DOCUMENT RESUME

ED 102 442 CG 009 459

TITLE	DOM(STP). Report Series 17, No. 1.
INSTITUTION	National Inst. on Drug Abuse (DHEW/PHS), Rockville, Md. National Clearinghouse for Drug Abuse Information.; Student Association for the Study of Hallucinogens, Biloit, Wis.
REPORT NO	Ser-17-No-1
PUB DATE	May 73
NOTE	13p.
AVAILABLE FROM	National Clearinghouse for Drug Abuse Information, P.O. Box 1908, Rockville, Maryland 20850
EDRS PRICE	MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS	*Behavior Patterns; *Drug Abuse; *Medical Treatment; Physiology; Research Needs; Social Problems; *State of the Art Reviews

ABSTRACT

The article suggests that many uncertainties exist with regard to the use of the "mega-hallucinogen" STP. Discussion centers on the history, chemistry, and pharmacology of the drug and its patterns of use. The subjective effects on humans as well as on animals is reviewed. Psychological and physiological effects of STP continue to be researched, and treatment procedures continue to be refined. Opinions by authorities in the field about the drug and its misuse are included in this fact sheet. (Author/PC)

report series

NATIONAL CLEARINGHOUSE FOR DRUG ABUSE INFORMATION

SERIES 17, NO. 1

MAY 1973

The National Clearinghouse for Drug Abuse Information recognized the need for clarifying some of the more complex issues in drug abuse by gathering the significant research on each subject and summarizing the major findings on various aspects of the problem. Report Series 11 through 18 deal with the pharmacology, chemistry, clinical effects, treatment and the patterns of use of each drug and provide a background in the area by outlining the history, legal status and the opinions of authorities in the field. These fact sheets were written and researched by the Student Association for the Study of Hallucinogens (STASH), Beloit, Wisconsin, under Contract No. HSM-42-71-26.

DOM* (STP)

Reports of a "mega hallucinogen," dubbed STP by the drug-using community, which could produce intense psychedelic effects lasting for up to three days, began to appear in 1967. The media's accounts of bizarre effects and frequent adverse reactions attributed to STP initiated a flurry of activity within the scientific community to identify the drug and accurately quantify its effects. Samples of the drug were obtained and upon analysis proved to be DOM, 2,5-dimethoxy-4-methylamphetamine, an amphetamine with hallucinogenic properties.

History, Chemistry & Pharmacology

In 1964, Dr. Alexander T. Shulgin synthesized DOM while working on the development of a series of methoxylated amphetamines for the Dow Chemical Company. DOM, MDA (3,4-methylene-dioxyamphetamine) and MMDA (3-methoxy-4,5-methylenedioxyamphetamine) are included in a group of some 28 psychoactive drugs referred to as "psychotomimetic amphetamines." The psychotomimetic amphetamines display hallucinogenic activity and are chemically related to both mescaline and amphetamine.

DOM has been estimated to be approximately 100 times more potent than mescaline, but 30 to 50 times less potent that LSD. As is the case with other hallucinogens, individuals develop tolerance to the clinical effects of DOM quite rapidly. Hollister et al. gave two volunteer subjects oral doses of one milligram (mg.) DOM twice daily on the first day of his study on the tolerance of the drug. The dose was gradually increased

*DOM is the biochemical abbreviation.
STP is a "street" slang name.

to 4 mg., three times daily, on the eighth day. On the ninth day, a "challenge" dose of 12 mg. was administered and partial tolerance was observed, meaning that the clinical syndrome produced by the 12 mg. challenge dose following the eight-day treatment was much milder than a comparable dose given without the pretreatment regime. Similarly, the syndrome produced by the challenge dose was considerably less than that produced four weeks later when the subjects again received 12 mg. of DOM without pretreatment. Although tolerance to the effects of DOM does develop rapidly, there is no evidence of physical dependence associated with the use of the drug.

Studies of the distribution and excretion of radioactive (tritium-labelled) DOM in animals have been conducted at the Texas Research Institute. Idanpaan-Heikilla et al. (1969) found that although behavioral effects lasted for 4 hours following injection of 10 milligrams per kilogram (mg./kg.) in cats, the unchanged compound was detected in the brain for at least 6 hours.

In a later study, Idanpaan-Heikilla et al. (1970) administered intravenous doses of radioactively-labelled DOM to sixteen male (28 mg./kg.) and six female (14 mg./kg.) mice. Complete absorption of the drug from the stomach and gastrointestinal tract was rapid with peak concentrations occurring in most tissues within 15 to 30 minutes after injection. Five minutes after administration, the brain was found to contain twice the radioactivity measured for the blood. Brain concentrations peaked at 20 minutes and this level was maintained for two hours. The cortex showed the first significant accumulation of the drug and was later followed by both the white matter and thalamus. At one and two hours, the hippocampal region of the brain exhibited the greatest concentration and maintained this level for six hours. The liver, kidney, salivary and lacrimal glands showed high uptake of radioactivity. DOM was found to pass the placental barrier slowly; however, traces of radioactivity were detected in fetuses from 5 to 20 minutes following administration. The finding of radioactivity, however, does not necessarily mean that the whole drug was present, for the label could have been separated from the molecule during metabolism of the drug.

In efforts to study the metabolism of DOM, Tacker et al. injected 5 mg./kg. into the abdominopelvic, or peritoneal, area of rats and rabbits. In the rats, 40% of the drug was excreted in urine within 7 hours. Over 60% was excreted by this route in 24 hours, while 30% of the dose was excreted in the feces. It was determined that over 45% of the dose appeared in bile, most of it accumulating within the first five hours. Two of the four rabbits died within two hours after receiving the drug, displaying intense pulmonary congestion. Of the remaining two, 70% of the dose was excreted in urine and 8% in feces, leaving about 20% unaccounted for.

Snyder et al. (1967) found 20% of the unchanged compound appeared in the urine of human subjects (2 to 3.2 mg. oral) within 24 hours with peak urinary excretion between 3 to 6 hours.

The LD_{50} of DOM (the dose required to produce death in 50% of the population to which a drug is administered) in rats is 60 mg./kg. (Dow Chemical, DOM Data Sheet). Although numerous instances of "freak-outs" have been attributed to STP (DOM), no human deaths resulting from a lethal dose of the drug have been reported.

Patterns of Use

The reputation of STP (Serenity, Tranquility and Peace) primarily emanated from the West coast, notably the "psychedelic mecca" of the Haight-Ashbury district of San Francisco. In May, 1967, the underground press in the area of the Haight began promoting the superior qualities of STP which was said to insure a good long trip, was inexpensive and, at that time, legal. Acknowledged leaders of "Psychedelphia" received samples of the early capsules which contained 20 mg. DOM, whereas most capsules were later to contain 10 mg. of the drug. Five thousand tabs were given away at a summer solstice celebration in Golden Gate Park on June 21, 1967. Numerous "bad trips" occurred; however, most of these acute adverse reactions were treated by the community (i.e., friends). The Haight-Ashbury Free Medical Clinic estimated that 60 individuals came to professional attention.

The consumed drug's duration of action was 16 to 24 hours as compared to the usual 8 to 10 hour "trip" with LSD. This extended length of action and atropine-like side effects (i.e., tachycardia, blurred vision, photophobia, dryness of mouth) may have contributed to these acute panic reactions. It was this early experience with STP intoxication that resulted in the subjective impression among many physicians that chlorpromazine (Thorazine) potentiated or exacerbated the acute STP reaction. However, controlled research (Hollister et al.) revealed that chlorpromazine did not potentiate the effects of DOM, but actually ameliorated them.

Due to the widely publicized adverse reactions, the use of STP decreased sharply. In an effort to unload supplies of the drug in a rapidly dwindling market, STP was disguised as other preparations, notably the "wedge series." This "series" included the pink wedge, white wedge, yellow wedge, purple wedge and the red barrel. The pink wedge, a pink tab with sloping sides, was sold as 1500 micrograms (mcg.) of LSD but upon analysis was found to contain 270 mcg. of LSD and .9 mg. of STP.

Subjective Effects

As with the other hallucinogens, the state produced by DOM may be described as a multipotential one. That is, the paradoxical and ambivalent feelings (e.g., feeling happy and sad simultaneously) produced by the drug may be channelled into any of several directions. The direction chosen is largely determined by the individual's set (i.e., personality and expectations) and setting (i.e., environment). Under the influence of DOM the individual may experience visual imagery, distortion in time perception, feelings of

depersonalization, rapid mood changes, alterations in body sensations and increased thought processes often laden with deep emotional meaning.

One and a half hours after ingestion of 3.3 mg. of DOM, a subject in a clinical study stated:

> I am becoming incoherent . . . . I'm having visual images with my eyes closed; they seem to symbolize my alternate feelings of tension and relaxation. [Fifteen minutes later.] I feel changes very rapidly. A mood that would normally take a couple of hours to play itself out can flick through you in a quarter of a minute. Now I have a feeling of well-being. Boy, I'm really flying.

Apparently, the hallucinogens interfere with the individual's ability to filter and fully integrate sensory input. Therefore, and this may be particularly true for the inexperienced user, the individual receiving DOM may feel overwhelmed by a bombardment of stimuli (i.e., visual, auditory, tactile, etc.) issuing from the environment. The following is a description of a DOM experience related ten hours after taking the drug (3.2 mg.) in a hospital setting.

> The first effect came during lunch (2 hours after administration of the drug) when I started staring at the orange sherbet which was beautiful, brilliant orange, failing disorganizedly like a whirlpool . . . . Later [5 hours after taking the drug], I began shrinking, and water in the glass on the table was getting bigger and moving toward me, coming to envelop me . . . . I was really scared . . . . I saw a witch doctor, then a horse on the wall . . . . Then the ceiling started moving up and down and was purple and yellow . . . . I felt I was losing control.

As previously mentioned, the hallucinogenic drug experience may by described as a multipotential one, in which suggestibility can influence whether the "trip" is a good one or not. A young American yogi describes how a rapidly developing "bad trip" was transformed into an enlightening encounter:

> Buzzzzz--Mordor had invaded. Witches, bats, spiders, hideous trolls, orcs, goblins, serpents--all seemed to be coming at me from all ends. I told myself that all came from my mind--yet they were as real or as unreal as our world. All part of the divine dream turned to nightmare. It seemed all the energy of the cosmos was turned against me. I thought of the horror of the permanently paranoids--is this the hell they are stuck

in? More deadly armies arrived. The black plague kept spreading. How does one fight these forces? Thinking only confused me. Confusion led to weakness; I must move out of the enemy's camp to locate myself in my left side. How? How? My mantra! I breathed deeply and began to chant. The sound rang out through the cosmos. Everything stopped. Again I pronounced the sacred syllables. The blackness began to break. The heavy clouds lifted. A blue mist rushed in, the sound echoed many hundreds of times. Light filled me, and from the distance a figure in saffron robes came to me--my guru. Swami Satchidananda appeared, he raised his right hand. I knew then that all was right; there was no need to fear, ever to fear.

Animal Behavior

Phillips & Mesley found that DOM produced behavior similar to mescaline-like activity when the drug was administered to rats (Hall's "Open Field" test) and mice ("Head Twitch" count method).

Florio et al. observed spontaneous behavior and electroencephalogram (EEG) recordings in rabbits, cats and rats bearing permanently implanted electrodes. Behavioral effects in rabbits receiving small doses (0.5 mg./kg. i.v.) included difficulty in breathing (hyperpnea), pupil dilation (mydriasis), startle reactions to external stimuli, bristling of hair and lacrimal, salivary, and bronchial hypersecretion. Rabbits alternated searching and exploration with periods of stupor often resembling catatonic posture with mouth open and tongue protruding. Activation of the EEG was noted. At higher doses (1-2 mg./kg.), rabbits displayed convulsive motor dysfunction. The convulsions brought the animal to a state of deep prostration leading to death. Convulsive EEG seizures were apparent. The intravenous injection of doses of chlorpromazine varying from 2 to 5 mg./kg. did not retard the progression of the intoxication that resulted in death. However, at smaller doses causing the milder syndrome, administration of chlorpromazine controlled behavior and slow waves reappeared on the EEG.

Administration of 0.25 mg./kg. of the drug into the peritoneal area blocked performance of an instrumental reward discrimination task in conditioned cats. However, following the period of intoxication (6 hours), the animals reacquired the conditioned skills.

At a dose level of 1 to 3 mg./kg., rats exhibited various degrees of excitation similar to amphetamines. A toxic response was elicited at 4 mg./kg. Pretreatment with chlorpromazine (5 mg./kg., intraperitoneally) did not reverse the toxic effects nor antagonize the intoxication. At 2 and 3 mg./kg. DOM, chlorpromazine did attenuate the behavioral response and concomitant EEG patterns.

Joffe observed that oral administration of 5 mg. of DOM in the chimpanzee (25 kg.) impairs the animal's fine perceptual discriminations but not gross sensory-motor functioning; at 10 mg., however, both gross sensory-motor functioning and fine perceptual discrimination were altered.

Psychological Effects

Investigations into the clinical effects of DOM in humans have been carried out by two research teams, Dr. Solomon H. Snyder and his colleagues at John Hopkins University and Dr. Leo E. Hollister and his colleagues at the Veterans Administration Hospital in Palo Alto, California. Hollister et al. gave 18 volunteer subjects DOM in doses ranging from 2-14 mg. (30-220 mcg./kg.) orally. Four subjects received simultaneous doses of chlorpromazine with the equivalent amount of "street" doses of DOM. The setting was an "experimental" one consisting of austere laboratories and research offices. Two mg. was found to be the threshold dose; 5 mg. and above produced LSD-like effects.

A compilation of questionnaire data summarized the clinical syndrome produced by the drug. Perceptual effects reported included: blurred vision; double or multiple images; vibration of objects; visual hallucinations; distorted shapes; objects appeared lighter; colors more vivid; body looked distorted; details stood out; contrasts increased; subjective slowing of time; hearing increased. Intense psychic effects included: difficulty in attending; awareness of environment; happy, uncontrolled laughter; difficulty in control of thoughts; difficulty in expression; words inadequate to describe experience; mind flooded with thoughts; mind occasionally blank; memory poorer at times; distractable; good memory for drug experience. Chlorpromazine appeared to ameliorate the clinical syndrome, rather than aggravate it.

On the Clyde Mood Scale, individuals receiving only DOM displayed a marked decrease in clear thinking and an increase in dizziness (similar to other hallucinogens studied). Subjects receiving both chlorpromazine and DOM reported decreased friendliness, increased sleepiness and increased discomfort (similar to chlorpromazine alone). Psychometric testing (Number Facility Test and the Flexibility of Closure Test) was conducted prior to administration and 1, 3 and 5 hours after. The number of problems attempted as well as the number correct were significantly decreased for the Number Facility Test at 3 to 5 hours. The number of correct figures circled in the Flexibility of Closure Test was significantly decreased at 3 hours. The percent accuracy in relation to attempts remained rather constant for the Number Facility Test. Poor performance was mainly attributable to those subjects receiving higher doses.

Snyder's group (Faillace et al., Snyder et al. 1968, Snyder et al. 1970) conducted a double-blind study in which six subjects received a tap-water placebo and six subjects received DOM dissolved in water (four received 3.3 mg. and two received 2.7 mg.). The onset of

subjective effects in those receiving the DOM appeared after 1 to 1 1/2 hours, peaking at 3 to 4 hours and subsiding at 5 to 6 hours. No hallucinogenic or psychotomimetic effects were recorded, but closed-eye imagery occurred in three of the six subjects.

On the Subjective Drug Effects Questionnaire (SDEQ) consisting of 240 items, the DOM subject reported a significant increase in LSD-like symptoms as compared to placebo and baseline scores. A significant increase in both euphoria and dysphoria scales was also noted as compared to the control group. Interestingly, both drug and placebo groups exhibited significantly increased dysphoria symptoms as compared to SDEQ scores received prior to the drug administration phase of the study (the baseline scores).

Subjective mood changes were also measured on a symptom check list. The anxiety of drug subjects was significantly increased at 3 and 6 hours. A significant reduction of depressive symptoms was evident in subjects receiving DOM. They also exhibited significantly higher obsessive-compulsive symptoms after 6 hours, while there was no difference at 3 hours. Marked differences between the drug and control groups were noted at 3 and 6 hours in reported somatic symptoms. These reported somatic effects in the drug group were significantly different from pretest and 3 hours scores, but not as compared to placebo.

On a serial learning task, subjects receiving DOM learned a word list in significantly fewer trials than did controls. Therefore, at these dose levels DOM did not impair cognitive functioning nor short-term memory. No differences were observed between drug and control groups in simple visual perception as tested by estimation of horizontal and vertical line lengths. However, subjects given DOM mislabelled stimuli more frequently than did subjects given placebo on the Thematic Apperception Test (TAT). DOM may, therefore, alter associative organization of perceptual information without affecting simple visual perception.

Physiological Effects

Somatic effects reported by subjects in clinical circumstances (Hollister et al.) may be summarized as follows: nausea; appetite decreased more often than increased; increased sweating; feelings of heat slightly more often than cold; paresthesias (numbness); tension; tremors; fatigue. Measured physiological symptoms such as pupillary dilation, increased deep tendon reflexes, tremor and increased pulse rate present evidence of sympathetic stimulation. Early in the course of the drug's effects, drowsiness was noted with no apparent direct central nervous system stimulation. Increased pupil size, blood pressure and pulse rate were more clearly related to subjects receiving higher doses. Only three of 18 subjects had a temperature increase of 1°C. or more and all were on the higher doses. Although subjective feelings of weakness were reported, none was detectable clinically.

Biochemical measures (Hollister et al.) demonstrated free fatty acid (FFA) mobilization clearly, with a peak at 4 hours. A slight increase in plasma glucose was observed. Creatinine and phosphorus clearance were reduced significantly during the first 2 hours after administration as compared to the preceding 2 hours. Vanilylmandelic acid (VMA) excretion was not significantly altered, although a trend upward was seen with higher doses. The total leucocyte count increased, but the total circulating eosinophils decreased substantially. The biochemical changes were similar for DOM plus chlorpromazine as for DOM itself.

In a study of evoked EEG responses in rabbits, Fujimori and Himwich found that infusion of 0.2-0.8 mg./kg. of DOM produced EEG alerting 2 to 3 minutes following injection comparable to a control alerting in intact rabbits. The EEG arousal pattern lasted for 15 to 20 minutes. The EEG reaction was notably distinguishable from that produced by d-amphetamine. It was suggested that the basis of the DOM reaction may be a feedback relationship between a midbrain center for EEG alerting and a medullary center for the resting EEG. The authors hypothesize that DOM, as an example of a psychedelic drug, acts by "inhibiting the medullary mechanism and removing its restraints on the midbrain center."

In recent years, the hallucinogens have been scrutinized for possible drug-induced genetic damage or embryonic malformations. Spindler & Garcia Monge conducted a pilot investigation of the effects of DOM on the embryos of white leghorn and Ross breeds of hens. Two hundred and eight eggs received 0.5 or 0.05 mcg. of DOM at 30 hours and their development was compared to an equal number of controls. The total number of dead was 94 (45%) in the DOM groups as compared to 32 dead (15%) for controls. Anomalies appeared in greater frequency than controls with 115 normal (55%) and 93 (45%) displaying varying degrees and types of malformations.

Treatment

STP (DOM) has developed a "bad name" among drug users because of the widely publicized adverse reactions associated with the drug. The extended duration of action (16-24 hours) of STP, as compared with the 8-10 hour "acid trip," experienced by street users may have contributed to the numerous acute panic reactions. In the early street experience with STP, physical symptoms similar to belladonna or atropine intoxication were observed (e.g., dryness of mouth, blurred vision, photophobia, tachycardia, etc.) suggesting that the samples of STP consumed also contained these drugs. The erroneous street impression that phenothiazines, including chlorpromazine, potentiate the STP reaction could be due to the fact that the drugs taken were contaminated with belladonna alkaloids. Since the phenothiazines have been known to exacerbate toxic reactions to the belladonna drugs, the use of chlorpromazine and related drugs in the management of hallucinogenic drug crises should be avoided.

The "talk-down" technique in a secure and non-threatening setting has proved to be the most effective technique in handling acute adverse reactions

produced by the hallucinogens. Dr. David E. Smith, Medical Director of the Haight-Ashbury Free Medical Clinic, suggests that sedative medication such as chlordiazepoxide (Librium) or diazepam (Valium) may be helpful for the treatment of anxiety and chloral hydrate may be used for sleep induction.

Legal Status

DOM (STP) is considered a controlled dangerous substance under the Comprehensive Drug Abuse Prevention and Control Act of 1970. Illegal possession of DOM could result in a sentence to a term of imprisonment of not more than one year, a fine of not more than $5,000, or both. Conviction of illicit manufacture or sale could result in a sentence to a term of imprisonment of not more than 5 years, a fine of not more than $15,000, or both. Subsequent convictions would result in increased penalties.

Comments

Reports about STP in the media, scientific journals, and on the "street" appear to be confusing and somewhat incompatible in nature. The experiences of users do not seem to coincide with the research results of competent investigators. The following comments illustrate some of the points of controversy:

> It appears...that STP produced a higher incidence of acute and chronic toxic reactions than any of the other commonly used hallucinogens. It is impossible, however, to state what percentage of those who ingest STP actually develop some difficulty because many of the adverse reactions are handled by the community and are not brought to medical attention.
>
> --David E. Smith, M.D.

Influenced by reports on STP in the media, a discussion of youthful illicit drug use mistakenly reported:

> The letters stand for Serenity, Tranquility and Peace--and any association with a tombstone may not be inappropriate in view of the occasional fatal outcome of STP ingestion.
>
> --J. Robertson Unwin

Perhaps the following may provide some explanation of the inconsistency of reports about DOM cases:

> In discussing this contrast, of which they (Snyder, Faillace & Hollister) were aware, they stated, "It is possible that those of the 'Hippie' population who developed prolonged reactions to 'STP' had been sensitized by previous experiences with hallucinogenic drugs." However, the fact that these reactions were, in quality and duration, exact fulfillments of the mythology that had grown up about "STP," suggests that factors of expectation, learning and placebo response were operative as determinants. If so, this should probably be taken into consideration in evaluating other supposedly drug-induced phenomena reported by this group, such as the "spontaneous" return of drug symptoms reported long after the ingestion of LSD.
>
> --Burton M. Angrist, M.D.

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