ROLE OF FORENSIC PATHOLOGISTS IN MASS DISASTER: INDIAN SCENARIO

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ABSTRACT

Usually how will you investigate a case of mass disaster and what measures will you undertake for proper identification of persons involved; preservation of trace evidences in mass disaster and methods of identification in burnt bodies, aircraft accidents and autopsy procedures in mass disaster, these are the common questions are faced by forensic pathologist in mass disaster management. WHO has defined disaster an occurrence that causes damage, ecological disruption, loss of human life or deterioration of health and health services on a scale sufficient to warrant an extra ordinary response from outside the affected community or an area. A mass disaster is considered to have occurred when the number of casualties occurring in a single event exceeds 12 or more lives are lost. Major disaster usually involves an international dimensions and it is imperative to be sensitive to customs and traditions of each community in order to avoid future action. Forward planning, outline of necessities in mass disaster planning. Provision of forensic pathologists and other staff, provision of mortuary facilities, retrieval of bodies. The investigating team should consist of forensic pathologist, forensic dentist, forensic scientist, fingerprint expert, ballistic expert, etc. The main objective of this study is role of forensic pathologist in mass disasters management and investigation or autopsies are conducted to determine identity, cause of death, and cause of disaster.

KEYWORDS

Mass Disaster, Forensic Expert, Triage, Management, Mortuary.

INTRODUCTION

The activity which focuses most public attention on the work of forensic pathologists is the mass disaster with the exception of the more dramatic murders. Such tragedies are becoming more common with the increase in terrorism, the expansion of travel facilities and the larger size of passengers. Recent years have seen a tragically frequent need for the expertise of mass disaster teams, following such events at Khedanath by floods, most recently the terror attacks, train fire accidents in India and Nepal earthquakes. The forensic pathologist will thankfully spend their entire carrier without having to participate in a major mass disaster; a commonly accepted definition is the death of more than 12 victims in a single event. No one can predict when such a tragedy might occur, however as typified by the 1988 onwards and in Britain, the Royal College of pathologists [1990] have published a useful booklet on the role of the pathologists in these disasters. It is thus essential that every forensic institute, department and individual pathologist should make some forward provision for such an eventuality. A mass disaster is a catastrophic event where there is almost always a substantial loss of life, as well as damage of property and occasionally loss of crops and livestock. In certain parts of the world, nature is frequently responsible for mass disaster with flood, hurricanes, earthquakes killing more of the people. The task would be far too great and the most that attempted would be identification of some of the dead bodies. The reasons for examination of the bodies of victims by forensic pathologist for to identify each dead body, to establish the cause of death for legal purposes so that death certificate can be issued and to discover evidence relating to investigations of the disaster itself like obtaining sample for toxicological analysis where appropriate and to find out the cause of the disaster itself. Medico legal investigations are required for the proper identification of the dead to restore dues e.g., bomb fragments, residues of explosives etc. and to catch criminals for determining the cause of the accident. Mass disasters are increasing in incidence due to bizarre climatic conditions, transportation accidents and terrorism. Disaster victim identification: many times, the facial features are so distorted that the body cannot be identified by looking at them. Sometimes, only parts of the body are available in such situations, one should use all the facilities that are available or can be made available at the site for proper identification as under: Finger Prints, DNA profiling, Odontology, Physical characteristics, Radiology, Clothing, Documents, Jewellery, and visual identification. This study concerned primarily with civil rather than military disasters and dealing only with the forensic pathology and investigation of deaths arising from such events.

The role of forensic pathologist in mass disaster management as a member of investigative team has the main important responsibility is treatment of survivors, identification of dead, reconstruction of mutilated remains to make them fit for presentation and collection of evidence to determine and reconstruct the cause of disaster. A forensic pathologist as a member of the team has a pivotal role in mass disaster situations identification, display, handling, storage, recording and disposal of large number of dead bodies at the scene of disaster. Mass embalming is resorted in order to overcome lack of store facilities. Other forensic services included public display of bodies for identification, photographing and recording forensic anthropological data with collection of personal effects and disposal in mass graves. A well-defined portion of cemetery is allocated for disaster victim identification [DVI] system with a separate plan for the DVI graves and numbers were allocated to the graves. In each coffin, photograph of the body, location where the body was

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found, external description with particular reference to special marks, clothing, deformities, and finger prints odontological data, post mortem DNA profile, etc were kept in a mind of the forensic pathologist while at scene of disaster. Jewellery and clothing with corresponding number were kept in sealed bag in the custody of police. Each grave carrying the identification number with elevated concrete monument. Coffins were also marked to enable identification in the event of re-exhumation. This can be brought about only by team work of professionals of different fields, such as forensic pathologist, forensic expert medical, administration officials, police, fire services, army services, civil defense, water and power supply services, tele communications transportations services, etc. Management of persons or rescues who immediately arrive at the scene of occurrence has to make sure that the scene is not distorted by the onlookers who may want to help in the rescue operations. Dead bodies should not be removed in a hurray lest it should destroy evidence on the scene. Role of police, role of the hospital, Triage a French word thus means a process of giving priority to patients based on the severity of their condition and chances of survival, so as to treat successfully as many patients as possible when resources are insufficient to treat all the patients simultaneously."Every accidental death is a disaster to the individual family involved and to them is of the same dimension irrespective of how many others were similarly affected at the same time. Every accidental death has its preventive aspects and often these lie in the hands of the forensic pathologist."[Mason 1989]. The recent upsurge of terrorism for political purposes in many parts of the world has brought with it the use of the home-made bomb. Targets have usually been buildings, vehicles and aircraft. Often there is no intention to harm people and then warning of the planting of the bomb is usually given, the warning is sometimes insufficient or the location of the bomb is given in accurately and people are injured and killed and sometimes bomb is deliberately planted to so as to hurt people.It seems that in the general political unrest which pervades the world, will continue to be used to reinforce political aims and forensic experts will have to deal with the results with increasing frequency.5

Aims and Objectives
The medical community having disaster management adequate knowledge and their common problems arises when mass casualty arrives in hospital
The disaster management plan ultimate aim is to save life of patients and provide them best medical care as soon as possible.

Some Principle of Disaster Management are
It should be a continuous process. Should evoke appropriate and prompt response. Plan should be based on valid knowledge must foresee what is likely to happen. It should be tested.

Mass Disasters Classified into
I. Natural
a. Non-biological: earth quake, cyclone, flood, drought, heat wave, volcanic eruption, landslide, and recent one tsunami.
b. Biological: disease epidemic, mass poisoning (food/liquor).

II. Man-made
a. Accidental: Transportation [Road, rail, sea, river and air] building collapse, mining accidents, dam bursts, food poisoning, fires, football tragedies like Ibrox Park, Hillsborough, crush tragedies at Mecca and recent Uttar khand tragedy etc.
b. Industrial: Fires, explosions, leakages of toxic substances/gases
c. Civil Disturbances: Riots, and demonstrations
d. Warfare: Conventional [Bom bardment, exchange of fire, shell ing] and non-conventional [Nuclear, biological and chemical warfare and terrorism].

Main Objectives of Mass Disaster
1. Retrieval, reconstruction, examination, and early disposal of the bodies decently.
2. Establishing personal identity.
3. Conducting autopsy to establish cause of death, all necessary factual evidence needs to be obtained at the time of autopsy including samples for histology, toxico logical [especially alcohol and carbon monoxide], odontology, radiology, and DNA analysis and to assist in re constructing cause of the disaster.
4. Seeking evidence of the cause of the disaster from autopsy examination in the form of some foreign material, fragment of bomb or detonator that may be embedded in the bodies.

Management of Mass Disaster
It is primarily team work of the civil administration and its agencies especially the police on one hand a multi-disciplinary medical task force usually comprising of clinicians, nurses, para medical staff, odontologists, radiologists, forensic Pathologist, Forensic scientists, mortuary assistants and funeral officials, etc. on other hand, resources of armed forces may be called in to reinforce efforts.

Protocol for the Management of Disaster
Over the past couple of decades many countries have established Protocols for the management of disasters, often with the setting up of Disaster Victim Identification [DVI] teams.

Worldwide Disaster Management Authorities
Over the past two or three decades, many countries have established protocols for the management of the disasters, often with the setting up of disaster victim identification [DVI] teams. These teams usually include police, pathologists, dentists, radiologists, forensic scientists, mortuary assistants, embalmers and funeral directors, with provision for fingerprinting, forensic toxico logical and DNA analysis

A mass disaster, another term sometimes used synonymous with a Mass Fatality Incidents [MFI] is considered technically to be any incident resulting in the death more than one person; the practical definition of an MFI is the actual number of deceased determined to be an MFI on a local level and should be defined by the death investigation team. There are two main authorities overseeing death investigation in the USA, the medical examiner and the coroner. The goal of each system is the same, namely determination of the cause and manner of death for an individual dying in sudden, suspicious or traumatic circumstances.
The forensic pathologist brings a necessary expertise to an MFI, in every death investigation during an MFI identification and investigation. For all decedents the same questions apply the cause of the death and the identity of person; the core training and daily experience of the forensic pathologist makes him or her well suited to answer these questions. It is up to the forensic pathologist to ensure that professional protocols and procedures are followed, decedents properly identified and the accurate cause and manner of death assigned. It is not always possible to separate out these individual causes, it is the job of the forensic pathologist to try, even in the face of extreme adversity. It should be remembered throughout that flexibility and adaptation are key to a successful operation.

In 1990, the Royal College of Pathologists published a definitive guide for pathologists to the problems of mass disasters, which is strongly recommended as a standard set of procedures.

In many advanced countries, especially Britain the armed services have permanent aviation pathologists who deal with all service aircraft crashes anywhere in the world who are often available to deal with or attend as advisers any civil air disaster.

Indian Scenario
After tsunami disaster, Indian government also constituted the National Disaster Management Authority under the chairmanship of the Prime Minister with a vice chairman and five members in 2005.

Some Features Peculiar to Mass Disaster
Sudden occurrence, extensive damage of both life and property and lack of preparedness and delayed response. Panic and anxiety. Lack of timely and correct information and disruption of communications. Sometimes bureaucratic delay in decision making.

In most advanced and developing countries like India, each region now has a mass casualty plan covering medical and hospital services, fire service and police. This is covering every aspect of transfusion, drugs, casualty transport, emergency surgery and anaesthetia. The plans are clinically oriented but often completely ignore provision for the dead or they have some cursory statement at the end such as mortuary accommodation will be provided with obviously no thought given to how several hundred corpses are to be accommodated will be provided. Through clinical planning is of course vital especially in rail disasters, multiple motor crashes and urban bomb outrages it has to be appreciated that, in many air crashes, there are few if any survivors and that all the clinical planning may be redundant, leaving a massive and unprepared crisis in relation to the dead. It is essential that forensic pathologists should ensure that, in the area for which they are responsible, there is cooperative preplanning that includes adequate provision for collection, accommodation, and examination and disposal large numbers of dead victims. Naturally the pathologist is usually no position to do this alone, but he is often the person with the most foresight and professional knowledge to act as the stimulus and catalyst between the major agencies responsible for overall planning.

These are usually the police, military and the local health administration. When a mass casualty plan does exits, but the serious omissions in respect of dealing with the dead or where no such plan exits, the forensic pathologist should energetically stimulate the responsible authorities into making a compressive plan. This entails a series of meetings to identify danger areas in the region and to discuss potential buildings for temporary mortuaries, the provision of materials such as markers, plastic bags and labels, which may be needed in large quantities at a few hours’ notice. Communications between such groups as police, pathologists, mortuary and laboratory technicians, radiographers and dentists also need to be established in advance.

The Main Objective of the NDMA
The authority aim is a relief-centric approach to a holistic multidisiplinary and multisectoral approach. Because the circumstances differ so much from incident to incident, it is impossible to try and anticipate every contingency and draw detailed plans to cope with them [Walsh.1989]. Hence, protocols need be simple and flexible.

Isolation, Demarcation and Protection
Isolation, demarcation and protection of the site by security cordon and entry of the team through some predetermined route. Involvement of by-standers and other officials need be checked.

Scene of Disaster
Secure the disaster site. Prepare a sketch plan of the site showing parts of wreckage and position of the bodies. Take photographs of the site. Locate each body and label it with Mass causality card giving serial number. Mutilated bodies and fragmentary remains should also be labelled and numbered. Maintain the relationship between clothing and personal effects found at the scene and the respective remains. Transport bodies to mortuary as soon as possible.

The Problems Commonly Encountered during the Management
The greatest problem encountered in protecting the scene was the unauthorized attendance of police personnel and high ranking officials coming along to help. This occurred especially in the more high-profile cases, which were attended by great deal of publicity. Another problem is such visitors either contaminated or destroyed valuable evidence or got in the way. The left behind material initially thought to be valuable trace evidence, which was consequently, needlessly examined.

THE DISASTER MANAGEMENT PLAN SHOULD HAVE FOLLOWING FEATURES
Identification and Investigation
Both are not different exercises but are complimentary in similarities.

Medico Legal Expert’s Role and Responsibilities
A forensic pathologist as an investigative team member has a pivotal role in such situations. After emergency medical teams have satisfied themselves that all living survivors have been removed for treatment, the position of very corpse or body fragment must be marked, numbered and photographed. They must then be removed to a temporary mortuary close to the site, which has adequate lighting, and water connections, and communications facility a part of this building can be used as an autopsy hall. A team must be constituted comprising a forensic pathologist, forensic scientist and dentist to
undertake meticulous medico legal investigation. While management of mass disasters is done systematically in most western countries, the situation is unfortunately far from satisfactory in India."

Identification exercised as the major priority. Some forensic pathologists place it first in the list of medico legal expert’s responsibilities. Others take the view that identification is ultimately the responsibility of the police and that the medico-legal expert’s obligation to provide such information or evidence of identity as available stands ancillary to forensic pathologists’ responsibility towards investigation.

**Identification**

For each unknown remains, as well as for multiple remains, prepare photographs, diagrams, and tables for comparison between the unknown and known features examine for comparison with medical records eyeglasses, including frames and lenses. Look for contact lenses. Review reports of missing persons, statements of witness and relatives in mass disaster situations and content of passenger manifests provided by representatives of airlines following aircraft accidents. Examine, describe, record, and photograph the clothing and other physical evidence. Describe the size, colour, condition and type of each garment. Record the descriptions of laundry marks, labels, and name tags. Examine personal effects, such as rings, watches belt buckles, and bracelets for engraved markings. Determine if keys found on the remains provide access to the home or vehicle of the missing person. Obtain fingerprint patterns for comparison, remove and examine dentures if present. Examine teeth for comparison with ante mortem dental records and x-rays. Age can be determined by examination of ground sections of teeth. Examine denture for name and identification number.

Examine skeletal remains to determine race, sex, age, evidence of prior disease or injury, etc. Obtain blood for grouping, Rh typing, sex chromatin, karyotyping and DNA finger printing. Skiagrams of skull can be compared with films obtained during life. Occupation marks, moles, tattoos, operation scars, congenital defects, pre-existing disease, old injures and fractures, absence of organs and nails, plates etc. due to surgical procedures should be compared with medical and employment records. Compare hair with known hair. Confirm gross pathological findings by microscopic examination. Determine the age of ante mortem injuries. Retain tablets or capsules found in stomach. Preserve blood for alcohol, drugs, co, etc., establish and maintain a chain of custody for physical evidence. Body recovery: this stage starts once the person has been declared dead and properly tagged. The first thing that needs to be decided at this stage is whether the existing mortuary facilities are sufficient or a new, temporary set-up is required.

Visual recognition may not be helpful because of severe disfigurement due to trauma, burning, decomposition, etc. and emotional factors involved in visual recognition make it unwise to accept either a positive or negative response in such circumstances.

Belongings can be helpful and may include clothing, jewellery and personal documentation. Clothing found on a body can be of great value in establishing identity but must not be accepted as a positive proof in isolation. Jewellery being relatively fire-resistant can be very helpful especially unusual and strongly identifiable fragment is available.

It is secondary evidence must not always be assumed that the item belongs to the deceased or will be recognized by relatives and documents contain potential value but again being secondary evidence should not in their own be used to assume the identity of the deceased.

**Medical and X-ray Evidence**

May contribute or confirm identification. Medical or post-surgical condition is the more positive will be the identification of the body. Comparison of x-rays taken in life may be used when there is some abnormality as per medico legal point of view normal structures may be of such a variety that they can almost provide proof of personal identification, the cranial sinuses and the pituitary fossa are good examples.

**Forensic Odontology**

Has proven to be very helpful, especially when fire or putrefaction has destroyed the soft tissues. When this method is applicable dental records are need. Approximately 70-73% of the deceased were identified in Western countries, because Western people had dental work on them prior to disasters.

**Finger Printing**

Is another method of personal identification with well-established criteria for reliability. Fingers or finger prints may be destroyed in the event of fire or severe mutilation. For this reason, heel print records also some recommended, the heel being relatively better protected from fire or decomposition by shoes or boots by Western people.

**DNA-Profiling**

Has been shown to be of great value in identifying a wide range of human fluids and tissues, chiefly because DNA molecules remain highly stable in stains, are present virtually all human cells and are extremely polymorphic.

**Management of Survivors**

In case of survivors, establishing a system of Triage to determine priority for evacuation is the need of the hour. Colour coded tokens may be hung around the neck of injured. The colours recommended are includes: Category I[Red]-requiring resuscitation and emergency lifesaving surgery, Category II[Yellow]-requiring possible resuscitation surgery, and early surgery, Category III[Green]-less serious injury not endangered by delay, and Category IV[Black]-survival not likely.

**Difficulties in Forensic Services:** the forensic services encountered great difficulty in identification, display, handling, storage, recording and disposal of large number of dead bodies during the tsunami disaster in 2004 and Khadrynath in 2013.

**Cause of Disaster**

Evidence of organic diseases like coronary occlusion, cerebrovascular accident, etc. can produce sudden collapse in the pilot or driver. Evidence of poisoning due to alcohol psychotropic drugs affecting higher mental faculties. Explosion injuries with evidence retained explosive material suggest sabotage.
Role of the Police
Should be to cordon off the area to prevent improper handling of bodies and to rescue the survivors to correct the number of bodies and their position methodically and scientifically.

ROLE OF THE HOSPITAL
It should be the Hospital Documentation team which should undertake important duties such as:
- To establish proper communication between the hospital and other agencies involved in the rescue operations.
- To ensure the proper documentation and identification of the casualties.
- To ensure that the forensic expert get correct data regarding the casualties.
- To interview the casualties and other people present or those who visited the scene of incident for the reconstruction of the scene.

Triage
A French word, its meaning is to separate or sort or sift or select, it is used by emergency physicians or surgeons in the circumstances when medical resources are limited. Triage, thus means a process of giving priority to patients based on the severity of their condition and the chances of survival, so as to treat successfully as many patients as possible when resources are insufficient to treat all the patients simultaneously.

TYPES OF TRIAGE: SIMPLE TRIAGE AND ADVANCED TRIAGE
I. Simple Triage: it sorts the patients having serious injuries and needing immediate attention. It is done at the scene of mass disaster.

- It divided the Patients into Four Categories
  a. Those who are dead and do not need any help.
  b. Those injured who need urgent medical intervention and can be helped by immediate transport.
  c. Those injured who can wait and do not need immediate transport.
  d. Injured with minor injuries and not requiring urgent help.

Simple Triage can be done by paramedical staff and nurses.

II. Advanced Triage: the doctors treating the patients decide which patients are terminally injured and may not survive even with the best medical care. Such patients are removed from the treatment and those who are not seriously injured are first put on treatment so that their lives may be saved. Advanced Triage has to done only by skilled doctors.

Investigation of Mass Disaster
General principles apply to all mass disasters. After any catastrophic event, whether natural or man-made, once the scene is safe for emergency response personnel to enter the search and rescue teams under taken to find all survivors. When it becomes obvious that no survivors remain, the search and recovery teams begin. The team workers first be protected against potential hazards of the scene to which they will be exposed and appropriate personnel protective equipment for the biohazards. No intact bodies were recovered. Clothing and jewellery were kept on recovered body parts until they could be photographed and processed in the mortuary, in order to maintain the association of specific personal effects with specific body parts; the integrity of this association greatly facilitate the identification of the remains. The dental specimens recovered were radiographed and charted by a forensic odontologist. All remains that had portions of bone were radiographed. A forensic anthropologist assisted in the interpretation of radiographs for such features as ossification centers and also examined the bones from the children to correlate the findings. Recovered records were compared with ante mortem radiographs. Specimens from appropriate remains were retained for DNA profiling. Remains that were identified, regardless of the size the body part, were treat in dignified manner and placed in a regular-size coffin before being hand over to families. Personal effects were display and receipted over to family members who could identify the items.

DISCUSSION
Forward Planning
The role of forensic pathologists it is very difficult to conceptualize the forensic processing of a mass disaster and must see the common thread and apply professional protocols even in the face of extreme adversity. Forensic pathologists, in particular, are called upon to perform perhaps the most gruesome of duties detaining the physical aspects of the human carnage and helping to identify those who have perished. The involvement of forensic pathologists in the mass disaster scenario and how they can proceed with calm and efficiency, applying forensic techniques in mass fatalities. The duties of forensic pathologists are they will postmortem processes and focuses on investigations and autopsies to determine how people die.

Outline of Necessities in Mass Disaster Planning, Provision of Forensic Pathologists and other Staff
Depending up on the scale of the tragedy, it may be necessary to require to recruit other pathologists to assist in large cities there may be sufficient persons with expert forensic knowledge, but elsewhere, hospital pathologists from a distance may also volunteer. It has to remembered that a really large disaster may need many days or even weeks of work and therefore personnel may be unavailable for the whole the period. In addition whatever the degree of willingness and unselfish devotion offered by doctors and all other staff, the physical and especially psychological stresses of this harrowing work mean that strictly limited periods of work should imposed. Apart from the deleterious effect upon the doctor, the standard of work declines dramatically with fatigue and therefore it is in the interests of the investigation as well as of the pathologists that sufficient staff be required. This may however be easier said than done. One person must be in overall charge of the investigation. Usually a senior police officer has the ultimate responsibility, but the medical aspects should be firmly under the control of a senior pathologist, though he must delegate extensively to avoid being swamped by less important tasks and thereby being rendered totally inefficient. Again all these aspects are modified by the scale of the disaster. Proper facilities for meals, rest and washing must be established and again forward planning is essential for these mundane, but vital, features. Forensic dental and radiological expertise will be run independently by their own specialists, but there must still be a normal chief in the form of
the senior forensic pathologist who acts as overall coordinator and arbiter of medical matters.

When an aircraft crash occurs in some remote place or abroad where no satisfactory forensic pathologists' services, it is the usual practice for a team from the country of origin of the aircraft or a volunteer team arranged at governmental level to fly to the scene and provide expertise to the local authorities.

**Provision of Mortuary Facilities**

In India, most hospital mortuaries and even larger public mortuaries have limited storage capacity for bodies and even smaller provision for performing simultaneous autopsies. It must also be appreciated that normal functioning of a mortuary has to continue even through a mass disaster, so the massive increase in work is an addition to, not a substitution for the normal handling facilities. Where more than about ten bodies are involved most mortuaries cannot cope with these problems, especially when it has to be remembered that some of the corpses may have to be retained for considerably longer periods than usual if identification cannot be made rapidly. Thus external facilities will have to be provided in some temporary accommodation. When the disaster is a longer distance from the regular mortuary, transport and other logistic considerations may make it imperative to store and examine the bodies nearer to the crash site. Again forward planning is essential to identify hangars, storehouses, empty factories, halls and other building near potential danger spots such as airports, shipyards, major train transportation, main bus station and all religious famous temples, masjids, churches. Whenever possible, all bodies should be taken to one site, as the separation of the identification of sites is a recipe for inconvenience, delay and mistakes, it is sometimes necessary especially in remote regions to set up tented mortuaries but this is a last resort as facilities cannot be laid on with the same degree of efficiency. Where the mass disaster occurred is totally remote it is usual for the authorities or the armed services to bring out the dead by helicopter or other transport to an urban site. A prime example was the Kedarnath, Uttarkhand due to overcrowding, where the dead and survival were help by armed services. Temporary accommodation of factory/building in required size with minimum facilities are needed which are good electric lighting, portable lights for close inspection and power points for radiographic equipment and electric instruments are required. Adequate piped water and washing and toilet facilities are essential. If any of these is deficient then portable generators and water tankers must be supplied by the armed services or the police. Telephone and if possible telegram/fax facilities should be available for the input of identifying data. In hot climate or in the summer in temperate climates body refrigeration is vital, not only for the decent preservation of the dead but for retention of tissues awaiting identification. If a disaster is too large to be handled in the usual mortuary then some form of air conditioning cooling units can be installed in part of mortuary and refrigerated trucks used for the transport food stuffs is the usual answer and again preplanning is necessary to discover sources of such facilities in disasters where there are both living and dead victims, the mortuary should be sited away from the clinical facilities or screened in some way to avoid the distressing sight of bodies arriving being visible to survivors or their relatives and the press.

Temporary mortuary should be large enough for the expected load and the area to be used for examinations and autopsies should not be too congested. No one should be allowed in who does not have direct duties there, no matter of what eminence or rank. Security of admission should be tight, this being the responsibility of the police. Flooring should be water proof and capable of being hosed down. It can be protected against blood, mud and burned fragments by covering with polythene from large rolls. Tables for examination can be wooden trestles, covered with polythene. These should be in rows one meter apart with 2 meters between rows. 1, 6, 8

**Retrieval of Bodies**

This is task of the police or armed services, but must be carried out in a manner approved by the forensic identifying team. It is essential that everybody is first certified as dead by a doctor at the scene. Often volunteer casualty surgeons may be the first medical person at the scene, whose primary duty is to rescue living survivors and to confirm death in the remainder. Each body or fragment should be flagged with a sequential and unrepeatable serial number and marked on a grid plan, being photographed in situ wherever possible. It is then bagged and taken with its numbered label to the mortuary. Different teams will have different methods of dealing with the logistics of handling of data and increasingly this is being performed on either microcomputers or on terminals linked to a central computer. The police have responsibility for these aspects, as they collect and record the clothing and personal belongings that play such an important part in the personal identification. 6

Either the same serial number is used from the recovery stage or a different pathology number is begun in the mortuary, which must be matched up with the previous serial number. Everything that has come from that body including clothing, wallets, rings, teeth and jewellery must carry the same number.

The pathologist and lay assistants under the clothed bodies and dictate a description of what is found as accompanying artifacts. The clothes are stored in strong paper bags to avoid the fungal growth that inevitably appears on damp fabric kept in plastic bags.

Many items will have been found loose at the site, but they must all be tagged and an attempted made to relate them to a nearby body, though this is obviously fraught with error. The objects found on a body are recovered on an inventory form and a separate form [usually the Interpol document] used for the purely medical and anato-pathological aspects. The latter data are acquired by meticulous and systemic external examination, followed by an internal autopsy is this to be carried out.

Whether or not an autopsy is to be performed on some or all of the victims will depend upon facilities, availability of forensic pathologists. The legal direction and the system prevailing in the particular country. The wishes of the legal authority such as police or magistrate will be the deciding factor in the determining how many victims are subjected to autopsy. The forensic pathologist should exert his influence where there is reluctance to sanction any autopsies, emphasizing the benefit to the crash investigators of autopsy data on key victims. The forensic pathologists’ findings may
often be of use it has even been claimed that victims can be separated into different category.

As mentioned above, the aircrew or other persons in charge of a vehicle or train should always have a full examination and analysis of body fluids as part of the accident investigation. Full photography of the clothing and bodies should be taken and then all physical features such as height, weight, gender, race, colouring, scars, tattoos and deformities must be recorded. The forensic dental examination is then carried out on those bodies where obvious identity cannot be established by non-medical or dental means.

Radiological examination will almost always be required to assist in identification from osteological features and dental aspects and perhaps also to seek forging bodies that may assist in accident reconstruction, such as metal fragments blown upwards in to the thighs and buttocks in a hold explosion in an aircraft bomb or even parts of the bomb or detonator itself, more especially in land based or bicycle, motor cars, two vehicles, steel boxes set up based terrorist attacks.

Toxicology should be taken as extensively as possible even from some of those bodies that are not to have an autopsy. The data acquire from this painstaking work is then forwarded to the police department who have been collecting personal data from the records and relatives of the victims and efforts are made to match the two sets of data. This is increasingly being performed by computer and many efforts have been made by international agencies such as Interpol to set up universally compatible systems so that data can be acquired by and exchanged electronically via telephone systems and network from any of the world.

The forensic pathologist examines the scene and body, performs a complete autopsy and collects samples for toxicology, there are two important points are present in mass disaster investigation one is identify the dead and document their injuries and second one is determined the cause of the disaster.

In enormous disasters, when whole communities are wiped out, there can be little detailed investigations. The task would be far too great and the most that could be attempted would be identification of some of the dead bodies. Examination of the bodies of the victims by forensic pathologists is necessary for two main reasons:[i] to identify each dead body and to establish the cause of death for legal purposes so that a death certificate can be issued[ii] to discover evidence relating to the investigations of the disaster itself like obtaining sample for toxicological analysis where appropriate [iii] to find out the cause of the disaster itself e.g., bomb or detonator fragments that may be embedded in the bodies of the victims.

Scandinavian practice provides for the appointment by a prefect of police of an identification commission including a policeman, a doctor usually forensic pathologist and a dentist, whenever the need arises by reason of mass disaster or crime. This commission collects evidence of identity of the bodies recovered, each member working in his own field of competence and jointly it reviews all the evidence and determines whether or not in each the evidence warrants a particular identity being assigned to a particular body. ⁶

In India, no such practice is followed and collection of evidence at the site as well as shifting the bodies to the mortuary is the role of the police officials. The cooperation of forensic pathologist and the police can be conveniently considered in three phases.

First phase [At the Accident Site]
In this stage the most important aspect is to make sure that survivors are rescued and should save the life without any delay. Evidence should be preserved that may contribute both to their identification and to the investigation of the accident. The first task should be to locate bodies, label them with a number, photographing them in situ and preparing a plan of the disaster site showing scene of disaster and position of bodies. Exact location of a body at a site may prove to be very important, whatever the disaster. Work of identification of the bodies should be under taken and reconstruction from medical evidence, bodies labelled semitransparent to the numbered label attached to a body without need for further labelling to facilitate carrying, photographed and record made of their precise position. Record each body and place it in a suitable container for transfer to mortuary. Make sure that things belonging to one body are not assigned to another and polythene cover can be used for cover it. Media room a temporary room may constructed and news regarding the victims may be provided to the press as well as relatives periodically. Counselling room the counsellors to be there for counselling of relatives of the victims and if not possible at the site then near the mortuary counselling should be carried out.

Second Phase [In the Mortuary]
In the mortuary accommodation and particular refrigeration are likely to be problems following any major disaster. Bodies should be dispersed to numerous small mortuaries but preferably a building suitable size to be designated a temporary mortuary, for a coordinated investigation, where there is sufficient space and light can be used in certain types of disaster, where identification is not difficult and evidence in the bodies cannot contribute in any way to a reconstruction or explanation of the accident, only external examination may be required. As a rule, in aircraft accidents, a full autopsy is required from the point of view of accident investigation itself, then better facilities such as a properly equipped autopsy rooms becomes essential.

It is ideal to have in close proximity an autopsy room, refrigerated mortuary accommodation, an area for embalming and casketing room for interviewing relatives and viewing bodies, a suitable room for use as a communication headquarters. The ideal is likely to be most closely approached when there has been pre-planning by the appropriate local authorities particularly police, before a disaster situation of medium to considerable magnitude occurs, with decisions having been taken in advance about what accommodation could be brought into use in the event of a disaster of particular size.

The procedures in the mortuary should be a matter for team work involving at least a forensic pathologist and a police officer, usually a forensic odontologist and occasionally other specialists such as a radiologist, when appropriate to the particular circumstances and conditions of the bodies.

It is always important to count the number of bodies recovered. This is easy enough when there has been little or no mutilation and fragmentation, but when the traumatic forces of the accident have been serve, the total number of items of
human remains recovered may far exceed the number of persons killed.

**Primary Identification**
A team that could apply either to the first clue to identity discovered in a given instance, whether it be strong or insubstantial evidential, or to the most valuable clue, judged in retrospect, when all evidence has been adduced. The categorization of pieces of evidence as primary or secondary is probably of little practical consequence that is seek routinely from the outset to establish identity by all or several of the different means and not to rest content unless identity has been established and confirmed by at least two different means if at all possible. Visual identification is standard method used for by police to establish identity of a dead body and its value is considerably reduced in burn disaster. Another method, photographs of distinctive clothing, personal possessions or physical characteristics may be recognized if facial features are damaged. The initial and subsequent photography is essential to make a photographic record to relate, body, site, and cadaver numbers. After initial photography clothing and jewellery must be removed from the body, examined and catalogued; this is primary for identification purposes.

**Examination of Clothing**
Evidence of vomit, blood or stains upon clothing may prove useful and any marks on clothing like manufacturers label or laundry marks also prove valuable. Examination of clothing is necessary to find out any damage to clothing due to the accident sequence or bomb explosion.

**External Examination**
To determine sex, height, weight, hair colour location and abundance of hair, colour of eyes and skin. Any anatomical, surgical, traumatic scars and tattoos or birth marks, abnormalities such as congenital or acquired. Injury sustained during the accident related to cause of death. In case of blast injuries, trace evidences may have been preserved.

**Radiographic Examination**
Ideally, complete set of skeletal x-rays should be taken for each victim, in case of suspicion of sabotage, full skeletal radiography is required. Radiographs are helpful in identification in case of extremely burnt body and they are also helpful in revealing the presence of articles embedded deeply in charred muscle that may be overlooked otherwise. A permanent record of bone injuries is obtained that reduces the time spent in assessing and recording these during autopsy.

**Full Internal Autopsy**
Evidence relevant to identification will be collected such as surgical absence of internal organs, presence of postsurgical states like gastroenterostomy and evidence of pre-existing disease, any internal injury, precise cause of death. Histological examination at the end of the autopsy, dentist should make an examination of the jaws and teeth; value of dental evidence in identification has become widely recognized after the work of a Scandinavian forensic odontologist such as Strom, Keiser Nielsen and Gustafson, a positive identification can be made when there are a number of points of similarity as between teeth missing and points of matching in restorations by a particular tooth and surface and when there are no incompatible inconsistencies, minimum number of points similarity [7 or 8] are required for a confident identification, but each case must be judged on its merits by forensic odontologist, a tooth present in a cadaver recorded as extracted in a known person or an intact tooth in the body recorded as having been filled in the known person’s chart, is an incompatible inconsistency; it can only be disregarded in the face of overwhelming forceful evidence that the inconsistency is due to miscasting of other artefact perhaps in the telegraphed transmission of the dental notes or chart; in context of mass disaster in which traumatic forces are severe the value of dental charts is reduced and the value of radiographs is evidenced, it is quite common for a body to have retained one or two fragments of jaw, perhaps with one or two teeth. If an ante mortem radiograph of the relevant part of the dentition is available, it may prove to be of greatest possible value for comparison with the postmortem radiograph of the fragments recovered e.g., aircraft accidents. When mass disaster involves quite unknown persons, is usually the case in a department store fire or railway disaster, the reconstructive value of dental evidence is more often utilized. Our point of view teeth may reveal about its owner, country of origin from restorative work, occupation and age. Analysis of race in cranium, and cephalic index, identification of scars of parturition, other symphysisal changes in the skeletal remains of female and neutron activation of analysis of hair are also used.

Last task to be performed in the mortuary is the examination of any fragments of bodies, with as far as possible, matching of those fragments with the bodies from which they originated and cause of the accident can be ascertained.

**Third Phase [Comparison of Records and Identification]**
Identification of bodies depends upon accurate information about those who are believed to have been involved. When the persons killed are of the country in which the disaster occurs, it is probable that normal police communication system is the best for collection of required information. During recent years, the need for practical record forms in the context of a mass disaster has come to be appreciated. Australian police, Interpol has produced a disaster victim identification form framed by Royal Air Force Aviation Pathology Department. These forms four different coloured forms and a white one. Two of the coloured forms are for the males, other two for the females; white form is form missing persons. one of the coloured forms is for external feature of the body and the other is for autopsy findings. These are kept in transparent envelop upon completion and since they are coloured, on single sheets of paper, the subsequent exercise of matching records and proving; the identification of bodies is much more simplified. In India no such forms are available and all the information related to identification should be a post mortem report.

**Review of Evidence and Accident Reconstruction**
In some disaster the pathological examination of bodies of victims, can achieve beyond proving evidence leading to identification and confirmation of an obvious cause of death. Compressive pathological investigation can help a great deal to reconstruct the accident, sometimes to the extent of revealing the cause, through more often helping to encode
possible causes. Sometimes a serious disease is revealed as a likely cause of an accident. Routinely toxicological tests on the tissues of human bodies also reveal a cause of death like CO poisoning in disaster due to navigational error. Injuries in passengers and their correlation with damage to seat structures and other solid structures is also helpful in knowing the relative safety of different parts of aircrafts/other vehicles and how to improve them to prevent such disasters.

CONCLUSION
- Collect complete toxicology samples from the driver or pilot.
- Be aware of the many possible ways for identifying victims.
- Seek help of when the scope of the disaster is greater than team can handle.
- Exclude natural disease in the pilot which may cause disaster.
- Modify mass disaster plan according to the disaster at hand.
- Collect pertinent information from other investigation team.
- Do not forget x-rays hands and feet of the pilot or driver.
- Do not exclude suicide or homicide until the investigation is completed.
- Do not panic in mass disasters.
- Do not forget to consider the safety of all personnel involved in the investigation.

REFERENCES