidities of neurodevelopmental and neurodegenerative disorders.
- In most cases, the exact cause and pathophysiology of ICDs remain largely unknown.
- Treatment of ICDs is often multimodal, including both pharmacotherapy and cognitive-behavioral therapy approaches, based on the individual presentation.

INTRODUCTION

Impulsivity is both a personality trait and a clinical construct, defined as a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individual or to others.[1]

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Impulse control disorders (ICDs) are prevalent and disabling psychiatric disorders, characterized by the repeated inability to resist an impulse, drive, or temptation to perform an act that is harmful to the person or others.[2] ICDs tend to develop early in life, with a chronic, sometimes fluctuating, course. Although the consequences are damaging, carrying out the impulsive act may be experienced as rewarding or may relieve distress, implicating dysfunction of the neural circuitry involved in reward processing and/or behavioral inhibition. Comorbidity with other psychiatric disorders is common, hinting at overlapping neurobiological processes across various diagnostic groups.

Multiple neurotransmitter systems (serotonergic, dopaminergic, adrenergic, and opioidergic) seem to be implicated in the pathophysiology of ICDs. For instance, ICDs, such as pathologic gambling (PG), hypersexuality, compulsive eating and shopping, can develop as adverse effects of dopamine replacement therapy in patients with Parkinson disease (PD).[3] Neuroimaging studies have implicated the ventromedial prefrontal cortex and ventral striatum in the pathophysiology of ICDs.[1] This review focuses on the clinical characteristics and treatment of the main ICDs and discusses their role as comorbidities in neurodevelopmental and neurodegenerative disorders.

DIAGNOSTIC CLASSIFICATION OF IMPULSE CONTROL DISORDERS

ICDs have traditionally been problematic in terms of psychiatric classification. The *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*), Fourth Edition, Text Revision included intermittent explosive disorder (IED), kleptomania, PG, pyromania and trichotillomania, with pathologic skin picking, compulsive sexual behavior (CSB), and compulsive buying (CB), categorized as ICDs not otherwise specified.[4] The *DSM-5* introduced a new chapter on Disruptive, Impulse-Control, and Conduct Disorders covering disorders characterized by problems in emotional and behavioral self-control, which encompasses the following clinical entities: oppositional defiant disorder (ODD), IED, conduct disorder (CD), antisocial personality disorder (ASPD), pyromania, and kleptomania.[2] In the *DSM-5*, PG was reclassified as an addictive disorder, manly based on clinical and biological similarities to substance use disorders.[5] Specifically, PG shares several features with drug addiction, such as the development of euphoria, craving, and tolerance, possibly mediated by similar alterations in the dopaminergic mesolimbic reward system. Although the intent was for *DSM-5* to reflect the most up-to-date scientific understanding of PG and addiction, the changes in the classification system have been controversial, because of their impact on prevalence figures, as well as their wider implications on the diagnosis and treatment of PG.[6] Trichotillomania and pathologic skin picking, referred to as Excoriation (Skin Picking) Disorder (ED), were moved into the category of obsessive-compulsive spectrum disorders, mainly because of their ritualistic nature.[7] Finally, CSB and CB were dismissed because of the lack of compelling biological evidence.

CLINICAL CHARACTERISTICS OF IMPULSE CONTROL DISORDERS
Pathologic Gambling

Gambling involves risking something of value in the hopes of obtaining something of greater value. The essential feature of PG is the persistent and recurrent maladaptive gambling that disrupts personal, family, or vocational pursuits.[2] Besides impulsivity, lack of perseverance and suspiciousness may be predictors of disease severity, possibly through emotion dysregulation.[8] The prevalence of PG has been estimated as 0.2% to 1.6% in the general population, with higher prevalence figures in men (2–3:1).[9,10] The onset is typically in early adolescence, and women seem to progress

more rapidly in disease severity.[11–13] Psychiatric comorbidity is the rule in patients with PG, especially nicotine dependence (60.1%), substance misuse (57.5%), affective disorders (37.9%), and anxiety disorders (37.4%).[14]

Kleptomania

Kleptomania is defined as a recurrent failure to resist the impulse to steal items not needed for personal use or for their monetary value, with an urge to perform the act that is pleasurable at the moment but later causes significant distress and dysfunction.[2] The value of the stolen items tends to increase over time, suggesting the development of tolerance, akin to that of substance addiction.[15] The overall prevalence has been estimated at 6 per 1000.[16] Kleptomania is more common in women (2:1 in clinical samples), and the mean age of onset is in late adolescence or puberty.[15,17] Lifetime rates of other psychiatric disorders in kleptomania are high, including personality disorders (55.0%), substance misuse (29.0%–50.0%), suicidal behavior (36.0%), affective disorders (27.0%), anxiety disorders (18.0%), and attention-deficit/hyperactivity disorder (ADHD) (15.0%), as well as other ICDs (36.0%), particularly CB (18.0%) and trichotillomania (9.0%).[15,17–19]

Trichotillomania

In trichotillomania, a build-up of tension results in recurrent hair pulling with noticeable hair loss, followed by relief, gratification, or pleasure.[2] The mean age of onset is 12 to 13 years.[20] The lifetime prevalence of trichotillomania has been reported to be 0.5% to 4.0% in the United States, and this condition is significantly more common in women (93.2%), with men usually having a later onset and greater functional impairment.[21–23] The most commonly affected body areas are the scalp and eyebrows (56.4%).[24] Subjects reported an elevated lifetime prevalence of affective disorders (51.8%), anxiety disorders (8.9%–32.0%), obsessive-compulsive disorder (OCD) (8.3%–30.4%), and substance misuse (15.0%–20.0%).[25–28]

Excoriation (Skin Picking) Disorder

ED is defined as recurrent skin picking resulting in skin lesions despite repeated attempts to decrease or stop that behavior.[2] It has been suggested that both ED and trichotillomania can belong to a group of body-focused repetitive behaviors.[27] The reported prevalence of ED is 4.0% in college students and 0.2% to 5.4% in the general population.[29,30] Skin picking is more common in women, and the face is the most common site of excoriation, although any body part can be involved.[31] Individuals with ED often present with comorbid psychiatric conditions, especially substance misuse (38.0%), affective disorders (28.6%–36.4%), and OCD (15.2%–19.0%).[25,27,32] The association between ED and organic disorders is rare, despite occasional case reports of ED in patients with neurodegenerative disorders, such as frontotemporal dementia (FTD).[33]

Intermittent Explosive Disorder

IED is characterized by brief (<30 minutes) outbursts of aggression that result in serious assaultive acts or destruction of property, out of proportion to precipitating stressors.[2] Prevalence figures vary between 4.0% and 7.0%, and IED usually manifests in adolescence, with an earlier onset and possibly higher prevalence in men.[34] Psychiatric comorbidities are frequently reported: these include affective (11.0%–93.0%) and anxiety disorders (48.0%–58.1%), substance misuse (35.1%–48.0%), ADHD (19.6%), suicide attempts (12.5%), and nonlethal self-injurious behaviors (7.4%). Moreover, about 25.0% of patients with IED have a previous history of CD

or ODD.[34] Among organic conditions, aggressive behaviors have been associated most strongly with traumatic brain injury (TBI).[35]

Pyromania

Pyromania is characterized by multiple episodes of deliberate and purposeful fire setting without external reward, preceded by tension or affective arousal and commonly followed by a feeling of relief.[2] The prevalence and long-term course of pyromania are poorly described, because this is a relatively rare condition. The mean age of onset has been estimated as 18 years, with a significantly higher prevalence in men (8:1).[36] Pyromania is associated with affective disorders (14.0%–91.9%), anxiety disorders (33.3%), substance misuse (33.3%), kleptomania (23.8%), PG (9.5%), IED (9.5%), and trichotillomania (4.8%).[32,36]

Oppositional Defiant, Conduct, and Antisocial Personality Disorders

ODD and CD relate to challenging or disruptive behavior exhibited by children and adolescents that go beyond what is expected in this population and lead to significant distress or functional impairment. The symptoms of ODD are grouped into 3 types: angry/irritable mood, argumentative/defiant behavior, and vindictiveness.[2] Oppositional behaviors often manifest in the home setting and with adults the youth knows well.[37] Like children with ODD, those with CD may have an issue with controlling their temper; however, they also violate the rights of others, including aggression toward people and/or animals, destruction of property, deceitfulness, theft, and serious violation of rules.[38] CD can appear as early as in the preschool years, with ODD as a common premorbid condition that may progress to CD: the 2 disorders share common risk factors and genetic backgrounds.[39] ASPD refers to a persistent impairment in self and interpersonal functioning associated with the pathologic personality traits of antagonism and disinhibition.[2] Although ASPD and psychopathy are similar and are highly comorbid with each other, strictly speaking, they are not synonymous: psychopathy is theorized as a disorder of personality and affective deficits, whereas the diagnosis of ASPD is primarily behaviorally based.[40]

ASPD is typically an outcome of CD rather than ODD, because individuals with ASPD often engage in repetitive irresponsible, delinquent, and criminal behavior.[41] Prevalence rates have been reported for ODD (1.0%–11.0%), CD (2.0%–10.0%), and ASPD (1.0%–4.0%).[2,42] Studies of the comorbidity rates for ODD have shown that 14.0% to 40.0% of patients also have ADHD, and 9.0% to 50.0% have an anxiety or affective disorder.[43] Youth with both ODD and ADHD have a poorer prognosis and are at increased risk of transitioning to CD.[2] Among youths with serious emotional or behavioral disorders, adolescents with CD have the highest risk for problem alcohol and substance misuse.[44] A strong relationship between CD, academic failure, and learning disabilities has also been identified.[45]

Compulsive Buying and Compulsive Sexual Behavior

CB and CSB are not formally recognized by the *DSM-5*. CB is characterized by preoccupation with buying unneeded items or more than one can afford, and shopping for longer durations of time than originally intended, resulting in marked distress or interference with social and occupational functioning.[46,47] Purchased items typically do not get used, are given away, or are returned.[48] CSB is characterized by nonparaphilic, impulsive, recurrent, and intense sexual fantasies resulting in significant distress or functional impairment.[49] The estimated prevalence of CB in the United States is 5.8%, and most patients are women (80%–95%).[50] Comorbid conditions include affective (21%–100%), anxiety (41%–80%), and substance misuse (21%–

46%) disorders, as well as other ICDs (21%–40%).[32,48,51] The prevalence of CSB remains uncertain, with estimated figures of 5% to 6% in the US population.[52] Individuals with CSB usually present with other comorbid disorders, including affective disorders (71.6%), substance misuse (40.8%), anxiety disorders (38.3%), and ADHD (35.8%).[53]

TREATMENT OF IMPULSE CONTROL DISORDERS

Pharmacologic treatments for primary ICDs have been relatively understudied. There are no Food and Drug Administration–approved medications for any individual ICD. Serotonergic antidepressants may be useful for some of the ICDs (IED, ED, CB, and CSB), whereas there is more robust evidence for the use of opioid antagonists for the management of PG and kleptomania.[47] *N*-acetyl cysteine is a promising agent for the treatment of patients with PG and trichotillomania.[54] Atypical antipsychotics are unlikely to offer significant benefits, and data on mood stabilizers are far too limited at the moment for their use to be recommended, unless a diagnosis of comorbid bipolar affective disorder has been established. Finally, cognitive behavioral therapy (CBT) appears to be particularly useful in the management of kleptomania, CB, and PG.[55]

IMPULSE CONTROL DISORDERS IN NEURODEVELOPMENTAL AND NEURODEGENERATIVE DISORDERS
Attention-Deficit/Hyperactivity Disorder

ADHD is characterized by inattentive, hyperactive, and impulsive behaviors, associated with elevated levels of impulsivity as measured by poor performance on a variety of tasks requiring attentional ability and/or behavioral inhibition.[56] The neural correlates of ADHD converge on the prefrontal cortex, ventral regions of the frontal lobes, and subcortical structures within the basal ganglia.[57] These areas have consistently been linked to deficits in a variety of inhibitory processes and are known to be implicated in the development of impulsive behaviors. Furthermore, there seems to be a differential contribution of the various frontostriatal loops to different aspects of behavioral disinhibition and impulsivity. Specifically, dysfunction in the prefrontal cortex and striatal systems could mediate loss of inhibitory control in 1 subgroup of ADHD patients, and abnormal activity within areas involved in reward-learning and regulation of affect such as the nucleus accumbens and the amygdala could be implicated in avoidance of delay in another subgroup. It has been shown that about two-thirds of patients with ADHD have at least 1 ICD, the most common being IED (29.6%), followed by CB (23.4%), PG (7.4%), kleptomania and CSB (2.4%), and trichotillomania (1.2%).[58] Studies looking at psychiatric comorbidities in patients with known ICDs have also shown high prevalence rates for ADHD. In particular, ADHD was diagnosed in 20% to 25% of patients seeking treatment of PG.[59–61] In a large sample of non-treatment-seeking gamblers in the United States, 20.3% screened positive for ADHD and only 7.3% of those subjects had ever received a formal diagnosis, suggesting that this disorder might remain unrecognized in adults who gamble.[62]

Psychostimulants, the first-line pharmacotherapy for ADHD, have been shown to reduce several measures of impulsivity in this patient population.[63] A similar improvement in inhibitory control has been achieved with atomoxetine, and nonpharmacologic treatments, such as neurofeedback, have also been associated with a reduction in measures of impulsivity.[64,65] However, studies looking at the relationship between psychostimulant treatment and substance misuse in patients with ADHD often report contradicting results, with some studies showing an increased risk for substance

misuse, and other studies suggesting a reduced risk or no change in risk.[66] Only anecdotal evidence is currently available regarding treatment outcomes for comorbid ICDs in patients with ADHD. For example, patients with PG and ADHD features were reported to have benefited from treatment with bupropion in 1 open-label study,[67] and a patient with ADHD and skin picking disorder improved with methylphenidate.[68]

Tourette Syndrome

Tourette syndrome (TS) is a neurodevelopmental disorder characterized by the presence of multiple motor and phonic tics.[69] Most patients with TS present with comorbid psychiatric disorders.[70,71] About 50% of children diagnosed with ADHD have been shown to have a comorbid tic disorder, whereas ADHD-related symptoms have been reported in 35% to 90% of children with TS.[72] Several studies have shown that most cognitive impairment found in patients with TS can be linked to comorbidity with ADHD or OCD, whereas patients with uncomplicated TS tend to perform similarly to healthy controls in most cognitive domains.[73] There is the possibility that TS is associated with deficits in inhibitory functioning regardless of the presence of comorbid ADHD, although these impairments may only be apparent on particular measures. Specifically, deficit in inhibitory functions has been linked to dysfunction at the level of the anterior cingulate pathways, and neurobiological changes in this region have been associated with TS.[74,75]

Overall, neuropsychological changes related to impulsivity appear to be subtle in patients with TS, whereas antisocial behaviors, inappropriate sexual activity, nonobscene socially inappropriate behaviors, and self-injurious behaviors have consistently been reported in this population.[70,71] There is sparse literature available on the prevalence of specific ICDs in patients with TS, but it has been reported that as much as 74.2% of patients present with at least 1 ICD.[76,77] IED has been reported in 16.0% of patients with TS, and temper tantrums and rage attacks were found in 34.8% to 64.0% children with TS.[76,78,79] The frequency of these comorbid symptoms, in particular, rage attacks, was found to be increased when ADHD was present, and even more so when both ADHD and OCD were present.[78] Trichotillomania has been reported in 2.6% to 3.0% of patients with TS, a prevalence figure that was found to be independent from the presence of comorbid ADHD.[72,80] Trichotillomania has also been reported to be more prevalent in female (12%) than male (2%) patients.[81] CSB has been observed in 2.0% to 4.3% of patients with TS and has been linked to comorbid ADHD and adult age.[76,80] Prevalence rates have also been reported for CB (13%), compulsive computer use (7%), kleptomania (4%), and pyromania (3%).[76] Little is known about the treatment of ICDs in patients with TS and other chronic tic disorders: both alpha-2 agonists and antidopaminergic medications might prove beneficial for impulsive behaviors, in addition to their known anti-tic effects.[82]

Parkinson Disease

PD is the second most common neurodegenerative disorder after Alzheimer disease and is characterized by the motor symptoms of tremor, bradykinesia, and rigidity. Over the last few years, interest has gathered around the nonmotor symptoms of PD, and there is now ample evidence that cognition and emotion are also impaired, with psychiatric symptoms being present in more than 60% of patients with PD.[83] ICDs are clinically relevant nonmotor manifestations, as it has been reported that as many as 20% of patients with PD present with an ICD.[84] The most commonly reported ICDs are PG (3.9%–5.30%), CSB (3.5%–9.7%), binge eating (4.3%–10.5%), and CB (4.6%–6.5%).[85] Crucially, there seems to be no increased risk for the development of ICDs or related reward-seeking behaviors in patients with PD in the absence of

dopamine replacement therapy.[86] Risk factors for the development of ICDs in patients with PD encompass male gender, higher disease severity and earlier age of onset, novelty-seeking personality traits, and family history of ICDs.[87] Therefore, the development of ICDs in patients with PD can be linked to 3 distinct but possibly interacting processes: disease process, premorbid susceptibility to impulsivity, and dopaminergic treatment. Studies looking at the neuropsychologic performance of drug-naïve, nondemented patients with PD have yielded inconsistent results.[88] Historically, the emergence of impulsivity in PD has been attributed to neuronal dopaminergic degeneration, facilitating the development of ICDs in patients receiving dopamine replacement therapies. In patients with PD and ICDs, a diminished striatal D2/D3 receptor level and an increase in mesolimbic dopaminergic tone have been documented.[89,90] Dopamine replacement therapy acts at the level of a depleted dorsal striatum and a relatively intact ventral striatum: this can affect the function of the lateral orbitofrontal cortex, the rostral cingulate cortex, the amygdala, and the external pallidum, resulting in impaired inhibitory response and impulse control.[84,85,91]

The management ICDs in patients with PD typically involves dose reduction or discontinuation of dopamine agonists. When doing so, the risk of increasing motor symptoms and inducing dopamine agonist withdrawal syndrome must be taken into account.[92,93] A double-blind randomized controlled trial looking at the effect of amantadine in 17 patients with PD and PG showed a significant reduction in PG behavior in the patient group.[94] Another trial on 45 patients with PD and ICDs treated with nurse-led CBT revealed a statistically significant decrease in impulsive behaviors.[95]

Frontotemporal Dementia

FTD is a neurodegenerative condition characterized by selective involvement of the frontal lobe and anterior temporal lobe, resulting in profound alterations in behavior and social conduct, in the context of relative preservation of perception, spatial skills, praxis, and memory.[96,97] The behavioral variant of FTD can be associated with cognitive and personality impairment, leading to antisocial behavior (including kleptomania), as well as specific ICDs.[33,98] Importantly, behavioral problems are often the earliest manifestations of the behavioral variant of FTD.[99] Compared with PD, relatively little is known about the prevalence and clinical characteristics of ICDs in FTD; however, several case reports suggested a possible link between the behavioral variant of FTD and PG.[100–105] Because abnormal functioning of the orbitofrontal cortex appears to be implicated in the pathophysiology of gambling behavior, FTD could be considered in the differential diagnosis of a new-onset gambling behavior in adults if there are changes of personality and other more "typical" features of FTD. In summary, this literature provides additional evidence that FTD should be considered in the differential diagnosis of late-onset PG and raises the possibility that it could be appropriate to broaden the behavioral criteria for FTD toward psychiatric symptoms in the early phase of the disease. Clearly, additional research is needed to further clarify the relationship between ICDs and regional brain involvement in patients with FTD. Likewise, the management of ICDs in patients with FTD is an area that deserves further investigation in order to establish evidence-based treatment approaches.

IMPULSE CONTROL DISORDERS IN TRAUMATIC BRAIN INJURY

TBI is a relatively common injury characterized by a change in brain function after an external blow to the head and is associated with psychological distress, substance abuse, risk-taking behaviors, and ICDs.[106] There is evidence suggesting that TBI could be a risk factor for the later development of changes in brain structure and

function.[107] Specifically, several studies have shown evidence of long-term brain changes and accumulation of pathologic biomarkers (eg, amyloid and tau proteins) related to a history of moderate to severe TBI. These findings have led to the suggestion that patients with moderate to severe injuries have an increased risk of developing neurodegenerative disorders.[107] Reports on long-term brain changes in patients with milder forms of TBI have been mixed, because they are often complicated by factors related to injury exposure and complications, including the development of substance abuse and psychiatric conditions. Overall, it appears that most subjects who sustain a TBI of milder severity do not experience worse outcomes with aging. Chronic traumatic encephalopathy, although often described in terms of a neurodegenerative disorder, remains a neuropathologic condition that is poorly understood. Future research is needed to clarify the significance of pathologic findings in chronic traumatic encephalopathy and to determine whether such changes can explain any clinical symptoms, including psychiatric manifestations and ICDs.

Impulsivity has been commonly described in persons with TBI.[108,109] A multidimensional model of impulsivity encompassing 4 dimensions (urgency of reactions, lack of premeditation, lack of perseverance, and sensation seeking) has been confirmed in patients with TBI.[110–112] Moreover, specific impulsivity dimensions have been related to different behavioral disorders and/or psychopathologic states, including ICDs. For example, significant correlations have been reported between the urgency dimension of impulsivity and a tendency to CB in patients with moderate to severe TBI.[111] These findings illustrate the existing relationships between the different types of problematic behaviors and the potential implications of common psychological mechanisms in the various behavioral changes in patients with TBI.[113]

In addition to sparse evidence on hypersexuality,[114] multiple clinical observations have suggested that TBI can be associated with PG.[115–117] Moreover, it has been found that problem gamblers may be characterized by increased aggressiveness, risk-taking behaviors, and impulsivity in comparison to the general population, which are characteristics that have been observed among those who have experienced TBI.[118] Thus, it is possible that increased aggressiveness, impulsivity, and risk taking that can result from TBI might predispose individuals to problem gambling, although there is insufficient evidence to determine if there is a causal relationship. Further research is needed also to determine the potential implications of the link between TBI and moderate to severe problem gambling in terms of prevention and treatment.

SUMMARY

Although their first description dates back to over a century ago, ICDs have received relatively little attention from researchers and clinicians for decades. In the last few years, however, there has been an increase in the amount of research and clinical information on these fairly common and debilitating disorders. The nosologic reorganization brought about by the *DSM-5* and the upcoming ICD-11 reflects the growing understanding of the underlying neurocognitive and biological processes governing different types of impulsive behaviors, although controversy persists.[119] Research over the past decade has shown that impulsivity is linked to 2 or more dissociable domains, for example, a failure of motor or cognitive inhibitory control, and a failure of the reward valuation system. These components may relate to specific aspects of psychiatric practice in terms of behavior prediction and understanding of interaction between genetic and environmental factors.[120] Undeniably, a significant amount of work remains to be done; however, sustained and directed research efforts will help

develop more accurate diagnostic protocols and more targeted treatment strategies for patients with ICDs.

DISCLOSURE

The authors have nothing to disclose.

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