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Mass disasters observed at the Sapienza University of Rome: a retrospective study between 1964 and 2005

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Abstract: The specialists of the Department of Legal Medicine of the "Sapienza" University of Rome (Italy) were involved in the investigation of ten mass disasters over fifty years (1964-2005). The victims examined were 230. The cases, distributed both in Italy and abroad, included four terrorist attacks, three airplane accidents, two collapsed buildings, and one shipwreck in a river.

One of the most important tasks in mass disasters is the identification of victims. Another key issue is the determination of the cause of death and the contribution to the reconstruction of the events.

In all cases the training and the capability of our specialists to interact with all the entities involved in the mass disaster management played a critical role.

For all cases the timeline of operations is provided, beginning with the collection of the antemortem information. Specialists of our Department took part to the antemortem teams, due to their particular experience.

For postmortem collection of information our Institute historically played a central role, especially because all the Italian victims of any accidents happened abroad are examined in "Sapienza" morgue.

The aim of this contribution is to highlight the changes that have occurred over the years in the management of mass disaster investigations in Rome and to present the latest developed organisation of specialists involved and their procedures, stressing the necessity of a multidisciplinary approach in mass disaster management.

Key Words: mass disaster, disaster victim identification (DVI), disaster victim management (DVM), multidisciplinary approach, forensic pathology.

Mass disasters are generally understood as crisis situations that far exceed the capabilities and the ability to recover of a community. They are usually unpredictable and unexpected situations demanding a multidisciplinary and well-coordinated approach to take on the seriousness of the event and/or the large number of victims involved on the basis of the human and means resources available on the territory.

Definitions of mass disasters

Given the variety of the possible events (for typology, dimension, extension, etc.) and the number of necessary interventions (humanitarian, healthcare, logistic, victim management and identification, etc.) there is not an unequivocal definition of mass disasters.

The World Health Organization (WHO) defines disaster as "a sudden ecologic phenomenon of sufficient magnitude to require external assistance" [1]; the United Nations Office for Disaster Risk Reduction (UNISDR) describes it as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts,

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which exceeds the ability of the affected community or society to cope using its own resources" [2].

In summary each event is unique, raises its own issues and requires specific management.

Classification of mass disasters

In general terms, mass disasters can be divided, based on their primary cause, in natural (e.g. earthquakes, volcanoes, hurricanes, floods, fires and tsunamis) and manmade (increased or caused by humans) catastrophes (e.g. transportation accidents, terrorist activities, building collapse, explosion, pollution, hazardous materials exposures, wars or political crisis), however the earthquake that destroyed the nuclear power plant in Japan, in 2011, tragically reminded the eventuality of combined natural man-made disasters.

Consistently with the variety of possible disastrous events, when it comes to the victims, many variables must be considered.

The number of victims involved can vary from five (e.g. in a light aircraft crash), as asserted by Kvaal [3], to thousands (e.g. tsunami or in earthquake disasters); the bodies may be intact or fragmented, fresh or putrefied, and many issues related to jurisdiction, recording of data and security may arise [4].

Both large-scale fatality disasters, as well as smaller scale incidents with multiple fatalities are referred to as "mass fatality incidents" (MFI). Generally, the term MFI is use to describe situations in which the resultant number of deaths exceeds the local jurisdiction's ability to respond effectively. In addition, the term of "Complex Fatality Management" (CFM), is being used in recognition of the fact that local capacity can be overwhelmed by even a single fatality if the incident involves hazardous chemical, biological, radiological, nuclear or explosive (CBRNE) agents [5].

Based on the number and the possibility to group together the victims, the classification of the Disaster Victim Identification (DVI) Guidelines, proposed by Interpol, sorts disasters in "open" and "closed". According to these guidelines an open disaster is a major catastrophic event resulting in the death of a number of unknown individuals without prior records or descriptive data available (e.g. earthquake, etc.), while a closed disaster is defined as a major catastrophic event resulting in the death of a number of individuals belonging to a fixed, identifiable group (e.g. airplane disasters with a known passenger list) where antemortem (AM) data can be obtained more quickly. Combinations of open and closed disasters are also conceivable (e.g. aircraft crash in a residential area) [6-9].

The experience in mass disasters gained by the Department of Legal Medicine of the "Sapienza" University of Rome (Italy) covering both disasters happened in Italy and any event involving Italian citizens abroad is reported. No previous papers reporting such a wide time frame, as well as a great variability in mass disasters typology exists in literature. The aim of this paper is to highlight the developments and the analytical processes in mass disaster victim identification and management, and lead to a better understanding of the multiple facets of a phenomenon that represents one of the major challenges in the forensic scientist's practice.

MATERIALS AND METHOD

In the period considered, a total of ten mass disasters were observed in our Department. Three airplane crashes, four terrorist attacks, two collapsed buildings and one shipwreck in a river are presented (Table 1).

All the reported information about these tragic events are the result of an extensive review of the existing documentation (e.g., investigation acts and mass-media communications).

Each case has been examined by analysing the AM and postmortem (PM) data of the victims that were recorded at the time of the event. In particular the autopsy reports, the results of the toxicological and haemogenetic analysis, the radiological examinations and the personal interviews to the relatives of the victims, that are all still conserved in our archive, were reviewed retrospectively and the relevant information compared.

Airplane crashes

Fiumicino (Rome) "Leonardo da Vinci" Airport, November 23rd 1964

A Trans World Airlines (TWA) Boeing 707-331 with 73 occupants on board (62 passengers and 11 crew members) directed to Athens caught fire during the take-off. After the explosion the plane travelled 400 meters (m)

Table 1. Location, date, type of accident and number of victims of the mass disasters observed in the Department of Legal Medicine – "Sapienza" University of Rome

No.	Location	Date	Type of accident	Number of victims
1	Rome - Fiumicino Airport (Italy)	1964-11-23	Airplane crash	50
2	Rome - Fiumicino Airport (Italy)	1988-10-17	Airplane crash	33
3	Priština (Kosovo)	1999-11-12	Airplane crash	24
4	Rome - Fiumicino Airport (Italy)	1973-12-17	Terrorist attack	31
5	Rome - Fiumicino Airport (Italy)	1985-12-27	Terrorist attack	16
6	Nassiriya (Iraq)	2003-11-12	Terrorist attack	19
7	Sharm el-Sheikh (Egypt)	2005-07-23	Terrorist attack	6
8	Rome - Di Vigna Jacobini Street (Italy)	1998-12-16	Building collapse	27
9	Rome - Ventotene Street (Italy)	2001-11-27	Building collapse	8
10	Nile - Edfu (Egypt)	1988-08-08	Boat shipwreck	16

before stopping, engulfed in flames, 50 people died [10].

Autopsy examination of the bodies was performed between one and two days after the event; in each case diffused char burns were detected.

Among the 50 victims only six were still recognizable allowing direct identification by family members: in these cases pictures of the faces of the victims as well as their personal effects (e.g. rings, bracelets, necklaces, etc.), that were useful to confirm the identification, were shown to the relatives. Thirty-eight cases were identified comparing dental data obtained from autopsy report with dental radiographs and case-history provided by the family; while the remaining six bodies were identified through the X-ray examination.

The carboxyhemoglobin level was measured in each victim. A complete toxicological examination was carried out on the bodies of the pilots but the results were negative.

Fiumicino (Rome) "Leonardo da Vinci" Airport, October 17th 1988

A Uganda Airlines Boeing 707-338C, during descent to Rome airport, impacted on the roof of a house. After the impact, the plane broke up and burst into flames.

The disaster was caused by a human fault: the total number of the victims were 33 [11]. All identity cards were removed from the victims by the local police force, before the arrive of the forensic pathologists. Autopsy examinations took places between one and three days after the event.

Twenty-eight victims were still recognizable and the identification process took place by direct recognition, photographic comparison and personal effects. For five victims the identification took place with the help of the X-ray (three victims) and forensic dental analysis (two victims).

The recovery of a victim that was not among the passengers listed at the time of the take-off (successively recognized as an illegal passenger) and the untimely removal of identity cards from the victims by the local police forces were the main critical situations of this event.

A complete toxicological exam, performed on the flight crew bodies, resulted negative.

Prishtinë (Priština - Kosovo), November 12th 1999

An ATR-42-312 airplane operating on behalf of the United Nation World Food Program (WFP), with 24 passengers (12 Italian people), crashed into a hill, 30 km far from Priština Airport; none of the passengers survived [12].

The PM examination took place between one and two days after the event. The identification of the victims was carried out by simultaneous comparison between AM information and PM findings (tattoos, scars, moles, personal effects, etc.) collected in real time; two Spanish soldiers victims were identified through fingerprint recognition.

In each case a haemogenetic typization confirmed the results obtained with other methods of identification. A complete toxicological analysis, carried out on both the pilots, resulted negative.

Terrorist attacks

Fiumicino (Rome) "Leonardo da Vinci" Airport, December 17th 1973

Five terrorists entered the Rome Fiumicino Airport terminal and opened fire in the crowded transit lounge. The terrorists took several hostages and threw incendiary grenades into a Pan American World Airways (PanAm) Boeing 707 N407PA that was boarding passengers for a flight to Beirut; terrorists also killed a guard and hijacked a Lufthansa Boeing 737. The total number of victims was 31 [13].

The PM examination took place between one and three days after the event.

Five carbonized victims were identified by the comparison of the dental autoptic report with AM dental radiographies and odontoiatric case-history provided by the families.

In cases in which victims were still recognizable, identification took place directly by physical evidence or by photographic comparison.

Fiumicino (Rome) "Leonardo da Vinci" Airport, December 27th 1985

On December 27, 1985 four terrorists attacked El-Al Israel Airline's ticket counters at "Leonardo da Vinci" - Fiumicino Airport in Rome. The terrorists killed 13 people shooting with assault rifle Avtomat Kalašnikova 1947 (AK 47) and throwing grenades at the boarding gates of the El-Al and TWA Companies. Thirteen people were killed, more than 70 people were injured by the terrorists; three of the perpetrators were killed by Israeli airport security staff [14].

The PM examination took place between one and three days after the event.

The identification of the 16 victims, all still recognizable, was helped by photographic comparison with passport or identity card and by personal effects.

Nāṣiriya (Nassiriya - Iraq) "Maestrale" Italian Military Base, November 12th 2003

A tank full of explosive driven by two kamikazes armed with AK-47 exploded in front of the Multinational Specialized Unit (MSU) Italian military base in Nassiriya; a powder-magazine caught fire causing the death of 28 persons (both militaries and civilians: 19 Italian people and nine Iraqi people) and the wounding of about 140 persons. The 19 Italian victims were all male (17 militaries and two civilians).

The PM examination took place between four and six days after the event.

Fifteen victims were still recognizable and the identification process took place by direct recognition or by photographic comparison.

In four charred bodies the identification was made comparing data obtained from dental autoptic

report with the dental radiographies and the odontoiatric case-history provided by the family.

DNA analysis was used to confirm the identity of all victims, while fragments of human tissues were all typed in order to correctly attribute them to the right body as well as to detect any other genetic profile possibly related to the authors of the massacre.

Among the DNA profiles that were detected, one did not match any of the identified victims. The findings related to the unknown subject were reported to Interpol and the profile was added to the international DNA database. At a later stage, after the terrorist attack in Madrid, March 11, 2004, the unknown DNA matched the DNA profile of one of the terrorists involved in the latter attack. The matching percentage was consistent with the two subjects being related, most likely cousins.

Sharm al-Shaykh (Sharm el-Sheikh - Egypt), July 23rd 2005

Three kamikaze bombing attacks occurred in the area of Sharm el-Sheikh. There were 88 victims (6 Italians) and more than 200 injured.

The PM examination of the six victims took place between six and seven days after the terrorist attack.
Five of the six victims were identified by physical evidences. In a case of charred victim, dental comparison and DNA analysis were necessary for identification, in all cases haemogenetic typization was carried out for confirmatory purposes.

Building collapses

Di Vigna Jacobini Street (Rome), December 16th 1998

A building of six floors collapsed in Di Vigna Jacobini Street (Rome) in the middle of the night due to a structural failure. The total amount of the victims was 27. The PM examination took place between one and three days after the event. The identification of the victims, who were all still recognizable, took place through visual recognition, photographic comparison and examination of their belongings carried out by the relatives.

In each case a haemogenetic typization that confirmed the results obtained with other methods of identification was conducted.

Ventotene Street (Rome), November 27th 2001

A building partial collapse, secondary to a gas leak caused eight victims.

The PM examination took place between one and three days after the event.

The identification of seven of the eight victims was performed by physical evidences. In the case of charred body, dental radiographies were necessary and the personal effects were useful for the identification process. The haemogenetic typization was carried out in order to confirm the results obtained with other methods of identification.

River shipwreck

Nile - Edfu (Egypt), August 8th 1988

While cruising the Nile, the ship "Nubia" was capsized. Among the 100 passengers, 33 died drowned (16 Italian people and 17 Egyptian people).

The recovery of the victims took place at different times: 12 bodies belonging to Italian citizens were recovered after five days, while the other four after a longer period (15, 19, 21 and 36 days after the disaster).

The first 12 corpses were stripped of their personal effects as well as clothes and were submitted to a first autopsy in Egypt, before they were transferred to Rome. They were marked with serial numbers, locked in coffins, treated with dehydrating substance (sawdust and charcoal) and preservatives (formalin), then repatriated without being identified.

In these cases AM data, acquired by Italian police forces, were compared with the PM ones; comparison with personal effects and clothes was impossible.

The inadequate onsite management in recovering bodies and the difficulties raised from the first investigation was represented to the local authorities in Egypt, and because of this the last four corpses arrived in Italy as they were found.

In the first 12 cases, because of the total absence of personal effects and clothes, dental radiographies were used as confirm in the identification process. The identification of the last four victims was performed using physical evidences, clothes and personal effects.

RESULTS

The total number of victims of mass disasters examined in our Department in the years 1964-2005 was 230. Victim identification was achieved through forensic odontology analysis in 63 cases (27.4%); identification through fingerprints analysis was carried out in two cases (0.9%); DNA analysis was applied for the first time in 1998 on the victims of the Di Vigna Jacobini Street building collapse and has been used to confirm identification in 84 cases (36.5%), since then.

X-ray was used in nine cases (3.9%), other methods of identification (e.g. identification by relatives, photographic comparison, matching between correspondence of AM and PM victim's personal effects, etc.) were used in 156 cases (67.8%) (Table 2).

In our experience, regardless the dynamics of the mass disasters, the casualties occurred abroad in which we were not able to intervene on-site [four of the ten events reported – Edfu (Egypt), Prishtinë (Kosovo), Nāṣiriya (Iraq), and Sharm al-Shaykh (Egypt)] were the most critical to deal with. In particular, in the reported cases, the lack of shared international protocols to recover the victims and the objects from the scene of the disaster (e.g. no numbering and no coordinates of the mass disaster perimeter) and, in some cases, the untimely and disorganized alteration of

the corpses on-site (e.g. cutting of clothes, separation of personal effects and identity documents, manipulation of the corpses before repatriation), markedly affected the forensic analysis of the event.

DISCUSSION

Evolution of DVI criteria

During the considered time interval (1964-2005), the adopted criteria in DVI internationally evolved. Before the international guidelines were established, we applied identification criteria distinguishing them in preliminary and definitive. The preliminary criteria consisted of: analysis of personal effects, sex, hair and eye colour, body shape (constitution, height, weight, presence and distribution of fat, etc.) while the definitive ones consisted of: presence of moles, flaws, other skin formations or deformities, scars, prostheses, osteosynthesis, previous fractures. The identification was confirmed if two of the definitive criteria were satisfied.

Since the uniformed criteria of the Interpol DVI Guide were published in 1984, we relied on them in DVI process [6]. At present, according to the Interpol Guide, comparison of forensic dental traits and characteristics, fingerprints and DNA profile analysis are classified as primary methods of identification, that is to say they are considered essential to identify the bodies. Personal description/medical findings (e.g. medical devices, prostheses, etc.), evidence/clothing (e.g. traits, such as tattoos, body piercing and other adornments) and generally all other procedures adopted in the DVI process are listed among the secondary methods of identification [6, 14]. Based on this classification of the DVI methods, the role of the forensic pathologist as the leader of a multidisciplinary team of experts in a disaster situation is emphasized [15].

DVI approach at the Sapienza University

In the past years, in Italy, the management of victims' identification in cases of large incidents was conducted on an ad hoc basis, without a permanent readiness group. In recent years, in step with the international guidelines, a formalized DVI team was established in our Department.

Our DVI team is composed by a Postmortem Team (PM-T), an Antemortem Team (AM-T) and a Reconciliation Team (R-T), each led by a coordinator; members of our three teams are different to avoid misrepresentation of the data. At the head of the DVI readiness group there is a team chief that coordinates the activities of the teams (Fig. 1).

The comparison between the AM and PM data that is at the base of the DVI process requires the strict separation between AM and PM data during the data collection in order to ensure that there are no alterations in the process.

In our experience we found it extremely helpful to use different coloured forms to register AM and PM data as well as to designate different professionals to take care of each group of information. In general the coordinator of each team is responsible of compiling the respective forms. The collected data are finally compared and the potential matches between a found body and a missing person are pinpointed [14]. At present, automated programs are available that simplify the comparison between AM and PM data by assigning a relative weight to each information.

Once a possible match is made, the team coordinators draft and sign an identification report including the final conclusions and signatures of the experts. Finally the report is submitted to the R-T for the final comparison and, if appropriate, a death certificate is issued [16]. In accordance with Shuliar and Knudsen, the chief of our DVI readiness group as well as the final responsible of the identification process [15], is the forensic pathologist. However, DVI is a team's challenge that requires contributions from many different fields of expertise.

Primary methods of identification in DVI

Forensic odontology is among the three primary identifiers designated by Interpol in case of mass casualties. Teeth are the most resistant material in the human body and they withstand decomposition and even severe incineration [17, 18]. The comparison of clearly-documented PM findings and sufficient AM data (e.g. photographic documentation regarding previous surgical operations, prosthetics, implantology, etc.) is of considerable practical value in routine forensic casework, especially if a PM orthopantomography can be compared with an AM one [19-23]. However, forensic odontology cannot be used if there is no source of comparison, such as persons who have not been to the dentist, in particular children.

In our experience forensic odontology analysis were performed in 63 of 230 cases (27.4%); in 57 of 63 cases dental identification was performed before the DNA analysis was established, in the last six cases dental identification was conducted along with DNA typing, the latter used to confirm the results (Table 2).

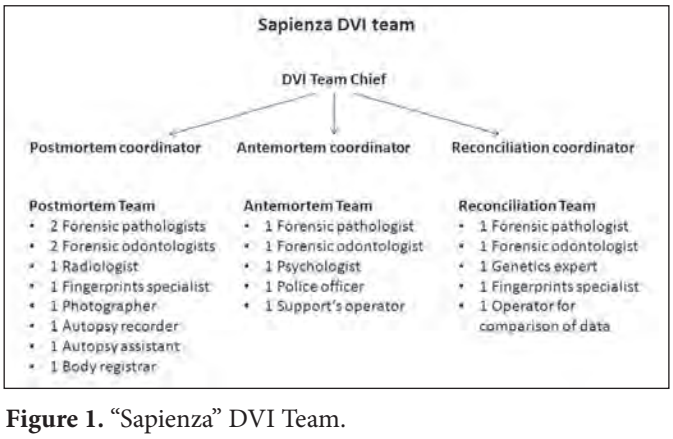

Figure 1. "Sapienza" DVI Team.

Table 2. Methods of identification used in each case

No.	Mass disaster	Fingerprints identification	Dental identification	X-ray identification	DNA*	Other identification**	Total positive identification
1	Fiumicino (Rome) "Leonardo Da Vinci" Airport, November 23rd 1964 – Airplane crash		38	6		6	50
2	Fiumicino (Rome) "Leonardo Da Vinci" Airport, October 17th 1988 – Airplane crash		2	3		28	33
3	Priština - Kosovo, November 12th 1999 – Airplane crash	2			24	22	24
4	Fiumicino (Rome) "Leonardo Da Vinci" Airport, December 17th 1973 - Terrorist attack		5			26	31
5	Fiumicino (Rome) "Leonardo Da Vinci" Airport, December 27th 1985 - Terrorist attack					16	16
6	Nassiriya – Iraq "Maestrale" Italian Military Base, November 12th 2003 -Terrorist attack		4		19	15	19
7	Sharm el-Sheikh - Egypt, July 23rd 2005 – Terrorist Attack		1		6	5	6
8	Di Vigna Jacobini Street (Rome), December 16th 1998 – Building collapse				27	27	27
9	Ventotene Street (Rome), November 27th 2001 – Building collapse		1		8	7	8
10	Nile - Edfu (Egypt), August 8th 1988 - Boat shipwreck		12			4	16
	Total	2	63	9	84	156	230

*DNA profiling was applied as a confirmatory test ever since the mass disaster occurred in 1998. **Other identification type include (e.g. relatives identification, photographic comparison, matching between correspondence of antemortem and postmortem victim's personal effects).

Figure 2 shows an example of dental findings in a victim of mass disaster of our casuistry.

Despite the great promises of fingerprints analysis for identification purposes based on the fact that fingerprints are unique and the chance of identical fingerprints in two individuals, including identical twins, has been estimated at 1:64.000.000.000 [17], this method has practical limitations. The main obstacle at the routine fingerprints study is that the database of fingerprints is scarce and only includes specific categories of professionals (military personnel, members of international organizations, law enforcement agents, etc.) and registered criminals. The comparison with AM fingerprints needs comparative material from the deceased person; photos not being an option in these cases. Another disadvantage of fingerprints is that they are strictly connected to the body condition: in case of a charred corpse or traumatic arms' amputation, this DVI method may not be suitable a priori.

In accordance with the practical limitations of

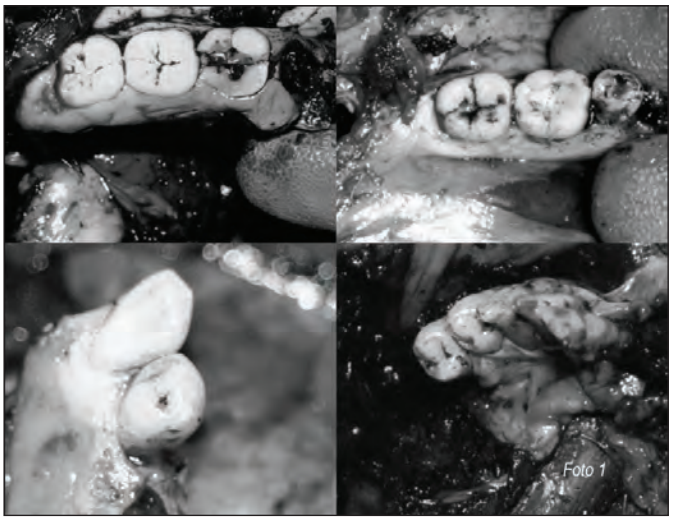

Figure 2. Example of dental findings in a victim of mass disaster of our casuistry.

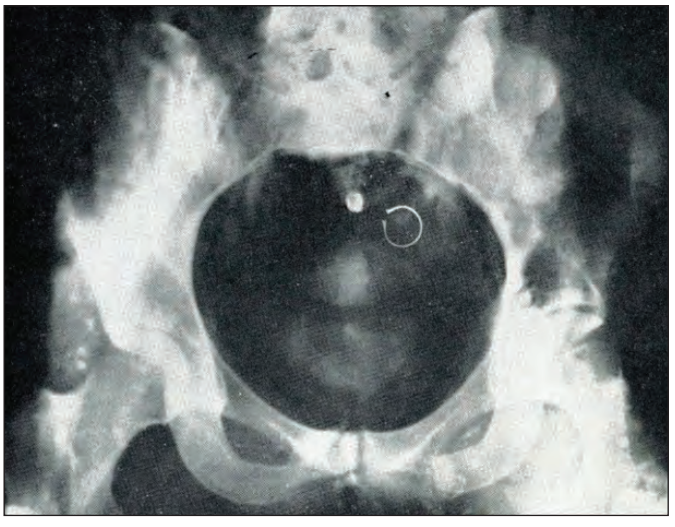

Figure 3. Example of X-ray findings in a victim of mass disaster of our casuistry.

this method, in our experience, fingerprints analysis only allowed the identification of two victims (0.9%), soldiers, in the airplane crash occurred in Prishtinë (Table 2).

The process of identifying a victim by DNA includes the collection of the best possible AM samples, the choice of PM samples (recorded at the site and in the autopsy room during examination and sampling), DNA analysis and statistical weighting of the genetic relationship or match [24]. The Interpol DVI guidelines recommend three sources of DNA-AM data in the following order: (1) first degree relatives, if possible more than one; (2) blood or biopsy samples from the potential victim; or (3) personal objects that have been used by the deceased (such as unlaundered clothing, a toothbrush, Phenylketonuria (PKU) cards from State mandated newborn genetic screening programs, or even archival pathology tissue) [25, 26]. The tissues that can be used are for example blood, muscle, bone, teeth or nails. A significant advantage of DNA-typing, is that it is possible to obtain usable material even from severely decomposed bodies, in particular from the hard tissues that are more resistant to autolysis and putrefaction [27]. It is reported, however, that the extraction of DNA form soft tissues for DVI purposes becomes problematic when other factors such as fire, contamination of remains (e.g. with dirt or chemicals such as jet fuel), or delay in recovery resulting in microbial infestation and putrefaction occur [28]. For this reason, bones, teeth and nails may be the only source of DNA in many forensic cases [29, 30].

Despite its many advantages, DNA-typing is still considered a "long time method" in comparison with other identification tools such as direct recognition, dental and fingerprint analysis, hence, based on the circumstances, it is not necessarily the best choice [31, 32]. In Italy, owing to explicit requests made by the national authorities to rapidly identify the bodies and return them to the relatives, the recommended time frame to carry out the whole process is one or two days on average and DNA-typing, in our experience, has in some occasions delayed the final result. Obviously when DNA analysis is needed in order to ensure certain identification, time becomes a minor issue.

Since 1998, we relied on DNA to confirm victim identification in 84 cases (36.5%) as reported in Table 2.

Radiography has been used for identification since 1927, and established a role in mass fatality investigations in 1949 [33, 34]. Radiological examination may also be used in DVI [35, 36]. The current standard approach in case of mass fatality incidents (MFI), involves fluoroscopic investigations, to screen for potential contaminants; standard radiographic imaging, for anthropological and pathological examination; dental radiography, for dental identification. Using postmortem computed tomography (PMCT) has the potential to replace these three independent modalities [37].

Other Authors have suggested that CT scanning may be useful in the mass disaster scenario both for the evaluation of dentition [38, 39] and for assistance in the completion of the Interpol PM forms incorporating items such as age, gender, height, medical devices, natural disease, any previous surgical interventions, bone fractures, or for eliciting more individual specific characteristics by the detection of unique biological or physical features [40-42].

In May 2014, a consensus document regarding the use of PMCT in DVI, recommended that it should be used for: (1) identifying the cause of, and contributory factors to death; (2) disaster victim identification (DVI); (3) identifying potential hazardous materials within the body; (4) gathering evidence for criminal justice procedures [43].

In the cases analysed X-ray examination was used in nine victims (3.9%) starting from the mass disaster occurred in Fiumicino Airport in 1964. Figure 3 shows an example of X-ray findings in a victim of mass disaster of our casuistry.

When foreign victims are involved, the body investigation may need to be adjusted to take into consideration ritual procedures and/or religious traditions such as circumcision, scars or tattooing.

Secondary methods of identification in DVI

During the autopsy, forensic pathologists should carefully look for all the other findings described in the secondary methods of identification of the DVI Interpol guidelines in both the external and internal examination. These procedures may sometimes be overlooked because of the serious traumatic injuries such as in the mass disaster occurred in "Leonardo da Vinci" Airport in November 1964, where other methods of identification were applied (Table 2).

However, these methods, when the identification marks (e.g. medical devices, scars, tattoos, body piercing and other adornments, clothing) were in good condition, represented the most frequent method of identification in our casuistry, in 156 of 230 cases (67.8%), as reported in Table 2.

Antemortem data collection

Generally the AM data collection is made by police forces through an interview with the relatives of the victims. The interview rooms, in which our AM team works, are set up in the Department, and a living room with foods and beverages is made available for the victims' relatives. In our AM team interviews are conducted by the forensic pathologist, at the presence of a psychologist and the police officer. The decision to give the forensic pathologist the role of interviewer derives from the observation that the relatives tend to respond better to the doctors' bedside manner than to the investigative approach of the police forces. The interview is conducted giving the relatives as long as they need

to remember the family member and describe his/her physical details. The questions are not asked directly, but collected by offering the family member the opportunity to retell the relative's life. Our experience proves that this approach increases the confidence, and since it requires the family member to retell stories from the victim's life, it is more likely to yield details that would otherwise remain unexplored. This helps family members to deal with the initial stages of mourning, and we observed that the trust that is established between the AM team and the relatives prompt them not to insist on seeing the body remains.

Continuing education and training

In Italy, Ministry of Health, according to the learning principles theorized by many authors [4, 44-46], provides continuous updating and training for health professionals [47]. Based on the above-mentioned principles, our Department, in 2006, has formalized a DVI team that has been taking part in training courses and practice exercises, such as the recent Twist - Tidal Wave In Southern Tyrrhenian Sea [48], in order to maintain appropriate levels of preparation and scientific knowledge.

CONCLUSION

Conducting DVI operations takes an important amount of experience, pre-planning and training; in mass disasters, DVI practitioners need to work with other response agencies such as military, fire and scientific officers to accomplish the task safely and effectively.

This article provides a unique overview of mass disasters. Based on the experience gained by the forensic pathologists of our Department, both in Italy and abroad, between 1964 and 2005, ten mass disasters were described and retrospectively analysed. The results aim to lead to a better understanding of the multiple facets of a phenomenon that represents one of the major challenges in the forensic scientist's practice by showing in a single paper a wide variety of possible circumstances and management approaches.

Conflict of interest. The authors declare that they have no conflict of interest concerning this article.

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