BRIEF REPORT

The Evaluation of Readiness of Medical Personnel to Act Under Conditions of Chemical Contamination

Łukasz Szarpak, MSc; Andrzej Kurowski, PhD, MD

ABSTRACT

Objective: We evaluated the knowledge of physicians, nurses, and paramedics in Poland about the procedures in a chemical contamination.

Methods: An anonymous survey was mailed to 600 randomly selected physicians, nurses, and paramedics. The survey included questions concerning the process of decontamination, knowledge of toxidromes, and the use of selected antidotes.

Results: Completed surveys were received from 510 respondents (85%). A very low level of knowledge was observed regarding decontamination techniques (from 8.3% to 34.2%), use of antidotes (from 13.7% to 61%), and knowledge of toxidromes (from 10.2% to 22.7%).

Conclusions: Our findings showed that for all aspects of chemical rescue procedures queried, the knowledge of medical personnel was not satisfactory. Both practical and theoretical training of medical personnel is urgently needed for life-saving procedures during a chemical contamination. (*Disaster Med Public Health Preparedness*. 2014;8:297-300)

Key Words: medical personnel, knowledge, chemical contamination

Due to the development of new technologies and the possible danger of terrorist attacks, the risk of chemical contamination has become a real threat in today's world.[1,2] Helping victims of mass chemical contamination can be one of the most stressful situations that medical personnel and rescue workers may encounter.[2] The possibility of spreading contamination to other persons, including other medical workers, makes it imperative for medical personnel to know what procedures to follow in such circumstances.

In Poland, mass decontamination of victims is performed by state-run fire service as well as medical personnel. The specific rescue operations entail the deployment of onsite decontamination by the fire brigade and the participation of staff medical rescue teams for the subjects who are decontaminated. For persons who are transported to the hospital (without being decontaminated at the scene), it may be possible to undergo decontamination at the hospital, next to the entrance to the emergency unit. In that situation, the entire process of decontamination rests entirely with the medical staff.

According to the current literature, it appears that few published reports have discussed the preparation of medical personnel in cases of chemical contamination in Poland. The present study was conducted to evaluate the knowledge of physicians, nurses, and paramedics of procedures regarding chemical contamination.

METHODS

A survey was conducted from January to December 2012 with a group of medical personnel in Poland who worked in hospital emergency departments and emergency medical service teams. The research was approved by a bioethics commission.

An anonymous evaluation survey that consisted of 18 questions was used as the research tool. The survey was distributed at random via the Internet to 600 people working in hospital emergency units and in emergency medical teams throughout Poland. To assess the respondents' extent of knowledge about chemical contaminations, a series of questions related to procedures in certain circumstances. Questions regarding the use of specific antidotes and knowledge of clinical symptoms were multiple choice. Questions specific to the proceedings of ammonia, sarin poisoning, and measures to decontaminate patients were open-ended questions.

Data encryption was done using MS Excel 2010 software, and the results were evaluated with the use of Statistica version10 software package for Windows. Statistically significant discrepancies between groups were calculated using the Kruskal-Wallis test. Results were statistically significant at $P < .05$.

TABLE 1

Correct Responses About the Use of Antidotes

Medicines /Antidotes	Group 1 n	Group 1 %	Group 2 n	Group 2 %	Group 3 n	Group 3 %	P
Atropine	50	71.4	15	10.3	246	83.4	= .000
Methylene blue	24	34.3	9	6.2	70	23.7	= .000
Calcium chloride	19	27.1	5	3.4	63	21.4	= .000
Flumazenil	47	67.1	17	11.7	139	47.1	= .000
Calcium gluconate (gel)	18	25.7	3	2.1	49	16.6	= .000
Hydroxocobalamin	25	35.7	8	5.5	55	18.6	= .000
Obidoxime	15	21.4	8	3.5	73	24.7	= .000

TABLE 2

The Connection Between Selected Chemicals and Clinical Signs

Chemical Weapons – Toxidromes	Group 1 n	Group 1 %	Group 2 n	Group 2 %	Group 3 n	Group 3 %	Kruskal–Wallis Test, P Value
Cholinergic	39	55.7	14	9.7	63	21.4	= .000
Irritant	23	32.9	7	4.8	38	12.9	= .000
Choking	24	34.3	5	3.4	43	14.6	= .000
Depressant	20	28.6	3	2.1	29	9.8	= .000
Cholinolytic	33	47.1	6	4.1	64	21.7	= .000
Corrosive	17	24.3	8	5.5	88	29.8	= .000

RESULTS

We received completed questionnaires from 510 (85%) of the 600 surveys sent. Respondents were divided into 3 groups by profession: group 1 was composed of physicians (N = 70), group 2 included nurses (N = 145), and group 3 consisted of paramedics (N = 295). The respondents were between the ages of 22 and 54 years (average, 32 years), and their professional work experience ranged from 1 to 32 years (average, 6.3 years). The hospital was the main place of work for 85.7% of persons in group 1, for 62.1% of those in group 2, and for 33.2% of those in group 3. All others reported that their main place of work was a medical service team.

In the beginning of the survey, participants were asked to evaluate their own knowledge of life-saving procedures during chemical contamination on a scale from 1 (no knowledge) to 5 (high level of knowledge). The average level of knowledge for all interviewees was 3.7 points. The group 2 nurses were scored the highest (4.05 points), while the group 1 physicians were scored at 3.67 points, and the group 3 paramedics were scored at 3.59 points. Differences between particular groups were statistically significant (H = 21.68313; $P < .0001$). The knowledge of the term toxidrome within the interviewed groups varied greatly. The term was known to 74.3% of persons from group 1, to 15.9% of persons from group 2, and to 56.6% of persons from group 3. Differences obtained were statistically significant (H = 87.99410 $P = .000$).

Altogether 26.1% of interviewees reported having the knowledge of the procedures to be applied during the decontamination of patients. Significant differences (H-149.6658; $P = .000$) were observed regarding answers given by the respondents in each group: group 1, 28.6%; group 2, 8.3% (of 105 persons); and group 3, 34.2%. Only 12.2% of respondents referred to sodium hypochlorite as a compound to be used in the decontamination process. The responses were 27.1%, 4.8%, and 12.2% for groups 1, 2, and 3, respectively (H = 67.93812; $P = .0000$).

Table 1 shows the results from the respondents regarding the proper usage of antidotes. The highest level of knowledge was reported for the use of atropine as an antidote (61%), whereas the lowest level of knowledge was reported for the use of calcium gluconate (13.7%). Paramedics (group 3) showed the highest level of knowledge regarding the use of antidotes, followed by the physicians (group 1), and the nurses (group 2) (H = 93.53897; $P = .000$). Knowledge regarding the use of antidotes was influenced by the place of work. Persons working in emergency medical service teams showed a higher level of knowledge than those working in hospital emergency departments ($P = .0253$).

Table 2 provides the results of the respondents' knowledge of relationships between chemical substances and the clinical symptoms they produce. The highest reported scores were for knowledge of symptoms that are characteristic of cholinergic,

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corrosive, and anticholinergic toxidromes (22.7%, 22.2%, and 20.2%, respectively). The lowest level of knowledge was for knowledge of symptoms that are characteristic of suffocating, irritating, and depressing toxidromes (14.1%, 13.3%, and 10.2%, respectively). Differences in knowledge within specific groups were statistically significant ($P < .01$). In addition, a relationship was found between the knowledge of different kinds of toxidromes and place of work. Persons working in emergency medical service teams had better knowledge regarding evaluated parameters ($P = .0157$).

Regarding hypothetical contamination with ammonia, only 31.4% (137 persons) from group 1 provided answers about the proper life-saving procedure; the response rate was 4.1% from group 2, and 24.1% from group 3 ($H = 32.11014$; $P = .000$). Knowledge of life-saving procedures regarding contamination with sarin was 17.1%, 2.1%, and 15.9%, respectively ($H = 19.34675$; $P = .0001$). In both of the queries, persons working in emergency medical service teams showed better factual knowledge than those working in hospital emergency departments ($P = .0382$) as well as persons with greater working experience ($P = .04239$).

The level of confidence of the respondents did not reflect their actual knowledge of procedures in chemical contaminations. Subjects in group 2 expressed the highest level of confidence but the lowest level of actual knowledge. In groups 1 and 3, the level of confidence corresponded with that of their knowledge. Seniority in the profession did not statistically influence their knowledge in any of the groups analyzed.

The majority of respondents, including 48 physicians (68.6%), 82 nurses (56.6%), and 249 paramedics (84.4%) negatively rated their workplaces regarding possible life-saving activities in case of chemical contamination. Also, 73.7% of the respondents (87.1%, group 1; 22.1%, group 2; and 95.9%, group 3) confirmed the need for systematic training to prepare medical personnel for possible future chemical contamination. Interest in a training course covering theoretical exercises in case of chemical contamination was reported by 92% of the physicians, 21% of the nurses, and 89% of the paramedics.

DISCUSSION

The main task of medical services in cases of mass chemical contamination involves maximal restriction of human loss and limitation of the spread of the contamination.[3] To prepare for this type of event, the personnel responsible for providing these activities are supposed to have adequate training. In particular, this knowledge is vital for persons working in emergency medical service teams, for they are in direct contact with the persons who are most likely to be affected by the contamination.

Unfortunately, the findings from this study demonstrated that the knowledge of medical personnel who are involved in the response of chemical contamination is far from satisfactory. A correct knowledge of the term toxidrome as a set of symptoms caused by chemical substances and their effects on a human organism was known to nearly half of the respondents (47.45%). Burda et al also indicated a lack of knowledge of physicians regarding procedures in cases of chemical contamination,[4] and Mitchell et al observed this lack of knowledge in nurses.[5]

As indicated by Karayilanoglu[6] and Okumura,[7] an important issue during life-saving procedures in cases of chemical contamination is the effect of secondary contamination. The key element is the knowledge of medical personnel of the procedures for decontaminating patients.

Although decontamination procedures may be designated to firefighters and paramedics, the terrorist attack in Japan that involved the use of sarin gas showed that hospital personnel also must be prepared to assist in the process of decontamination.[8] Previous research by one of us (L.S.) has shown that the knowledge of the procedures regarding sarin contamination was known to only 12% of survey respondents, while 19.4% reported knowledge of procedures regarding ammonia contamination. Those results were lower than the ones obtained by Burda et al (sarin contamination, 28%; ammonia contamination, 37.3%).[4]

Unfortunately, in the present study, only 1 in 4 persons knew the basic principles in cases of chemical contamination that can prevent medical personnel, hospitalized patients, as well as medical equipment from secondary contamination. Unsatisfactory results were also obtained regarding knowledge of indications for the use of antidotes. In addition to atropine, the use of which was known to 61% of the respondents, their knowledge of other antidotes was between 13.7% and 39.8%. The lowest level of knowledge was observed among nurses.

It is important to note that the majority of respondents (74%) negatively rated their workplaces regarding possible life-saving activities in the case of chemical contamination. Similar reports of low-level readiness of medical personnel to act in the situations of chemical contamination have also been described.[9] It was not surprising that the majority of the respondents (90.4%) in our study expressed a need for systematic training in the procedures of chemical contamination.

CONCLUSIONS

The findings of our study showed that medical personnel demonstrated an unsatisfactory knowledge in all aspects of life-saving procedures regarding chemical contamination. This deficiency reflected an urgent need for both practical and theoretical training courses to be organized about life-saving procedures regarding chemical contamination.

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About the Authors

Departments of Cardiosurgery and Transplantology (Mr Szarpak), and Anesthesiology (Dr Kuowski), Institute of Cardiology, Warsaw, Poland.

Correspondence and reprint requests to Łukasz Szarpak, MSc, Modlinska 201A/11 St, 03-122 Warsaw, Poland (e-mail: Lukasz.szarpak@gmail.com).

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Supplementary material

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