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Short communication

Use of radiography and fluoroscopy in Disaster Victim Identification Positional statement of the members of the Disaster Victim Identification working group of the International Society of Forensic Radiology and Imaging

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Medical Imaging has an established role in the forensic investigation of death and has been used extensively in the investigation of mass fatalities. Imaging is applicable to human, animal and environmental material [1–8].

The exact requirements for medical imaging in a mass fatality incident will depend on the nature of the incident. However, experience from previous large-scale incidents involving aircraft, terrorist attacks and acts of genocide has emphasised the need for imaging facilities to be available on-site in the Major Incident Mortuary [9–12].

In such incidents we recommend that the main purpose for imaging will be

1. Disaster Victim Identification (DVI).
2. Identifying the cause of, and contributory factors to death.
3. Identifying potential hazardous materials within the body.
4. Gathering evidence for criminal justice procedures.

We propose the following processes and workflow in order to achieve integration with the DVI mortuary processes.

In providing these recommendations the authors recognise that the "professional titles" of staff involved in a DVI process may differ, depending on the country where the investigation occurs. Therefore, where a particular "professional title" is used in this document it does not preclude another member of staff performing this task, as long as they are trained or supervised to the standard expected of the staff grade stated for the specific task discussed.

1. Body handling

The safe handling of bodies or other material is beyond the scope of this document. However the imaging equipment and staff must work within the appropriate body handling protocols for a particular event. When the body is delivered to the imaging area it

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must be placed on the radiography/scan table, ideally in an anatomic supine "head-up" position.

2. Radiography

It is recommended that forensically-trained radiographers or appropriately trained cadaver imaging technicians undertake the radiography examinations required for DVI purposes. In jurisdictions where this is not currently possible, it is recommended that examinations take place under the supervision of the forensic pathologist. For brevity, the rest of this positional paper will refer to the forensically trained staff performing imaging as "radiographers".

3. Workflow

We propose that a workflow based on the principal of primary, secondary and tertiary survey should be undertaken as outlined below. A primary survey should be undertaken in all cases. Whether there is a requirement to undertake a secondary or tertiary survey will be dependent upon the incident, DVI question to be addressed and radiological methods employed.

3.1. The primary survey

It is advised that this should be undertaken in all cases for the initial examination of all bodies and body parts at the mortuary. It should occur prior to examination by any other member of the DVI team, with the exception of the Hazardous Materials Identification Team in a Chemical, Biological, Radiological or Nuclear (CBRN) incident.

Bodies are taken directly from the body store to the primary survey area. Imaging for the primary survey should be performed without breaking the seal of the body bag. The entire body bag should be scanned in every case, as evidence may have become detached from the palpable body or body parts. A primary survey may be undertaken using fluoroscopy, Digital X-ray or multi-detector computed tomography (MDCT) scanning.

The primary examination will yield some or all of the following information about the contents of the body bag:

- Whole cadaver or body part, with description of anatomical parts seen.
- Indication as to whether body parts of more than one individual are present (if possible).
- Indication of whether any non-human body parts are present.
- Location and nature (if possible) of any hazardous material, e.g. unexploded ordnance, metallic sharps, glass etc.
- Location of any projectile fragments with possible associated bony injury.
- Location of personal effects (particularly useful in cases of cremated bodies, where these artefacts mat be difficult to locate visually).
- Presence of any unique identifying features that may require further radiographic investigation following autopsy and/or odontology.

3.1.1. MDCT

The use of MDCT imaging is covered by a separate positional statement (8). It should be noted that in certain circumstances computed tomography scanning has significant advantages. In such cases, the use of MDCT for the primary survey may negate further imaging (including radiography for identification and dental imaging (the later as determined by the forensic odontologist).

3.1.2. Fluoroscopy

Ideally, the examination should be undertaken by two radiographers together with the forensic pathologist recording the information. Alternatively two radiographers may undertake the examination, making a written record of the appearances for the forensic pathologist to refer to when undertaking the "strip and search" and external examination of the body.

The examination should be conducted without breaking the seal of the body bag. The bag should be placed on the fluoroscopy couch in the supine position if possible. A large field-of-view C-arm fluoroscopy unit is preferred. The entire body bag should be screened from one end to the other, making several sweeps and adjusting the position of the cross arm to ensure that all areas are covered.

A written record of appearances should be made and the position of specific items noted diagrammatically as detailed below. Digital "spot" images should be made of specific artefacts and anatomical features as required. Images must be correctly recorded with the case number, date, time and radiographers' initials.

The written record, together with any images produced should be handed over to the appropriate DVI officer, and a written record of this transfer should be made.

3.1.3. Radiography (Direct Digital X-ray (DR), Indirect Digital X-ray (CR) or film)

Two radiographers should undertake the examination. DR is the method of choice and in all cases, a radiography table with a film or "Bucky" tray should ideally be used. The examination should be conducted without breaking the seal of the body bag. The bag should be placed on the radiography table in the supine position if possible.

Large size (35 cm × 43 cm) DR sensors, CR plates or film cassettes should be used and placed cross-wise in the film tray. Radiographs of the entire body bag from one end to the other should be made ensuring that all areas are covered. The left and right sides of the bag must be indicated on the images unless the position of the body in the bag is known with certainty; in such a case the correct anatomical markers should be used. A written record of the images, together with all images produced should be handed over to an appropriate DVI officer and a written record of this transfer should be made.

Following primary survey; the body bag will be transferred either back to a secure storage area or directly to the DVI area for examination. It should be noted that in some cases it will be necessary to return the cadaver or clothing/effects to the primary survey team if artefacts identified at the primary survey cannot be found.

3.2. The secondary survey

Direct digital radiographic examination may prove useful for identification by demonstrating the presence of unique dental and skeletal features, which have been previously documented in ante-mortem records. Standard practice in many previous mass fatality incidents has been for complete skeletal survey (antero-posterior (AP) and lateral radiography) of all bodies and body parts. However, the use of MDCT, high definition digital fluoroscopy or radiography for the primary survey should provide sufficient information in the majority of cases and the additional time taken for a full AP and lateral radiography secondary survey does not justify its application as a routine. A full dental radiography survey is however recommended in all cases.