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ARTICLE

Epidemiology of Lindane Exposures for Pediculosis Reported to Poison Centers in Texas, 1998–2002

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ABSTRACT

Background: Lindane (gamma-benzene hexachloride), commonly used as a treatment for pediculosis, has been associated with adverse reactions and has recently undergone increased regulation. *Objective:* We sought to describe the patterns of a large number of lindane exposures reported to poison centers in Texas during 1998–2002. *Methods:* Data on all lindane exposures for pediculosis reported to the Texas Poison Center Network were analyzed. *Results:* There were 528 reported human exposures to lindane for pediculosis. The incidence of lindane exposures has decreased by 52% from 1998 to 2002. Misuse or abuse of lindane was reported in at least 87% of the cases. Of those cases with a known patient age, 45% were less than age 6 yrs, 23% age 6–19 yrs, and 32% over age 19 yrs. Female patients accounted for 55% of reported cases. Of those cases with a known medical outcome, 61% reported no effects. The most frequently reported symptoms were vomiting, nausea, and ocular irritation or ocular pain. *Conclusion:* The number of reported lindane exposures in Texas is decreasing. The majority of reported exposures involve misuse or abuse of the product. The pattern of symptoms reported in Texas was consistent with the literature.

Key Words: Lindane; Pediculosis; Texas Poison Center Network.

INTRODUCTION

Lindane (gamma-benzene hexachloride) is a chlorinated hydrocarbon commonly used as an agricultural pesticide and for the treatment of scabies and pediculosis when applied topically. In the latter instance, lindane is approved by the FDA and is available by prescription only. The primary target of action of lindane is the

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Table 1. Lindane lotion and shampoo exposures reported to the Texas Poison Center Network during 1998-2002 by year.

Year	Total Texas population	Lindane exposures	Penetrance*	Percentage change in penetrance from previous year
1998	19,759,614	132	0.007	
1999	20,044,141	131	0.007	−2.2%
2000	20,851,820	96	0.005	−29.6%
2001	21,195,281	94	0.004	−3.7%
2002	21,500,997	75	0.003	−21.3%

*exposures per 1,000 population

central nervous system. Animal studies indicate that lindane is readily absorbed through the gastrointestinal tract, skin, and lungs (1).

Although adverse reactions after normal use of lindane have been described (2), adverse reactions mainly result from misuse of the product such as prolonged dermal exposure, repeated dermal applications, application to diseased skin, or ingestion (3,4). Misuse may result from problems understanding the application directions on the label where the product is administered orally rather than dermally (5).

Dermal exposure to lindane results in symptoms including seizures, dizziness, headache, nausea, diarrhea, abdominal pain, urinary and fecal incontinence, muscle weakness, myoclonic jerks, fatigue, weight loss, hair loss, sleep disturbance, cognitive dysfunction, and anemia, with some of the symptoms reportedly lasting for long periods of time (2,3,6–8). Common symptoms of lindane ingestion include nausea, vomiting, seizures, drowsiness, and lethargy. Other symptoms observed with oral exposure to lindane include headaches, dizziness, irritability, tremors, coma, renal failure, and muscle necrosis (5,9–13). Both dermal and oral lindane exposure have been associated with death (5,12,13). Treatment of lindane exposure is symptomatic, and there is no specific antidote. Lavage and charcoal have been used for treatment of oral lindane exposure (11).

Over the past eight years, lindane has become more tightly regulated. In 1995, lindane was classified as a second-line therapy because safer, more effective treatments had been found. Effective January 1, 2002, the State of California banned the use and sale of any lindane-containing product used for the treatment of pediculosis or scabies (14). In March 2003, the United States Food and Drug Administration (FDA) issued a Public Health Advisory announcing the addition of extensive warnings to the labels of topical formulations of lindane lotion and shampoo for the treatment of lice and scabies (15).

Much of the literature on the adverse effects of lindane consists of case reports. The intent of this investigation was to describe the patterns of lindane exposures reported to poison centers in Texas during a recent five-year period.

MATERIALS AND METHODS

A five-year retrospective study used data from the Texas Poison Center Network (TPCN), a network of the six poison centers that together service the entire state. All of the TPCN centers use the American Association of Poison Control Centers (AAPCC) Toxicall program and Toxic Exposure Surveillance System (TESS) database in order to collect information on received calls.

Cases reviewed included all human exposures involving lindane reported to the TPCN during 1998–2002. Exposures to lindane used as an agricultural pesticide or veterinary treatment were excluded from the analysis. The exposure incidence was calculated for each year of the study period. The distribution of lindane exposure factors such as patient age and gender, reason and route of exposure, outcome, exposure and management sites, symptoms, and treatment was determined using AAPCC categories.

The proportion of cases known to be due to misuse or abuse of lindane was determined. Information on symptoms and treatment were not available for 1998 and 1999; analyses of those variables were restricted to 2000–2002. Seasonal patterns were analyzed by calculating the distribution of lindane exposures by month. All variables were not necessarily available for all of the cases, so the sum of the subcategories will not always equal the total number of cases.

RESULTS

There were 571 human exposures to lindane reported to the TPCN during 1998–2002. Forty-three of the exposures were excluded as they involved

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Table 2. Distribution of lindane lotion and shampoo exposures reported to the Texas Poison Center Network during 1998-2002 by selected variables for various patient age groups.

	Total No. (%)	<6 years No. (%)	6-19 years No. (%)	>19 years No. (%)
Gender				
Male	232 (45.3)	113 (49.3)	41 (34.7)	78 (47.3)
Female	280 (54.7)	116 (50.7)	77 (65.3)	87 (52.7)
Reason for exposure				
Unintentional	474 (90.3)	228 (99.1)	102 (87.2)	132 (80.0)
Intentional	31 (5.9)	0 (0.0)	10 (8.5)	21 (12.7)
Adverse reaction	18 (3.4)	2 (0.9)	5 (4.3)	11 (6.7)
Other	2 (0.4)	0 (0.0)	0 (0.0)	1 (0.6)
Exposure route				
Ingestion	415 (78.9)	188 (81.4)	97 (82.9)	120 (72.7)
Dermal	71 (13.5)	23 (10.0)	13 (11.1)	33 (20.0)
Ocular	21 (4.0)	11 (4.8)	6 (5.1)	4 (2.4)
Inhalation	4 (0.8)	0 (0.0)	0 (0.0)	4 (2.4)
Ingestion & Dermal	11 (2.1)	7 (3.0)	0 (0.0)	3 (1.8)
Ocular & Dermal	3 (0.6)	1 (0.4)	1 (0.9)	1 (0.6)
Other	1 (0.2)	1 (0.4)	0 (0.0)	0 (0.0)
Outcome				
None	199 (60.7)	106 (70.7)	47 (59.5)	43 (46.2)
Minor	104 (31.7)	35 (23.3)	28 (35.4)	40 (43.0)
Moderate	22 (6.7)	9 (6.0)	3 (3.8)	9 (9.7)
Major	3 (0.9)	0 (0.0)	1 (1.3)	1 (1.1)
Death	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Exposure site				
Own residence	471 (92.2)	219 (95.2)	106 (89.8)	146 (89.6)
Other residence	19 (3.7)	9 (3.9)	7 (5.9)	3 (1.8)
Workplace	2 (0.4)	0 (0.0)	0 (0.0)	2 (1.2)
Other	19 (3.7)	2 (0.9)	5 (4.2)	12 (7.4)
Management site				
Non-health care facility	238 (46.3)	95 (41.1)	54 (45.8)	89 (53.9)
At/En route to health care facility	130 (25.3)	62 (26.8)	30 (25.4)	38 (23.0)
Referred to health care facility	143 (27.8)	73 (31.6)	33 (28.0)	37 (22.4)
Other	3 (0.6)	1 (0.4)	1 (0.8)	1 (0.6)
Month of exposure				
January	38 (7.4)	14 (6.1)	11 (9.3)	13 (7.9)
February	48 (9.3)	22 (9.5)	10 (8.5)	16 (9.7)
March	52 (10.1)	29 (12.6)	10 (8.5)	13 (7.9)
April	46 (8.9)	13 (5.6)	18 (15.3)	15 (9.1)
May	44 (8.6)	18 (7.8)	9 (7.6)	17 (10.3)
June	46 (8.9)	17 (7.4)	7 (5.9)	22 (13.3)
July	39 (7.6)	13 (5.6)	8 (6.8)	18 (10.9)
August	37 (7.2)	18 (7.8)	9 (7.6)	10 (6.1)
September	44 (8.6)	26 (11.3)	9 (7.6)	9 (5.5)
October	37 (7.2)	20 (8.7)	8 (6.8)	9 (5.5)
November	40 (7.8)	18 (7.8)	9 (7.6)	13 (7.9)
December	43 (8.4)	23 (10.0)	10 (8.5)	10 (6.1)

lindane formulated for agricultural or veterinary purposes, including one instance where a veterinary product was used to treat human pediculosis. Thus, 528 cases were analyzed. Table 1 contains the distribution of reported lindane exposures by year. Although the Texas population increased during the five-year period, the number of reported lindane exposures decreased. As a result, the number of lindane exposures declined

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during 1998–2002, with the number of cases in 2002 being 52% that reported in 1998.

Of the 514 cases with a known patient age, 231 (44.9%) were less than age 6 yrs, 118 (23.0%) age 6–19 yrs, and 165 (32.1%) over age 19 yrs. The distribution of reported lindane exposures by other selected variables is shown in Table 2. A higher proportion of reported lindane exposures involved female patients. This pattern was found among all age groups, although the gender difference was greatest for cases 6–19 yrs of age.

The distribution of total lindane exposure cases by month demonstrated no clear seasonal pattern. The highest percentage of lindane exposures for patients age less than 6 yrs were reported to have occurred in March and September but otherwise showed no obvious seasonal trends. Reports of lindane exposures were relatively constant throughout the year for patients age 6–19 yrs with the exception of a high proportion of exposures reported in April. Reported lindane exposures among patients age greater than 19 yrs tended to be higher in February–July, with the highest proportion of reported exposures occurring in June.

Therapeutic error was reported in 152 (28.8%) of the cases. In 116 (22%) of the cases, lindane was reported to have been ingested when it was mistaken for another medication or beverage. In 7 (1.3%) cases, the lindane was in an incorrectly labeled container. Lindane was ingested instead of applied topically in 11 (2.1%) cases, including 1 case where poison center notes indicated a language barrier existed. In 31 (5.9%) cases, lindane was used on the skin more frequently or for a longer period of time than recommended.

The majority of reported lindane exposures were unintentional, a pattern observed among all of the age groups. However, the proportion of reported intentional exposures and adverse reactions increased with age. Most of the reported lindane exposures occurred through ingestion. The next most common exposure route was dermal, followed by ocular. A small portion of exposures occurred via multiple routes. The 19 yrs and older age group was more likely than the other age groups to report dermal exposure.

Among all lindane exposures reported during 2000–2002, the most frequently reported symptoms were vomiting (n=32), nausea (n=16), and ocular irritation or pain (n=13). Other symptoms reported in four or more patients included erythema, dermal irritation or pain, abdominal pain, throat irritation, agitation or irritability, dizziness, drowsiness or lethargy, seizures, and conjunctivitis. The most frequent symptoms reported among ingestion cases were vomiting (n=31), nausea (n=10), and throat irritation (n=6). Among dermal exposure cases, the most common reported symptoms were erythema (n=5), dermal irritation or pain (n=4), and nausea (n=4).

The most frequently reported treatments for cases of ingested lindane during 2000–2002 were dilution or irrigation (n=89), charcoal (n=79), and use of a cathartic or other emetic (n=49). Other treatments reported in four or more cases of lindane ingestion were lavage, food, anticonvulsant, and IV fluids. For dermal lindane exposures during the same time period, the most frequent treatment was dilution or irrigation (n=21).

Outcome information was unavailable for more than half (62%) of the reported exposures. No health effects were reported for 199 (38%) of the lindane exposures, and few cases reported major health effects. Medical outcome was classified as minor or moderate for 24% (N=126) of the lindane exposures. There were no deaths related to reported lindane exposures.

When the outcome distribution was examined by patient age, the proportion of cases with minor or moderate effects tended to increase with age. A preponderance of reported lindane exposures among all age groups occurred at the patient's own residence. In the majority of all reported lindane exposures, the patient was either at or en route to a health care facility or referred to a health care facility by the poison center. Similar patterns were noted for patients aged less than 6 yrs and aged 6–19 yrs, whereas more patients aged greater than 19 yrs were managed in non-health-care facility settings.

DISCUSSION

This investigation described the epidemiology of lindane exposures reported to poison centers in Texas during a recent five-year period. In spite of the potential seriousness of lindane exposures, most of the literature on the subject consists of reports of a small number of cases. This investigation provides information on over 500 reported cases of lindane exposure.

While the 2000 Census reported that 69% of the Texas population was 20 yrs of age or greater, only 32% of reported lindane exposures were found among adults. This disproportionate number of cases among children and adolescents is either due to a higher likelihood of adverse lindane exposures among non-adults or a greater tendency to report lindane exposures to poison centers if they involve children and adolescents.

Seasonal variation in reported lindane exposures was only observed for adults. It might be expected that

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school-age children would be more likely to be exposed to scabies and head lice at school, and thus more likely to have lindane exposures during the school year. However, the data do not support such a hypothesis. It is unclear why the proportion of reported lindane exposures among patients aged 6–19 yrs was much higher in April than in any other month.

Most of the reported lindane exposures were unintentional. However, the proportion of cases that was intentional or involved adverse reactions increased with age. The most frequent exposure route was ingestion, followed by dermal and ocular routes. A dermal exposure among adults was twice as likely as in the other age groups, suggesting that adults were either less likely to ingest lindane or more likely to report dermal exposures.

Therapeutic error was reported in almost 30% of the cases. Approximately 80% of the therapeutic errors involved lindane ingestion. In at least one-in-five of the cases, the exposure involved lindane ingestion when it was mistaken for another medication or beverage. This indicates that a portion of the population is misusing lindane. Although some of this misuse may reflect carelessness, misuse also may occur if people were not directed to use the product correctly or they misunderstood instructions and thought the product was to be given orally.

Many of the symptoms reported in association to lindane exposures in this study—vomiting, nausea, ocular irritation or pain, erythema, dermal irritation or pain, abdominal pain, throat irritation, agitation or irritability, dizziness, drowsiness or lethargy, seizures, and conjunctivitis—have been previously reported in the literature. Anemia was not reported in any of our cases although this symptom has been reported in several previous studies (7,16). The more common treatments used for the lindane exposures were dilution or irrigation, charcoal, and use of a cathartic or other emetic and less frequently treatments for specific symptoms. These treatments also have been utilized in previous studies.

The majority of reported lindane exposures among children and adolescents had no reported effect. In contrast, a higher proportion of reported lindane exposures among adults had a reported minor-moderate effect. In spite of this, reported lindane exposures among the younger age groups were more often managed at health-care facilities while those among adults were more frequently managed outside of health-care facilities. These patterns may reflect a greater tendency to report exposures and to seek treatment at health-care facilities among young patients, even if there is little or no apparent health effect from the lindane exposure. This suggests that a portion of these visits to health-care facilities might be unnecessary.

Regardless of the lack of health effects reported for 199 of the lindane exposures in this study, the large number of exposures and persons who sought medical treatment at health-care facilities underscores the need for education to both consumers and health-care providers. Both physicians and pharmacists should clearly explain the correct directions for use of these lindane products. The fact that this formulation of lindane is available by prescription only may inadvertently bias consumers to perceive lindane as safe. Physicians should consider the potential adverse effects of lindane and appropriately counsel patients when it is prescribed; alternatively, physicians could consider prescribing non-lindane pediculicides.

The number of reported lindane exposures declined substantially during the five-year period of the study, with the number of cases reported in 2002 being slightly more than half the number of cases reported in 1998. There are several possible explanations for this decline. There could be decreased use of lindane products in favor of other products considered to be safer and more effective as pediculicides (10). There could also be a decline in the occurrence of adverse human exposures to lindane. Lastly, there could be decreased reporting of lindane exposures to the poison centers in Texas.

The main limitation to this investigation is the scope of the data. The TPCN is a passive system in that exposures are reported to poison centers and reporting is voluntary. Moreover, it cannot be assumed that all subgroups were equally likely to report lindane exposures; thus the data may be biased. Another limitation is that some of the reported exposures may have been identified as lindane lotion or shampoo when they were actually higher concentrations of lindane intended for agricultural or veterinary purposes. In addition, a proportion of cases may have been assigned the wrong codes, particularly in relation to exposure reason, by the persons handling the poison calls. Review of the case notes might be useful for identifying such coding errors. However, case notes are not collected in a consistent fashion, and no attempt at correcting case notes was made.

In conclusion, the pattern of symptoms and treatments reported for over 500 cases of lindane exposure in Texas was consistent with the literature. Exposures to lindane were most commonly reported among children and adolescents and among females. Reported exposures were predominantly unintentional and involved ingestion of the product. Errors in use of

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lindane products were common. No obvious seasonal patterns in reports of lindane exposures were observed, even among school-age children. Reported lindane exposure patterns tended to differ between the age groups. The reports of lindane exposures decreased over a five-year period as regulations on lindane increased. This information can be used by poison centers to target education for the prevention of adverse lindane exposures.

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