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ORIGINAL ARTICLE

Pattern of poisoning in Japan: selection of drugs and poisons for systematic toxicological analysis

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Abstract Patterns of poisoning are known to be different in different countries, because of the local environmental, cultural, and religious situations. Therefore, in Japan, it is important to know the pattern of poisoning in our own country and to prepare for every poisoning case by establishing an efficient systematic toxicological analysis system in forensic practice. We conducted a retrospective study of the kinds of compounds causing poisonings and the frequency of their use based on two series of reports dealing with poisoning cases in Japan prepared by the National Research Institute of Police Science and the Japanese Society of Legal Medicine for 2003 to 2006. From these reports, 459 and 177 compounds, respectively, were extracted as poisonous compounds over the study period. After data analysis, we selected 314 drugs and poisons as important target compounds for systematic drug analysis in Japan; they included 36 volatile compounds, 14 abused drugs, 170 medical drugs, 60 pesticides, 13 natural toxins, and 21 others. This is the first study to show the toxic drugs and poisons to be analyzed in Japan based on frequency of use, and as such the list will be useful in establishing the most efficient screening system in forensic practice.

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Introduction

Patterns of poisoning are known to be different in different countries, because of their environmental, cultural, and religious situations. Therefore, it is very important to know the pattern of poisoning in each country, and to be prepared for all poisoning cases by establishing an efficient systematic toxicological analysis system in forensic practice.

The population of Japan was 127.7 million in October 2008, and the number of persons who died of unnatural causes is reported to be 14% of the total (154 579 in 2007, except for traffic accidents). However, the rate of forensic autopsies is very low and only 9.5% (14 725 in 2007) of unnatural deaths are autopsied in Japan, mainly for criminal investigation purposes. In such situations, drug analyses are carried out at departments of forensic medicine especially for autopsied victims, and also at the forensic science laboratories belonging to police headquarters in Japan.

Although there are several reports on poisoning cases in Japan [1–3], no reports are available on the frequency of use of each poisonous compound. We have developed a unique gas chromatography-mass spectrometry (GC-MS) screening system that gives semiquantitative data without preparing standard compounds, and is based on the calibration-locking databases for 156 compounds using NAGINATA software [4]. To increase the number of drugs and poisons in the database for systematic drug analysis, accurate knowledge of poisonings in Japan is

essential. Thus, we conducted a retrospective study on the kinds of compounds that cause poisoning, and on the analysis of their frequency using the above reports [1,2].

Materials and methods

Selection of reports for this study

In Japan, there are three series of reports dealing with poisoning cases. They are *Annual case reports of drug and toxic poisoning in Japan* (Report A) published by the National Research Institute of Police Science [1], *Annual report of forensic autopsy cases in Japan* (Report B) published by the Japanese Society of Legal Medicine [2], and *Annual report by Japan Poison Information Center* (Report C) [3]. Among the three reports, the former two were selected in this study, because the purpose of our study was focused on forensic practice and the names of poisonous compounds (not drug groups) included in the two reports. Because these two reports are not available to the public, permission for using the data for this study was obtained from the National Research Institute of Police Science and the Japanese Society of Legal Medicine.

Retrospective study using the two series of reports

Table 1 shows the numbers of poisoning cases listed in Report A, and the numbers of autopsy cases listed in Report B from 2003 to 2006. The Japanese islands have a total of 47 prefectures, and poisoning cases extracted from all unnatural deaths were collected from the data of 44 (2003), 45 (2004), 46 (2005), and 46 (2006) forensic science laboratories belonging to the police headquarters of each prefecture. The collected data were integrated by the National Research Institute of Police Science and published each year in Report A [1]; the cases in each year were classified into the groups of toxic substances such as volatile compounds, medical drugs, pesticides, and so on. Table 2 shows an example of their listing mode in Report A. Age, sex, sample, route of intake, commercial name(s) of compound(s) taken and amount(s), and components in the material(s) are listed in each case. The components shown in the right column are the most common drugs in poisoning cases.

In Japan, forensic autopsies are carried out in 76 departments of forensic medicine in universities and 3 medical examiner's offices in Tokyo, Osaka, and Kobe. The data in Report B were collected from 75 (2003), 71 (2004), 66 (2005), and 59 (2006) institutions. Figure 1 shows a typical screen for Report B, in which digital data were collected on CD-ROM. On the screen, the outline of a case and autopsy findings are described; the age, sex, cause of death, time before death, postmortem time, and examination items are included. The names of drugs detected are given in the box of autopsy findings. In forensic autopsy cases, analyses of drugs and poisons are important not only in fatal poisoning cases, but also in cases in which the ingestion of a drug influences the cause of death. Thus, we extracted the names of drugs from the boxes of autopsy findings in all autopsy cases

Table 1 Numbers of poisoning cases in Report A and autopsy cases in Report B

Year	Report A	Report B
2003	4877	5979
2004	4807	6222
2005	6003	5787
2006	5691	5864
Total	21378	23852

Table 2 An example of the listing of the poisoning cases adopted in Report A

Age (years)	Sex	Sample	Route of intake	Commercial name(s)	Component(s)
30	Male	Heart blood, urine	Oral	Vegetamin A, Halcion, Myslee, Rohypnol	Chlorpromazine, promethazine, phenobarbital, triazolam, zolpidem, flunitrazepam
40	Male		Oral	Vegetamin A, Halcion, Rohypnol	Chlorpromazine, promethazine, phenobarbital, triazolam, flunitrazepam
40	Female	Blood	Oral	Vegetamin A 2 tab, Artane 14 tab, Tegretol, Sepazon, Anafranil 9 tab, Lexotan	Chlorpromazine, promethazine, phenobarbital, trihexiphenidyl, carbamazepine, cloxazolam, clomipramine, bromazepam
30	Male		Oral	Vegetamin A 30 tab, Benzalin 30 tab, Contomin 30 tab	Chlorpromazine, promethazine, phenobarbital, nitrazepam
30	Male		Oral	Vegetamin B, Benzalin, Rivotril, Aleviatin, Serenica-R, Tasmolin, Excegran, Risperdal, Zyprexa	Chlorpromazine, promethazine, phenobarbital, nitrazepam, clonazepam, phenytoin, valproate, biperiden, zonisamide, risperidone, olanzapine
30	Male	Blood	Oral	Vegetamin A, Flunitrazepam, Goodmin	Chlorpromazine, promethazine, phenobarbital, flunitrazepam

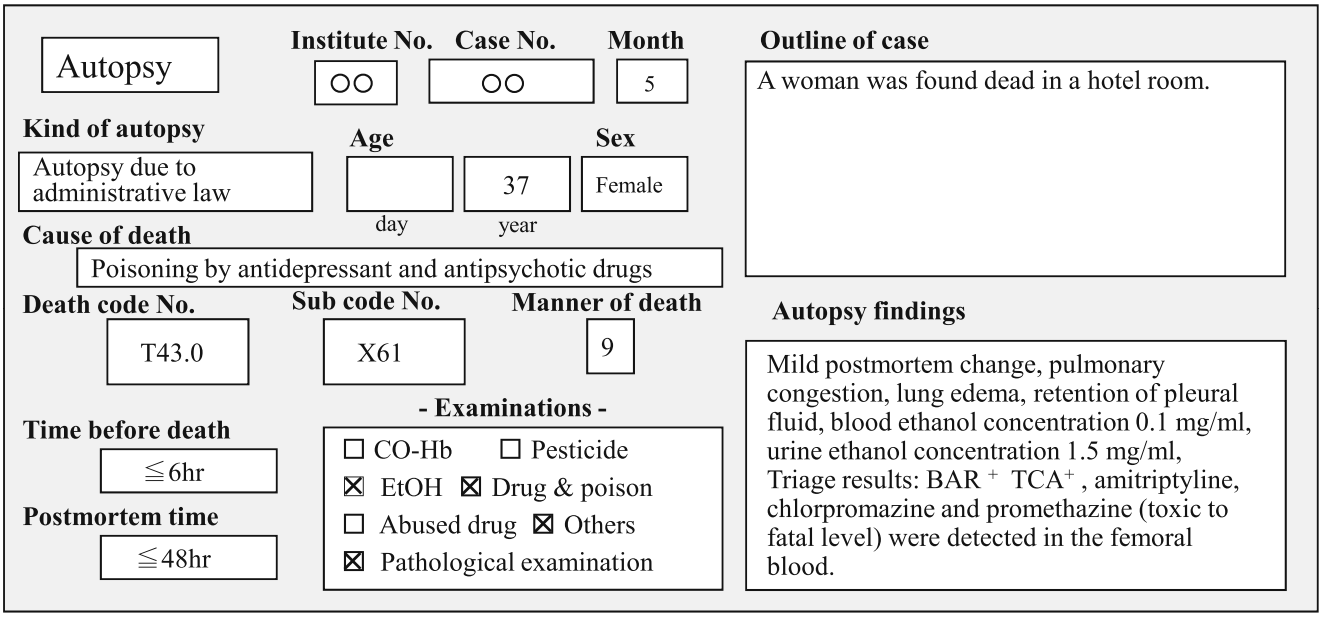

Fig. 1 Typical screen display of a case included in CD-ROM of Report B

(23 852 cases in total), and the frequency of use of each drug was counted.

Selection of drugs and poisons for systematic toxicological analysis

In the study period from 2003 to 2006, 459 and 177 compounds were extracted as poisonous compounds from Reports A and B, respectively, including compounds mentioned only once. The compounds listed in Report B were obtained only from autopsy cases, while the compounds listed in Report A were obtained from both autopsied and nonautopsied poisoning cases in Japan. Therefore, the number of compounds counted in Report A was more than 2 times larger than those counted in Report B. Thus, the candidate compounds for systematic drug analysis in Japan were selected primarily from Report A, but the final selection was carefully carried out comparing the data described in Report B.

Results and discussion

Pattern of poisoning in Japan

Table 3 shows the top 22 poisonous compounds arranged according to the count frequency obtained from Report A. Similar patterns in the numbers of compounds were observed in each year in Japan. Poisoning by carbon monoxide showed the highest frequency probably due to the inclusion of suicide victims by automobile exhaust gas (423 in 2006), fire victims (899 in 2006), and fatalities due to incomplete combustion of heating equipment (2545 in 2006). Poisoning by paraquat and diquat dipyridylium herbicides showed the second highest frequency. Among the top 22 toxic compounds, 7 were pesticides. This result seems to be related to an aspect of Japanese culture, in which pesticides are chosen as a means of suicide [5]. This pattern is totally different from those in the UK, Germany, Iran, and Nordic countries [6–9], but similar to those reported in Greece, India, South Korea, and Uganda [10–13].

Another characteristic pattern of poisoning was the very high frequency of the three drugs chlorpromazine, promethazine, and phenobarbital (Table 3). These three drugs are components of Vegetamin, which is widely prescribed as a hypnotic and antianxiety agent in Japan. Paulozzi and Ryan [14] investigated the relationship between sales of prescription opioid analgesics and the mortality rate of poisoning by the same drugs in the USA. They found that sales of opioid analgesics including methadone and oxycodone correlated well with their mortality rates. This relation is probably valid for Vegetamin in Japan.

Table 4 shows the top 22 poisonous compounds from Report B in terms of appearance frequency for each compound. Because ethanol and carbon monoxide are routinely analyzed in forensic autopsy cases, it is not surprising that the 2 compounds showed the highest frequency. Methamphetamine was listed as the third compound; this drug is commonly abused in Japan and is

Table 3 Top 22 poisonous compounds obtained from Report A according to appearance frequency of each compound

No.	Compound	Compound category	Year				
			2003	2004	2005	2006	2003–2006
1	Carbon monoxide	Volatile compound	3807	3638	4963	4491	16899
2	Paraquat	Pesticide (herbicide)	238	178	184	173	773
3	Diquat	Pesticide (herbicide)	197	131	142	130	600
4	Chlorpromazine	Antipsychotic	105	149	124	157	535
5	Promethazine	Antipsychotic	110	144	118	154	526
6	Phenobarbital	Hypnotic (barbiturate)	101	145	111	158	515
7	Flunitrazepam	Hypnotic (benzodiazepine)	82	101	105	139	427
8	Methomyl	Pesticide (carbamate)	93	91	67	80	331
9	Levomepromazine	Antipsychotic	50	69	83	109	311
10	Fenitrothion	Pesticide (organophosphorus)	61	61	45	62	229
11	Etizolam	Hypnotic (benzodiazepine)	34	65	61	63	223
12	Triazolam	Hypnotic (benzodiazepine)	38	58	54	73	223
13	Malathion	Pesticide (organophosphorus)	48	59	44	49	200
14	Nitrazepam	Hypnotic (benzodiazepine)	28	49	49	58	184
15	Brotizolam	Hypnotic (benzodiazepine)	36	44	37	58	175
16	Glyphosate	Pesticide (herbicide)	29	39	52	46	166
17	Zolpidem	Hypnotic	15	42	24	54	135
18	Bromazepam	Hypnotic (benzodiazepine)	17	40	31	46	134
19	Zopiclone	Hypnotic	19	26	34	37	116
20	Dichlorvos (DDVP)	Pesticide (organophosphorus)	41	28	21	26	116
21	Biperiden	Anti-Parkinson	20	21	27	35	103
22	Bromisovalum	Hypnotic	19	33	18	29	99

Table 4 Top 22 poisonous compounds obtained from Report B according to appearance frequency of each compound

No.	Compound	Compound category	Year				
			2003	2004	2005	2006	2003–2006
1	Ethanol	Volatile compound	750	773	605	611	2739
2	Carbon monoxide	Volatile compound	669	601	581	665	2516
3	Methamphetamine	Abused drug	19	45	40	28	132
4	Phenobarbital	Hypnotic (barbiturate)	19	48	20	35	122
5	Amphetamine	Abused drug	12	31	15	18	76
6	Promethazine	Antipsychotic	5	26	11	26	68
7	Chlorpromazine	Antipsychotic	5	21	11	25	62
8	Acetone	Volatile compound	6	8	5	21	40
9	Lidocaine	Local anesthetic	11	9	3	14	37
10	Toluene	Volatile compound	13	9	9	2	33
11	Diphenhydramine	Antihistamine	6	2	9	7	24
12	Diazepam	Hypnotic (benzodiazepine)	2	6	6	7	21
13	Levomepromazine	Antipsychotic	4	5	3	6	18
14	Flunitrazepam	Hypnotic (benzodiazepine)	2	7	1	7	17
15	Triazolam	Hypnotic (benzodiazepine)	7	5	1	4	17
16	Nitrazepam	Hypnotic (benzodiazepine)	3	9	1	4	17
17	β-Phenethylamine	Putrefaction amine	0	1	1	13	15
18	Amobarbital	Hypnotic (barbiturate)	4	5	1	4	14
19	7-Aminoflunitrazepam	Hypnotic (benzodiazepine)	3	2	0	8	13
20	Cyanide	Volatile compound	3	1	0	8	12
21	Methomyl	Pesticide (carbamate)	5	4	0	3	12
22	Gasoline	Volatile compound	7	0	0	4	11

often found in autopsy cases. Acetone is analyzed to test for the condition of starvation, and β-phenethylamine produced by bacteria during putrefaction is analyzed to discriminate the amine from methamphetamine, when the positive result by immunoassay screening for amphetamines is obtained. The frequencies of detection of paraquat (no. 38) and diquat (no. 71) were much lower than those obtained from Report A (Table 3), probably due to the much lower frequency of autopsy for suicide cases in Japan.

Selection of drugs for systematic toxicological analysis

Table 5 shows the list of drugs and poisons selected as the most important compounds for systematic toxicological analysis in Japan based on the frequency obtained from Reports A and B in 2003–2006. We finally selected 314 drugs and poisons, consisting of 36 volatile compounds, 14 abused drugs, 170 medical drugs, 60 pesticides, 13 natural toxins, and 21 others.

In addition to common poisoning compounds, such as carbon monoxide, ethanol, and cyanide, hydrogen sulfide showed high frequency in Report A (Table 5).

Table 5 List of drugs and poisons selected for the systematic drug analysis

	Name of compound	Report A	Report B
Volatile compounds (36)			
1	Carbon monoxide	16899	2516
2	Ethanol	88	2739
3	Toluene	57	33
4	Cyanide	45	12
5	Butane	30	7
6	Hydrogen sulfide	27	0
7	Propane	25	1
8	Isobutane	20	2
9	Ethane	9	0
10	Ethylene glycol	7	0
11	Carbon dioxide	6	0
12	Trichloroethylene	5	3
13	Gasoline	4	11
14	Methanol	4	4
15	Xylene	3	3
16	Dichloromethane	3	5
17	Benzine	3	0
18	Chloroform	2	0
19	Nitrite	1	0
20	Acetylene	1	0
21	Acetone	1	40
22	Chlorine	1	0
23	Kerosene	1	2
24	Trichlorotrifluoroethane	1	0
25	Nitromethane	1	0
26	Hydrazine	1	0
27	Benzene	1	6
28	Methane	1	0
29	Methyl ethyl ketone	1	0
30	Isopropanol	1	1
31	*n*-Propanol	0	6
32	Ammonia	0	1
33	Ethylbenzene	0	1
34	Styrene	0	1
35	Fluoride	0	1
36	Tetrafluoroethane	0	1
Abused drugs (14)			
1	Methamphetamine	45	132
2	Phenylpropanolamine	3	0
3	3,4-Methylenedioxymethamphetamine (MDMA)	3	5
4	5-Methoxy-*N,N*-diisopropyltryptamine (5-MeO-DIPT)	2	0
5	Morphine	2	3
6	Amphetamine	2	76
7	Fenfluramine	1	0
8	Ketamine	1	2
9	Tetrahydrocannabinol	0	2
10	3,4-Methylenedioxyamphetamine (MDA)	0	1
11	Oxycodone	0	1
12	Cocaine	0	2
13	Heroin	0	1
14	Methadone	0	1
Medical drugs (170)			
1	Chlorpromazine	535	62
2	Promethazine	526	68
3	Phenobarbital	515	122
4	Flunitrazepam	427	17
5	Levomepromazine	311	18
6	Etizolam	223	5
7	Triazolam	223	17
8	Nitrazepam	184	17
9	Brotizolam	175	4
10	Zolpidem	135	10
11	Bromazepam	134	8
12	Zopiclone	116	4
13	Biperiden	103	5
14	Paroxetine	99	2
15	Bromisovalum	99	10
16	Diphenhydramine	98	24
17	Diazepam	98	21
18	Pentobarbital	98	7
19	Fluvoxamine	91	7
20	Estazolam	90	7
21	Amobarbital	90	14
22	Risperidone	89	3
23	Amitriptyline	89	9
24	Alprazolam	87	4
25	Carbamazepine	82	11
26	Amoxapine	77	2
27	Sulpiride	73	2
28	Haloperidol	61	6
29	Quazepam	60	2
30	Valproate	55	8
31	Trazodone	54	1
32	Clomipramine	53	6
33	Mianserin	53	3
34	Lorazepam	50	1
35	Acetaminophen	47	10
36	Milnacipran	47	0
37	Imipramine	45	6
38	Quetiapine	43	1
39	Olanzapine	39	4
40	Allylisopropylacetylurea	38	2
41	Cloxazolam	38	0
42	Ethyl loflazepate	36	1
43	Aspirin	34	1
44	Caffeine	34	11
45	Trihexyphenidyl	33	1
46	Insulin	32	1
47	Lithium carbonate	30	1

Table 5 *Continued*

	Name of compound	Report			Name of compound	Report	
		A	B			A	B
48	Clonazepam	29	0	108	Nemonapride	3	0
49	Maprotiline	29	3	109	Medazepam	3	0
50	Lormetazepam	29	1	110	Thiopental	3	2
51	Ibuprofen	28	4	111	Azelastine	2	0
52	Flurazepam	28	4	112	Tranexamic acid	2	0
53	Ethenzamide	25	1	113	Metformin	2	0
54	Rilmazafone	24	1	114	Flecainide	2	0
55	Loxoprofen	23	1	115	Glimepiride	2	0
56	Zotepine	21	4	116	Scopolamine	2	0
57	Nortriptyline	20	2	117	Ephedrine	2	2
58	Lidocaine	19	37	118	Codeine	2	0
59	Bromperidol	18	0	119	Isopropyl antipyrine	2	0
60	Perospirone	15	0	120	Salicylamide	2	1
61	Sennoside	14	0	121	Tiaprofenic acid	2	0
62	Clotiazepam	14	2	122	Clemastin	2	0
63	Perphenazine	12	0	123	Clobazam	2	1
64	Dosulepin	11	0	124	Tiapride	2	1
65	Barbital	11	1	125	Fluphenazine	2	0
66	Diprophylline	10	0	126	Prochlorperazine	2	0
67	Warfarin	10	0	127	Setiptiline	2	0
68	Dihydrocodeine	10	9	128	Sertraline	2	0
69	Methylephedrine	10	3	129	Clorazepate	2	1
70	Diclofenac	10	2	130	Chlordiazepoxide	2	0
71	Chlorpheniramine	10	11	131	Tofisopam	2	1
72	Eperisone	9	0	132	Erythromycin	1	0
73	Phenytoin	9	5	133	Bisacodyl	1	0
74	Hydroxyzine	9	2	134	Hydrocortisone	1	0
75	Propericiazine	9	1	135	Methotrexate	1	0
76	Nimetazepam	9	0	136	Pancuronium	1	0
77	Sultopride	8	2	137	Verapamil	1	2
78	Thioridazine	8	0	138	Indomethacin	1	0
79	Methylphenidate	7	1	139	Zaltoprofen	1	1
80	Tandospirone	7	0	140	Pentazocine	1	1
81	Theophylline	6	4	141	Tetracaine	1	0
82	Midazolam	6	6	142	Bupivacaine	1	0
83	Nifedipine	5	0	143	Olopatadine	1	0
84	Haloxazolam	5	0	144	Carbinoxamine	1	0
85	Distigmine	4	0	145	Diphenylpyraline	1	0
86	Diltiazem	4	0	146	Meclizine	1	0
87	Domperidone	4	0	147	Selegiline	1	0
88	Metoclopramide	4	3	148	Oxypertine	1	0
89	Disopyramide	4	0	149	Clocapramine	1	2
90	Tizanidine	4	0	150	Spiperone	1	0
91	Salicylic acid	4	5	151	Timiperone	1	0
92	Mefenamic acid	4	1	152	Pipamperone	1	0
93	Zonisamide	4	0	153	Promazine	1	0
94	Flutoprazepam	4	0	154	Pemoline	1	0
95	Amlodipine	3	0	155	Desipramine	1	1
96	Carvedilol	3	1	156	Trimipramine	1	0
97	Difenidol	3	0	157	Moclobemide	1	0
98	Picosulfate	3	0	158	Lofepramine	1	0
99	Vecronium	3	1	159	Thiamylal	1	2
100	Suxamethonium	3	0	160	Droperidol	1	0
101	Pilsicainide	3	0	161	Propofol	1	2
102	Propranolol	3	0	162	Atenolol	0	1
103	Mexiletine	3	0	163	Dobutamine	0	2
104	Glibenclamide	3	0	164	Faropenem	0	1
105	Atropine	3	0	165	Cloperastine	0	1
106	Noscapine	3	0	166	Dextromethorphan	0	1
107	Amantadine	3	0	167	Sulpyline	0	2

Table 5 *Continued*

	Name of compound	Report A	Report B
168	Mepivacaine	0	2
169	Secobarbital	0	2
170	Triclofos	0	1
Pesticides (60)			
1	Paraquat	773	7
2	Diquat	600	3
3	Methomyl	331	12
4	Fenitrothion (MEP)	229	2
5	Malathion	200	1
6	Glyphosate	166	2
7	Dichlorvos (DDVP)	116	1
8	Trichlorphon (DEP)	55	0
9	Glufosinate	46	0
10	Methidathion (DMTP)	44	0
11	Lime sulfur	33	0
12	Acephate	25	0
13	*O*-Ethyl-*O*-4-nitrophenyl phenylphosphonothioate (EPN)	18	0
14	Diazinon	18	0
15	Phenthoate (PAP)	15	0
16	Parathion	15	1
17	Endosulfan	14	1
18	Carbaryl (NAC)	14	0
19	Propanil (DCPA)	13	0
20	Isoxathion	11	0
21	Ethylthiomethon	11	0
22	*o*-Dichlorobenzene	10	0
23	Fenthion (MPP)	10	0
24	Cartap	9	0
25	Mecoprop (MCPP)	7	0
26	Chlorpyriphos-methyl	7	0
27	Dimethoate	6	0
28	Tolfenpyrad	5	0
29	Nicotine sulfate	5	0
30	Fenobcarb (BPMC)	5	0
31	Cyanophos (CYAP)	5	0
32	Diuron (DCMU)	4	0
33	Pirimiphos-methyl	4	0
34	2,4-Dichlorophenoxyacetic acid (2,4-D)	3	0
35	Iminoctadine	3	0
36	Chlorpicrin	3	0
37	Hexythiazox	3	0
38	Bentazone	3	0
39	Pyraflufen ethyl	3	0
40	Benfuracarb	3	0
41	Tetrachloroisophthalonitrile (TPN)	3	0
42	Thiometon	3	0
43	Fenthion	3	0
44	Alachlor	2	0
45	Endrin	2	0
46	Chlorfenapyr	2	0
47	Trichlopyr	2	0
48	Fenvalerate	2	0
49	Blasticidin	2	0
50	Pretilachlor	2	0
51	Permethrin	2	0
52	Phosalone	2	0
53	Methoxydiazon	2	0
54	Chlorthiamid (DCBN)	2	0
55	Bialaphos	2	0
56	Ethiofencarb	2	1
57	Edifenphos (EDDP)	2	0
58	Vamidothion	2	0
59	Etofenprox	1	0
60	Tebufenpyrad	1	1
Natural toxins (13)			
1	Nicotine	11	4
2	Tetrodotoxin	10	4
3	Bee-poison	8	0
4	Aconitine	4	1
5	Strychinine	4	0
6	Snake toxin	3	0
7	Colchicine	2	0
8	Scopolamine	2	0
9	Muscarine	1	0
10	Digoxin	0	1
11	Sinomenine	0	1
12	Jesaconitine	1	0
13	Mesaconitine	1	0
Others (21)			
1	Cresol	42	6
2	Hydrochloric acid	15	0
3	Surface active agent	11	0
4	Sodium hypochlorite	11	0
5	Polysulfide	7	0
6	Sodium hydroxide	6	0
7	Potassium chloride	5	1
8	Benzalkonium chloride	3	0
9	Zinc chloride	3	0
10	Quick lime	3	0
11	Sodium azide	2	0
12	Arsenic and arsenic compounds	2	3
13	Chlorhexidine	2	0
14	Methyl bromide	2	0
15	Potassium dichromate	2	0
16	*p*-Dichlorobenzene	2	0
17	Formaldehyde	2	0
18	Poly(oxyethylene)nonylphenyl ether	2	0
19	Benzethonium chloride	1	1
20	Acetic acid	1	0
21	Mercury	0	1

This phenomenon was probably due to a recent trend of suicide in Japan using hydrogen sulfide gas produced by mixing a liquid bath essence containing sulfur with a toilet bowl cleaner containing hydrochloric acid [15].

Although opioid analgesics are the most frequently abused drugs in many countries [9,16–18], abuse of these drugs were not significant in Japan in the study period. However, the number of abusers of heroin, cocaine, and

marihuana increased significantly in recent years; these drugs will probably become important targets for systematic drug analysis in the future.

Among 170 medical drugs selected, the most frequently used drug groups were benzodiazepines and their related hypnotics (27), antipsychotic drugs (24), antidepressants (19), and analgesics (17). Apart from dipyridylium herbicides (paraquat and diquat), 22 organophosphorus compounds, such as fenitrothion and malathion, and 7 carbamate pesticides, such as methomyl and carbaryl, were included in the list of pesticides. Amino acid herbicides glyphosate and glufosinate were also listed with high frequency of use.

In Japan, poisonings by natural toxins often occur by mistaken ingestion of mushrooms, wild vegetables, and puffer fish, and several homicide cases using natural toxins have been also reported [19,20]. Therefore, establishing a screening system for natural toxins is also considered important.

Although new drugs and poisons are continually introduced to the market and patterns of poisoning events change according to social situations, an established list can be useful as the fundamental data in taking measures against poisonings. Such a list is also important in establishing the most efficient screening system in forensic practice.

Conclusions

We retrospectively studied the pattern of poisoning in Japan using two reports dealing with fatal poisoning cases. On the basis of careful analysis of the data, we listed 314 drugs and poisons that should be included for systematic drug analysis in Japan. The addition of many compounds to the NAGINATA database [4] is now in progress in our laboratory on the basis of the present study.

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