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The Effects of Hallucinogen Use During Pregnancy

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Hallucinogens are drugs that can cause a change in the user's mental state to the point where the perception of objective reality is distorted. These drugs are sometimes referred to as illusionogenic, psychedelic, or mind-expanding, and have long been used in cultural and religious contexts.

Hallucinogens vary greatly in chemical structure, and can exist naturally or be produced synthetically. For example, Lysergic Acid Diethylamide (LSD) was first synthesized in Europe in the late 1930s. There was little recognition that certain drugs had hallucinogenic properties in modern society until research began on the therapeutic effects of LSD in the 1950s. Hallucinogens were widely used in the youth culture of the 1960s and 1970s, and during the 1980s, their popularity declined. Some recent studies have indicated that hallucinogen use is again on the rise.

Lysergic Acid Diethylamide (LSD)

LSD is a semi-synthetic alkaloid derived from lysergic acid, which is found in ergot, a fungus that grows on rye and other grains. Commonly referred to as "acid," the drug is often encountered in tablet, capsule or liquid form (sometimes added to absorbent paper). It is odorless and colorless with a slightly bitter taste. The effects of the drug last roughly 2 to 12 hours. Physical effects include increased blood pressure, dilated pupils, and rapid heartbeat. Muscular weakness, trembling, nausea, chills, and hyperventilation occur frequently. Motor skills and coordination may be impaired.

Sensations and feelings change much more dramatically than the physical signs. The user may feel several different emotions at once or swing rapidly from one emotion to another. Mood-swings, the intensification or merging of the auditory, olfactory and visual systems, and an alteration in the sense of time and space are also experienced. More negative effects include panic, serious depression, anxiety, and even psychotic reactions.

Most animal studies on LSD have not shown adverse effects on pregnancy, other than fetal loss at high doses (Alexander et al, 1970). However, central nervous system and ocular defects were associated with fetal LSD exposure in studies involving mice and hamsters (Auerbach et al, 1967; Geber et al, 1967). Sally Long (1972) examined the reports of 162 children of parents who took LSD before or during pregnancy. Of these children, seven were thought to have defects that could potentially be attributed to LSD intake. These included mostly cases of limb defects and one case of megacolon. Another series of cases reported by Jacobson et al (1972) included reports of sacral myelomeningocele, heart defects, including tetralogy of Fallot and an AV malformation, various limb defects and hydrocephalus. It was also speculated at the time that LSD could directly alter DNA and result in cellular abnormalities. Apple et al (1974) observed an exposed fetus with extensive ocular malformations (including marked cortical degeneration of the left eye lens and partial opaqueness of

the cornea) and anencephaly.

However, there is no solid epidemiological evidence of a cause-and-effect relationship between LSD use and congenital anomalies (McGlothlin et al, 1970). The greatest drawback to the aforementioned studies on LSD and hallucinogens in general is that people who use LSD as a recreational drug during pregnancy are more likely to use other drugs as well (e.g., cannabis, alcohol, tobacco), more likely than someone in the average population to have infectious diseases such as gonorrhea and hepatitis, and more likely to be exposed to additional risk factors that could also have an adverse effect on pregnancy. Since the 1970s, there have been few studies done on the teratogenic effects of LSD.

Psilocybin (Psilocin)

Psilocybin is the active ingredient in the *Psilocybe mexicana* mushroom and other mushroom species. It is a derivative of tryptamine, and is chemically related to LSD. The drug is often encountered in a crude mushroom form or as a capsule containing a powdered material of any color. Effects usually last several hours. A small dose may produce sensations of mental and physical relaxation, detachment, mood changes, and perceptual distortions. Disrupted thought patterns often lead to reports of profound spiritual experiences. Larger doses can produce nausea, dizziness, anxiety, lightheadedness, shivering, abdominal discomfort, and numbness. Other reported effects include a sense of time passing slowly, yawning, facial flushing, sweating, depersonalization, feelings of unreality, and an inability to concentrate.

Rolsten (1967) found psilocybin not to be teratogenic in pregnant mice. No human case reports or studies have been done regarding the teratogenicity of this substance.

Dimethyltryptamine (DMT)

DMT (dimethyltryptamine) is a chemical resembling psilocin. It can be found in the human brain and in plant substances such as *Piptadina peregrina*. The drug is often encountered in liquid form, and other substances such as marijuana are sometimes soaked in a DMT solution to add potency. The effects, which are similar to those of LSD, begin almost immediately after ingestion and last approximately 30 to 60 minutes. Anxiety reactions and panic states are more frequently associated with DMT than with other hallucinogens, probably because of the unexpected rapidity of its effects. There have been no human studies on possible teratogenic effects of this chemical.

Mescaline

Mescaline is prepared from the peyote cactus, and has been used for centuries in religious rituals by some Indians in the southwest. For preparation, parts of the cactus are dried and ground, and sometimes put into capsules. Mescaline can also be synthesized in a powder form. At low doses, effects last between 1 and 18 hours. Physical effects include a rise in body temperature, dilated pupils, nausea, vomiting, and muscular relaxation. Common mental effects include an inability to think clearly, visual hallucinations, and a heightened sensory perception. High doses can cause hypotension, a slow respiratory rate, dry skin and headache. Geber's (1967) animal study involving pregnant hamsters reported an increase in central nervous system defects, but a dose-response relationship was not seen. In a study by Dorance et al (1975), 57 Huichol Indians with a lifelong individual history of ingestion of peyote were compared with 50 Huichol Indian controls and ten laboratory controls for effects on lymphocyte chromosomes. The frequency of abnormalities in the experimental and control groups did not differ significantly, and no effects on lymphocyte chromosomes were found. N-methyl-3,4-methylenedioxyamphetamine, 3,4-methylene-dioxymethamphetamine (MDMA)

MDMA is chemically related both to mescaline and to the amphetamines. Its common street name is "Ecstasy". MDMA commonly exists in a powder form and occasionally as a liquid. At low doses, effects appear 30 to 60 minutes after ingestion and persist for approximately eight hours. Users

generally report a sense of well-being along with heightened tactile sensations, intensification of feelings, and increased self-insight. Higher doses produce effects similar to those of LSD, including hallucinations or sensory distortions. Psychological difficulties including confusion, depression, sleep problems, and paranoia have been reported and can occur during and sometimes weeks after taking MDMA.

Physical effects include an increase in heart rate and blood pressure, dilated pupils, dry nose and throat, muscle tension, involuntary teeth clenching, nausea, blurred vision, rapid eye movement, faintness, chills, and sweating. Occasionally, adverse after-effects do occur, usually in the form of marked physical exhaustion coupled with anxiety, lasting up to two days. At high doses, serious physical reactions requiring immediate medical treatment have occurred, and MDA associated deaths and near deaths have been reported.

When Colado et al (1997) administered a large dose of MDMA to rats during days 14 through 17 of gestation, hyperthermia was induced and a reduction in maternal weight gain and litter size was observed in exposed animals. However, the researchers were unable to find the same neurotoxic effects in offspring compared to the initially exposed rats. One prospective study in humans by McElhatton et al followed 127 pregnancies in which 71 cases involved exposure to ecstasy alone and 56 included exposures to other illicit drugs in addition to ecstasy. An analysis of outcomes in 78 of these pregnancies uncovered apparent increases in the incidence of club foot in female infants and congenital heart disease. Two infants with congenital heart defects were identified in this study giving an overall incidence of 26 per 1000 births (as opposed to 5-10 per 1000). However, the two infants in question were exposed to (1) ecstasy and alcohol at 6 weeks and (2) ecstasy, amphetamine and gamma hydroxybutyric acid at 0-7 weeks. Another case of a congenital heart defect after prenatal ecstasy exposure was reported by Rost van Tonningen et al (1998), but in both studies, the limitations of small sample size and other possible environmental influences could not be ruled out.

Nutmeg

The known active ingredient in this common household spice is elemicin, a compound chemically related to mescaline. Nutmeg oil is also a component of Vicks Vaporub, a commonly used nasal decongestant and cough suppressant. Low doses of nutmeg may result in a mild and brief euphoria, lightheadedness, and CNS stimulation. At higher doses, there can be hallucinations, panic, excessive thirst, agitation, anxiety, increased heartbeat, and vomiting. Recovery from nutmeg intoxication is slow and often involves unpleasant hangover effects.

There is one report of nutmeg intoxication during pregnancy involving a woman in her 30th week of gestation, who accidentally prepared and ate some cookies containing approximately 25 times the amount of nutmeg suggested by her recipe. Her symptoms were sinus tachycardia, hypertension and a sensation of impending doom. The fetal heart rate temporarily increased, but leveled off within 12 hours of maternal exposure. Her baby was delivered 10 weeks later with no complications.

Phencyclidine (PCP)

PCP was developed in the 1950s as an intravenous anesthetic. The use of PCP in humans was discontinued in 1965, because it was found that patients often became agitated, delusional, and irrational while recovering from its anesthetic effects. It is usually encountered as a white crystalline powder that is readily soluble in water or alcohol, and it has a bitter taste. PCP may be encountered in a variety of tablets, capsules, and colored powders. In low doses, PCP produces muscle stiffness and a lack of coordination, a slight increase in breathing rate, slurred speech, drowsiness, confusion, and a generalized numbness of the extremities. Nausea and vomiting may also develop, as well as profuse sweating, flushing, and increased heart rate. At high doses, anesthesia, blurred vision, flicking up and down of the eyes, loss of balance, drooling and dizziness may occur. Strange and violent behavior can

result, sometimes involving paranoia, catatonia, and garbled speech. People who use PCP for long periods report memory loss, difficulties with speech and thinking, depression, and weight loss. Coma or death may result from severe side effects induced by large doses (uncontrollable convulsions, respiratory depression, high fever, and a sudden surge of blood pressure resulting in intracranial hemorrhage), or from an accidental injury or suicide during PCP intoxication.

PCP is known to cross the placenta in humans and other animals, and it also enters the breast milk (Nicholas et al, 1982). Animal studies by Jordan (1979) and Marks (1980) have found the drug to be teratogenic at very high doses, with abnormalities that include skeletal dysplasias and cleft palate. There are isolated reports of birth defects in human babies exposed to the drug in utero. In a case reported by Golden et al (1980), asymmetrical facial growth and persistent spasticity were observed. Other reports of anomalies in the offspring of phencyclidine-using women include a case of microcephaly reported by Straus et al (1981) and one case of multiple birth defects by Michaud et al (1982). The defects included an absence of the septum pellucidum, hypoplasia of the optic nerves, chiasm and tracts, moderate hydrocephalus, and agenesis of the posterior lobe of the pituitary. Other congenital anomalies observed by Michaud involved the cardiovascular, respiratory, urinary, and musculoskeletal systems. However, a study by Wachsman et al (1989) looked at 57 infants exposed to PCP (and, in some cases, other substances) during pregnancy. No overall increased risk of congenital anomalies was noted. Other studies have obtained similar results (Patrucha et al, 1983; Chasnoff et al, 1983).

In one study (Harry et al, 1992), mild behavioral and developmental abnormalities were found among preschool children exposed to phencyclidine prenatally. However, Wachsman et al (1989) and Chasnoff et al (1983) found no behavioral differences at one year of age in 62 infants exposed to PCP in utero when compared to non-exposed infants. As with the previous drugs, the multiple risk factors associated with maternal PCP use make an analysis of teratogenicity difficult.

Postnatal symptoms of maternal PCP use have been more widely observed (Wachsman et al, 1989; Strauss et al, 1981). The manifestations resemble those of maternal narcotic use, and include jitteriness, hypertonia, vomiting, diarrhea, lethargy, irritability, and flapping tremors.

Summary

There is a lack of epidemiological evidence showing that hallucinogens adversely affect pregnancy outcome. Therefore, risk assessments cannot be made with any certainty. In the case of MDMA and PCP, studies are still in progress that may better characterize fetal effects. Other drugs, e.g. LSD, have not been studied over the past decades. Individuals using hallucinogens during pregnancy are often exposed to additional risk factors, making counseling difficult. The avoidance of these substances during pregnancy should be stressed.

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