© Pediatr Med Rodz 2019, 15 (3), p. 276–280
DOI: 10.15557/PiMR.2019.0046

Received: 02.01.2019
Accepted: 01.02.2019
Published: 29.11.2019

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A retrospective analysis of cases of intentional dextromethorphan intoxication in the Department of Paediatrics and Gastroenterology of the Medical University of Lublin between 2008 and 2017

Retrospektywna analiza hospitalizacji z powodu celowych zatruć dekstrometorfanem w Klinice Pediatrii i Gastroenterologii Uniwersytetu Medycznego w Lublinie w latach 2008–2017

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Abstract

Aim: The aim of the study was to retrospectively assess cases of intentional dextromethorphan intoxication which were the reason for admissions to the Department of Paediatrics and Gastroenterology at the Medical University of Lublin between 2008 and 2017. **Material and methods:** We analysed medical records of patients hospitalised due to intentional dextromethorphan intoxication in the Department of Paediatrics and Gastroenterology at the Medical University of Lublin between 2008 and 2017. **Results:** Dextromethorphan poisoning was the reason for 55 hospital stays. The number of hospital stays due to dextromethorphan intoxication during subsequent years was as follows: 2008 – 3, 2009 – 4, 2010 – 8, 2011 – 7, 2012 – 7, 2013 – 11, 2014 – 3, 2015 – 9, 2016 – 1, 2017 – none. The analysis included as many as 47 girls (85.4%) and only 8 boys (14.6%). The age of patients ranged between 11 years and 11 months to 16 years and 3 months. There were 47 (85.4%) urban and only 8 (14.6%) rural children. **Concusions:** The observed drop in the number of deliberate dextromethorphan intoxications from 2016 onwards may be due to the limited availability of the drug resulting from a change in the Polish law. Intentional dextromethorphan intoxications are most common among girls, adolescents aged between 13 and 15 years and urban residents. Family and school education on the harmful effects of psychoactive substances should play a particularly important role in the prevention of psychoactive substance abuse.

Keywords: dextromethorphan, intoxication, children, adolescents

Streszczenie

Cel pracy: Celem pracy jest retrospektywna analiza celowych zatruć dekstrometorfanem, będących przyczyną hospitalizacji w Klinice Pediatrii i Gastroenterologii Uniwersytetu Medycznego w Lublinie w latach 2008–2017. **Materiał i metody:** Materiał pracy stanowiła dokumentacja medyczna pacjentów hospitalizowanych z powodu celowych zatruć dekstrometorfanem w Klinice Pediatrii i Gastroenterologii Uniwersytetu Medycznego w Lublinie w latach 2008–2017. **Wyniki:** W analizowanym okresie zatrucie dekstrometorfanem było przyczyną 55 hospitalizacji. W poszczególnych latach liczba hospitalizacji z powodu zatruć dekstrometorfanem wynosiła odpowiednio: 2008 – 3, 2009 – 4, 2010 – 8, 2011 – 7, 2012 – 7, 2013 – 11, 2014 – 3, 2015 – 9, 2016 – 1, 2017 – brak. Wśród objętych analizą dzieci było 47 dziewczynek (85,4%) i 8 chłopców (14,6%). Zakres wieku badanych wynosił od 11 lat i 11 miesięcy do 16 lat i 3 miesięcy. Ze środowiska miejskiego pochodziło 47 dzieci (85,4%), a z wiejskiego jedynie 8 dzieci (14,6%). **Wnioski:** Obserwowany spadek liczby celowych zatruć dekstrometorfanem od 2016 roku może być związany z ograniczeniem łatwej dostępności do leku, wynikającej ze zmiany prawa obowiązującego w Polsce. Celowe zatrucia dekstrometorfanem najczęściej dotyczą dziewczynek, osób w grupie wiekowej między 13. a 15. rokiem życia, mieszkających w mieście. W profilaktyce celowych zatruć lekami szczególnie ważną rolę powinna odgrywać edukacja rodzinna i szkolna dotycząca szkodliwości przyjmowania środków psychoaktywnych.

Słowa kluczowe: dekstrometorfan, zatrucia, dzieci, młodzież

INTRODUCTION

The abuse of medications, psychoactive substances and alcohol among children and adolescents is a serious and growing problem worldwide. Due to the scale of the problem, it seems important not only from the medical point of view, but also in the context of public health. Social consequences of intentional intoxication at developmental age include school absenteeism, learning difficulties, a tendency to undertake risky behaviours, acts of violence and crimes. Stimulants are used in the paediatric population for entertaining or suicidal purposes, or to draw the attention of others (the so-called demonstrative suicidal attempts)[1]. Adolescents often use OTCs (over the counter), which, when used unsupervised and at doses higher than therapeutic levels, may have euphoric and hallucinogenic effects by stimulating the central nervous system[2]. The popularity of OTCs among children and adolescents is due to their wide availability (pharmacies, shops, gas stations), low price as well as the lack of legal consequences arising from their possession or use. OTCs include, among other things, antitussive, expectorant, analgesic and anti-inflammatory drugs containing substances such as pseudoephedrine, codeine or dextromethorphan (DXM)[2]. Young people are convinced that these are substances that facilitate learning, improve body's efficiency, induce a feeling of confusion, hallucinations, and a feeling of "detachment from one's own body." They share information in peer groups or via social media. OTCs are usually in the form of complex pharmaceuticals and additionally contain paracetamol, ibuprofen, antihistamines, herbal extracts or other compounds.

Dextromethorphan is a synthetic derivative of morphine with no effects on opioid receptors[3]. Preparations containing this substance are used for the symptomatic treatment of non-productive cough in pharyngitis, bronchitis or laryngitis[4]. The antitussive action of DXM is the result of suppressing the cough reflex by increasing the sensitivity threshold of the respiratory centre located in the medulla oblongata, and by inhibiting synaptic glutaminergic transmission[4,5]. Dextromethorphan is well absorbed in the gastrointestinal tract, with the onset of effects already after 10–30 minutes, and duration of effects of about 6–9 hours[3,4]. The compound is metabolised in the liver through O- and N-demethylation catalysed by CYP2D6. It is excreted in the urine both in the form of demethylated metabolites and unchanged[5].

Dextromethorphan is a component of up to 24 preparations available on the Polish pharmaceutical market, but only one of these requires a prescription. It is available in the form of tablets, capsules, syrups and powder for oral solution[4]. The doses of DXM are 10–15 mg for tablets, 15–30 mg for capsules, 3.75–15 mg/5 mL for syrups, and 20 mg for powders[4].

The maximum daily dose of DXM should not exceed 60 mg in children aged between 6 and 12 years and 120 mg in patients >12 years of age[4]. Recommended doses cause no or negligible adverse effects[6]. The most common adverse effects of therapeutic doses include somnolence, nausea, vomiting, headache, dizziness, epigastric pain, diarrhoea or constipation, and allergic reactions. Toxic doses may induce many other symptoms in many different systems. Neurological adverse effects of DXM include coma, somnolence, dizziness, anxiety, ataxia, hypertonia, nystagmus, agitation, convulsions, euphoria, auditory and visual hallucinations, confusion, hypersensitivity, psychosis and even respiratory depression. DXM intoxication may be also manifested as symptoms from other systems like: nausea, vomiting, diarrhoea or constipation, dry mouth, tachycardia, increased blood pressure, pruritus, redness of the skin, anaphylactic shock, hyperthermia, and increased sweating. Lethal dose of DXM is 20–25 mg/kg body weight[7–10].

Due to the lack of Polish nationwide data on DXM abuse among paediatric population, we conducted a study to analyse hospitalisation rates due to intentional DXM intoxication in the Department of Paediatrics and Gastroenterology at the Medical University of Lublin between 2008 and 2017.

MATERIAL AND METHODS

This was a retrospective study. We analysed medical records of patients hospitalised due to intentional DXM intoxication in the Department of Paediatrics and Gastroenterology at the Medical University of Lublin between 2008 and 2017. The analysis included demographic data of patients (age, sex, place of residence), exposure to other substances (medications, drugs, psychoactive substances, alcohol), the general condition of the patient on admission, symptoms, the results of psychological consultation and the treatment used.

RESULTS

A total of 55 patients were hospitalised in the Department of Paediatrics and Gastroenterology of the Medical University of Lublin between 2008 and 2017 due to intentional intoxication with DXM-containing pharmaceuticals, accounting for 7.53% of all hospital stays due to poisoning during this period.

The distribution of the number of hospitalisations due to DXM intoxications in the particular years is shown in Fig. 1. There were as many as 47 girls (85.4%) in the study group; boys accounted for 14.6%. The number of children hospitalised due to intentional DXM intoxication in the individual years (including patient's sex) is shown in Fig. 2.

The patients' age ranged between 11 years and 11 months and 16 years and 3 months. Different age groups of patients are shown in Fig. 3. Children aged between 13 and 15 years

 DOI: 10.15557/PiMR.2019.0046

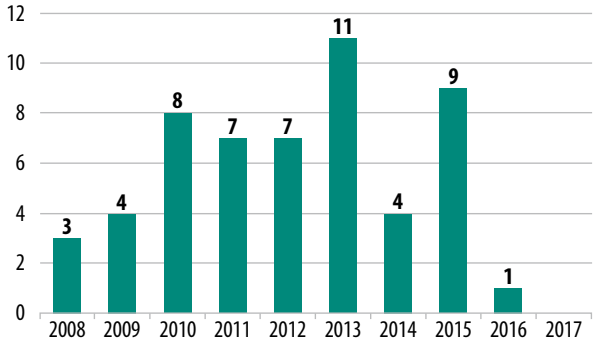

Fig. 1. The number of hospitalisations due to intentional DXM self-intoxication between 2008 and 2017

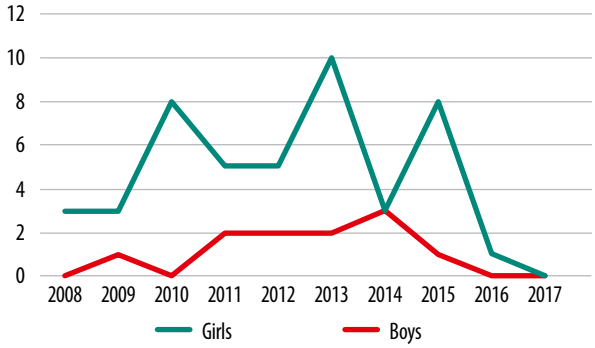

Fig. 2. The number of children hospitalised due to intentional DXM intoxication in the individual years, considering patients' sex

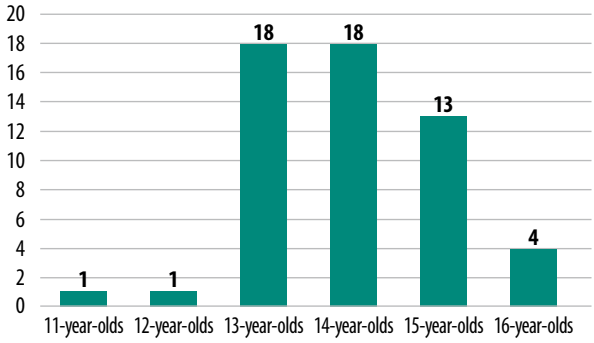

Fig. 3. Age groups of children hospitalised due to intentional DXM intoxication

old were the largest group (49 patients; 89.1%). DXM intoxication under the age of 13 years was reported for only 2 patients. Mean age of hospitalised patients was 14 years (13.96 ± 1.05 years).

Urban residents dominated (47; 85.4%), with more than half of patients residing in Lublin (24; 51%). A total of 23 patients came from other smaller towns of the Lublin Voivodeship, accounting for 49% of all urban dwellers in the analysed group. There were only 8 rural children (14.6%). It should be noted that 4 children came from the same village, and 3 of these children were hospitalised in the same period.

A co-administration of other psychoactive substances, including ethanol (3; 5.5%) and marijuana (1; 1.8%), was reported in several cases.

Poisoning Severity Score (PSS)	Number of children (%)
None (no symptoms)	3 (5.4%)
Minor	41 (74.6%)
Moderate	11 (20.0%)
Severe	0 (0%)
Fatal	0 (0%)

Tab. 1. The severity of poisonings graded with the Poisoning Severity Score (PSS)

The overall condition of DXM-intoxicated patients on admission to the Department of Paediatrics and Gastroenterology was relatively good. According to the Poisoning Severity Score (PSS), most cases were mild (41 patients; 74.6%). Tab. 1 shows PSS scores in the group of patients.

The main symptoms of DXM intoxication observed in the study group included dry mouth, headache, dizziness, dilated pupils poorly reacting to light, tachycardia, high blood pressure, and agitation. Fig. 4 shows a detailed analysis of intoxication symptoms in the study group. Furthermore, physical examination revealed signs of self-injury in 11 (20%) children.

Two patients required administration of naloxone by the ambulance crew as a prehospital management. The vast majority of patients (48; 87.3%) underwent gastric lavage in the emergency department. Other children (7; 12.7%) did not undergo the procedure due to the long time elapsed between drug ingestion and admission to the department. All patients received IV infusions in the emergency room,

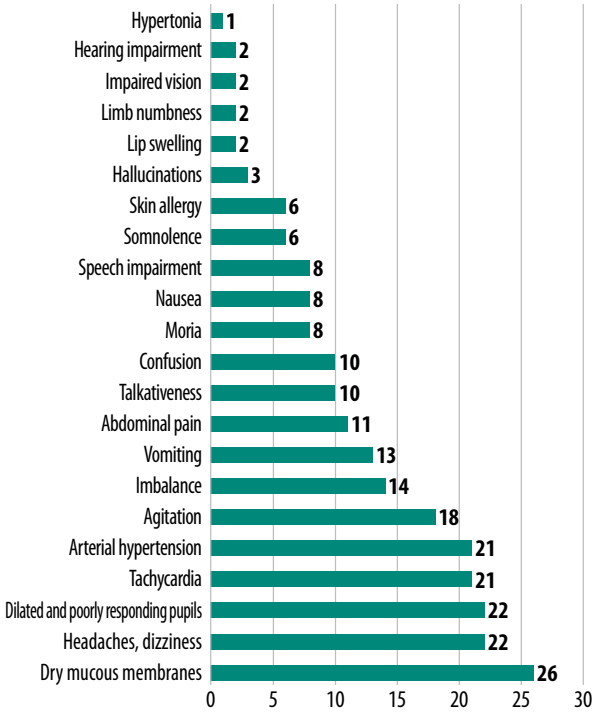

Fig. 4. Symptoms of DXM intoxication in the study group of patients

DOI: 10.15557/PiMR.2019.0046

which were continued after admission to the Department. Vital signs of patients were monitored in the first hours of hospitalisation.

A total of 43 children (78.2%) were consulted by a psychologist, and 5 (9%) of these children needed psychiatric consultation. Three children (5%) required further treatment in the Department of Child and Adolescent Psychiatry at the Neuropsychiatric Hospital.

The consultant psychologist drew attention to the following problems in children hospitalised due to DXM intoxication: difficult relationships with parents (15; 27.3%), problems at school (9; 16.4%), and difficult relationships with peers (5; 9.1%). Suicidal tendency was reported for 2 patients (3.6%).

A total of 30 children (54.6%) admitted that they had ingested DXM as an equivalent of psychoactive substances; 2 (3.6%) – for suicidal purposes, and 1 (1.8%) – to attract the attention of the opposite sex. The motive for intoxication could not be determined in the remaining 22 cases (40%).

The mean duration of hospital stay was 3.12 days. Three patients were discharged home on parents' request.

DISCUSSION

Intentional self-intoxication with pharmaceuticals among children and adolescents is a serious medical and social problem worldwide. The growing problem of abuse of medications and psychoactive agents by children and adolescents is probably associated with the rapid progress of civilisation. Easy access to mass media, the Internet in particular, can have a significant impact on the dissemination of the idea of using psychostimulants by children and adolescents. Information on the availability, prices and symptoms of different psychoactive substance may be quickly and easily found by browsing online forums. Young people believe that DXM has narcotic, mood-improving effects and that it increases body efficiency. Furthermore, there is a misconception among young people that the substance shows low toxicity, which may be an additional factor encouraging its use for euphoric purposes.

In the United States of America (USA), there is an upward trend in DXM abuse. A retrospective analysis of intoxication cases reported in the California Poison Control System between 1999 and 2004 showed that there were 1,382 cases of DXM self-intoxication, accounting for 0.1% of all poisoning cases. Most cases of DXM self-intoxication (n = 1,029; 74.5%) were reported for children aged between 9 and 17 years. Considering the cases of both children and adults, there were ten times more DXM intoxications in 2004 vs. 1999. During this period, a 7-fold increase in the incidence of DXM poisoning was observed in the USA. Also, up to 16-fold increase in the incidence of DXM intoxication was observed in 9–17-year-olds in the analysed period[11].

An analysis of epidemiological data in the National Poison Data System showed a 3-fold increase in the incidence of intentional DXM intoxication between 2000 and 2006. Detailed data show that there were 4.4 cases per 1,000,000 people of DXM poisoning in 2000 and 14.9/1,000,000 in 2006. The incidence of DXM abuse reached an almost constant level in the years 2006–2015. It was only between 2012 and 2013 that an increased incidence of DXM abuse of up to 14.5/1,000,000 was reported; the incidence was about 12/1,000,000 in the remaining years. In the discussed report, a total of 30,867 cases of intentional DXM intoxication were reported in US children between 2000 and 2015, accounting for 55.6% of all cases of DXM poisoning. This means that annually there were about 1,929 cases of DXM intoxication among children and adolescents[12].

Our study showed a rapid drop in the number of hospital stays due to DXM intoxication since 2016. Only one case of intentional DXM intoxication was reported between 2016 and 2017. This may be due to the changes in Polish law. The Act of 24th April 2015 amending the Act on counteracting drug addiction and some other acts changed the rules for the sale of over-the-counter medications (OTCs) containing pseudoephedrine, DXM or codeine. According to the provisions of this Act, only one package of a given medicinal product containing the above substances may be purchased at a time, as in accordance with the principles of one-time sale. Furthermore, pharmacists and pharmaceutical technicians have been obliged to refuse to sell these medicinal products to persons less than 18 years of age, or if they suspect that the products may be used for non-medical purposes or cause a threat to health and life[13]. Furthermore, the Regulation of the Minister of Health of December 16, 2016 regarding the list of psychoactive substances and their maximum content in a medicinal product, which imposed a restriction on the sale of medicinal products as part of one-time sale, set the maximum content of DXM in these products at 360 mg[14]. These legal provisions have limited the availability of medicinal products containing DXM, as reflected in the decreasing trend of hospitalisations due to intoxication with this drug in our Department.

The problem of DXM abuse is most common among adolescents. An analysis conducted in California showed that most cases of intoxication with this substance were reported for 15–16-year-olds[11]. On the other hand, epidemiological data from 2000–2015 from all US states indicate that DXM abuse was more common in 14–17-year-olds[12]. In our study, DXM abuse was reported for a slightly younger age group, i.e. between 13 and 15 years of age. This may be due to the easy access of young children to information on the non-therapeutic effects of the drug. The age of 13–15 years is the period of psychological changes referred to as the "adolescent rebellion." Young people at this age are faced with

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changes in their body and mind. At the time of the study, this was also the age of transition from elementary to junior high school. Changes associated with entering adolescence and different school environment in the absence of adequate support from family and teachers can be a great stress for young people and a stimulus for using psychoactive substances for recreational purposes.

Bryner et al. and Karami et al. showed a higher incidence of DXM abuse among males; however, they included both children and adults in their analysis[11,12]. On the other hand, Banerji et al. fund that intentional DXM intoxication was more common among women[15]. In our study, DXM abuse was significantly more common among girls. This may result from the fact that intentional intoxication was generally more common among girls vs. boys in our material. Our earlier observations also showed that intoxication with medications was more common in girls, and that boys were more likely to consume alcohol[16].

In our analysis, we also considered the place of residence of DXM abusers. It is worth noting that more than 85% of patients came from urban areas. This trend may result from both, easy access to places where medications can be purchased, and virtually unlimited access to various sources of information on psychoactive substances, the Internet in particular. Data on the place of residence of children intoxicated with DMX are missing in the available literature.

The aim of the study was to analyse symptoms induced by DXM intoxication. The most common symptoms included dry mouth, headache, dilated pupils, cardiovascular symptoms (tachycardia, high blood pressure), agitation and impaired balance. Most cases of intoxication were mild. The low incidence of moderate-to-severe intoxications may result from the fact that the children were reported to hospital shortly after drug intake and received first aid in the emergency room.

Similar findings were obtained by Bryner et al. – no or mild symptoms were reported in 53% of patients, and moderate intoxication was observed in 42% of patients[11].

CONCLUSIONS

Intentional DXM self-intoxication usually occurs in girls, 13–15-year-olds and urban residents.

The observed reduction in the incidence of DXM abuse in recent years may be a result of changes in the Polish law on the principles for selling OTCs.

Measures to prevent DXM abuse should be targeted primarily at risk groups and involve family and school education on the harmful effects of psychoactive substances.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organisations, which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

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DOI: 10.15557/PiMR.2019.0046