The Royal College of Pathologists
Pathology: the science behind the cure

Guidelines on autopsy practice:

Deaths following known or suspected hanging

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NICE has accredited the process used by The Royal College of Pathologists to produce its autopsy guidelines. Accreditation is valid for 5 years from 25 July 2017. More information on accreditation can be viewed at www.nice.org.uk/accreditation.

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Foreword

The autopsy guidelines published by The Royal College of Pathologists (RCPath) should enable pathologists to deal with non-forensic consented and medicolegally authorised post mortems in a consistent manner and to a high standard. The guidelines are systematically developed statements to assist the decisions of practitioners and are based on the best available evidence at the time the document was prepared. Given that much autopsy work is single observer and one-time only in reality, it must be recognised that there is no reviewable standard that is mandated beyond that of the FRCPath Part 2 exam or the Certificate of Higher Autopsy Training (CHAT). Nevertheless, much of this can be reviewed against ante-mortem imaging and/or other data. This guideline has been developed to cover most common circumstances. However, we recognise that guidelines cannot anticipate every pathology and clinical scenario. Occasional variation from the practice recommended in this guideline may therefore be required to report a death in a way that is maximally beneficial to pathologists, the Coroner/Procurator Fiscal and the deceased's family.

There is a general requirement from the General Medical Council (GMC) to have continuing professional development (CPD) in all practice areas and this will naturally encompass autopsy practice. Those wishing to develop expertise/specialise in autopsy pathology are encouraged to seek appropriate educational opportunities and participate in a relevant external quality assurance (EQA) scheme.

The guidelines themselves constitute the tools for implementation and dissemination of good practice.

The following stakeholders will be contacted to consult on this document:

- the Forensic Pathology Specialist Group of the Forensic Science Regulator
- the Human Tissue Authority.

The information used to develop this autopsy guideline was obtained by undertaking a systematic search of PubMed. Key terms searched included hanging, suspension, post mortem, necropsy and autopsy; dates searched were between January 2012 and December 2022. However, much of the content of the document represents custom and practice and is substantially based upon clinical experience. Consensus of evidence in the guideline was achieved by review, with College members providing feedback during consultation. The sections of this autopsy guideline that indicate compliance with each of the AGREE II standards are indicated in Appendix B. Published evidence was evaluated using modified SIGN guidance (see Appendix A). Gaps in the evidence will be identified by College members via feedback received during consultation.

No major organisational changes or cost implications have been identified that would hinder the implementation of these guidelines.

A formal revision process for all guidelines takes place on a five-year cycle. The College will ask the authors of the guideline to consider whether or not the guideline needs to be revised. A full consultation process will be undertaken if major revisions are required. If minor revisions or changes are required, whereby a short note of the proposed changes will be placed on the College website for two weeks for members' attention. If members do not object to the changes, the short notice of change will be incorporated into the guideline and the full revised version (incorporating the changes) will replace the existing version on the College website.

The guideline has been reviewed by the Professional Guidelines team, Death Investigation Committee, Human Tissue Authority, Specialty Advisory Committee and Lay Advisory Group. It was placed on the College website for consultation with the membership from 28 February to 28 March. All comments received from the membership were addressed by the author to the satisfaction of the Clinical Lead for Guideline Review.

This guideline was developed without external funding to the writing group. The College requires the authors of guidelines to provide a list of potential conflicts of interest; these are monitored by the Professional Guidelines team and are available on request. The authors of this document have declared that there are no conflicts of interest.

1 Introduction

These guidelines have been compiled to provide advice to autopsy pathologists who may be required to perform examinations on bodies that have been recovered from a point of suspension. By the nature of the circumstances, such examinations will generally be instructed by the Coroner, Procurator Fiscal or similar legal authority.

1.1 Target users and health benefits of this guideline

The target primary users of this guideline are consultant histopathologists who undertake routine Coronial and Procurator Fiscal post-mortem examinations.

The recommendations will also be of value to trainees preparing for the Certificate of Higher Autopsy Training (CHAT) and the FRCPath Part 2 or the Diploma in Forensic Pathology.

2 The role of the autopsy

Hanging may be defined as a form of ligature strangulation whereby a band of pressure tightens across or around the neck, produced through the act of gravity upon the body or part of the body.

The investigation should focus on the need to assist with the duties of the instructing body, in particular the recognition of the manner and cause of death.

The purpose of the autopsy is to confirm the mechanism of death and to ascertain whether the ligature was placed prior to, or after, death.[1] The conclusions regarding the possibility of self-suspension (by accidental or purposeful means), or the involvement of another party ultimately rest with the instructing party. However, it is the duty of the pathologist to fully examine for injuries or signs that might support or refute either suggestion. Clearly, recognition of injuries that might point to suspicious circumstances should result in suspension of the examination and communication with the Coroner/Procurator Fiscal as to the findings, such that a forensic examination may be undertaken.

Finally, a further role of the autopsy is to establish any factors of relevance for the investigation by the instructing body, such as the presence or absence of natural disease and the results of toxicological analyses.

It should be recognised that any autopsy is challenging on numerous levels and requires sufficient professional time and mortuary staff support to properly address the issues arising from the death, many of which cannot be addressed through external-only examinations.

3 Potential pathology encountered at the autopsy

The potential pathological findings that may be encountered at autopsy are described in Table 1.

Table 1: Pathological findings that may be observed upon external and internal examination, in cases of hanging.[2]

External examination
1. Ligature: • material (including any pattern that might replicate on the skin surface) • type of knot (running or fixed; specific type of knot) • number of loops around neck • position of the knot or other prominent feature (e.g. buckle) • dimensions for comparison against ligature mark. **2. Face:** • petechiae (more commonly seen in incomplete hangings) – presence or absence – number and distribution (including eyelids, sclerae and conjunctivae, retro-auricular) • protrusion of the tongue due to upward pressure from the ligature • possible dried saliva trail from the corner of the mouth contralateral to the point of suspension. **3. Neck:** • ligature mark – dimension (broad or narrow type ligature) – depth – appearance (colour, markings from ligature material) – course around neck and point of suspension – possible bleeding into skin ridges formed between two loops of a ligature • decapitation (partial or complete) – associated with long drop suspension • additional surface injuries, especially those inconsistent with suspension. **4. Lividity:** • presence or absence • distribution, e.g. circumferential petechial lividity to the lower legs with complete suspension. **5. Other injuries:** • evidence of medical intervention • evidence of self-harm (e.g. recent wounds or scars to forearms) • any other injuries (especially those inconsistent with self-suspension or cutting down).

Internal examination
1. Fascial haemorrhage. **2. Bruising:** • to strap muscles • thyroid gland • carotid sheath and its contents. **3. Laryngeal bleeding and fracture:** • thyroid horns or body (bilateral or unilateral) • cricoid fracture **4. Hyoid fracture:** • greater horns • fibrocartilage joint. **5. Vascular injuries** (see Table 2). **6. Ligamentous and bony injury to cervical spine, and associated damage to spinal cord.**

4 Specific health and safety aspects

If there is any suggestion in the history of blood-borne viruses, intravenous drug abuse or tuberculosis, then the autopsy is best considered high-risk and the appropriate precautions should be taken. Post-mortem imaging might also provide a means of recognition of occult tuberculosis. Further information regarding safe working and the prevention of infection in the mortuary and post-mortem room can be found at www.hse.gov.uk.

[Level of evidence – GPP.]

5 Clinical information relevant to the autopsy

- A complete and appropriate collateral history of events surrounding the death (as is practicable) is integral to the investigation and a pre-requisite prior to undertaking the post-mortem examination. This would include scene details such as the presence or absence of a written note, alcohol containers, drugs and medications. The information should ideally also include the manner of removal from suspension and the form of any resuscitation attempted. If scene photographs are available, review of these can be of assistance.
- The manner and position of the body, with respects to the type of suspensions (e.g., complete or full suspension from a roofing beam, partial or incomplete suspension from a door handle, etc), and whether there were means to access the suspension point (e.g. a ladder, a step, a chair, etc).
- Police documentation confirming that the death is considered non-suspicious. Even with such documentation, the pathologist must remain vigilant for, and document where appropriate, the presence or absence of suspicious findings.

- If death was in custody or prison, confirmation of whether the deceased was in a single occupancy cell and the presence or absence of CCTV or body worn video covering the events and discovery of the body.
- Ideally, access to relevant and past medical history details, including prescriptions and mental health history.

6 The autopsy procedure

The usefulness of post-mortem imaging as an adjunct to standard invasive autopsy examination has been well documented, having both advantages and disadvantages.[3] Options for the type of imaging modalities utilised (e.g. plain x-ray or post-mortem CT (PMCT) scanning) depends upon local availability and agreed access. Such examination may provide better visualisation of any trauma related to the vertebrae and points of articulation.

In one study of fifty cases, PMCT was able to recognise a small number of fractures of the laryngo–hyoid complex that were not described at subsequent post-mortem examination.[4] However, considerably more fractures were missed on PMCT examination compared to direct visualisation during post mortem. In addition, PMCT does not specifically identify muscular haemorrhage (though soft tissue swelling may be recognised) and may be limited in its ability to allow identification of the ligature mark, particularly where skin folds are present due to the body habitus or neck positioning during the post-mortem period.[4]

Current best practice remains that PMCT should not replace a thorough external examination by an experienced autopsy pathologist, nor should it be used to assess internal injuries to the neck.[4]

6.1 External examination

A detailed complete examination of the external aspects of the body (anterior and posterior) should be undertaken prior to, and following, cleaning of the body. The approach to the autopsy will depend to a large extent on the condition of the deceased, but a systematic and careful examination is required in all cases to optimise the documentation of relevant findings. This includes documentation of the presence or absence of any congestive asphyxial signs (facial congestion, petechial haemorrhages, epistaxis, etc). In the presence of the latter, consideration should always be given as to the potential for third-party involvement in the death.

Blunt force injuries may occur in response to the act of hanging, be it through the act itself (with the suspended body impacting a surface/object) or through the onset of hypoxic seizures in the peri-mortem period.

Documentation of any ligature mark, its dimensions and depth, appearance and orientation, and whether it raises to a point of suspension.[1,5] Also, any areas of skin sparing (such as at the rear of the neck) and whether there is an associated pattern within the ligature mark (as above).[5]

The type of ligature should be documented, when present, together with the position of any knot(s). When not present, enquiries should be made through the relevant parties so that it may be examined, and comparison be made between the surface profile of the ligature and any ligature mark to the skin. For example, a woven rope may have the weave pattern replicated within the furrow of the ligature mark, whereas a soft broad material (such as a bed sheet) may leave little or no injury, either externally or internally.

Careful consideration should be given as to the presence of any fingertip bruising or fingernail-related abrasions, though these do not necessarily point to third-party involvement, as a person may pull at the ligature while suspended.

A low horizontal ligature mark, an absence of skin sparing to one region, or the presence of additional injuries (including congestive asphyxial signs) require additional investigation, being considered potential markers of third-party involvement.[1,5]

Any recent injuries or scarring suggestive of previous deliberate self-harm should also be documented.

6.2 Internal examination

The brain and chest structures should be removed before dissecting the neck, to limit the creation of post-mortem artefacts.[6–9]

Best practice dictates that the neck muscles should always be examined through a Y-shaped incision, with layered dissection looking for signs of fascial haemorrhage or intra-muscular bruising.[8] The approach to such a dissection can be found in several published texts.[7]

The carotid sheath should be opened and assessed for bleeding and the vessels laid open to examine for intimal tears, which may be associated with vascular dissection or luminal thrombosis, or other vascular injuries. The most frequently described are detailed below.

Table 2: Reported vascular injuries associated with hangings.[10]

Eponymous sign	Vascular finding
Ammussat's Sign	Transverse rupture of the internal carotid artery intima due to combined forced compression and longitudinal stretching. Not unique to hanging – seen with blunt neck trauma and cervical hyperflexion-extension injuries.
Etienne Martin's Sign	Haemorrhage within the carotid adventitia due to rupture of the vasa vasorum.
Dominguez–Paez Sign	Axial sub-intimal haemorrhage without intimal tear, within the common carotid artery.
Ziemke–Otto's Sign	Transverse intimal tears within the jugular vein.

The laryngo–hyoid complex should be handled minimally prior to individual dissection to limit the risk of introducing artefactual fracturing (see below).

Dissection of the paraspinal muscles may reveal bruising and consideration should be made regarding dissection of the cervical spinal cord in cases of spinal injury. The so-called Hangman's fracture (bilateral fracture traversing the pars interarticularis of C2), caused by hyperextension and longitudinal distraction of the neck during sudden suspension, is an uncommon finding, even in cases with a drop.[1,2,5] PMCT studies appear to support this finding.[11,12] It has been suggested the fracture is more commonly observed with submental knot placement or a large body habitus with a significant drop.[12]

Examination of the lumbar anterior ligament and intervertebral discs may reveal the presence of Simon's bleeding,[5,13] seen more frequently with complete suspensions and due to hyperextension of the spinal column.[5]

Completion of the post-mortem examination is necessary to identify any natural diseases that may be of relevance during the inquest, such as chronic diseases, malignancies or neuropathological changes.

[Level of evidence – D.]

7 Specific organ systems

The importance of examining the laryngeal structures and the bony skeleton has been highlighted above. Such examination requires the dissection of the hyoid free from the larynx, with examination for the presence or absence of fracturing and haemorrhage. Care should be taken to differentiate fractures from the natural fibrocartilaginous joints that exist within the hyoid.[5]

Similarly, soft tissue should be carefully removed from the horns of the thyroid cartilage for better visualisation. Anatomical variations exist, including triticeous cartilages, that should not be confused with fractures.[7]

Consideration should be given to the potential for further fracturing within the thyroid laminae or cricoid cartilage.[5]

[Level of evidence – GPP.]

8 Organ retention

Retention of organs is not often necessary. However, if injuries are identified to the larynx and skeleton, retention in fixative may be useful. Such material may be decalcified and processed for histological examination.

[Level of evidence – GPP.]

9 Recommended blocks for histopathological examination

Histopathological examination is not always necessary, though may be used to confirm the presence and nature of fractures (ante-mortem versus post-mortem) within the laryngo–hyoid complex.

Sampling of any natural disease that may be of relevance to the instructing party's investigation should be undertaken.

[Level of evidence – D.]

10 Other samples and investigations

In most cases, toxicological sampling is highly recommended and includes (though is not limited to) peripheral blood and urine. The following samples are recommended:

- 10ml peripheral blood, preserved
- 20ml urine, preserved.

The stomach contents should be inspected for tablets, which can be isolated and submitted, but it is not generally necessary to retain the entire contents.

The potential role of drugs of abuse (including alcohol) in the circumstances of death is important to establish for the purpose of any inquest or inquiry.

Similarly, the presence or absence of certain medications, such as antidepressants, may be of relevance when attempting to consider the question of compliance with treatment. This latter issue may be addressed through retention of a sample of hair, so that retrospective exposure can be assessed through means of segmental analysis.

Interpretation of the results should recognise the effect that post-mortem redistribution and decomposition can have on drug concentrations,[14] as well as the potential for the creation of compounds, such as alcohols and gamma hydroxybutyrate.

[Level of evidence -– D.]

11 Clinicopathological summary

The commentary should incorporate the known circumstances of the death, the post-mortem examination findings and the results of the further investigations performed.

Noting what positive findings have been identified, in addition to the significant negative findings (particularly with reference to ante-mortem injuries), should assist the investigating authority in establishing that no suspicious circumstances exist. This would include the presence or absence of other injuries or marks of violence.

It is not necessary to comment upon the mode of death in cases of hanging, though more recent studies consider this due to cerebral ischaemia caused by vascular compression, rather than upper airway obstruction.[15,16]

Comments can be made regarding the nature of any chronic disease present, when relevant.

[Level of evidence – GPP.]

12 Examples of cause of death opinions/statements

On the balance of probabilities, the cause of death can be offered as:

Ia) Hanging.

13 Criteria for audit

The following standards are suggested criteria that might be used in periodic reviews to ensure post-mortem reports for coronial autopsies conducted at an institution comply with the national recommendations provided by the 2006 NCEPOD study.

- Supporting documentation:
  - standards: 95% of supporting documentation was available at the time of the autopsy
  - standards: 95% of autopsy reports documented are satisfactory, good or excellent.
- Reporting external examination:
  - standards: 100% of the autopsy report must explain the description of external appearance
  - standards: 100% of autopsy reports documented are satisfactory, good or excellent.
- Reporting internal examination:

- standards: 100% of the autopsy report must explain the description of internal appearance
- standards: 100% of autopsy reports documented are satisfactory, good or excellent.

A template for coronial autopsy audit can be found on the RCPath website.

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Appendix A Summary table – explanation of grades of evidence

(modified from Palmer K *et al. BMJ* 2008;337:1832)

Grade (level) of evidence	Nature of evidence
Grade A	At least one high-quality meta-analysis, systematic review of randomised controlled trials or a randomised controlled trial with a very low risk of bias and directly attributable to the target population or A body of evidence demonstrating consistency of results and comprising mainly well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias, directly applicable to the target population.
Grade B	A body of evidence demonstrating consistency of results and comprising mainly high-quality systematic reviews of case-control or cohort studies and high-quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relation is causal and which are directly applicable to the target population or Extrapolation evidence from studies described in A.
Grade C	A body of evidence demonstrating consistency of results and including well-conducted case-control or cohort studies and high-quality case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relation is causal and which are directly applicable to the target population or Extrapolation evidence from studies described in B.
Grade D	Non-analytic studies such as case reports, case series or expert opinion or Extrapolation evidence from studies described in C.
Good practice point (GPP)	Recommended best practice based on the clinical experience of the authors of the writing group

Appendix B AGREE II compliance monitoring sheet

The guidelines of The Royal College of Pathologists comply with the AGREE II standards for good quality clinical guidelines. The sections of this guideline that indicate compliance with each of the AGREE II standards are indicated in the table below.

AGREE II standard	Section of guideline
Scope and purpose	
1 The overall objectives of the guideline are specifically described	Foreword
2 The health questions covered by the guideline are specifically described	Foreword, 1
3 The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described	Foreword, 1
Stakeholder involvement	
4 The guideline development group includes individuals from all the relevant professional groups	Foreword
5 The views and preferences of the target population (patients, public, etc.) have been sought	Foreword
6 The target users of the guideline are clearly defined	1
Rigour of development	
7 Systematic methods were used to search for evidence	Foreword
8 The criteria for selecting the evidence are clearly described	Foreword
9 The strengths and limitations of the body of evidence are clearly described	Foreword
10 The methods for formulating the recommendations are clearly described	Foreword
11 The health benefits, side effects and risks have been considered in formulating the recommendations	n/a
12 There is an explicit link between the recommendations and the supporting evidence	4–11
13 The guideline has been externally reviewed by experts prior to its publication	Foreword
14 A procedure for updating the guideline is provided	Foreword
Clarity of presentation	
15 The recommendations are specific and unambiguous	2–12
16 The different options for management of the condition or health issue are clearly presented	2–12
17 Key recommendations are easily identifiable	2–12
Applicability	
18 The guideline describes facilitators and barriers to its application	Foreword
19 The guideline provides advice and/or tools on how the recommendations can be put into practice	Foreword
20 The potential resource implications of applying the recommendations have been considered	Foreword
21 The guideline presents monitoring and/or auditing criteria	13
Editorial independence	
22 The views of the funding body have not influenced the content of the guideline	Foreword
23 Competing interest of guideline development group members have been recorded and addressed	Foreword