

## INVITED REVIEW

### The role of the pathologist in the investigation of iatrogenic deaths

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One of the most difficult and sensitive issues in medico-legal pathology is the autopsy investigation of a death which may be associated with medical intervention. There is a wide spectrum of these cases, ranging from surgical and anaesthetic mishaps to drug reactions or the failure to offer the correct (or any) treatment. Before further discussion of the subject, it should be appreciated that:

- (a) the death may be due to causes quite **unrelated** to medical intervention
- (b) even if due to diagnostic or therapeutic procedures (or their omission), the death may have been entirely unavoidable, i.e. purely **accidental**
- (c) the error or omission leading to death may have been due to an **error of clinical judgement**, which is not necessarily negligent
- (d) the death may have been due to **medical negligence**.

There is often a natural tendency on the part of the patient's relatives - and their lawyers - to assume that any medical mishap, especially when fatal, must be due to the negligence of the doctor(s). This is far from true and only a thorough investigation, in which the pathologist plays a vital role, can see that justice is done to both sides.

Though it will be emphasised again later, it is important to point out that the pathologist should **never** state that a death was due to negligence - this is a **legal** decision, not a medical one.

Occasionally, that fact may be obvious and the pathologist may legitimately have his or her own private opinions, but the duty of the pathologist is to provide as much factual information as possible, so that subsequent decisions can be made; but it is not for him or her to anticipate what is purely a legal process.

#### **Preliminaries to the autopsy**

Before any autopsy is carried out on a possible iatrogenic death, steps must be taken to ensure

that the maximum information will be obtained and that the proper legal and ethical matters have been dealt with.<sup>1,2</sup>

- (a) *The autopsy should be under the jurisdiction of the coroner, magistrate or other legal authority that authorises and request an autopsy.* The very fact that there is the possibility of a non-natural cause of death makes the case reportable to the coroner. This is the duty of the clinicians, but sometimes they may not be very anxious to initiate a legal enquiry which may result in criticism, publicity or even a legal action against them. However, the pathologist should not agree to carry out such a case as a clinical "consent" autopsy, but advise the clinicians that they must report the death to the coroner.
- (b) *Ideally, the pathologist performing the autopsy should not be a close colleague of the clinicians who had care of the deceased patient.* This is to avoid both possible embarrassment over the revelation of facts leading to actual or implied criticism of the standard of care, especially if the autopsy reveals some error - and also to avoid allegations by the family of "covering up" between friendly doctors. Admittedly, it may be quite impossible to use anyone else other than the regular pathologist in an outlying General Hospital, but in a large city where there are a number of pathologists - or preferably a forensic pathologist - then the use of a relative "stranger" may be an advantage. In Britain, for example, the coroner will usually request the regional forensic pathologist or a pathologist from another hospital, to carry out the autopsy.
- (c) *It is absolutely essential to obtain the full co-operation of the clinician(s) who were involved in the care of the patient.* The pathologist should ensure that they are informed of the time and place of the autopsy and if there is any difficulty in their being able to attend, to be as flexible as possible in arranging an alternative time when they can

attend. The value of an autopsy without the clinicians present is greatly reduced, both as regards the conclusions reached and the audit value of the procedure. This is particularly true of deaths under anaesthesia, where the autopsy findings may be virtually negative and the expert contribution of the anaesthetist may form the only way to explain the death.

- (d) *The attitude of the coroner's pathologist to the clinicians must never be critical or confrontational* as, where appropriate, this aspect is a matter for coroners, magistrates and lawyers. The pathologist's role is to be impartial and totally objective, seeking only to find the facts in a professional and harmonious way. This is not to say that any findings disadvantageous to the clinician should be ignored or concealed. It is **not** the function of the pathologist to act as a judge, but to discover the facts and offer pathological interpretation of those facts in an unbiased way.
- (e) *Before the autopsy, the pathologist should obtain and read all available clinical records and notes.* To carry out an autopsy "blind" is often a waste of time. As well as studying the clinical notes, it is essential to discuss the case with the relevant clinicians, either before and/or during the autopsy.
- (f) *The clinicians should be present at the autopsy wherever possible - preferably the senior clinician in clinical charge of the case.* Even if unable or unwilling to attend, **they must always be invited**, so that they cannot later complain that the post-mortem examination was done without their knowledge. It is not satisfactory if only a junior doctor attends, such as a house-officer, who often claims to know little or nothing about the case.
- (g) *Where there are complaints by the family and the possibility of allegations of negligence, the autopsy should be carried out by a senior pathologist,* as there may be later legal complications, which require expert interpretation and may lead to an appearance in court. If a junior pathologist actually performs the autopsy, a more senior colleague should be present to offer support and advice and to review the findings.
- (h) As mentioned earlier, in deaths during anaesthesia, *the full co-operation of the anaesthetist is vital,* as the autopsy findings may be minimal or absent. A pathologist is

rarely competent to comment on modern anaesthetic techniques and it may be useful on some occasions to seek the advice of an independent senior anaesthetist either before, during or after the autopsy. This also applies to other specialities such as with surgical or radiological procedures or to pharmacological problems. Where an independent expert is consulted, the pathologist must be tactful about possible professional rivalries between specialists in other disciplines. It is often a difficult situation, where the clinicians who treated the deceased patient feel that they may be criticised for an error of clinical judgement or even sued for negligence.

### The autopsy

The actual autopsy is no different from any other, except that special techniques and investigations may be required where relevant.<sup>1,3,4</sup> For example, in suspected air embolism or where the position of an endotracheal tube or central venous catheter is in doubt, a pre-autopsy radiograph may be required, and in possible pharmacological errors, extra samples may be needed for analysis.

A full examination is required, though this should apply to all autopsies. The report should be in detail and full histology and other relevant investigations carried out, remembering that the pathologist's factual findings and interpretation may become the subject of detailed and prolonged legal scrutiny, if the case becomes a matter for civil or even criminal litigation.

The body should be first seen by the pathologist in the mortuary in its original state, with any medical equipment still in place. The mortuary technicians should be instructed not to remove dressings, airways, catheters or intravenous lines and needles, until the pathologist has seen them in position. For example, cases seen by the author have involved an overlength endotracheal tube misplaced in a bronchus or in the oesophagus, and an incorrect intravenous catheter perforating the atrial wall.

Where death follows surgical operation, the autopsy may be rendered much more difficult due to the surgical intervention, especially if complications led to repeated surgical operations. Following haemorrhage or sepsis, especially if an interval occurred before death, the abdomen may be an nightmare for the pathologist to explore, with post-operative adhesions, fluid, blood, drains, pus or faeces obscuring the examination site.

As there is such a wide variety of circumstances in suspected iatrogenic deaths, no comprehensive

autopsy routine can be suggested, but the following points should be kept in mind where appropriate:

- (a) *The state of the coronary arteries and myocardium.* In older patients, but occasionally in the younger adult, a fatality apparently related to medical treatment may be due to unsuspected ischaemic heart disease. Coronary ostia should be examined and the three major branches of the coronary arteries cut across (not slit longitudinally) at close intervals, to assess the patency of the lumen. Heart weight and left ventricular preponderance should be recorded.
- (b) *The presence of emboli* in the pulmonary arteries and thrombi in the leg veins should be sought.
- (c) In deaths during or following surgical operations, the *integrity of suture lines* in the stomach, intestine, ducts and blood-vessels etc, should be carefully assessed. The pathologist must beware of post-mortem deterioration in stitch-lines and also artefactual damage during autopsy procedures. For example, an anastomosis in the gut may appear to have loose sutures and be leaking, though this may merely be post-mortem autolysis, worsened by traction during the removal of the organs during the autopsy.

It is always advisable in the abdomen, thorax and even cranium, to make a careful preliminary inspection of the cavities by gently moving organs aside, before attempting to dissect and remove them.

Of course, it is absolutely essential for the pathologist to see all organs *in situ* and not allow the mortuary technician to remove them himself. In fact, in all autopsies, the pathologist should make the skin incision, inspect the body cavities and remove the organs – this is even more important in post-operative cases.

- (d) *Tracing bleeding points* where haemorrhage has occurred during or after surgical operation can be difficult or even impossible. The pathologist does not have the advantage of the surgeon in seeing blood leaking under arterial or venous pressure. Breaches in vessel walls found at autopsy must be carefully differentiated from artefacts caused by the autopsy knife or by traction during organ removal.
- (e) Where suspected, *evidence of a*

*pneumothorax* should be sought at autopsy. Probably the best test is a chest radiograph taken during life, but a post-mortem film may also reveal the translucency of air in the pleural cavity and a visible line of the lung margin.

The usual test of puncturing an intercostal space under water poured into the reflected skin flap is quite valid, but only gives a positive result where there is a tension pneumothorax. More commonly, where there is a patent communication between a bronchus and the pleural cavity - or where a chest drain has been inserted, no air will escape through an intercostal puncture.

Where a pneumothorax is suspected, the lung surface should be carefully searched for a defect, such as a ruptured emphysematous **bullae**, a torn adhesion or a puncture from a cannula or needle placed through the chest wall. The lung can be inflated with water or formalin through a bronchus to see if a leak can be seen in the visceral pleura, though care must be taken to exclude artefacts caused by autopsy knives or a post-mortem tear from a pleural adhesion. Inflating the lung with water has been shown not to affect the quality of subsequent histology, if a small block of lung is taken soon after inflation and placed in formalin.

- (f) Where *air or gas embolism* is suspected after surgical intervention, the best means of detection is a post-mortem chest radiograph, where bubbles may be seen in the heart shadow.

Opening the right ventricle under water placed in the pericardium may be performed, but where fatal venous air embolism has occurred, froth will usually be obvious to the eye on opening the heart. A prolonged post-mortem delay before autopsy reduces the chances of detecting air embolism by any means.

The presence of air bubbles in the cortical veins of the cerebrum is of no significance, in spite of the many descriptions and illustrations in older text-books. Air in the venous circulation is driven to the right side of the heart, where it kills by forming an air-lock; it cannot move against the direction of circulation in the **jugulars** to reach the cortical veins - this is always an artefact due to the suction of removing the skull-cap and is often seen in autopsies of all kinds.

The detection of the rare arterial air embolism, usually in barotrauma, is difficult and requires careful removal of the brain after clamping of the intra-cranial carotid and vertebral arteries.

Where gases other than air are concerned -

such as oxygen introduced by the surgical use of hydrogen peroxide in closed wounds or body cavities - it may be impossible to demonstrate gas embolism, as oxygen is rapidly absorbed by haemoglobin.

- (g) *The taking of blood, urine, vitreous, cerebro-spinal fluid, stomach contents, etc is necessary where the iatrogenic damage is thought to be related to an incorrect dose of a drug, or the wrong drug.* Where insulin may be concerned, a sample of the subcutaneous tissues centred on the injection site may be required for assay.

When analysis results are available, the pathologist must be aware of the ante-mortem and post-mortem decline of many drugs, due to metabolism in life and breakdown after death. Post-mortem glucose and electrolytes are notoriously inaccurate in post-mortem samples, to the point where they are virtually useless.

### Deaths under anaesthesia

One of the most difficult autopsies is that on a death during anaesthesia. They are often known as "anaesthetic deaths," but this is an unfortunate title, as only a small proportion are due to the effects of anaesthesia. They can be classified as follows:

- (a) Those due to the anaesthetic agent or procedure (relatively rare)
- (b) Those due to surgical complications or mishap
- (c) Those due to the previous trauma for which the operation was being performed (in high risk or even 'heroic' surgery).
- (d) Those due to natural disease:
  - (i) for which the operation was being performed
  - (ii) incidental disease, the existence of which was known before operation (risk/benefit decision)
  - (iii) incidental disease, unsuspected before operation.

Where the anaesthetic itself is thought to have been the major cause of death, it is essential to have the full co-operation of the anaesthetist, who can explain the procedure and the agents used and detail the physiological state of the patient all through the period of anaesthesia.

As stated earlier, it is also very helpful to have the independent interpretation of another

experienced anaesthetist, though this may be something that the coroner or other investigative authority will also require.

There is very little point in attempting to obtain body fluids and tissues for analysis in deaths associated with anaesthesia, especially gaseous agents. If an overdose of barbiturates, muscle relaxants, etc, is suspected, blood levels may be of help, though experience has shown that this is rarely useful, except in major overdoses.

There is also often little to find on gross autopsy examination or histology, which makes the obtaining of a complete clinical history all the more important.

Particular points to note at autopsy include whether the endotracheal tube is in the wind-pipe or misplaced in the oesophagus - and also its length in relation to the carina and bronchi.

The presence of gastric contents in the air passages at autopsy is difficult to evaluate, as it is a frequent agonal and post-mortem process. If a cuffed tube is in place, then vomit deep in the air passages must have arrived there before intubation, but where no tube has been used, the significance of gastric contents is doubtful, without clinical observation of aspiration.<sup>5</sup> A series of consecutive autopsies in both adults and children showed that gastric contents was present in 25% of all types of death, so that without clinical corroboration, it is not legitimate for a pathologist to claim intra-vital aspiration purely on autopsy appearances<sup>6</sup>

Other causes of anaesthetic fatalities (not all detectable at autopsy) include malignant hypothermia associated with halothane and curare-like drugs, hypoxia due to equipment failures, gas supply defects or defective anaesthetic management.

### Deaths associated with intra-vascular procedures

The increased use of intravenous and even intra-arterial lines has its own risks, including perforation of vessel walls and cardiac chambers by cannulae. Broken cannulae may embolise into the heart or other vessels; a former fault with soft polythene catheters introduced through wide-bore needles was that the needle bevel could cut through the catheter and detach it. Air embolism is a possible complication, especially where a vein is punctured above the level of the atrium.

Incompatible blood transfusion is uncommon, but still occurs, almost always due to human errors, rather than to serological mishaps. Most are due to mistakes in identifying patients and blood units; the pathologist should collect all

available antemortem blood samples, together with any remnants of the transfused blood and post-mortem blood. These should be given to an independent haematology laboratory for checking as to grouping, cross matching and haemolysis and coagulation defects. Full histology should be carried out to detect any signs of a consumption coagulopathy, DIC, etc., and any renal effects of haemolysis.

### Fatal surgical mishaps

These are potentially numerous and range from operations on the wrong patient, wrong side and wrong organ, to retention of instruments and swabs within the operation site. Many such errors are not fatal, but ligation of vital ducts, such as ureters or damage to arteries or slipped ligatures or faulty anastomoses, may lead to death.

The autopsy investigation consists of a painstaking examination of the whole operative zone, together with a full evaluation of any other natural disease. The inspection and dissection of the area which has undergone surgical intervention may be extremely difficult, as mentioned earlier, due to fibrin, pus, adhesions, haemorrhage, fluid, oedema or intestinal leakage. Great care must be taken not to mistake autopsy **arterfacts** and post-mortem disintegration for true antemortem abnormalities.

### Pharmacological mishaps

These may be totally undetectable at autopsy and even laboratory analysis of post-mortem samples may not reveal the true antemortem drug state. Particular problems may arise in relation to asthmatics or epileptics, especially among the young. Death can occur suddenly and unexpectedly purely from these two natural diseases, but may also be associated with treatment overdose.

Wrong drugs, the wrong dosage of the correct drug, incorrect routes of administration, idiosyncratic hypersensitivity and allergic reactions, drug interactions, etc, all make the advice of a pharmacologist very useful in trying to interpret the situation.

It may well be that such interpretation should be made by the coroner or investigating authority, rather than the **pathologist**, but the medical advice of the latter is invaluable when non-medical authorities such as magistrates, lawyers or police have to try to understand the significance of certain facts and circumstances.

In summary, the role of the pathologist in a death thought to be associated with medical diagnosis or treatment is to carry out a thorough

autopsy in the light of the maximum clinical and circumstantial evidence available; then to evaluate natural disease and trauma and the effects, if any, of medical intervention; and to offer the most reasonable cause of death - or a range of possible causes - to the investigating authority. The pathologist should not make legal judgements such as "negligence," but confine his or her opinion to an evaluation of all the medical evidence and help to integrate the pathological findings with the wider knowledge of independent expert clinicians, so that justice may be done - and injustice avoided.

### REFERENCES

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