

Recognition and Prevention of Inhalant Abuse

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Inhalant abuse is a prevalent and often overlooked form of substance abuse in adolescents. Survey results consistently show that nearly 20 percent of children in middle school and high school have experimented with inhaled substances. The method of delivery is inhalation of a solvent from its container, a soaked rag, or a bag. Solvents include almost any household cleaning agent or propellant, paint thinner, glue, and lighter fluid. Inhalant abuse typically can cause a euphoric feeling and can become addictive. Acute effects include sudden sniffing death syndrome, asphyxia, and serious injuries (e.g., falls, burns, frostbite). Chronic inhalant abuse can damage cardiac, renal, hepatic, and neurologic systems. Inhalant abuse during pregnancy can cause fetal abnormalities. Diagnosis of inhalant abuse is difficult and relies almost entirely on a thorough history and a high index of suspicion. No specific laboratory tests confirm solvent inhalation. Treatment is generally supportive, because there are no reversal agents for inhalant intoxication. Education of young persons and their parents is essential to decrease experimentation with inhalants. (Am Fam Physician 2003;68:869-74,876. Copyright © 2003 American Academy of Family Physicians.)

See page 785 for definitions of strength-of-evidence levels.

Although inhalant abuse is quite prevalent, it is an often overlooked form of substance abuse in adolescents. National surveys¹ report that nearly 20 percent of young persons have experimented with inhalants at least once by the time they are in eighth grade. In the United States, the mean age of first-time inhalant abuse is 13 years.² At present, rates of abuse are higher in Hispanics and whites than in blacks.

Because the inhalants that are abused are in common household products and are relatively inexpensive, they are accessible to children who are too poor or too young to access other drugs. Furthermore, inhalant abuse appears to be a gateway phenomenon among younger adolescents: children who abuse inhalants early in life are more likely later to use other illicit drugs.^{3,4}

Injuries and illnesses related to inhalant abuse occur with alarming frequency. Hence, family physicians should be alert to the presence of this form of substance abuse in young patients and should provide information about its acute and chronic effects. Parents also should be educated about the warning signs and dangers of inhalant abuse.

See editorial
on page 811.

► A patient information handout on inhalant abuse, written by the authors of this article, is provided on page 876.

Illustrative Case 1

A 21-year-old man is unconscious when he is brought to the emergency department. His friends report that he has been “huffing” (placing a rag soaked in a substance over his nose and mouth and then inhaling) for several months. On examination, the thin young man is briefly arousable to deep pain. He slowly becomes more arousable. Laboratory tests and a computed tomographic (CT) scan of the head are negative. At 24 hours after presentation, the patient becomes completely coherent and demands to be released from the hospital. He is released against medical advice.

Three weeks later, the young man again presents to the emergency department, this time in full cardiac arrest. After extensive resuscitative efforts, the patient dies. Family and friends confirm that he had been inhaling gun cleaner daily.

Illustrative Case 2

A 13-year-old girl with a primary complaint of headaches is brought to the physician’s office by her mother. The patient reports headaches that have been increasing in frequency over the past year and are now

Signs of recent inhalant abuse include paint or oil stains on clothing or skin, spots or sores around the mouth, red eyes, rhinorrhea, chemical odor on the breath, and a dazed appearance.

present daily. The headaches have resulted in several days missed from school. The patient's mother also notes that the adolescent occasionally seems confused and uncoordinated ("clumsy"), and is "not eating much." Her grades have declined dramatically over the past semester.

On physical examination, the patient is noted to have dry, cracked perioral skin with irritation and sores on the lips, and fingernail beds that appear to be stained with ink. The examination is otherwise normal. During private questioning, the patient admits to sniffing glue and spray paint "once or twice" with a friend over the past few months.

Definition

Inhalant abuse involves breathing in a substance directly from its container (sniffing or snorting), placing a rag soaked in the substance over the nose and mouth and inhaling ("huffing"), or pouring the substance into a plastic bag and breathing the fumes ("bagging").^{5(pp257-60)}

Abused substances include fuels, solvents, propellants, glues, adhesives, and paint thinners. The active chemicals in commonly abused inhalants are listed in *Table 1*.^{6,7} Abuse of amyl and butyl nitrites (called "poppers") is not included in this review because of the different mechanism of action and adverse effects of these substances.⁸ Inhaled solvents likely share cellular actions with γ -aminobutyric acid–receptor drugs (e.g., benzodiazepines, barbiturates, alcohol), resulting in a depressant effect.^{5(pp257-60)}

Use of inhalants can produce a euphoric feeling similar to that experienced with other illicit drugs.⁹ When a person using inhalants becomes hypercapnic and hypoxic by rebreathing from a closed bag, the effects of the inhalant are intensified.⁸

The criteria for inhalant abuse, intoxication, and dependence are outlined in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. (DSM-IV). These criteria are listed in *Table 2*.^{5(pp239)}

Presentation

In the office setting, it is seldom obvious which preadolescent or adolescent patients are abusing inhalants. Victims of child abuse tend to be at greater risk for inhalant abuse,¹⁰ as are young persons whose friends or relatives abuse other substances.

Patients who have been abusing inhalants may report dizziness, irritability, tiredness, loss of appetite, headache, photophobia, or cough.^{11,12} Most symptoms are nonspecific and can be mistaken for those of other illnesses or syndromes. Signs of recent inhalant abuse include paint or oil stains on clothing or

TABLE 1
Chemicals in Commonly Abused Inhalants

Chemical	Commonly abused inhalants
Toluene	Paint thinner, spray paint, airplane glue, rubber cement, nail polish remover, shoe polish
Butane	Lighter fluid, fuel, spray paint, hair spray, room freshener, deodorants
Propane	Gas grill fuel, spray paint, hair spray, room freshener, deodorants
Fluorocarbons	Asthma sprays, analgesic sprays, Freon® gas, spray paint, hair spray, deodorants, room fresheners
Chlorinated hydrocarbons	Dry-cleaning agents, spot removers, degreasers, correction fluid
Acetone	Nail polish remover, rubber cement, permanent markers

Adapted with permission from Bowen SE, Daniel J, Balster RL. Deaths associated with inhalant abuse in Virginia from 1987 to 1996. *Drug Alcohol Depend* 1999;53:241, and Sharp CW, Rosenberg NL. Inhalants. In: Lowinson JH, Ruiz P, Millman RB, Langrod JG, eds. *Substance abuse: a comprehensive textbook*. 3d ed. Baltimore: Williams & Wilkins, 1997:246-64.

skin, spots or sores around the mouth, red eyes, rhinorrhea, chemical odor on the breath, and a dazed appearance (*Table 3*).¹³

Patients with long-term inhalant abuse can present to the emergency department or office setting with a wide range of neuropsychiatric signs and symptoms. The most commonly recognized acute presentation is sudden unconsciousness or death during known inhalation of a solvent. Other, nonspecific complaints include the following: memory loss, especially loss of short-term memory; delusions or hallucinations; slurred or changed speech; staggering, stumbling, or wide-based ataxic gait; visual and optical changes, such as nystagmus; and loss of hearing or sense of smell.⁸ Unfortunately, no specific syndromes or clinical presentations confirm inhalant abuse.

Because of the variety of solvents that are inhaled, the range of adverse effects is quite broad⁹ (*Table 4*).¹⁴ Furthermore, it is difficult to pinpoint which chemicals cause adverse effects, because the biologically active compound is often a metabolite of the listed active compound.

The most serious acute consequence of inhalant abuse is death, which usually occurs secondary to aspiration, accidental trauma, or asphyxia. Other acute causes of death include cardiac arrhythmias, anoxia, vagal inhibition, and respiratory depression. As many as 50 percent of inhalant-related deaths are caused by sudden sniffing death syndrome.^{15,16} This syndrome occurs when the acutely intoxicated inhalant abuser is startled, causing the release of a burst of catecholamines that can trigger ventricular fibrillation.⁸ Other serious acute effects include burns from accidental flash fires, hypothermic injuries from propellants, and the triggering of underlying asthma or allergic reactions.

Chronic inhalant use causes toxicity to several organs, including the brain, heart, lung, kidney, liver, and bone marrow. Cardiac toxicity encompasses myocardial edema, irreversible myocarditis, fibrosis, and congestive

Sudden sniffing death syndrome occurs when the acutely intoxicated inhalant abuser is startled, causing the release of a burst of catecholamines that can trigger ventricular fibrillation.

TABLE 2

Diagnostic Criteria for Inhalant Intoxication

Recent intentional use or short-term, high-dose exposure to volatile inhalants (excluding anesthetic gases and short-acting vasodilators)

Clinically significant maladaptive behavior or psychologic changes (e.g., belligerence, assaultiveness, apathy, impaired judgment, impaired social or occupational functioning) that developed during, or shortly after, use of or exposure to volatile inhalants

Two (or more) of the following signs developing during, or shortly after, inhalant use or exposure: dizziness, nystagmus, incoordination, slurred speech, unsteady gait, lethargy, depressed reflexes, psychomotor retardation, tremor, generalized muscle weakness, blurred vision or diplopia, stupor or coma, or euphoria

The symptoms are not due to a general medical condition and are not better accounted for by another mental disorder.

Adapted with permission from American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Rev. Washington, D.C.: American Psychiatric Association, 2000:239.

TABLE 3

Signs and Symptoms of Inhalant Abuse

Physical appearance

Paint or oil stains on clothing or body
Chemical odor on breath
Spots or sores in or around mouth
Rhinorrhea
Injected sclera
Nystagmus
Diplopia
Stained fingernails

Behavior

Dazed appearance
Dizziness or unsteady gait
Slurred speech
Forgetfulness or difficulty concentrating
Anorexia or nausea
Irritability or excitability
Anxiety
Sleep disturbances

Adapted with permission from Jones HE, Balster RL. Inhalant abuse in pregnancy. Obstet Gynecol Clin North Am 1998;25:161.

TABLE 4
Adverse Effects of Inhalants

Cardiovascular effects	Neurologic effects	Pulmonary effects
Dysrhythmias	Ataxia	Cough or wheezing
Hypoxia-induced heart block	Cerebellar degeneration	Dyspnea
Myocardial fibrosis	Change in speech	Emphysema
Sudden sniffing death syndrome	Nystagmus	Goodpasture's syndrome
Dermatologic effects	Neuropsychiatric effects	Renal effects
Burns	Peripheral neuropathy	Acid-base disturbance
Contact dermatitis	Sensorimotor polyneuropathy	Acute renal failure
Perioral eczema	Tremor	Fanconi's syndrome
Gastrointestinal effects	White matter degeneration	Renal tubular acidosis
Hepatotoxicity	Apathy	
Nausea or vomiting	Dementia	
Hematologic effects	Depression	
Aplastic anemia	Insomnia	
Bone marrow suppression	Memory loss	
Leukemia	Poor attention	
	Psychosis	

Adapted with permission from Brouette T, Anton R. Clinical review of inhalants. *Am J Addict* 2001;10:84.

heart failure.⁸ Respiratory damage often is related to toluene abuse and can include panacinar emphysema¹⁷ and Goodpasture's syndrome.¹⁸ Renal toxicity entails distal renal tubular acidosis, anion-gap acidosis, Fanconi's syndrome, renal calculi, hematuria, proteinuria, and renal failure. Toluene-induced renal tubular acidosis is reversible after cessation of

inhalants. Long-term inhalant use can result in bone marrow suppression, leading to leukopenia, anemia, thrombocytopenia, and hemolysis.¹¹ Hepatic toxicity also has been reported.¹⁹

Neurologic toxicity is the most recognized and reported chronic side effect of inhaled solvent abuse. Common findings on brain imaging include enlarged ventricles, widened cortical sulci, and cerebral, cerebellar, or brain stem atrophy.⁸ Magnetic resonance imaging suggests that these white-matter changes in chronic abusers are irreversible.²⁰ Dementia, chronic encephalopathy, and peripheral neuropathy also occur. Peripheral neuropathy may present as proximal or distal muscle weakness, muscle wasting, absent or decreased tendon reflexes, or paresthesias. Peripheral neuropathy may be confused with Guillain-Barré syndrome but can be distinguished by sural nerve biopsy, which will show axonal swelling in inhalant abusers.⁸

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Inhalant abuse by women who are pregnant can increase the risks of spontaneous abortion. It also can result in fetal solvent syndrome, which manifests as low birth weight, small head size, facial dysmorphology, and muscle tone abnormalities similar to those occurring in fetal alcohol syndrome.¹³

Diagnosis

The diagnosis of inhalant abuse relies almost entirely on a high index of suspicion. A diligent history and a thorough physical examination are the mainstays of diagnosis.

Only a few laboratory tests are helpful in detecting inhalant abuse. Suggested laboratory testing for a patient presenting with acute inhalant intoxication or suspected inhalant use includes a complete blood count, determination of electrolyte, phosphorous, and calcium levels, an acid-base assessment, hepatic and renal profiles, and cardiac/muscle enzyme analysis.¹¹

Blood collected in a sealed tube containing ethylenediaminetetraacetic acid or heparin can be analyzed by gas chromatography for the presence of aliphatic hydrocarbons (the substances found in inhaled solvents).¹¹ However, this test is usually unavailable on an emergency basis.

A urine drug screen is recommended to rule out other illicit drug use. An electrocardiogram should be obtained to detect dysrhythmias, and brain imaging should be performed if neurologic findings are present.

Treatment

The treatment of acute inhalation-related injury and illness is generally supportive. Acute dysrhythmias should be treated according to established protocols. The use of sympathomimetics (e.g., epinephrine, norepinephrine, isoproterenol [Isuprel]) should be avoided in patients with ventricular fibrillation.²¹ Beta blockers should be administered early to protect the catecholamine-sensitized heart. Acid-base and metabolic disturbances should be corrected. Cardiopulmonary monitoring is

Fetal solvent syndrome manifests as low birth weight, small head size, facial dysmorphology, and muscle tone abnormalities similar to those occurring in fetal alcohol syndrome.

recommended because of the risk of apnea and cardiac arrest after acute exposure.¹²

Many acute neurologic findings are reversible after cessation of inhalants. Chronic neurologic sequelae (e.g., dementia, cerebral dysfunction, cerebellar dysfunction) are often permanent and difficult to manage.

Treatment of inhalant abuse and dependence involves counseling, strict abstinence by the abuser, and other drug dependency protocols (e.g., 12-step programs, support groups, inpatient and outpatient dependency treatment). However, a survey²² of drug treatment providers concluded that most treatment programs are not yet adequately equipped to handle inhalant abuse or dependence. While addiction to inhalants has been reported in various case studies, no studies have estimated its prevalence.

Tolerance to inhalants can develop with frequent use. A withdrawal syndrome has been described, although it occurs infrequently. When withdrawal occurs, it should be supported in a controlled setting, if possible. Withdrawal symptoms are similar to those that occur in withdrawal from alcohol or benzodiazepines. Symptoms can include sleep disturbance, irritability, jitteriness, diaphoresis, nausea, vomiting, tachycardia and, occasionally, hallucinations or delusions.^{5(pp257-60)} Withdrawal can last one month or longer, and relapse rates are high.²²

Currently, no specific agents can reverse acute solvent intoxication. In addition, no medications have proved helpful in the treatment of inhalant withdrawal or dependence.

Prevention

Prevention of inhalant abuse is a primary goal, and preadolescents and adolescents

should be given extra attention. In addition to questions about tobacco, alcohol, or other drug use, the social history should include a question about "huffing" and "sniffing." For example, "Have you or your friends ever tried sniffing glue or paint thinner?" Any experimentation by the patient or the patient's friends should be considered a risk factor.

The dangers of sudden death, burns, flash fires, and serious brain damage should be reiterated to patients who are at risk for inhalant abuse. Parents also should be informed about the dangers and warning signs of inhalant abuse. Promoting education of children, parents, and teachers is essential to curtailing inhalant abuse.¹⁶ [Evidence level C, expert opinion]

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