Inhalants are abused by many people, mainly socioeconomically disadvantaged children and adolescents from various parts of the world.\(^1\) In 2001, nearly 150,000 Americans received treatment for inhalant-related disorders.\(^2\)

Inhalant use is defined as the intentional inhalation of vapors from commercial products or specific agents for the purpose of achieving mind-altering effects.\(^3\) Commonly used products include gasoline, glue, paint thinner, nail polish, nail polish remover, spray paint, deodorants, hair sprays, and typewriter correction fluids.\(^3\) Other specific chemical mixtures that are used as inhalants include acetone, benzene, butanone, n-hexane, and toluene.

The Diagnostic and Statistical Manual for Mental Disorders, fourth edition, text revision (DSM-IV-TR) provides two broad categories of inhalant-related disorders. The first category is inhalant-use disorders, namely inhalant abuse and inhalant dependence, which are characterized by maladaptive patterns of inhalant use. The second category, inhalant-induced disorder, such as inhalant toxification, results from the toxic effects of inhaled substances.\(^4\)

No controlled studies that could provide the specific modalities for the treatment of patients who meet criteria for inhalant abuse or dependence have been published in the scientific literature. This article is a case report of a patient with inhalant dependence who was treated only symptomatically, and no specific treatment is offered.

CASE

Ms. B. is a 47-year-old white woman with a history of depressive disorder and alcohol dependence with physiological dependence for more than 5 years. She is married, currently unemployed, and lives with her husband and four children. The patient has a history of two detoxification admissions and one rehabilitation program at the Carrier Foundation Clinic in 2008, and since that time she reported remaining abstinent from alcohol. However, in the past 6 months, she began using inhalants (hair spray) and has started to abuse them on daily basis, often 10 to 15 containers daily via the paranasal route and “huffing” by mouth, with last use on the day of presentation to the emergency department. On the day of presentation, she was found unresponsive after she had inhaled her 12th can of hair spray that day.

The Diagnostic and Statistical Manual for Mental Disorders, fourth edition, text revision (DSM-IV-TR) provides two broad categories of inhalant-related disorders. The first category is inhalant-use disorders, namely inhalant abuse and inhalant dependence, which are characterized by maladaptive patterns of inhalant use. The second category, inhalant-induced disorder, such as inhalant toxification, results from the toxic effects of inhaled substances.\(^4\)

No controlled studies that could provide the specific modalities for the treatment of patients who meet criteria for inhalant abuse or dependence have been published in the scientific literature. This article is a case report of a patient with inhalant dependence who was treated only symptomatically, and no specific treatment is offered.

CASE

Ms. B. is a 47-year-old white woman with a history of depressive disorder and alcohol dependence with physiological dependence for more than 5 years. She is married, currently unemployed, and lives with her husband and four children. The patient has a history of two detoxification admissions and one rehabilitation program at the Carrier Foundation Clinic in 2008, and since that time she reported remaining abstinent from alcohol. However, in the past 6 months, she began using inhalants (hair spray) and has started to abuse them on daily basis, often 10 to 15 containers daily via the paranasal route and “huffing” by mouth, with last use on the day of presentation to the emergency department. On the day of presentation, she was found unresponsive after she had inhaled her 12th can of hair spray that day.

The Diagnostic and Statistical Manual for Mental Disorders, fourth edition, text revision (DSM-IV-TR) provides two broad categories of inhalant-related disorders. The first category is inhalant-use disorders, namely inhalant abuse and inhalant dependence, which are characterized by maladaptive patterns of inhalant use. The second category, inhalant-induced disorder, such as inhalant toxification, results from the toxic effects of inhaled substances.\(^4\)

No controlled studies that could provide the specific modalities for the treatment of patients who meet criteria for inhalant abuse or dependence have been published in the scientific literature. This article is a case report of a patient with inhalant dependence who was treated only symptomatically, and no specific treatment is offered.

CASE

Ms. B. is a 47-year-old white woman with a history of depressive disorder and alcohol dependence with physiological dependence for more than 5 years. She is married, currently unemployed, and lives with her husband and four children. The patient has a history of two detoxification admissions and one rehabilitation program at the Carrier Foundation Clinic in 2008, and since that time she reported remaining abstinent from alcohol. However, in the past 6 months, she began using inhalants (hair spray) and has started to abuse them on daily basis, often 10 to 15 containers daily via the paranasal route and “huffing” by mouth, with last use on the day of presentation to the emergency department. On the day of presentation, she was found unresponsive after she had inhaled her 12th can of hair spray that day.

The Diagnostic and Statistical Manual for Mental Disorders, fourth edition, text revision (DSM-IV-TR) provides two broad categories of inhalant-related disorders. The first category is inhalant-use disorders, namely inhalant abuse and inhalant dependence, which are characterized by maladaptive patterns of inhalant use. The second category, inhalant-induced disorder, such as inhalant toxification, results from the toxic effects of inhaled substances.\(^4\)

No controlled studies that could provide the specific modalities for the treatment of patients who meet criteria for inhalant abuse or dependence have been published in the scientific literature. This article is a case report of a patient with inhalant dependence who was treated only symptomatically, and no specific treatment is offered.
Despite noncompliance with psychiatric treatment during the past month, which included duloxetine 60 mg by mouth twice daily, she had been doing relatively well until 2 weeks before presentation, when she began to feel more depressed and stopped her daily routine. She began to have feeling of hopelessness and helplessness and described feeling worthless and dissatisfied with her life. The patient stated feeling extremely anxious and irritable at times and started to have passive suicidal thoughts without plan or intent in the last 4 days before presentation. No manic or psychotic symptoms were reported or elicited. There were no reported changes in her appetite and no homicidal thoughts. She had difficulty sleeping at night, sleeping only 4 to 5 hours with frequent awakening. She has abused alcohol in the past (up to 2 pints of vodka daily) for approximately 10 years, but had continued to stay sober for the past 2 years. She also made suicidal statements in the past, but no attempts were made. A history of destruction to property was reported, but no homicidal ideas or attempts, legal charges, or self-mutilation were reported. The family psychiatric history was not available.

On mental status examination, she appeared her stated age. She was sitting up in a chair and wearing a hospital gown. She appeared unkempt with poor hygiene. Her posture was tense but slumped, and she was very restless with accelerated body movements. Her speech had normal stream but was underproductive. She maintained minimal eye contact throughout the interview. Her mood was anxious and depressed with constricted affect. Her thought form was circumstantial. There were no perceptual disturbances, and she denied suicidal or homicidal ideation. She also denied delusions, obsessions, or phobias. She was awake, alert, and oriented to person, time, and place. Cognitive function was grossly intact, but she was easily distracted. Her insight was partially impaired, and her overall judgment was poor.

Inhalant Dependence with Physiological Dependence

According to DSM-IV-TR criteria, the patient qualified for the diagnosis of inhalant dependence with physiological dependence. She also met the diagnosis of inhalant-induced mood disorder with depressive features and alcohol dependence with physiological dependence in sustained full remission. A blood alcohol level and urine toxicology screen returned normal results. Initial laboratory results were within normal limit except for hypokalemia. Initial emergency department management included potassium replacement, citalopram for depression, hydroxyzine for anxiety, and trazadone for insomnia. After initial stabilization, the patient was transferred to a co-occurring treatment unit. While admitted in the unit, hydroxyzine was discontinued and clonazepam and gabapentin were added to control anxiety symptoms.

After receiving the treatment for 2 weeks, the patient was able to resist her craving for inhalants. When desires or anxiety occurred, the patient was able to avoid them. She did not have any significant side effects with ongoing treatment. The patient was discharged on citalopram, gabapentin, and trazadone. The patient has been on the same medications for 6 months without using any inhalants.

**DISCUSSION**

Inhalant use is a poorly studied form of substance-use disorder. There is a paucity of literature regarding inhalant abuse/dependence potential and withdrawal despite its ubiquitous nature and steady growth as a public health problem. We tried to develop treatment modules and therapeutic approaches to understanding the physiological and pharmacological effects by researching the role of laboratory and evidence-based psychopharmacological treatment of inhalant disorders.

**Effects of Inhalants**

The inhalants act in ways that are similar to several abused drugs, especially by causing euphoria followed by central nervous system depression. When inhaled, these chemicals are rapidly absorbed through the lungs into the blood and act on the brain and other organs to produce intoxication. They produce effects similar to those caused by ethanol, resulting in confusion, a loss of self-control, violent behavior, nausea, vomiting, ataxia, giddiness, and, at higher dosages, hallucination.
loss of motor skills, slurred speech, palpitations, seizures, diarrhea, and abdominal pain. However, the neuro-psychopharmacological effects of abused solvents differ from one inhalant to another.¹

**Causes of Death**

Common causes of death from inhalant abuse occur in two ways: acute and delayed.

Acute death is caused directly by immediate or “postponed” sudden sniffing death syndrome (i.e., meth-hemoglobinemia). It is caused indirectly by suffocation, aspiration, trauma, and loss of consciousness that can lead to accidental death (e.g., drowning, motor vehicle accident, fire, etc).³

Delayed death is caused by cardiomyopathy, central nervous system toxicity (toluene dementia and brainstem dysfunction), hematologic problems ( aplastic anemia, leukemia), hepatocellular carcinoma, and renal toxicity (nephritis, nephrosis, tubular necrosis).³

**Mechanism of Action**

The cellular mechanisms of inhalant actions are unclear. The animal model of inhalant abuse hypothesizes that N-methyl-D-aspartate (NMDA), gamma-aminobutyric acid-A (GABA-A), glycine, nicotine, and 5-HT3 receptors appear to be the important target of action for abused inhalants, but the data are very sparse. In animal studies, inhalant drug exposure activates mesolimbic dopamine neurons and is thought to mediate the rewarding effects, including craving, associated with its abuse. Although the exact mechanism by which inhalants exert their effect on the central nervous system is unknown, it is postulated that they, like ethanol, benzodiazepines, and general anesthetics, may hyperpolarize neurons by acting at GABA-A receptor sites and reversibly enhance the receptor-mediated synaptic currents, as observed in rat hippocampal slices.

**Role of the Laboratory**

Chemicals that are commonly abused by inhalation are not detected in routine urine drug screens. Laboratory identification of inhalant abuse most often requires analysis of body fluids by head space gas chromatography with flame ionization, electron capture, or mass spectrometer detection devices. If a laboratory does not have gas chromatographic instrumentation, it is essential that specimens be collected and stored properly between −5°C and 4°C in tightly sealed containers for shipment to referral laboratories.

These volatile compounds have a relatively brief presence in the body and may be detected in urine for only a few hours after use. For cooperative, conscious patients, it may be possible to collect and then analyze expired air. However, the half-life of inhalants in air is a matter of few minutes, so breath may be useless for monitoring treatment progress in patients who show no current signs of intoxication. Therefore, clinical laboratory personnel should be aware of the clinical symptoms associated with inhalant use; such knowledge will assist in the assessment of the symptoms and the monitoring of treatment.

The laboratory’s role in cases of inhalant use is to support the ongoing treatment of inhalant abusers. Generally, the therapy for substance-use disorder often uses repeated tests of biological samples to validate patient’s reports of abstinence or use. However, with inhalants, such a test may be difficult to interpret. The detection of some volatile substances in blood does not in itself indicate inhalant abuse. For example, acetone and other volatile compounds are often present in ketoacidotic patients. Some inborn errors of metabolism can also result in volatile compounds accumulating.

Urinary metabolites that have been used to confirm the inhalation of volatile substances include phenol (benzene metabolite), trichloroacetionic acid, hippuric acid (toluene), and methyl hippuric acid (xylene). Caution must be used when interpreting the laboratory results of these urinary metabolites. For example, urinary hippuric acid may be due to ingestion of benzoate preservatives in foods and not exposure to toluene, raising the possibility of false-positive findings.

After the initial chemical detection of inhalant abuse, initial laboratory support includes assessment of acid base and electrolyte status and monitoring of treatment to correct any further disturbances. Additional laboratory testing may include screening using conventional tests (including organ-specific profiles) and complete blood count for hematological, hepatic, renal, and muscular complications associated with specific compounds. In rare instances, chronic use may result in nontoxicological laboratory results, such as abnormal aspartate aminotransferase, alanine aminotransfer-
ase, prothrombin time, and activated partial thromboplastin time, due to impaired liver function, which may make the clinician suspicious of long-term use.

**TREATMENT**

Little research has been conducted on specific modalities for the treatment of inhalant abuse. A literature search on PubMed did not return any study regarding the efficacy of psychopharmacological support in inhalant users. There are few references (mainly case reports) for evidence-based treatment protocols in the literature.

Our search found one case report of lamotrigene treatment for inhalant dependence, two case reports of risperidone and buspirone for inhalant abuse, and one case report of baclofen for inhalant withdrawal. The only randomized controlled trial found in our search was a study of carbamazepine and haloperidol for the treatment of inhalant-induced psychotic disorder.4,7-10

Appropriate medical care is required for the disorder’s sequelae. Vigorous treatment is needed for patients who progress from experimentation to inhalant abuse or dependence.

When treating a patient with inhalant-use disorder, the clinician must rely on the principles used in the treatment of other substance-use disorders and apply strategies that have been effective for some communities in curbing inhalant use.

The first step in treatment is obtaining a detailed history of which products are used, how often, and via what medium the substances are inhaled, and giving the patient a thorough examination.2

In chronic inhalant abusers, the physician should pay particular attention to the neurological examination and laboratory workup (because of heterogeneity of inhaled compounds), and be sure to screen the patient for damage to the liver, kidney, and heart. Initial lab results should include electrolytes, blood urea nitrogen, creatine, liver function, and an electrocardiogram. Further workup can then be performed as needed. Many inhalant users have neurocognitive deficits, and in such cases, formal neuropsychiatric testing may be needed to better characterize the deficits and alter the treatment plan accordingly.6,11

Patients who have been abusing volatile solvents may be at risk for withdrawal. Although inhalant abusers rarely experience significant withdrawal symptoms, we recommend that the patient be closely monitored as if he/she were being treated for alcohol withdrawal. If symptoms develop, the limited literature suggests benzodiazepines should be the first line of drug used to treat those symptoms.11

Patients rarely present for the treatment of inhalant use, so other substance abuse and psychiatric comorbidity are high within this patient group. Therefore, the treatment of comorbid illness should be a priority. Most inhalant users have comorbid conduct disorder, attention-deficit/hyperactivity disorder, major depressive disorder, dysthymic disorder, alcohol dependence, and psychosis.4

In cases in which the patient is a child, adolescent, or is mentally handicapped, a family assessment should be performed with particular concern for parental substance use and mental disorders. This evaluation can offer an intervention to address difficulties within the family and help identify stressors within the patient’s life. Relapse is very common among people who abuse inhalants. Therefore, it may be helpful to introduce abusers to safe and healthy forms of recreation.2

In adults, methods such as cognitive-behavioral therapy, 12-step facilitation, or motivational enhancement may be of benefit. Abusers often are not ready to begin therapy until detoxification is complete and they often require therapy for long duration. Because people who abuse inhalants tend to have short attention spans and difficulty with complex thinking, initial therapy sessions should be short.2,11

**CONCLUSION**

The literature survey indicates that currently available treatment protocols are limited. A stronger knowledge base about inhalant-related symptoms is needed to better understand the clinical course of inhalant-use disorders, which will greatly help in developing evidence-based treatments and aiding treatment selections. Our findings provide preliminary support for the use of the provider to discuss the case with the patient.

**Patients who have been abusing volatile solvents may be at risk for withdrawal.**

---

422 | Healio.com/Psychiatry

PSYCHIATRIC ANNALS 43:9 | SEPTEMBER 2013
of risperidone, buspirone, baclofen, and lamotrigine in the management of patients with inhalant dependence and in possibly preventing relapse. However, because of the limitations of these currently published uncontrolled case reports, further investigation in placebo-controlled studies will be necessary.

REFERENCES

AD INDEX
SLACK INCORPORATED
6900 Grove Road
Thorofare, NJ 08086
Healio.com/Psychiatry...............................390
SUNOVION PHARMACEUTICALS INC.
84 Waterford Dr.
Marlborough, MA 01752
Latuda.................................................424-432, C3, C4

While every precaution is taken to ensure accuracy, Psychiatric Annals cannot guarantee against occasional changes or omissions in the preparation of this index.