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Review

Clinical and pharmacological aspects of bath salt use: A review of the literature and case reports

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ABSTRACT

Bath salts are designer drugs with stimulant properties that are a growing medical and psychiatric concern due to their widespread availability and use. Although the chemical compounds in the mixtures referred to as "bath salts" vary, many are derivatives of cathinone, a monoamine alkaloid. Cathinones have an affinity for dopamine, serotonin, and norepinephrine synapses in the brain. Because of the strong selection for these neurotransmitters, these drugs induce stimulating effects similar to those of methamphetamines, cocaine, and 3,4-methylenedioxy-N-methylamphetamine (MDMA). Much of the emerging information about bath salts is from emergency department evaluation and treatment of severe medical and neuropsychiatric adverse outcomes. This review consists of a compilation of case reports and describes the emergent literature that illustrates the chemical composition of bath salts, patterns of use, administration methods, medical and neuropsychiatric effects, and treatments of patients with bath salt toxicity.

Contents

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1. Introduction

Bath salts are sympathomimetic stimulants with serotonergic actions and hallucinogenic properties. The term, bath salts, refers to a group of chemicals, generally derivatives of cathinone. Cathinone is a monoamine alkaloid found in khat (*Catha edulis*), a shrub whose leaves are chewed or dried and consumed as tea for their stimulant properties in East Africa and the Arabian Peninsula. Bath salts typically contain at least one of three major synthetic cathinones: mephedrone, methylone, or methylenedioxypyrovalerone (MDPV). Other non-cathinone derived compounds identified in bath salts preparations include piperazines (Forrester, 2012).

Despite efforts to regulate sales and distribution, bath salts are available for purchase at convenience stores, gas stations, and on the Internet. The initial rise in popularity of bath salts in Europe and the United States has been attributed to their convenient availability and marketing claims that they are safe to use, as well as an overall lack of understanding of their adverse effects (Prosser and Nelson, 2012). The increase in abuse and attraction to bath salts can be attributed to the ability of users to evade detection by standard urine toxicology testing. These compounds are seen as legal substitutes that produce desirable effects similar to methamphetamine, cocaine, and 3,4-methylenedioxy-N-methylamphetamine (MDMA).

The most common emergency department presentations of bath salt users are tachycardia, diaphoresis, and hypertension. Adverse neuropsychiatric effects reported include agitation, paranoia, psychosis, and serotonin syndrome. Undesirable psychotic effects associated with bath salts illustrate the importance of a greater awareness among clinicians. This review describes pertinent information on trends in sales and use, effects, withdrawal symptoms, chemical composition, animal research data, legal regulations, medical and psychiatric toxicity, and treatment considerations for bath salt use. The most recent published case reports are also compiled to provide a review of the existing medical literature.

2. Methods

A systematic literature review of articles was conducted through PubMed, including articles published between January 1950 and January 2013. The search was done using the following terms: bath salt, cathinone, mephedrone, methylone, and methylenedioxypyrovalerone, in order to identify articles on patterns of use, physical and neuropsychiatric characteristics, chemical composition and pharmacology, and legal regulation of bath salts. Literature evaluated included English only retrospective studies, toxicology data, chemical analyses studies, and case reports. Case report studies regarding individual bath salt use were examined and compiled in a detailed table (Table 3). The GovTrack.us website was examined to identify any federal bills regarding chemicals in bath salts. The Drug Enforcement Administration and Federal Register websites were also searched to identify recent legislation on bath salts.

3. Results

The literature search resulted in a total of 428 published medical articles written in the English language relating to the key search terms (bath salt, cathinone, mephedrone, methylone, and methylenedioxypyrovalerone), with the oldest report published in 1981. 146 of these articles discussed non-human animal studies; 122 of these articles strictly pertained to the clinical characteristics of bath salts and these were tabulated for their experimental studies and study characteristics. Additionally, 11 surveys of user reports and 20 articles regarding the pharmacology and chemical composition of bath salts were included in the review. Case reports began to appear in literature in 2010; 29 case reports were identified and compiled into Table 3 with sections including patient population, administration methods, physical and neuropsychiatric characteristics, and disposition. The remaining 90 articles were not relevant to the clinical aspects or the chemical composition of bath salts.

3.1. Packaging and sales of bath salts

Illicit bath salts are often sold in small appealing packages that vary in content and quantity to circumvent state and federal restrictions (El Paso Intelligence Center, 2011; National Drug Intelligence Center, 2011). The packages contain white, crystalline powder or ingestible tablets (Forrester, 2012). Unlike traditional bath salts sold as Epsom salts in large containers, illicit bath salts are often sold in small 200–500 mg quantities at elevated prices, typically 25–75 dollars per package. These drugs are sold under various trade names such as Cloud Nine, Drone, Ivory Wave, Ivory Coast, Vanilla Sky, and White Rush (McGraw, 2012). Manufacturers seeking to evade regulations label bath salts for use as an aromatic potpourri, not intended for ingestion or intranasal use. Alternative marketing strategies include bath salts sold as plant food or insect repellant, with labels stipulating "not for human consumption" (National Drug Intelligence Center, 2011). Advertisements also promote that bath salt products are safe, produce euphoria, and have sexual or energizing effects.

3.2. Trends in use

Bath salts data compiled by the American Association of Poison Control Centers indicated 304 human exposure calls across the country in 2010 and 6138 in 2011, representing a 2019% increase within a one-year span in the United States (American Association of Poison Control Centers, 2012). Drug Enforcement Administration (DEA) National Forensic Laboratory Information System also received an increase in reports of synthetic cathinone seizures, receiving 14 reports in 2009 from 8 states to 290 reports from 21 states in 2010 (National Drug Intelligence Center, 2011). Epidemiological data from national indicators, such as Monitoring the Future, Drug Abuse Warning Network, and Substance Abuse and Mental Health Services Administration is not yet available. However, patterns of use are being tracked on the state level by the National Institute of Drug Abuse Community Epidemiology Work Group (Forrester et al., 2011).

Similarly, in the European Union, data from the Early Warning System has reported a steady increase in the number of police and forensic cases related to synthetic cathinones (methylone and mephedrone) since 2009. Synthetic cathinone seizures analyzed by the United Kingdom (UK) Forensic Science Service increased from less than 10 reports in 2009 to 650 reports in 2010. Additionally, UK healthcare providers accessed the National Poisons Information Service's entry on mephedrone 1664 times and made 157 telephone inquiries from 2009 to 2010 (European Monitoring Centre for Drugs and Drug Addiction, 2012).

The available survey data identify users as predominantly young males (Dulaney, 2012; Forrester et al., 2011; Spiller et al., 2011; James et al., 2010; Pohjalainen and Hoppu, 2010). However, individual case reports identifies a diverse population with users ranging from teenagers to those in their 50s (National Drug Intelligence Center, 2011; Wood et al., 2010a, 2010b, 2011). The Michigan Morbidity and Mortality 2012 weekly report stated that 46% of bath salt users presenting to emergency rooms had co-morbid mental illness, and 69% had self-reported drug abuse (Center for Disease Control and Prevention, 2011). Prosser and Nelson's review (2012) demonstrated that bath salt users tended to use two or more drugs simultaneously, which was confirmed in post mortem toxicology samples with bath salts normally found in conjunction with alcohol, cocaine, tobacco, and cannabis (Prosser and Nelson, 2012; Forrester, 2012).