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CASE REPORT

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Identification of victims from the M/S Estonia

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Abstract With 852 victims from 17 different countries, the sinking of the Estonia was Europe's most severe passenger ferry disaster. The Finnish Disaster Victim Identification (DVI) team identified all 93 victims recovered from the sea within 33 days of the accident as well as victim number 94 found 18 months later. Dental identification was established in 57 cases (60%).

Keywords M/S Estonia disaster · Victim identification · DVI team · Forensic odontology

Introduction

Rapid and accurate identification of mass disaster victims is of paramount importance for family members and for investigating authorities. This paper reports the experience gained by the Finnish DVI team from the M/S Estonia disaster.

Case report

On 27th September 1994 at 06.00 h, the M/S Estonia departed for her scheduled route from Tallinn to Stockholm carrying 989 passengers and crew from 17 different countries (Table 1). Shortly after midnight, the bow door lock broke because of heavy wave action and a structural weakness of the bow door visor attachment. At about 01.15 h the visor separated from the bow and large volumes of water filled the car deck. The ship rapidly took on a heavy starboard list and sank within 25 min (Joint Accident Investigation Commission 1997).

Although the first boat arrived within 50 min of the Mayday call, the first rescue did not take place until 2 h after the accident because of heavy weather conditions (wave height 7–10 m, wind speed 27.7 m/s). Within the next 7 1/2 h, 138 persons were rescued alive but 1 died later in hospital. Over the next 2 days 92 corpses were recovered, the body of another victim was found 33 days later and the skeletal remains of the last victim were found after 18 months. Because the sinking occurred within the Finnish rescue zone, the Finnish DVI team became responsible for the identification work. Therefore, the recovered bodies were transported to the Department of Forensic Medicine, University of Helsinki, Finland.

In 1991, the Finnish Ministry of the Interior appointed a permanent Finnish DVI team consisting of 2 forensic pathologists, 2 forensic odontologists, 16 policemen, a psychologist and a priest. The team had previously experienced two aircraft accidents with a small number of victims and had also drafted a mass disaster plan.

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Materials and methods

A complete medicolegal and dental examination of the 93 recovered victims was performed by 4 parallel autopsy groups. Each autopsy group was comprised of a forensic pathologist, two odontologists, an autopsy technician and three forensic investigators either from the Finnish DVI Team, National Bureau of Investigation, or the Technical Research Centres. Examinations were conducted according to Interpol PM data collection standards (Interpol manual on disaster victim identification 1984). The odontological examination included dental photography, orthopanthomography, clinical examination and completion of the dental section of the Interpol form. Simultaneously, other Finnish DVI team members collected ante-mortem (AM) data on the 852 victims and missing persons (Table 1).

The identification procedure

The team employed a computerised victim identification programme called DVI (disaster victim identification) that is based on Interpol DVI forms which performed searches among the victims using AM or PM information such as weight, height, personal effects and dental data. Final identification was confirmed by consensus of a leader group (consisting of a forensic pathologist, a forensic odontologist and a police officer). If AM and PM data sets were concordant, the victim was identified and the body was released to the family, otherwise, the data sets were sent back to the DVI team for further investigation.

Results

Medicolegal autopsies were completed for the 92 bodies recovered within 6 days of the accident and on the addi-

Table 1 Nationality, fate and availability of dental records of the passengers and crew members in M/S Estonia ferry disaster

Country	Rescued (*n*)	Identified victims (*n*)	Missing victims (*n*)	Number of victims AM dental data available (%)	Total (*n*)
Belarus	0	0	1	0 (0)	1
Canada	0	0	1	1 (100)	1
Denmark	1	0	5	3 (60)	6
Estonia	63	48	237	137 (48)	348
Finland	3	1	9	9 (90)	13
France	0	0	1	1 (100)	1
Germany	3	1	9	10 (100)	13
Latvia	6	4	13	7 (41)	23
Lithuania	1	0	3	1 (33)	4
Morocco	0	0	2	1 (50)	2
Netherlands	1	0	1	1 (100)	2
Nigeria	0	0	1	0 (0)	1
Norway	3	0	6	6 (100)	9
Russia	2	1	10	4 (36)	13
Sweden	52	40	461	467 (93)	553
Ukraine	1	0	1	1 (100)	2
United Kingdom	1	0	1	1 (100)	2
Total (*n*)	137	95[a]	757	650	989
%	14	10	77	66	100

[a] One survivor subsequently died and was identified in Sweden)

Table 2 Cause of death of the 93 autopsies carried out by the Finnish DVI team

Cause of death	Female	Male	Total
Drowning	34	35	69
Hypothermia	6	16	22
Injuries	1	1	2
Total (*n*)	41	52	93
%	44	56	100

tional victim found 33 days later. As Table 2 shows, most victims died from drowning and hypothermia, and 89% of them were naked or partly clothed. Fractures and/or injuries to internal organs were identified in 42 cases (45%), but were the cause of death in only 2 cases. All victims had sustained minor or more extensive superficial excoriations and bruises. Glucose was identified in the urine in 58 cases (62%). However, on the basis of AM information, only two victims suffered from diabetes. Neither alcohol nor medications played a significant role, and narcotics were not found.

The first 93 victims were all identified within 33 days of the disaster: three long bones and a skull of victim number 94 were recovered 18 months after the disaster and identified by dental means. DNA analysis confirmed that all the bones found were from the same victim. The bases of identification are presented in Fig. 1, the most frequent being physical description (95%) and dental identification (60%).

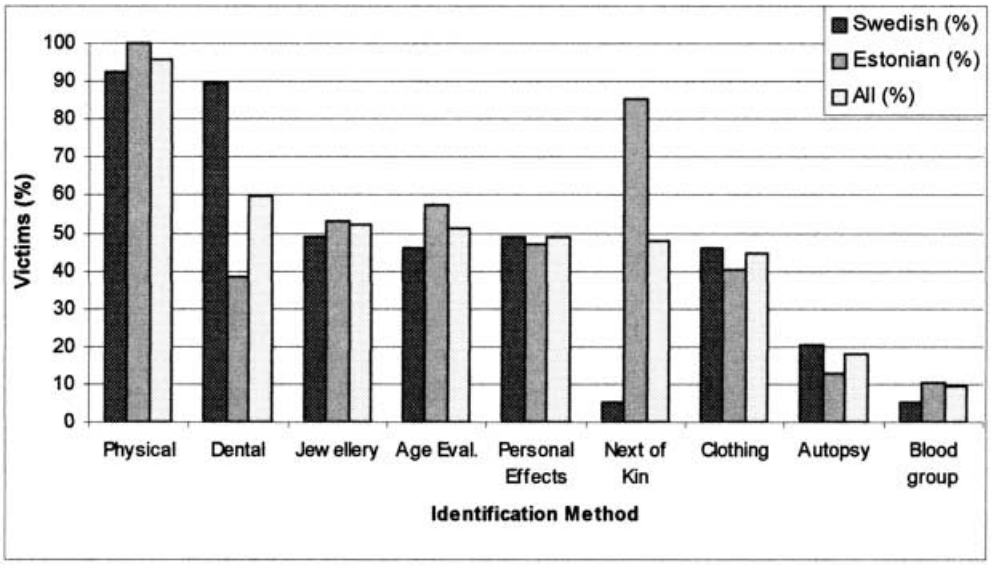

Fig. 1 Means of identification contributing to the final establishment of identity of 94 victims in M/S Estonia ferry disaster

Discussion

The M/S Estonia disaster caused a high number of fatalities due to the rapid sinking at night, adverse weather conditions and difficulties in the rescue operation. Compared with other disasters such as fire accidents, where victims are typically severely burnt (Solheim et al. 1992), the bodies of the victims in this disaster were in relatively good condition. Therefore, all victims were identified, even those without AM dental records.

In the M/S Estonia disaster, physical description and visual recognition were frequently used (95% and 48%, Fig. 1) for tentative identification. However, visual recognition made by next-of-kin has been proved to be unreliable due to the PM changes of the victim and the psychologically stressful situation for the family (Speers 1977). In this disaster, one member of the ship's crew, not aboard during the accident, falsely identified another crew member based on AM and PM photographs. Further investigation by the Finnish DVI team revealed the error.

Personal effects and clothing also provided identifying information (48% and 45% respectively, Fig. 1). However, use of personal effects for identification may also be unreliable. For example, in the M/S Estonia disaster people often grabbed the nearest jacket (not necessarily their own) while trying to escape.

Fingerprint identification is highly reliable, however, the condition of the body (e.g. mutilation, fragmentation) and lack of AM information are the main limitations. In this disaster, the bodies were well preserved and fingerprints were taken from all victims. However, no victims had AM fingerprints on file for comparison. This can be explained by the fact that in Sweden and Estonia, fingerprints cannot be legally kept on record for reasons of citizen privacy. Autopsy findings and toxicological data can contribute to the identification, but only if scars, amputations, medication or diseases can be compared with the AM data. This was the case in about 18% of the present victims. DNA samples were taken from all the victims, but DNA analysis was not routinely employed because of expense and because the victims could be identified by other means.

Dental identification is a very successful method because AM dental information is usually available and because the unique construction of teeth allows them to successfully resist PM changes. Many researchers have shown the benefit of dental identification in mass disasters, particularly fires and aircraft accidents (Vale et al. 1987; Mulligan et al. 1988; Solheim et al. 1992). Radiographs, such as orthopantomograms (OPGs) and bite-wings, are crucial factors in dental identification. DuChesne and co-authors (2000) have recently concurred with Haertig et al. (1991) that OPGs provide the only truly reliable identification records. They point out that OPGs provide an overall view of the entire dental and jaw anatomy, they are less likely than bite-wings to be confused for the left or right side, and that data transfer errors are minimized. For that reason, PM OPGs were done on all cases, although only 2 of 94 victims had AM OPGs available.

Table 3 Dental information of the 94 victims recovered

Country	Total number of victims		Full dental records available[a]		Partial dental records available[b]	
	n	%	*n*	%	*n*	%
Estonia	48	51	13	27	12	25
Sweden	39	42	38	97	1	3
Latvia	4	4	3	75	1	25
Finland	1	1	1	100	0	0
Germany	1	1	1	100	0	0
Russia	1	1	1	100	0	0
Total	94	100	57	60	14	15

[a] "Full dental records" refers to textual and graphic records about all the teeth plus radiographs
[b] "Partial dental records" were a subset of data, typically without radiographs

While 38 (97%) of the Swedish victims had full dental records, including bite-wing radiographs, the respective rates for Estonian victims were 13 (27%) full records and 12 (25%) partial dental records (Table 3). The lower rate of AM dental data among the Estonian victims was due to several factors. First, since standardised dental record keeping in Estonia is not legally required, but only recommended, some dentists used the dental record merely for billing information. Second, a number of dental clinics had recently reorganised and modernised their record-keeping systems and had discarded the old records. Third, some Estonian victims did not have any dental records because they had not seen a dentist in recent years. In contrast, the high rate of AM dental data among the Swedish victims is due to several legislative mandates regulating dental record-keeping (enacted in 1985 and 1993) in that country.

In conclusion, the Finnish DVI team succeeded in a challenging task involving identification of 94 victims and collection of AM data on 852 victims and missing persons. Crucial factors in the success included the use of Interpol standards for recording AM and PM data, computerisation of the data collection and data comparison, and preliminary practice drills in preparation for a major disaster. Another outcome of this disaster is that dental record keeping should be required by law in Estonia. In many cases of major disasters such as this one, dental evidence has provided and will continue to provide critical identification data.

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