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## **RCR/RCPPath statement on standards for medico-legal post-mortem cross-sectional imaging in adults**

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## Introduction

### Audience

This document is intended to be read by:

- those commissioning or authorising post-mortem examinations for medico-legal purposes (Coroners, Coroner's officers, Procurators Fiscal, service managers)
- pathologists who conduct post-mortem examinations on behalf of a legal authority
- radiologists who perform or interpret post-mortem cross-sectional imaging studies
- others interested in the use of imaging as a means of establishing a cause of death and as an alternative to an invasive autopsy.

### Area of practice

This statement applies to post-mortem examinations being performed for medico-legal purposes, but **excluding** those performed where criminal proceedings are in prospect (forensic examinations).

### Purpose

The document sets out:

- the scope and limitations of cross-sectional post-mortem imaging as an alternative to an autopsy and as a means of reliably establishing a cause of death in adults
- standards that should be in place when such a service is being commissioned or an examination is being authorised by a legal authority
- priorities for further work in development of this form of post-mortem examination.

## **Section A Information for those authorising post-mortem examinations**

### **1 Background**

- 1.1 The system of death registration in England and Wales leads to a higher rate of autopsy than is the case in most other Western countries; over 20% of all deaths in England in 2008 resulted in an autopsy.<sup>1</sup>
- 1.2 There have been calls to find an alternative means for establishing a cause of death other than through an autopsy, in particular from communities who have religious or cultural objections.
- 1.3 Concerns have also been raised about the quality of coronial autopsy reports in England and Wales, with the finding that the cause of death given following autopsy appeared questionable in about 20% of cases following an audit.<sup>2</sup>
- 1.4 There is a long history of radiographic imaging being used as an adjunct to invasive autopsy, mainly for the depiction of fractures and foreign bodies. In the last few years it has been appreciated that the use of post-mortem cross-sectional imaging, including multidetector computed tomography (CT) and magnetic resonance imaging (MRI), can add significantly to the information available from plain radiography, particularly in the setting of trauma,<sup>3</sup> in service personnel deaths,<sup>4</sup> and in disaster victim identification.<sup>5,6</sup>
- 1.5 At present in the UK, expertise in post-mortem cross-sectional imaging interpretation resides in a very small number of centres.
- 1.6 This area of work was perceived to lack appropriate appraisal of its use in clinical practice and published guidance.
- 1.7 A working party was established jointly by The Royal College of Pathologists and Royal College of Radiologists to review practice in this area and provide practice guidelines (Appendix B).

### **2 Limitations in the use of cross-sectional imaging to establish a cause of death**

- 2.1 At present, there are only a limited number of causes of natural death for which, in the right circumstances, imaging alone can be relied upon to provide an accurate diagnosis. These are mainly catastrophic haemorrhagic events such as acute intracerebral haemorrhage and ruptured aortic aneurysm. These account for a minority of deaths in the community.
- 2.2 In cases of death as a result of major trauma, imaging can sometimes demonstrate the nature and extent of injuries better than invasive autopsy.<sup>5</sup>
- 2.3 Imaging can also reliably demonstrate features which may have contributed to death, as in cases of disseminated malignancy, where the presence and location of metastatic deposits can be determined with a high degree of accuracy. This may be supplemented by image-guided needle sampling to provide a histological diagnosis.<sup>7</sup>
- 2.4 Post-mortem imaging cannot reliably diagnose some of the most common causes of death including coronary heart disease, pulmonary thromboembolism and pneumonia. Research is ongoing to try to improve imaging diagnosis of cardiovascular causes of death in particular through the use of post-mortem CT angiography, a minimally invasive adjunct to a standard CT examination.<sup>8-11</sup>

In the largest study comparing post-mortem imaging with invasive autopsy, radiologists using a consensus of CT and MRI findings indicated that invasive autopsy was not needed in 48%

of cases. In these cases, the major discrepancy rate compared with invasive autopsy was 16%.<sup>12</sup> However, imaging may still be used to plan further investigation and can allow the scope of a subsequent invasive autopsy procedure to be restricted or confined to a certain area of the body.

- 2.5 The decision as to whether or not an invasive autopsy is necessary can only be made after the post-mortem imaging result has been analysed.

### **3 The use of CT or MRI as the technique of choice is based on limited evidence**

- 3.1 The majority of the peer-reviewed literature concerning post-mortem cross-sectional imaging has described the use of CT rather than MRI. This is partly because of the superiority of CT for the detection of fractures in the situation of traumatic death, and partly due to greater availability of CT scanners.
- 3.2 MRI may have potential theoretical advantages in some circumstances, for example in assessing deep soft tissue bruising and in myocardial infarction, but there is as yet limited research in these areas.
- 3.3 In the largest comparative study published to date, comparing both modalities with invasive autopsy in unselected cases, CT had a major discrepancy rate with invasive autopsy of 32%, whilst for MRI the figure was 43%.<sup>12</sup>
- 3.4 Therefore, those commissioning or authorising cross-sectional post-mortem imaging should be aware that it cannot replace all invasive autopsies, and should seek expert advice where any issue is raised over suitability of CT or MRI in any diagnostic context.

## **Section B Standards for service delivery of cross-sectional post-mortem imaging**

### **4 Standard: information provision for the bereaved and/or their representatives**

- 4.1 When cross-sectional imaging is being used to establish a cause of death, a formal process must be in place, including the provision of written materials, which clearly explains to the bereaved and/or their representatives that post-mortem imaging has significant limitations, being unable to confirm some of the most common causes of death, and that in many cases an invasive autopsy will subsequently also be required.

### **5 Standard: A cause of death based upon post-mortem imaging must be delivered in the context of a multidisciplinary team investigating the death**

- 5.1 In any authorised examination, a pathologist must retain a central coordinating role in the establishment of the cause of death, working closely with practitioners who perform and interpret post-mortem imaging studies.
- 5.2 In cross-sectional imaging of the living, interpretation of the images is based whenever possible on knowledge of the history and clinical examination findings and laboratory tests. This is equally important when considering imaging of the dead. Therefore, full clinical information must be available to those interpreting post-mortem imaging studies. Interpretation of cross-sectional imaging should be undertaken by a radiologist or another medical practitioner with the necessary competence.
- 5.3 Imaging based post-mortem examination should never be undertaken without an expert external examination of the body having first been performed by an appropriately trained and experienced individual, either a pathologist or another practitioner trained to undertake the procedure and working under the governance of a lead pathologist. A written record of this examination should be made available to the competent medical practitioner interpreting imaging studies.
- 5.4 After imaging has been performed, there must be an opportunity for the pathologist and the relevant legal authority to discuss the findings and images with the competent medical practitioner in order to determine whether an invasive post-mortem examination is required and, if so, what its scope should be. Systems should be in place to ensure that this standard is met.

### **6 Standard: Where blood-based samples are required for diagnostic purposes, these must be obtained before the use of non-targeted angiography**

- 6.1 The use of contrast media, including air, to improve the accuracy of post-mortem cross-sectional imaging can potentially compromise the results of toxicology.

### **7 Standard: Formal agreements must be in place with service providers**

- 7.1 In order to minimise costs and inconvenience to users of a service, it is desirable that service agreements are established to perform imaging examinations as close to the site of body storage as possible. The Human Tissue Authority (HTA) has confirmed that non-invasive post-mortem examination does not need to be performed on HTA-licensed premises.
- 7.2 It should be possible to carry out post-mortem CT examinations in most NHS or independent sector CT facilities, subject to local service agreements being in place and given a standard of equipment suitable to deliver recommended imaging protocols. (An example CT protocol is attached to this document as Appendix A).

7.3 As currently only a limited number of individuals in the UK possess the skills to carry out such post-mortem image interpretation, remote reporting through teleradiology links can be used, but in this case service agreements must be put in place to facilitate multidisciplinary discussion between the interpreting radiologist, the pathologist who has performed the external examination and the Coroner or other relevant legal authority as appropriate.

**8 Standard: Those performing post-mortem imaging studies should be appropriately qualified and trained**

8.1 Those commissioning or authorising cross-sectional post-mortem imaging should ensure themselves that those providing the service are appropriately qualified and trained.

8.2 Interpretation of whole-body cross-sectional imaging should be performed by a radiologist holding the FRCR qualification or a medical practitioner with equivalent competencies in cross-sectional imaging, aware of the full range of normal and abnormal appearances. It is essential that the individual should be working as part of a multidisciplinary team.

8.3 The radiological skills required to interpret post-mortem CT and MRI are broadly the same as those required to interpret cross-sectional imaging in the living. Additional training for radiologists is required, particularly in the range of normal appearances after death, including the effects of decomposition, and mechanisms of death and in the limitations of the scanning techniques in imaging the dead.

8.4 Knowledge of the process and language of death investigation is desirable.

**9 Standard: Services providing cross-sectional post-mortem imaging should be subject to audit**

9.1 Current evidence suggests that post-mortem imaging with CT, MRI or both techniques without the use of contrast material is able to make an accurate diagnosis in approximately 50% of cases.<sup>12</sup> If a service is providing a definitive diagnosis in significantly more than 50% of cases, it follows that a number of these diagnoses will be incorrect.

9.2 Therefore those providing a service should regularly review the proportion of cases in which a definitive diagnosis is being made.

9.3 Systems should also be in place for those commissioning or authorising examinations to regularly review the proportion of cases in which a definitive diagnosis is being made by the service provider, and to take action to address any concerns.

## **Section C Development**

### **10 Priorities for development**

- 10.1 At national level, there should be further communication with, and education of, the public and voluntary sector to ensure that faith groups and other interested stakeholders are aware of the current limitations of cross-sectional post-mortem imaging. This should help guard against providers who do not meet these published practice guidelines being able to offer services to those who are bereaved.
- 10.2 At present, most units around the world delivering a post-mortem imaging service use CT. Further research into understanding the strengths and weaknesses of both CT and MRI should be encouraged.
- 10.3 There is scope for certain technical aspects of imaging procedures to be carried out by non-medical staff such as radiographers, anatomical pathology technologists or other suitably trained technicians. These could include, for example, the administration of contrast material if post-mortem CT angiography is confirmed by ongoing research as a valuable technique.
- 10.4 The Royal College of Pathologists and Royal College of Radiologists will work together to produce a competency framework for all those medical practitioners wishing to work in this field.



## Section D References

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## Appendix A Example CT protocol for cadaver scanning

	<b>Brain</b> Angled C2	<b>Head and neck</b> Straight tube to T2	<b>Chest</b> To include all ribs	<b>Abdomen/pelvis</b> Above diaphragm to below symphysis pubis	<b>Lower limb</b> Iliac crests to below feet
kV	120	120	120	120	120
mA	300	300	300	300	300
Rotation time	0.75	0.75	0.5	0.5	0.5
Range	350	350	600	600	850
FOV	320 – M	320 – M	400 – L	400 – L	400 – L
Thickness	0.5 x 32	0.5 x 32	0.5 x 64	0.5 x 64	0.5 x 64
Recon – thickness interval	1 0.8	1 0.8	2 1.6	2 1.6	2 1.6
Pitch factor	0.656	0.656	0.828	0.828	0.641
Helical pitch	21.0	21.0	53	53	41
Recon window	Brain	Body standard Bone sharp	Body standard Bone sharp	Body standard Bone sharp	Body standard Bone sharp

### Notes

- This protocol was devised for use with a Toshiba Aquilion 64 slice scanner but should be readily modified for use with other types of multidetector CT scanner.
- The main reason for scanning the head with both an angled and straight tube is to avoid dental artefact across the posterior fossa.
- Boost (metal artefact reduction) is on for all scans.
- Body is split into two areas to make smaller file sizes for image manipulation.
- 2 mm slice thickness in body to avoid data handling and data storage issues.
- Auto mA not used. Scans performed at higher mA than clinical scanning.
- Large field of view used as body, arm and limb positioning can be difficult.

## **Appendix B          Membership of the working party**

Dr Emyr Benbow	The Royal College of Pathologists
Dr Giles Maskell	The Royal College of Radiologists (co-chair)
Professor Bruno Morgan	The Royal College of Radiologists
Dr Roy Palmer	Coroners Society of England and Wales
Professor Ian Roberts	The Royal College of Pathologists
Professor Guy Ruttly	The Royal College of Pathologists
Professor Andrew Taylor	The Royal College of Radiologists
Dr Zoe Traill	The Royal College of Radiologists
Professor Michael Wells	The Royal College of Pathologists (co-chair)