Intermittent explosive disorder: A study in personalized psychopharmacotherapy

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Intermittent explosive disorder (IED) is categorized under the disruptive, impulse control, and conduct disorders section of the newly published *Diagnostic and Statistical Manual for Mental Disorders* (*DSM-5*).[1] The symptoms of this disorder include recurrent behavioral outbursts that are grossly out of proportion to any provocation or psychological stressors and are not related to any other physical or mental disorder or substance use.[1] These outbursts are not premeditated, and they contribute to significant impairment in the individual's social, occupational, and interpersonal functioning.[1] IED has a high comorbidity with other mental health disorders, such as mood, anxiety, and substance-related disorders.[2] These episodes may result in verbal and/or physical aggression carried out on people, animals, and/or property, and many patients have reported disruption of their daily work and personal lives.[1,3,4]

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IED treatments

Approximately 4% to 7% of Americans are diagnosed with IED; however, only 28.8% of these individuals will seek treatment.[2] One study investigated the efficacy of IED treatment using fluoxetine and found that only 44% of the patients demonstrated a response; of those, only 29% went into full remission.[5] Other studies have investigated the effectiveness of the mood-stabilizing antiepileptic drugs divalproex and levetiracetam as well as various selective serotonin reuptake inhibitor (SSRI) antidepressants, and found them to be ineffective for the treatment of IED.[4] Currently, there are no FDA-approved medications for the treatment of IED, so identifying effective treatment strategies is crucial to alleviate the impact on daily functioning.

One way to help identify effective treatments for individuals with all types of diagnoses (psychiatric or medical) is to apply personalized medicine techniques. Personalized medicine is defined by the National Cancer Institute as "a form of medicine that uses information about a person's genes, proteins, and environment to prevent, diagnose, and treat disease."[6] Patients may present with similar disease symptomatology but vary greatly in treatment response, which can be attributed at least in part to variations in genetics.[7] The Human Genome Project fueled the expanse of personalized genomics, and soon after the sequencing of an individual's genome became possible, genome-wide association studies were launched to identify common genetic variants and how these variants associate with disease.

Conventionally, treatment has been applied in a "one-size fits all" fashion.[7] Medications have been standardized to target a specific disease or symptom, allowing for minimal individual variation in response to treatment.[7] Personalized genetic information can allow a clinician to adjust therapeutic doses, predict responses, decrease the instances of adverse drug reactions, and create a personalized health plan.[7] This is particularly important with psychiatric illnesses, as many prescribed treatments can have serious adverse effects. Personalized genomics allows a patient and clinician to determine the likelihood of how that person may respond to different treatment options and to choose an individualized treatment plan.[7]

Case

An 18-year-old male presented to the author's outpatient psychiatric practice for medication evaluation and psychotherapy due to recurrent, violent outbursts with no identifiable precipitant or psychosocial stressor. The patient described "blacking out" and had "no recollection" of the events surrounding these episodes. The outbursts had become increasingly frequent and violent over the last 6 months and ranged from extreme verbal aggression to physically assaulting family members. Family members said these episodes occurred three to four times weekly. Symptoms had been present for years, and family members reported

that the patient experienced oppositional and defiant behavioral issues as early as elementary school. In more recent years, the patient's mood had become increasingly "dark," although without symptoms characteristic of depression.

This collection of symptoms led to a primary psychiatric diagnosis of IED. The patient was adopted at 3 weeks of age with no psychiatric or medical history known about his biological parents.

On initial examination, the patient's medications included lisdexamfetamine 60 mg in the morning, guanfacine 2 mg twice per day, and quetiapine 300 mg at bedtime. The lisdexamfetamine and guanfacine were prescribed to manage symptoms of impulsivity, inattention, and aggression, which were contributing to his explosive behaviors. The patient reported using quetiapine only intermittently due to excessive sedation. The patient had significant medication trials in his history, including multiple psychostimulant agents, which caused intolerable agitation and late-day "rebound" insomnia. Trials of clonidine and guanfacine produced sedation and daytime drowsiness. The mood-stabilizing antiepileptic drugs valproic acid and carbamazepine had no apparent effect, and the patient was uncooperative with lab studies and blood draws to monitor drug levels and potential alterations in the functioning of the liver and pancreas as well as white blood cell counts. Fluoxetine and escitalopram produced restlessness and diarrhea. Risperidone, aripiprazole, and ziprasidone caused irritability and weight gain.

Patients with similar disease symtomatology may vary greatly in treatment response.

Genetic testing

Given the lack of symptom stabilization, despite the various psychotropic medication trials, genetic testing was instituted to develop a more

personalized treatment plan. Genetic testing can be a valuable tool to help determine why a patient exhibits a poor response or adverse effects when prescribed certain medications. Genetic testing was performed using the Genecept Assay to address the need for targeted therapy. The Genecept Assay, Genomind's core product, is a saliva-based genetic test that helps inform clinician treatment decisions. Once a patient has been identified for testing and consent is obtained, the patient provides a teaspoon of saliva into the saliva collection tube. After the sample is received at Genomind's lab, the clinician receives the results within three to five business days. (See *Genetic variants identified using the Genecept Assay*.) The assay is reimbursed by many insurance providers and can be covered through a self-pay option or Genomind's Patient Assistance Plan. Genomind has a list of preferred providers on their website for patients in search of a clinician who utilizes this type of testing.

The assay revealed the patient to be a carrier of a short serotonin transporter (SLC6A4) allele and a risk variant in the dopamine receptor subtype D2 (DRD2). The patient was also found to be homozygous for a variant in serotonin receptor subtype 2C (5-HT2C).

The Genecept Assay was able to identify variations in genes essential to neurotransmission, neurotransmitter function, and drug metabolism. These pathways impact many different psychiatric disorders from depression to schizophrenia. By identifying where these pathways are being disrupted, clinicians will be able to determine a more appropriate treatment plan and intervention to improve the patient's symptom management and quality of life.

SLC6A4 is responsible for transporting serotonin from the synapse back to the presynaptic cells.[8] Variants in this gene can alter transcription levels and result in reduced expression of SLC6A4, and ultimately, reduced reuptake of serotonin.[8] Genotyping found this patient to possess one short allele and one long allele variant. The short allele is the risk variant and

Genetic variants identified using the Genecept Assay[8-19]

Gene	Variant	Functional significance
Serotonin transporter (SLC6A4)	Long/short (rs63749047) A>G (rs25531)	Reduced serotonin reuptake
Serotonin receptor subtype 2C (5HT2C)	-759 C>T (rs3813929)	Altered satiety signaling
Dopamine receptor subtype 2 (DRD2)	141 C INS/DEL (rs1799732)	Altered binding of dopamine and antipsychotics
Voltage-dependent calcium channel L-type, alpha 1c subunit (CACNA1C)	G>A (rs1006737)	Altered neuronal depolarization
Ankyrin G (ANK3)	C>T (rs10994336)	Dysregulation of sodium channels
Catechol-O-methyltransferase (COMT)	158 Val>Met (rs4680)	Altered dopamine degradation
Methylenetetrahydrofolate reductase (MTHFR)	677 C>T (rs1801133)	Impaired folic acid metabolism
Cytochrome P450 2D6 (CYP2D6)	Active alleles: *1,* 2 Variants: *3, *4, *5,* 6,* 9, *10, *17, *41	Variants can lead to poor metabolism, intermediate metabolism, or ultra-metabolism of certain medications
Cytochrome P450 2C19 (CYP2C19)	Active allele: *1 Variants: *2, *3, *17	Variants can lead to poor metabolism, intermediate metabolism, or ultra-metabolism of certain medications
Cytochrome P450 3A4/5 (CYP3A4/5)	Active allele: *1 Variants: *3	Increased metabolism of certain medications

has been demonstrated in large meta-analyses to be correlated to slow response, poor response, and a greater risk of adverse reactions with SSRI medications.[9,10] This patient's poor response and significant adverse reactions with fluoxetine and escitalopram may be partially explained by this genetic variation. Antidepressant agents that do not primarily target the serotonin transporter may be beneficial in patients who display this variation.

Neuroleptics

Neuroleptics antagonize the D2 subtype of the dopamine receptor (DRD2) to produce antipsychotic activity by inhibiting dopamine signaling.[11] This patient has the -141C Ins/Del variation, which results in reduced in vitro gene expression.[12] Clinical studies have shown that this variation leads to increased risk for poor response and adverse events with antipsychotic medications.[13,14] The patient's history of poor response and intolerability to multiple antipsychotic medications is consistent with this profile.

Similar to DRD2, the 2C subtype of the serotonin receptor (5HT2C) is antagonized by various neuroleptics. Serotonin influences satiety signaling via this receptor, and antagonism of 5HT2C can lead to increased food intake, hyperlipidemia, glucose intolerance, and obesity.[15-17] The C allele at the -759C/T polymorphism is linked to weight gain and metabolic syndrome in patients taking atypical antipsychotics.[17-19] The patient is homozygous for the C allele, and consistent with this finding, has a history of intolerable weight gain in response to risperidone, aripiprazole, and ziprasidone.

The patient's genetic profile suggested that he might benefit from a medication that does not target SLC6A4, DRD2, or 5HT2C. His results suggest that he may not respond well to atypical antipsychotics and SSRIs, which is supported by his previous treatment failure and intolerability with these agents. As a result of activating stimulant adverse reactions and weight gain in response to atypical antipsychotics, lisdexamfetamine and quetiapine were discontinued. A trial of lithium was started, as the mechanism of action of lithium does not inhibit SLC6A4 or target the 5-HT2C or DRD2 receptors, and therefore, this medication is less likely to have adverse effects or symptoms related to the patient's genetic variants. Following the addition of lithium, a reduction in outbursts was observed, and episodes of extreme rage ceased. Guanfacine was continued due to its action on alpha-adrenergic receptors, which potentially reduce impulsivity and aggression.

Moving forward

Upon achieving a therapeutic level of 1.0 on lithium 600 mg twice daily, this young man's symptoms markedly decreased. He and his family reported that over the 3 months since initiation of the new psychopharmacologic therapies based on the results of the Genecept Assay, he experienced only two brief episodes of anger, both of which were less severe in both duration and intensity. NP

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