Anesthetic management of the illicit-substance-using patient
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**Purpose of review**
During the last few years, drug abuse has risen to the point that almost 20 million Americans are current abusers of illicit substances. These patients present to us as anesthesiologists in a variety of circumstances: in obstetrics for labor and emergencies, in trauma for emergency surgeries or life-saving (resuscitative) situations and in everyday elective surgeries. Therefore it is important for anesthesiologists to know about the most common illicit drugs being used, to know their side effects and clinical presentation if abused or intoxicated, and to know what anesthetic options would be beneficial or detrimental.

**Recent findings**
In this article we will review some of the most commonly used illicit drugs, their effects on the organ systems and some tips to take into consideration when providing anesthesia for these patients. We will discuss marijuana, cocaine, opioids, hallucinogens, solvents and the newer so-called rave or club drugs. Newer treatment options for opioid detoxification will also be discussed.

**Summary**
Illicit substance abuse is a major health concern in the United States. Drug use, either acute or chronic, has potentially grave consequences which include changes affecting the pulmonary, cardiovascular, nervous, renal and hepatic systems. Anesthesiologists come into contact with these patients in emergency and everyday situations. Due to the diverse clinical presentations that may arise from single substance or polysubstance abuse, anesthetic management should be tailored to each individual and universal precautions should always be followed when providing care.

**Keywords**
anesthesia, illicit substance abuse

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**Introduction**
Through the years, abuse of illicit substances has been escalating despite efforts in health education, prevention and different detoxification or rehabilitation treatment approaches. This is illustrated by the fact that in 2003 an estimated 19.5 million Americans (8.2% of the population) of ages 12 and older were current users of illicit drugs \[1\]. Even though as anesthesiologists we are generally not the primary care physicians of these patients, we encounter these patients as we administer anesthesia to them for emergency or trauma situations, obstetrics and even for regular elective surgeries. The latest findings from drug-abuse-related visits to the Emergency Department reported by the Substance Abuse and Mental Health Services Administration (SAMHSA) in the year 2000 are collected in the Drug Abuse Warning Network (DAWN), a national probability survey of 466 hospital Emergency Departments in 21 metropolitan areas of the USA. These findings include that there were 601,776 drug-related Emergency Department episodes. In decreasing order, the following drugs were mentioned at the time of admission: alcohol in combination with other drugs (204,524), cocaine (174,896), heroin/morphine (97,287) and marijuana (96,446). On the other hand, the National Survey on Drug Use and Health (NSDUH) has estimated that marijuana is the most commonly used illicit drug (6.2% of the population or 14.6 million people), followed by cocaine (1% or 2.3 million people). An increase in the number of people aged 12 or older abusing nonmedical pain relievers increased from 29.6 million to 31.2 million between 2002 and 2003. Males were almost twice as likely to be classified with substance abuse or dependence when compared to females (12.2 versus 6.2%). However, in young people (ages 12–17) similar rates of drug abuse or dependence were reported in males and females (8.7 versus 9.1%). Understanding the complexity of the problem of substance abuse is a challenge, since an interplay of biological, genetic, psychological, social, cultural, environmental and spiritual factors are involved.

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Abbreviations

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<tr>
<th>Abbreviation</th>
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<tr>
<td>CNS</td>
<td>central nervous system</td>
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<td>GHB</td>
<td>γ-hydroxybutyrate</td>
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<td>IUGR</td>
<td>intrauterine growth restriction</td>
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<td>LSD</td>
<td>lysergic acid diethylamide</td>
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<td>MDMA</td>
<td>3,4-methylenedioxymethamphetamine</td>
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<td>PGP</td>
<td>phencyclidine</td>
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<td>THC</td>
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As anesthesiologists we need to be aware of the use of illicit drugs because of the long-term negative consequences that it may have on health and how it impacts on anesthetic care. Medical adverse effects range from pulmonary and cardiovascular effects, to irreversible brain damage; these could manifest or worsen while under anesthesia, when these substances interact with the anesthetics provided. Illicit drugs may encourage reckless driving and thus increase the potential for motor-vehicle accidents and suicide attempts, often requiring anesthesia for emergency and trauma situations. In a study performed in Los Angeles County and the University of Southern California, an overall 53% of patients with gunshot wounds, 32.9% of victims of motor-vehicle accidents, 32.9% of patients with falls and 28.6% of pedestrians tested positive for illicit drugs or alcohol use. But in that study they made clear that the prevalence of illicit drug use by trauma victims, although high, is associated with several factors, including: the mechanism of injury; age, gender and ethnicity of the patient; and geographic location of the trauma center [2**]. In another study, the risk for motor-vehicle accidents was increased for drivers using alcohol, benzodiazepines, amphetamines, cocaine and opiates. Exposure to cannabis alone did not affect driving performance, while the combination of cannabis with alcohol had serious effects on this activity [3**]. However, due to conflicting reports, the effects of substance abuse on trauma victims are unknown [2**].

Injected drugs and high-risk sexual behaviors are key risk factors for the transmission of blood-borne diseases such as HIV/AIDS and hepatitis C. Numerous reports have also described the involvement of skeletal structures in injection-drug users with infections. These patients are usually young and the entry of pathogens into the body is allowed after injecting narcotics by nonsterile techniques, including licking the needle or skin before injection (needle licker’s osteomyelitis) [4]. These infecting organisms may produce local disease at the site of injection or involvement of bone or joint by hematogenous spread (e.g. septic arthritis). Since some of these patients may have HIV, they may have concomitant tuberculosis which, if disseminated, may produce extra-pulmonary tuberculosis involving the vertebral bodies. Of note, vertebral osteomyelitis is most commonly caused by bacterial pathogens after hematogenous spread. In 53–60% of patients the most common site of involvement is the lumbar spine and these patients will present with chronic low back pain and permanent neurologic signs (in about 15%) [4]. Infection from bone can extend into the epidural or subdural space forming an abscess, which may lead to spinal-cord compression and neurological deficits. It is important to remember that patients using illicit substances are frequently under medicated for pain since they may require higher and more frequent doses of analgesics to achieve expected effects, especially since most have cross-tolerance to opioid analgesics [4].

Anesthetizing pregnant women who use illicit drugs is particularly complex and difficult, especially when the effects of drug abuse mimic disease such as preeclampsia. Substance abuse during pregnancy has ranged from 0.4 to 27% depending on the population being studied [5]. In one particular study, the prevalence of antepartum cocaine use among parturients without prenatal care in a New York City hospital was reported to be 68% [6]. Drug-abusing patients (especially when pregnant), due to social stigmas and fear of punitive actions, usually deny their drug habit and receive no prenatal care. Drug users have more health problems and more pregnancy complications but measuring the impact of drug exposure on the fetus has proven to be difficult and only animal studies provide information regarding toxic or teratogenic effects of some of these drugs. Pregnant women and women of child-bearing age may place the fetus at risk for developmental disabilities, low birth weight and prematurity [5].

In this article we will be discussing some of the most frequently used illicit substances, their effects and importance for anesthesiologists. We will also discuss why it is important to know a patient’s history of substance abuse prior to administering anesthesia or analgesia, allowing us to predict adverse drug interactions, predict tolerance to some anesthetic agents and recognize drug-withdrawal signs and symptoms.

**Marijuana**

One of the most popular recreational drugs of abuse among millions of people is the hallucinogenic agent marijuana, also referred to as pot, hash, grass, weed and THC. It is obtained from the plant *Cannabis sativa*, which contains chemicals also known as cannabinoids, including its active ingredient Δ⁹-tetrahydrocannabinol (THC) and the tobacco carcinogen benzopyrene [7]. Marijuana can be smoked as a cigarette (a joint), using a water pipe or using a hollow cigar filled with marijuana (a blunt); it can also be taken orally. Its users experience an intense feeling of relaxation within minutes and a pleasant euphoria that last several hours. Marijuana combined with drugs like alcohol or diazepam increases the sedative effect, while when combined with amphetamines or cocaine increases the stimulatory effects [7]. Other effects of acute marijuana ingestion include tachycardia, conjunctival congestion and anxiety [8**]. Although acute toxicity or major anesthesia interactions from this drug are rare, every system is affected by its use and its clinical picture is unpredictable.

Cannabinoids have a high fat solubility which leads to rapid accumulation in adipose tissue, from which it is
then released to the brain. Its elimination half-life in occasional users is approximately 56 h, while it is approximately 28 h in chronic users. Nonetheless, cannabinoids can be sequestered in adipose tissue, extending its tissue half-life to approximately a week [8**]. Complete elimination of a single dose may require up to 30 days, as THC can remain in the body a long time after being smoked [7,9]. Metabolism of cannabinoids occurs in the liver, into more than 20 metabolites, most with psychoactive properties [7].

Smoking marijuana on a frequent basis can lead to the development of cognitive impairment, shortened memory span, confusion, altered time perception and dulled reflexes, making it difficult to maintain normal daily activities at home or work. Some of the adverse reactions mostly seen in smokers include anxiety, fear, depression, delusions, violent behavior and hallucinations. This makes the smoker enjoy the so-called high while being unaware of the behavioral disabilities or how dysfunctional he or she has become. Abstinence following exposure to four or five cigarettes a day, even for a short period of 3 days, has been associated with a withdrawal syndrome where there is increased latency to fall asleep, negative mood and behavioral symptoms [10*].

Anesthetic considerations
As previously mentioned, cannabis can affect numerous body systems. On the autonomic nervous system, if low or moderate doses are taken, an increase in sympathetic activity occurs with a reduction of parasympathetic activity; this results in tachycardia and increased cardiac output. If high doses are ingested, there is inhibition of the sympathetic activity but not of the parasympathetic activity, leading to possible hypotension and bradycardia [8**]. Life-threatening arrhythmias have not been reported, but an increase in supraventricular or ventricular ectopic activity can occur as well as reversible ST-segment and T-wave abnormalities [8**]. The combination of marijuana with other sedative hypnotic drugs may enhance depression of the central nervous system (CNS). Cross-tolerance has been seen with cannabis and alcohol, barbiturates, opioids, benzodiazepines and phenothiazines.

Marijuana’s effect on the cardiovascular system includes increased myocardial depression and tachycardia. Therefore it is not surprising that its use may potentiate the effect of anesthetic drugs that affect blood pressure and heart rate [8**]. This can be seen when a patient is receiving general anesthesia and the effects of marijuana are added to the ones from potent inhalational agents resulting in profound myocardial depression. Adverse reactions such as this may interfere with a safe induction of anesthesia. Because of the tachycardia which occurs in patients with acute marijuana abuse, drugs increasing heart rate (such as ketamine, pancuronium, atropine and epinephrine) should be avoided.

As with tobacco, cannabis inhalation affects lung function as it is smoked unfiltered, exposing the user to carcinogens and contaminants. Its association with upper-airway irritability, in addition to impairment on airway epithelial function and damage to bronchial tissue, predisposes to chronic cough, bronchitis, emphysema and bronchospasm [11,12]. There have been reports of oropharyngitis, acute upper-airway edema and obstruction in cannabis-smoking patients who have undergone general anesthesia. Some even recommend administering dexamethasone as prophylaxis to these patients if undergoing general anesthesia [12].

In pregnant patients it seems that chronic use of marijuana may reduce uteroplacental perfusion and may thus result in fetal intrauterine growth restriction (IUGR) [13]. Although it is not a proven teratogen, some research suggests that cannabis is associated to low neonatal birth weight, increased risk of complications during labor and delayed cognitive development in infants [13,14]. Attempts to legalize this drug are controversial and complex. Its promoters enhance its antiemetic, analgesic and anticonvulsant properties in addition to its potential to increase appetite. In addition it may improve glaucoma. Others, however, discourage its therapeutic use because of its potential for tolerance and abuse and its psychoactive properties.

Cocaine
Cocaine abuse has become a serious health concern throughout the world. In the USA almost 5 million people use it regularly [15]. Cocaine is extracted from the leaves of <i>Erythroxylum coca</i>, a plant indigenous to South America. The drug was first introduced as a local anesthetic due to its topical anesthetic properties, commercially available in a hydrochloride form as powder, granules or crystals. But the hydrochloride form can be converted back to its alkalized form by the addition of baking soda or ammonia plus water followed by heating; the alkalized form is widely smoked and known as crack or free base. This crack cocaine (also called rock) is highly addictive and smoked in a base pipe, injected, snorted or ingested orally. Its low molecular weight and high lipid solubility allow easy diffusion across lipid membranes. Oral and snorted cocaine, due to slower rates of absorption, yields lower plasma levels. It has a biological half-life of 0.5–1.5 h as it is metabolized by plasma and liver cholinesterases to watersoluble metabolites that are excreted in the urine. Only 1–5% of the ingested drug is cleared unmetabolized in the urine, allowing its detection only 3–6 h after its use. On the other hand, two of cocaine’s metabolites (ecgonine methyl ester and benzoylecgonine) account for 75–90% of
its metabolism and can be detected in urine for 15–60 min after intake [16*,17**].

Cocaine interferes with presynaptic uptake of sympathomimetic neurotransmitters (e.g., norepinephrine, serotonin and dopamine) [17**]. A powerful euphoria (lasting 5–10 min if smoked and 10–30 min if snorted) is produced as a result of free catecholamines stimulating the sympathoadrenal axis and the prolongation of dopaminergic activity in the limbic system and adrenal cortex. Blood flow to arteries in areas like the heart and brain may be compromised as these vessels vasoconstrict or vasospasm temporarily, severely compromising oxygenation and supply; this may lead to irreversible brain damage, stroke and myocardial infarction or depression [16*]. At higher doses, cocaine can depress ventricular function and slow electrical conduction of the heart; pathologic changes of contraction-band necrosis and ventricular hypertrophy also contribute to the potentially lethal sequelae of this drug [18]. Although quite rare, acute aortic dissection can occur in these patients, perhaps as a consequence of abrupt, severe hypertension and catecholamine release [19]. Other adverse effects, many of which have implications to the anesthesiologist, include infection or perforation of the nasal septum, anxiety, restlessness, irritability, confusion, papillary dilatation, seizures, tachycardia, peripheral blood vessel constriction, hypertension, angina or myocardial infarction, ventricular arrhythmias and death [7]. Pulmonary complications associated with cocaine range from simple asthma to pulmonary hemorrhage [20]. Cocaine addiction is the result of tolerance, both psychological and physiological. Sudden discontinuation leads to craving for the drug, mental depression and fatigue.

Anesthetic considerations

Serious complications are associated with both regional and general anesthesia when administered to cocaine abusers. Although it is controversial if a platelet count is required for an otherwise healthy cocaine abuser, cocaine-induced thrombocytopenia can occur. Many theories for this have been proposed, including that this is the result of platelet activation due to arterial vasospasm or part of an autoimmune response [16*]. When regional anesthesia is provided, the hemodynamic consequences of cocaine use should be taken into consideration: hypertension may occur (a result of the peripheral vasoconstriction); as well as hypotension, which may lead to cardiac arrhythmias or myocardial dysfunction. Ephedrine-resistant hypotension may be encountered; however, it appears that low doses of phentolamine, titrated to effect, usually restore blood pressure. Patients under regional anesthesia may also show combative behavior and altered pain perception, perhaps due to changes in μ- and κ-opioid receptor densities and abnormal endorphin levels [16*].

Cocaine-abusing patients under general anesthesia may also exhibit hypertension and cardiac arrhythmias, with their subsequent complications. As mentioned previously, the pathogenesis of cocaine-related myocardial ischemia is due to increased myocardium oxygen demand, the result of the vasoconstriction of the coronary arteries and/or because of enhanced platelet aggregation, leading to thrombus formation [21]. The latter is the reason why sometimes these patients are placed in thrombolytic therapy during an acute infarction thought to be related to cocaine use [16*]. Severe hypertension may also occur as a result of direct laryngoscopy in cocaine-intoxicated patients undergoing general anesthesia. To reduce this complication, it is recommended that blood pressure be controlled with medications prior to induction. β-Blockers, such as propranolol, are contraindicated in these patients because of the potential for unopposed α-adrenergic stimulation [22]. Although some may consider that the short elimination half-life of esmolol is advantageous, its β-blockade may also enhance cocaine-induced coronary vasoconstriction. Intravenous hydralazine has also been used for the treatment of hypertension in these patients because of its beneficial vasodilatation and decrease in systemic vascular resistance. However, a suboptimal aspect of this medication would be the occurrence of reflex tachycardia, in a patient already tachycardic [23]. Labetalol has been another medication recommended, but its use is also controversial. Its nonselective β- and α-adrenergic blockade which acts fast and restores blood pressure without changes in heart rate, seems useful in cardiovascular changes resulting from cocaine toxicity [16*]. However, unopposed α-stimulation may occur. Other drugs mentioned include nitroglycerin, nitroprusside and calcium-channel blockers. Cocaine-related chest pain has been treated with phentolamine (α-adrenergic blocker), nitroglycerin, verapamil, benzodiazepines and aspirin.

The potent volatile anesthetics may also produce cardiac arrhythmias and increase the systemic vascular resistance in patients acutely intoxicated with cocaine. Halothane is an example of a volatile agent best avoided, because of its sensitizing effects on the myocardium to catecholamines [22]. Ketamine should be used with caution or avoided since it may stimulate the CNS and increase catecholamine levels, potentiating cardiac effects, or alternatively it may cause myocardial depression in the absence of catecholamines [24]. Etomidate administration should also be used with caution because of possible myoclonus, seizures and hypertreflexia. Induction with propofol and thiopental has proven to be safe in cocaine-abusing patients. It is controversial whether or not succinylcholine produces prolonged blockade because of depletion of cholinesterase by cocaine metabolism or a competition between cocaine and succinylcholine for plasma cholinesterases [25]. Dexmedetomidine a highly selective
α2-adrenoreceptor agonist, recently introduced into anesthesia practice for its sedative and analgesic properties, has demonstrated in rats that it delays the onset of cocaine-induced seizure activity and consequently increases the cumulative doses of cocaine necessary to produce seizures [26]. In addition, this may be related to dexametomidine-induced attenuation in the nucleus accumbens dopamine concentrations in the brain.

Research still continues on how cocaine affects other organ systems. Some authors emphasize that cardiovascular consequences persist after cessation of long-term cocaine use, and insist that asymptomatic patients may have subclinical cardiovascular pathology that should be assumed as an important cardiac risk factor [27]. Others show that even without acute intoxication, severe cardiovascular problems are still possible if there is chronic cocaine abuse and recommend a cocaine-free interval of at least 1 week before elective surgical procedures [28]. The powerful vasospasm caused by cocaine may also contribute to the acute renal insufficiency sometimes seen in these patients, although this could also be secondary to rhabdomyolysis [29]. Brazilian researchers have warned about the various effects this drug has on the respiratory system and stress those related to long-term use. Some of these pulmonary complications include infections (pulmonary tuberculosis, AIDS, Staphylococcus aureus), aspiration pneumonia, lung abscess, septic embolism, noncardiogenic pulmonary edema, barotraumas, pneumonias, lung infiltrates, vasculitis, pulmonary infarction, pulmonary hypertension and alterations in gas exchange [30].

The prevalence of cocaine abuse in young adults has increased markedly and nearly 90% of cocaine-abusing women are of child-bearing age [31]. Lack of prenatal care, history of premature labor and cigarette smoking are associated risk factors that may arouse suspicion of cocaine use in pregnancy [31]. Careful and non-judgmental history-taking, physical examination and toxicology screening are necessary to confirm the diagnosis [32]. Pregnancy enhances the cardiovascular toxicity of cocaine and its complications worsen due to the increased oxygen demand and limited or decreased supply, due to the increases in heart rate, blood pressure and left-ventricular contractility [16]. As mentioned above, due to its solubility there is rapid transplacental diffusion and high fetal-blood and -tissue cocaine levels, which may affect fetal blood vessels and uterine blood flow [16]. Decreased uteroplacental blood flow may lead to uteroplacental insufficiency, acidosis, hypoxia and fetal distress [33]. Acute effects from cocaine intake in parturients include fetal distress, placental abruption, preterm delivery, fetal tachycardia, hypertension and intruterine fetal death [34]. There is also a 4-fold increase in emergency abdominal delivery in these parturients. Chronic cocaine abuse produces permanent biochemical and functional changes in the fetus, affecting brain structures (e.g. manifested as low IQ scores), and it is still controversial if there is also an increased risk of congenital anomalies [34].

In the future it is possible the administration of ondansetron (0.2 mg/kg, subcutaneous), given during the acute cocaine-withdrawal period, may attenuate intake the following day, proving to be an effective cocaine-abuse therapy [35] and help in the perioperative period. This requires further research.

Opioids
The analgesic and/or euphoric effects of this class of medication is what attracts people to start using them; unfortunately, it leads rapidly to tolerance, physical addiction, psychological dependence and narcotic abstinence syndrome [7]. Addiction to opioids occurs rapidly if the drug is administered daily in increasing doses. These drugs may be abused orally, subcutaneously or intravenously. Codeine, oxycodone, meperidine, pentazocine, fentanyl, propoxyphene, methadone, morphine and heroin are all opioids that have been abused. Approximately 30% of adolescents who smoke heroin end up as adult heroin addicts and the younger the addict and the greater the number of years of addiction, the greater the risk for relapse after discontinuation [7]. Heroin abuse may lead to tetanus, botulism, multiple skin infections, hepatitis (B and C), HIV/AIDS, pneumonia, endocarditis (by S. aureus), osteomyelitis, fat necrosis, lipodystrophy, skin atrophy, peptic ulcer disease, amenorrhea, false-positive VDRL (venereal disease research laboratory) and many other complications, all which can be encountered in a patient requiring surgery [7]. Clinical manifestations of opioid overdose include slow respiratory rate with an occasional increase in tidal volume and miotic pupils [31]. When symptoms of restlessness, insomnia, mydriasis, tachycardia, tachypnea and hypertension are manifested, acute opioid withdrawal may be occurring [31]. These symptoms may occur 4–6 h after the last opioid intake, with a peak between 48 and 72 h. Dysphoria, bizarre behavior and unconsciousness are some of the CNS manifestations that can be seen; the risk of aspiration may also be increased since the patient may lose his or her ability to protect the airway. Pulmonary edema and death may result from heroin overdose. Studies on rats have shown that heroin can injure the myocardium by changing its myocardial ultrastructure, thought to be a result of myocardial apoptosis [36]. Craving for the drug is associated with lacrimation, rhinorrhea, yawning and piloerection [31].

In parturients, intravenous opioid abuse may affect the fetus indirectly, as a result of maternal malnutrition or infection, or directly, by transplacental opioid transfer.
and its direct effect on the fetus [31]. Consequences from intrauterine drug exposure include fetal IUGR, fetal distress and neonatal opioid withdrawal. Although methadone administration has its risks, its maintenance poses fewer hazards to mother and fetus [31].

**Anesthetic considerations**

Various medications have been beneficial in helping heroin addicts stay off this drug. Methadone is one of these alternatives that serve as a substitute blocking the narcotic effects, prevents withdrawal symptoms and reduces the addict’s craving for more drugs. It still provides the classic euphoric state of heroin but allows the user to re-enter society [7].

Opioid antagonists or agonist–antagonists administered via any route must be avoided in these addicts since they can precipitate acute withdrawal syndrome. For example, this occurs minutes after naloxone administration. These symptoms can be treated with clonidine, which replaces opioid-mediated inhibition with α2-agonist-mediated inhibition of the CNS [37]. Diphenhydramine and doxepine have also been used. The withdrawal syndrome may also be reversed by administration of an opioid or by substituting methadone.

Regional anesthesia can be administered safely to these patients. An increased tendency for hypotension, however, should be anticipated. It has been reported that these patients have an increased incidence of spinal, epidural and disc-space infection [38]. Since these patients may have HIV as part of their medical history, it is important to know that regional anesthesia is not contraindicated [39]. HIV is a neurotropic virus, which means that the CNS is infected early in the course of the disease [40]. However, if any of the patients has AIDS with CNS HIV infection, progressive demyelination and neurologic deficits, regional anesthesia may be contraindicated [31].

Opioid addicts may have difficult peripheral and central venous access. Sepsis, coagulopathy and hemodynamic instability may increase the risk associated with general anesthesia. These patients may have concomitant liver disease, malnutrition and reduced intravascular fluid volume which may require adjustments in anesthetic drug doses. Acute administration of opioids decrease minimal alveolar concentration or anesthetic requirements [31]. Chronic opioid abuse leads to cross-tolerance of anesthetic drugs and other depressants, usually a result of chronic receptor stimulation. Postoperatively, due to decreased pain tolerance secondary to decreased production of endogenous opioids, these patients may experience exaggerated pain. Perioperative management of the opioid-dependent patient poses a challenge to anesthesiologists and pain specialists due to the conflict between the patient’s rights and concerns for safety and abuse, raising ethical issues [41**].

While many opioid addicts want to undergo detoxification, most go through unpleasant and sometimes fatal detoxification processes. Often these prove to be unsuccessful. Newer methods are being studied for detoxification [42]. Ultrarapid detoxification allows the individual to withdraw from the opioid without suffering from withdrawal syndrome and, if done properly, with few adverse events. This is done in a controlled setting, like an intensive-care unit. The patient is not allowed to eat the night before and given a clonidine patch of 0.2 mg (12 h before the procedure). Aspiration prophylaxis, ondansetron and an anticholinergic are administered before the procedure. Once the patient is monitored, clonidine is administered to lower the heart rate to 60 beats per minute and systolic blood pressure is kept below 100 mmHg. Rapid sequence induction is performed and anesthesia is maintained with propofol, methohexital or inhalational agents. Patients are not maintained paralyzed after the induction dose of succinylcholine to observe the signs of withdrawal (mentioned above). Withdrawal is then precipitated by an antagonist (intravenous naloxone being one of the preferred choices). After the procedure is finished and extubation is accomplished, the patient is monitored and maintained on naltrexone (50 mg by mouth) for at least 6 months of the detoxification process. There is continued debate regarding new treatments like this, the use of naltrexone implants and the use of gabapentin after rapid opioid detoxification (ROD), and still more research has to be done.

**Hallucinogens and other so-called club drugs**

The hallucinogen group of drugs includes lysergic acid diethylamide (LSD), phencyclidine (PCP), psilocybin and mescaline. All are ingested orally and cause auditory, visual and tactile hallucinations with distortions of body image, surroundings and reality, anxiety, panic attacks and a fear of ‘going crazy’ [31]. These drugs are not associated with physical dependence or withdrawal symptoms but do cause psychological dependence and tolerance. They activate the sympathetic nervous system by causing hypertension and tachycardia, increase body temperature and dilate pupils. The effects of acute ingestion develop over 1–2 h and last for approximately 12 h. Unrecognized injuries can occur while intoxicated because of intrinsic analgesic properties (α2-agonist) [31]. Overdose with these medications can cause respiratory depression, seizures, coma (without respiratory depression) and death.

LSD is a chemical found in morning glory seeds and ergot, a rye fungus. It is colorless, odorless and tasteless. Its action is thought to involve an interaction with
serotonin neurotransmitters. PCP, or angel dust, leads to adrenergic potentiation by inhibiting catecholamine reuptake in the neurons. It is found in liquid, tablet or powder forms and is manufactured easily. Helpful medications used to treat agitation produced by these drugs include diazepam or haloperidol. PCP coma may present with nystagmus, muscle rigidity and increased deep-tendon reflexes [7].

Another drug that has the properties of both a hallucinogen and a stimulant is 3,4-methylenedioxymethamphetamine (MDMA), otherwise known as ecstasy. Other street names for this drug are X, E, XTC, the love drug, clarity and Adam, to name just a few. It was first synthesized and used as an appetite suppressant but its euphoric and energizing effects made it popular on college campuses and dance parties [7]. It has also been used as a date-rape pill. It is swallowed or inserted rectally, being absorbed readily by the gastrointestinal tract [43**]. Its effects usually last 3–6 h but it can last as long as several days. Some of its effects include memory dysfunction, cognitive disabilities and behavioral problems, a result of the damage done to serotonergic neurons in the CNS [7]. High doses of MDMA may induce malignant hyperthermia, cause breakdown of muscle tissue which may progress to kidney and heart failure [7,44]. Fulminant liver damage and disseminated intravascular coagulopathy have also been documented [45]. Several cases of seizures have been attributed to the severe hyponatremia and cerebral edema that results from profound sweating and increased water consumption (water intoxication) [43**].

Rohypnol or flunitrazepam is a CNS depressant from the same family as diazepam and midazolam. It has anxiolytic, anticonvulsant and sedative/hypnotic properties. It can be snorted or taken orally; if used on a regular basis, it can lead to physical dependence, and the abrupt withdrawal may potentiate most of its side effects and intoxication [7]. Its attraction to users comes from its ‘out-of-body experience’ and its dissociative effects. Delirium, amnesia, depression and long-term memory and cognitive problems are some of its common effects. In high doses respiratory arrest can occur, the sympathetic nervous system is upregulated and increases in systemic and pulmonary artery pressures can occur, along with increases in cardiac output and heart rate that could result in coronary ischemia in predisposed patients [7].

Fry is an altered form of marijuana that is smoked in ‘PCP-laced, formaldehyde-soaked marijuana cigarettes’ [43**]. The primary effect of smoking these cigarettes is toxic psychosis. Other effects include hallucinations, delusions, panic, paranoia and loss of consciousness. Side effects are associated with embalming fluid, which include disorganized thoughts, decreased attention span, psychomotor agitation and upregulation of the sympathetic nervous system. Exposure to the embalming fluid formaldehyde can cause bronchitis, brain and lung damage, inflammation, impaired coordination and sores in the throat, nose and esophagus [43**].

Parturients abusing hallucinogenic drugs have a higher risk of premature labor and delivery, fetal IUGR, meconium-stained fluid and neonatal withdrawal syndrome. The hyperthermia induced by these drugs is thought to increase maternal and fetal oxygen consumption, leading to possible fetal heat-induced neurological injury [46]. If MDMA is taken during pregnancy, the risk for congenital effects is increased (cardiac anomalies, cleft lip and palate, biliary atresia, fetal IUGR, intrauterine fetal demise and cerebral hemorrhage) [7,47,48].

It is important to be aware that these illicit drugs are often used in combination with other drugs and alcohol. This may potentiate most of their side effects and intoxication would be more harmful. There are no known antidotes for intoxication with rave or club drugs and treatment would be supportive if such a case arises.

Anesthetic considerations
During anesthesia and surgery, some issues can be anticipated in these patients. The risk of autonomic
dysregulation is high and wide swings in blood pressure and tachycardia should be prevented since there is an increased risk of cardiomyopathy, coronary and cerebral vasospasm [43**]. There have been reports of arterial vasospasm leading to nonhemorrhagic cerebral vascular accidents, myocardial ischemia and infarction [49,50]. Due to its sympathomimetic stimulation effects, extreme caution should be taken when using vasopressors such as ephedrine, even if regional anesthesia produces sympathectomyc-indued hypotension [31]. These patients exhibit an exaggerated response to sympathomimetic drugs and arrhythmias are likely. It is also thought that hallucinogens may prolong the analgesic and ventilatory-depressant effects of opioids. The overzealous consumption of water by ecstasy users may not only bring us a depressant effects of opioids. The overzealous consumption of water by ecstasy users may not only bring us a

Solvents
Inhalants include a variety of substances, such as organic solvents and volatile agents, that affect the CNS. Toluene is the most commonly used solvent and a major component of household paints, glue, rubber cement and cleaning agents. These drugs can be sniffed or ingested orally. The ease of obtaining these solvents and the transient euphoria that toluene yields is what attracts a great number or adolescents to abuse it. Inhalant-abuse complications include cardiac arrhythmias, bronchial irritation, acute respiratory distress syndrome, liver toxicity, pulmonary hypertension, methemoglobinemia and death from cerebral or pulmonary edema [7,31]. Chronic exposure causes changes in the CNS such as cerebellar degeneration and diffuse brain atrophy [53,54]. Lead poisoning is linked to gasoline sniffing and renal and hepatic toxicities are linked to trichloroethylene [7]. In pregnancy, the use of these solvents has been associated with an increased risk of preterm delivery, prenatal mortality and fetal IUGR [55,56].

Anesthetic considerations
As mentioned previously, these patients are at an increased risk of developing cardiac arrhythmias due to autonomic cardiac dysfunction caused by the abuse of these solvents. Myocardial infarction and labile blood pressures might also be encountered. In acutely intoxicated patients, general anesthesia is sometimes the best option due to their respiratory compromise and increased incidence of nausea and vomiting. Pulmonary complications may reflect increased airway resistance. When regional anesthesia is considered, it is important to consider the patient’s altered perception and combative behavior. Distal and proximal acidosis could be of concern in these patients.

Conclusion
Substance abuse remains one of the biggest societal problems around the world despite education on prevention and rehabilitation of illicit drugs. Anesthesiologists should be aware of this problem and the most likely effects and potential risks associated with the abuse of illicit substances. Some of these patients may present at preadmission testing, emergency situations (even critical care) or in the obstetric suite for anesthesia or analgesia. It is very important to enquire in a nonjudgmental way about addiction and substance abuse, obtain toxicology screens, and identify these patients in order to minimize the adverse effects of anesthetic agents and other drugs provided while in care. It is equally important to minimize postoperative risks from inadequate analgesia. Due to the diverse clinical presentations that may arise from substance or polysubstance abuse, the anesthetic management should be tailored to each individual and universal precautions should always be followed when providing care.

References and recommended reading
Papers of particular interest, published within the annual period of review, have been highlighted as:
• of special interest
•• of outstanding interest

3••• A prospective observational case–control study performed to prove that driving performance is impaired with the use of alcohol, licit and illicit drugs. Authors concluded that drug use increased the risk of road trauma requiring hospitalization.
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