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Drug Abuse in Adolescent Anaesthetic Implications.

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ABSTRACT

Despite ongoing preventive and rehabilitative efforts at the local and international level, drug abuse by adolescents has crossed social, economic, and geographic borders and - throughout the world remains one of the major problems facing society today. The clinical manifestation of drug abuse combined with physiologic changes may significantly have impact on the anaesthetic management. It is very difficult to predict the exact anaesthetic implications in drug dependent patients. Therefore, a complete understanding of the pathophysiology and anaesthetic implications of drug abuse in adolescent is essential for a safe anaesthetic plan for these high-risk groups of patients.

Keywords: Drug abuse, Adolescent, Anaesthetic implication

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INTRODUCTION

Illicit drugs have been of increasing social and medical concern. Abuse of illicit drugs is unfortunately not limited to adults. Although the rates of use of various drugs vary from year to year and decade to decade, adolescents and young adults continue to use tobacco, alcohol, and other drugs at terrifying high rates. Alcohol continues to be the drug of choice for intoxication, stimulant use continues its popularity in the form of methylenedioxyamphetamine (MDMA). Smoking rates may go down while smokeless tobacco use goes up; and inhalants continued to go abused, particularly by young adolescents. A survey among school children revealed that, frequently used drugs are marijuana (59%), amphetamines (19%), cocaine (18%), and LSD (18%).

Drug abuse has crossed social, economic, and geographic borders, and it remains one of the major problems facing society today. Because, drug abuse may result in increased morbidity and mortality during intra- and postoperative period, therefore, a thorough understanding of the consequences of drug abuse is essential for practicing anaesthesiologists.

Anaesthesia and postoperative analgesia in patients dependent on psychoactive substances poses special problems. Often these patients suffer from severe medical and psychotic illness. In addition, drug-specific adaptations such as tolerance, physical dependence, and withdrawal may diminish the effectiveness of anaesthetic and analgesic drugs. Therefore, problems resulting from drug intoxication, or recent ingestion of or exposure to a substance may arise in evaluation of patients for anaesthesia. When patients present for anaesthesia and surgery there is a mandate to detect manifest mental problems, as well as covert substance use patterns that may impact response to anaesthetic agents and the surgical procedures [1-15].

Drug abuse

Drug abuse may be defined as self-administration of drug(s) that deviate(s) from accepted medical or social use which if sustained can lead to physical and psychological dependence.

Adolescence

Between 10 and 20 years of age, children undergo rapid changes in body size, shape, physiology, and psychologic and social functioning. Adolescence precedes across three distinct periods -early (10-13 years), middle(14-16 years), late (17-20 years).

Alcohol

Alcohol use among adolescents has increased during the past decade and poses a threat to the normal functioning of the teenager as well as to the lives of those potentially jeopardized by drunken drivers. The initiation of alcohol use at an early age is associated with an increased risk for alcohol-related problems. Adoption studies indicate that male children of alcoholic parents are more likely to become alcoholic even when raised by nonalcoholic adoptive parents.

Alcohol is rapidly absorbed in the stomach and is transported to the liver and metabolized and leading to fatty liver followed by fibrosis, the hallmark of cirrhosis, even in those who are well nourished. Furthermore, chronic alcohol consumption may result in malnutrition, altered drug metabolism, coagulopathy, pancreatitis, and cardiomyopathy. Acute alcohol intoxication increases gastric fluid acidity and volume, with simultaneous decrease in the ability to protect the airway. If heavy alcohol ingestion is not associated with food intake, pronounced hypoglycaemia may occur.

Anaesthesia

Physiologic dependence on alcohol is manifested as a withdrawal syndrome when the drug is abruptly discontinued. Acute withdrawal manifestations include generalized tremor, tachycardia, cardiac arrhythmias, hypertension, nausea, vomiting, and confusion with agitation and hallucinations. The withdrawal symptoms may be suppressed by the administration of benzodiazepines, alpha 2 adrenergic agonists. Acute alcohol intoxication may pose a significant risk of pulmonary aspiration.

Regional anaesthesia can be safely administered to adolescent with a history or alcohol abuse. However, regional anaesthesia may be influenced by occasional patients who are treated with disulfiram and in whom polyneuropathy develops. Alcohol-containing solutions, as used for skin cleansing, probably should be avoided in disulfiram - treated patients. Furthermore, acute, unexplained hypotension could reflect inadequate stores of norepinephrine due to disulfiram-induced inhibition of dopamine β -hydroxylase. Therefore, intravascular fluid volume must be optimized before induction of regional anaesthesia to avoid adverse consequences of sympathetic blockade. This hypotension may respond to ephedrine, but direct acting sympathomimetics such as phenylephrine may produce more predictable responses in the presence of norepinephrine depletion. Neuropathy also should be considered as a medicolegal contraindication to regional anaesthesia.

If general anaesthesia is necessary, associated hepatic dysfunction, hypoalbuminemia, and cardiac failure may require appropriate dose adjustments of intra venous induction drugs. Chronic use of alcohol is usually associated with resistance to the actions of central nervous system (CNS) depressants. The use of excessive concentrations of potent inhaled anaesthetics can lead to cardiovascular depression. The risk of aspiration increase is due to increased gastric fluid volume and acidity, as well as impaired laryngeal reflexes.

Tobacco Cigarettes

Human and animal studies confirmed that the effect of nicotine, the primary active ingredient in tobacco produces a syndrome of dependence. Nicotine is absorbed by multiple sites in the body, e.g., lungs, skin, gas- trointestinal tract, and buccal and nasal mucosa.

The average smokers start at age 12 years, and most are regular smokers by age to 14 years. Most alarming is the compelling evidence of the addictive nature of cigarette smoking with greater than 90% of adolescent smokers becoming adult smokers.

Cigarette smoking affects pulmonary function primarily. The irritant effect of smoke decreases ciliary motility, increases sputum production, and impairs gas exchange. Smoking is associated with an increase in the rate of development of atherosclerosis. Smokers have an increased prevalence of peripheral vascular disease, coronary artery disease, and an increased risk of acute myocardial infarction.

Anaesthetic implications

In smokers, 4 to 6 weeks of abstinence from tobacco smoke is required to decrease postoperative respiratory morbidity to the level of a nonsmoker. However, any period of abstinence is recommended, and as little as a few days can improve mucociliary function¹⁰. In tobacco-abusing patients who undergo as little 48 hours of abstinence, levels of carboxyhaemoglobin may return toward those levels seen in non-smokers. Cigarette smoke may affect hepatic enzyme function and alter the metabolism of induction drugs used for general anaesthesia.

Regional anaesthesia seem suitable for tobacco- abusing adolescents. Intraoperative complications, such as bronchospasm, as well as postoperative respiratory dysfunction, can be avoided with the administration of neuraxial anaesthetic technique and avoidance of air- way manipulation.

Smokeless tobacco

Smokeless tobacco, comes in the forms of snuff, quid (khaini), guraku and chewing tobacco. Smokeless tobacco contains more nicotine than smoking tobacco.

In Central, Southern, and South -East Asia, the abuse of smokeless tobacco popularly involves the chewing of betel quid or "paansupari". The mixture is held adjacent to the buccal mucosa and slowly chewed over a long period of time. The abuse of smokeless tobacco can lead to oral submucosal fibrosis (OSMF). OSMF typically affects the buccal mucosa, lips, retromolar areas, soft palate and occasionally the pharynx and oesophagus. Finally, results in progressive inability to open the mouth, pain, burning sensation and dysphagia. Chewing of tobacco result in lesions, primarily in the mandibular mucobuccal fold. With chronic use, the lesions may become malignant.

Anaesthetic implications

Anaesthesiologist should have a high degree of suspicion and carefully examine the airway of patient who abuse betel quid or "paan-supari". Mallampati classification and Cormack's grading should be incorporated with routine preoperative assessments to decide whether these patients would need awake fiberoptic guided intubation. It is worthwhile to categorize all these patients as having "anticipated difficult airways". Mahajan et al have reported a case of "unanticipated difficult airway" in a patient with betel quid abuse, suggesting that indirect laryngoscopy be included in the routine preoperative assessment of these patients.

Opioids

Opiate abuse by adolescents decreased considerably during the 1980s, but the magnitude and variety of its medical sequelae warrant continued attention. Although it has been one of the least frequently reported drugs of use since 1991, heroin produces euphoria and analgesia. Heroin is hydrolyzed to morphine, which undergoes hepatic conjugation with glucuronic acid before excretion, through kidney, usually within 24 hours of admission.

Addiction to opioids is possible, in less than 14 days if the drug is administered daily in ever increasing doses. Opioids are abused orally, subcutaneously, or intravenously for their euphoric and analgesic effects. Numerous medical complications such as cellulitis, superficial skin abscess, septic thrombophlebitis, hepatitis, autoimmune deficiency syndrome (AIDS), endocarditis, and malnutrition have been observed in opioid addicted patients⁵.

Clinical manifestations of opioid overdose includes low respiratory rate (RR) with increased tidal volume (VT) however, the increase in VT may not always be present. The pupils are characteristically miotic. Acute opioid withdrawal syndrome is manifested by symptoms of increased sympathetic nervous system activity. Central nervous system manifestations range from dysphoria to various forms of bizarre behavior and unconsciousness. The ability to protect airway may be compromised and the risk of aspiration greatly increased.

Anaesthetic implications

Opioid addicts should have opioids maintained during the perioperative period. Preoperative medication may also include opioids¹⁶. Opioid agonist-antagonists are not recommended as these drugs could precipitate acute withdrawal reactions.

The symptoms of withdrawal from opioids may be treated with clonidine, or diphenhydramine¹⁷. Clonidine attenuates opioid withdrawal symptoms by replacing opioid-mediated inhibition with alpha-2 agonist-mediated inhibition of the central nervous system.

Regional anaesthesia may be safely administered to opioid-addicted patients. However, increased tendency for hypotension should be anticipated following the induction of spinal or epidural anaesthesia. However, regional anaesthesia may be relatively contraindicated in AIDS patients with central nervous system HIV infection and progressive demyelination.

General anaesthesia may be indicated in the patient with haemodynamic instability, coagulopathy, or sepsis. Reduced intravascular fluid volume, malnutrition or liver disease may require appropriate dose adjustments of anaesthetic drugs. Chronic opioid use leads to cross-tolerance to central nervous system depressants that may manifest as decreased analgesic responses to inhaled anaesthetics such as nitrous oxide. Conversely, acute opioid administration decreases anaesthetic requirements (MAC). Opioid overdose may cause respiratory depression and loss of the airway. There is a tendency for perioperative hypotension to occur, which may reflect inadequate intravascular fluid volume secondary to chronic infections, fever, malnutrition, adrenocortical insufficiency, or inadequate opioid concentrations in the brain.

Postoperatively, the opioid-abusing patient often seems to experience an exaggerated degree of pain. Decreased pain tolerance is secondary to decreased production of endogenous opioid peptides. Alternative methods of postoperative pain relief in these patients include continuous regional analgesia

with local anaesthetics, neuraxial opioids, and transcutaneous electrical nerve stimulation.

Volatile substances (solvent abuse)

Young adolescents are attracted to these substances because of their rapid action, easy availability, and low cost. "Huffing" i.e. directly inhaling, or inhaling deeply from a paper bag containing a chemical soaked cloth is the common method used by teens.

There are enormous variety of solvents and fuels that are used, including almost any household cleaning agent or propellant, paint thinner, glue and lighter fluid. Children and teenagers are more likely to abuse solvent than other CNS-depressant substances. Solvent produce euphoria and other effects similar to subanaesthetic concentrations of volatile anaesthetics, as well as CNS depression similar to alcohol intoxication. Physical dependence is rare but psychological dependence and tolerance can develop.

Glue sniffing can cause a unique distal and proximal tubular acidosis. Toluene, causes relaxation and pleasant hallucination for up to 2 hours. Toluene sniffing may lead to autonomic cardiac dysfunction, ventricular fibrillation, and myocardial infarction. Gasoline, contains a complex mixture of organic solvents. Euphoria is followed by violent excitement. Volatile nitrites, such as amyl nitrite, butyl nitrite, and related compounds marketed as room deodorizers, are used as euphorants, enhancers of musical appreciation, and aphrodisiacs among older adolescents and young adults. They may result in profound hypotension and cutaneous flushing followed by vasoconstriction and tachycardia; methemoglobinemia, and increased bronchial irritation. Chronic use of gasoline may cause pulmonary hypertension, restrictive lung defects or reduced diffusion capacity, peripheral neuropathy, acute rhabdomyolysis, haematuria, and possibly cerebral and cerebellar atrophy. Increased airway resistance, pulmonary hypertension, acute respiratory distress syndrome (ARDS) and liver toxicity have all been reported in patients with documented exposure to solvents²⁵.

Diagnosis of inhalant abuse is particularly difficult, relying almost entirely on a thorough history and high index of suspicion. No laboratory tests confirm solvent inhalation. However, complete blood counts, coagulation studies, and hepatic and renal studies may identify the complications.

Anaesthetic implications

Optimal anaesthetic management of solvent-abusing adolescent requires a high level of suspicion and early diagnosis. Altered perception of sensory stimuli, loss of coordination, headache, nausea, vomiting, and respiratory compromise may result from vapour sniffing. Careful physical examination, including determination of possible sensory and motor deficits, is indicated before induction of anaesthesia.

Chronic inhalant abuse can cause cardio-vascular and respiratory depression and the interaction with halogenated hydrocarbons may induce life-threatening dysrhythmias.

Hallucinogens

Adolescents for their hallucinogenic properties have used several naturally occurring and synthetic substances. Psychedelic agents are ingested orally to induce hallucinations, illusions, and distorted thought process. The hallucinogenic substances lysergic acid diethylamine (LSD), phencyclidine (PCP) and 3, 4- ethylenedioxy- methamphetamine (MDMA; Ecstasy) are the most commonly reported hallucinogens in high school. Although, there is a high incidence of psychological dependence, there appears to be no evidence of physical dependence or withdrawal symptoms when hallucinogens are discontinued.

Ingestion of these drugs activates the sympathetic nervous system as evidenced by increased body temperature, tachycardia, hypertension, and dilated pupils. Psychological characteristics of intoxication include anxiety, panic attacks, hallucinations, and fear of "going crazy". Chronic hallucinogen use is uncommon.

Anaesthetic implications

The mechanisms of action of both PCP and LSD are quite complex and include agonist, partial

agonist, and antagonist effects at various serotonin, dopaminergic, and adrenergic receptors. Anaesthesia during acute exposure with excitatory drugs is dangerous and should be avoided until acute effects have disappeared. Exaggerated response to sympathomimetic drugs should be anticipated in these patients (PCP is a structural analogue of ketamine). Hallucinogens may prolong the analgesic and ventilatory depressant effects of opioids. Prolongation in the effects of suxamethonium is possible due to inhibition of plasma cholinesterase activity by PCP and LSD.

General anaesthesia and surgery have been reported to precipitate panic responses in these patients. In the event that such responses occur, diazepam is likely to be useful. Postoperative hallucinations in patients undergoing general anaesthesia have been reported as well.

In regional anaesthesia, ephedrine should be used carefully (which has both direct and indirect actions) for the treatment of sympathectomy-induced hypotension.

Cocaine

Cocaine use for non-medical purposes is a public health problem with important economic and social consequences. Cocaine is an alkaloid (benzoylmet hylecgonine) that is prepared from the leaves of *Erythroxylon coca* plant. Cocaine can be abused via every possible route, including oral, nasal, intravenous, and rectal. The hydrochloride form can be chemically altered to the base form, which is then concentrated by extraction in ether or baking soda. The residue from this method is a form of cocaine base commonly called "crack" (based on the cracking sounds it makes when heated). The metabolism of cocaine occurs primarily through plasma and hepatic cholinesterase, and patients with pseudocholinesterase deficiency are at increased risk for cocaine toxicity. Less than 5% of ingested cocaine is excreted unchanged in the urine.

Cocaine produces prolonged adrenergic stimulation by blocking the presynaptic uptake of sympathomimetic neurotransmitters including norepinephrine, serotonin, and dopamine. The euphoric effects of cocaine "cocaine high" also result from prolongation of dopamine's activity in the limbic system and the cerebral cortex.

Anaesthetic implications

Preoperative assessment presents a special challenge, as self-reporting of drug abuse is notoriously unreliable. The nasal mucosa should be carefully observed for ulceration signs. All extremities should be examined for sclerosis of peripheral veins and needle marks from intravenous injections. Auscultation over the lungs is important to exclude cocaine-induced asthma and a careful cardio-vascular and neurologic examination is necessary.

Preoperative laboratory tests include complete blood cell count, with a platelet count, to rule out thrombocytopenia; ECG to identify signs of rhythm disturbance or myocardial ischaemia; chest radiography to rule out any pulmonary or cardiac involvement; and abdominal radiography to detect pseudo-obstruction.

General or regional anaesthesia in the cocaine abuse adolescent may be associated with serious complications. Any event or drug likely to increase already enhanced sympathetic nervous system activity must be carefully considered before its selection to avoid myocardial ischaemia and cardiac dysrhythmias. However, beta-blockade also causes cocaine-induced coronary vasoconstriction. Esmolol may provide effective control of tachycardia and hypertension. The short elimination half-life of esmolol may offer some advantages if drug administration is deemed necessary. Of concern is that (1) ketamine should be used with extreme caution in these patients because it can markedly potentiate the cardiovascular toxicity of cocaine; (2) because both cocaine and suxamethonium undergo metabolism by plasma cholinesterase, the use of suxamethonium may result in prolonged paralysis; however, they may produce cardiac arrhythmias; (3) an increased anaesthetic requirement for volatile anaesthetics may be present in the acutely intoxicated patient; and (4) the temperature rise and sympathomimetic effects associated with cocaine can mimic malignant hyperthermia (MH), and it may be difficult to differentiate between the two.

When regional anaesthesia is used, combative behavior; altered pain perception, cocaine induced

thrombocytopenia; and ephedrine - resistant hypotension may be encountered. Low doses of phenylephrine titrated to the effect usually restore blood pressure to normal values. Pronounced abnormalities in endorphin levels and changes in both mu and kappa opioid receptor densities resulting from cocaine addiction which may result in perception of pain despite adequate spinal - epidural anaesthesia sensory levels.

Marijuana

Marijuana is the most commonly used illegal drug. The hemp plant *Cannabis sativa*, from which marijuana grows throughout the world, flourishes in most temperate and tropical regions. Marijuana is commonly ingested by smoking, which increases the bioavailability of the primary psychoactive constituent, tetrahydrocannabinol (THC). Inhalation of marijuana smoke produces euphoria, with signs of increased sympathetic nervous system activity and decreased parasympathetic nervous system activity. The most consistent cardiac change is an increased resting heart rate, although orthostatic hypotension may occur. Chronic marijuana abuse leads to increased tar deposits in the individual's lungs, impaired pulmonary defense mechanisms, and decreased pulmonary function. As such an increased incidence of sinusitis and bronchitis is likely. Smoke from cannabis cigarettes is known to suppress both hormonal and cell-mediated immune responses. In predisposed persons, marijuana may evoke seizures.

Anaesthetic implications

Anaesthesia during acute exposure with excitatory drugs is dangerous and should be avoided until the acute effects have disappeared. Severe tachycardia should be controlled preoperatively with labetalol or esmolol. Marijuana may enhance the sedative-hypnotic effects of drugs that depress the CNS. Studies have shown cross-tolerance of marijuana with barbiturates, opioids, benzo-diazepines, and phenothiazines.

Additive effects of marijuana and potent inhaled anaesthetic can result in pronounced myocardial depression in general anaesthesia. Drugs that increase heart rate such as atropine, ketamine, pancuronium and ephedrine should be avoided. Barbiturate and ketamine sleep times are prolonged in THC - treated animals, and opioid induced depression of ventilation may be potentiated.

Possible intraoperative complications include bronchospasm secondary to airway irritability by the marijuana smoke, although marijuana is a bronchodilator. Adverse psychiatric and autonomic reactions to cannabis may interfere with postoperative recovery.

Amphetamines

Stimulants, particularly amphetamines, are among the most frequently reported illicit drugs other than marijuana. Methylamphetamine, commonly known as "ice", is accounted for more than 25% of its use as a stimulant. Methylamphetamine is particularly popular among adolescents and young adults because of its potency and ease of absorption. It can be used by snorting, smoking, ingesting by mouth, or absorption across mucous membrane such as vaginal mucosa. Amphetamines are abused individually or in conjunction with other CNS stimulants such as opioids or cocaine. Amphetamines stimulate the release of catecholamines from presynaptic vesicles, resulting in euphoria, increased cortical alertness, decreased fatigue, and appetite suppression.

The symptoms of acute amphetamine intoxication include, hypertension, arrhythmias, tachycardia, dilated pupils, hyperreflexia, proteinuria, and confusion. Chronic abuse of amphetamines results in depletion of body stores of catecholamines, which may be manifested as anxiety, somnolence, or psychotic state. Agitation and delusional behaviours can be treated with haloperidol or droperidol. Phenothiazines are contraindicated and may cause a rapid drop in blood pressure or seizure activity. Other supportive treatment consists of cooling blanket for hyperthermia and treatment of the hypertension and arrhythmias, which may respond to sedation with lorazepam or diazepam.

Anaesthetic implications

Avoidance of halothane is recommended in general anaesthesia as, it may sensitize the myocardium to endogenous catecholamines. Acute intake of amphetamine increases the minimum alveolar concentration of potent inhaled anaesthetics⁴³. However, chronic intake decreases the dose for general anaesthetic.

Sympathectomy caused by neuraxial blocks in regional anaesthesia may precipitate severe hypotension. The response to treatment of hypotension with vasopressors is unpredictable in amphetamine abusing adolescents.

CONCLUSION

Environmental, social and perhaps genetic factors lead to behavioral disorders from abuse of psychotropic (mind altering) substances. Knowledge of a patient's substance abuse preoperatively may prevent adverse drug interactions, predict tolerance to anaesthetic agents, and facilitate the recognition of drug withdrawal.

Anaesthetic requirements for substance abusers vary depending on whether the drug exposure is acute or chronic. Elective procedures should be postponed for acutely intoxicated patients and those with signs of withdrawal. Regional anaesthetics should be considered when Indian Journal of Anaesthesia, April 2008 possible. For general anaesthesia, a technique primarily relying on a volatile inhalational agent may be preferable so that anaesthetic depth can be readily adjusted according to individual need.

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