

3. Results of study

Tissue retention

Pathologists retain tissue from an autopsy in order to examine it in more detail. This can be through histopathology - the study of the cellular features using a microscope, through careful gross examination of an organ once it is fixed or preserved with chemical treatment; or both processes in sequence. It is well recognised by pathologists that the naked eye examination alone cannot diagnose all pathological conditions, and that for many diseases the diagnosis can only be made with such tissue examination. 'Tissue' is defined, by the Human Tissue Authority as 'any constituent part of the human body formed by cells'¹⁷. Thus it includes whole or part whole organs, organ samples of any size, and blood.

Previous NCEPOD reports have almost all commented on the tissue sampling rates for the autopsies on perioperative deaths. These have ranged from 13-55% depending on the focus of the study. There have been several consistent features in the reports:

- All have noted that according to current best practice guidelines, histopathological sampling of all major organs is recommended for all autopsies, irrespective of authorisation (i.e. whether consented or coronial autopsy);
- All recommended more extensive tissue analysis for certain cases to improve the quality of the autopsy evaluation, whilst noting that in many cases it is not necessary to establish a cause of death;
- All noted, where comparable, that autopsies performed with consent of relatives have higher tissue sampling rates compared with coronial autopsies, usually by a factor of 1.5 to 2;
- All noted problems and conflicts between pathologists and coroners in tissue taking; the perceived impression being that coroners desire lower rates of tissue retention than pathologists.

The RCPATH guidelines are clear that (in section 9.2) sampling of all the major organs is recommended for all autopsies (consented and coronial) as best practice³. They also state the benefits that result for national statistics on death and for the family (accuracy, and ability to review a case later), and provide some guidance on communications between coroners and pathologists over this issue. The Guidelines were published in 2002, at a time of change in autopsy practice, and before the 2005 amendments to the Coroners Rules concerning tissue retention.

Tissue retention at autopsy has probably been the most contentious of all issues around the autopsy, particularly relating to coronial autopsies, in the last decade. It includes not only retention of whole organs or significant parts thereof, but small tissue samples for histopathology, blood and other samples for various analytical purposes.

Following the Bristol Royal Infirmary Inquiry¹⁴ into cardiac surgery, there emerged the recognition that children's hearts were being retained by pathologists after coronial autopsy

without knowledge of the fact by relatives. This was compounded by information on the scale of retention of perinatal autopsy tissue at the Alder Hey Hospital¹⁵ pathology unit, following autopsies authorised through consent and also the coroner, without apparent knowledge of the parents. A nationwide survey of retained organs followed, and the realisation that the 1961 Human Tissue Act was inadequate to encompass either modern pathology practice or the interest of informed consent for significant tissue retention. Consultation ensued¹⁶ which resulted in the Human Tissue Act 2004¹⁷ and the establishment of the new Human Tissue Authority with effect from April 2006¹⁸.

The Human Tissue Act covers the process of consent for retention of tissues at autopsy, and their subsequent usage for scheduled purposes, as they apply to consented autopsies, i.e. those where the relatives have given consent. It does not apply to coronial autopsies in terms of whether or not tissues are retained for diagnostic purposes - that is a decision strictly to be made by pathologists. But it does apply to the disposal of tissues taken during a coronial autopsy once the inquiry has ended and the coroner has become *functus officio*. At this point he/she cedes jurisdiction over the body and its tissues.

Historically, the residual tissue blocks and slides from the retained tissues remained in the possession of the pathologist. In most cases this meant archiving in a pathology department files for as long as the policy of that unit indicated; in the case of independent pathologists, the blocks and slides may have been stored in private premises. This has changed with the Human Tissue Act 2004. It was recognised that when the coroner is *functus*, the tissue blocks and slides belong to the relatives, not the pathologist, and appropriate consultation with relatives needs to be made, through the coroner, to ascertain the wishes of relatives regarding the disposal of the tissues taken. These options are:

- Pathologist disposes of the tissues blocks and slides (i.e. cremation or incineration); or,
- Pathologist archives the material, and consent is given for various later scheduled purposes including teaching, research etc.; or,
- The tissue blocks and slides are returned to the relatives.

The response of the Government to this tissue retention issue resulted in the amendments to the Coroners Rules 9 and 12 (2005).

It is thus important to review the regulations under which coroners and pathologists operate in this area. Until June 2005, the basis for tissue retention in a non-suspicious coronial autopsy was defined in the Coroners Rules (1984) - Rule 9:

"A person making a post-mortem examination shall make provision, so far as possible, for the preservation of material which in his opinion bears upon the cause of death for such period as the coroner thinks fit."

Following limited consultation with professional bodies, this was amended in June 2005 to:

"A pathologist shall make provision, so far as possible, for the preservation of material which in his opinion bears upon the cause of death or the identification of the deceased¹⁹."

There follows the detailed depiction of the process of ascertaining the wishes of the relatives regarding tissue disposal once the coroner is satisfied that the tissues are no longer required for his/her inquiry into the cause of death of the deceased. This information is then communicated

to the pathologist as an instruction on disposal.

The practical point is that this is a considerable logistic process, consuming time and money, undertaken through the coroner's office by him/herself or his/her staff. It has nothing directly to do with a decision on the part of the pathologist as to whether tissue retention is required for making a diagnosis in a case. But because a decision to retain material automatically imposes extra work upon the coroner's office, it is not unreasonable to suppose that the coroners and their officers might be less keen to see tissue retained in any case unless it is absolutely necessary. These changes were anticipated at the time of this study. Although the amended Rules were not formally adopted until after the study week, pathologists were aware that the coroners were moving into the new system anyway, as the new system's processes were being used.

The strict point is that the decision on whether to take histology to assist in determining the cause of death rests with the pathologist only. As will be discussed later, this is not how it always appears to be.

For this study, and in each case, the following were recorded:

- Whether or not tissue **was** taken at autopsy (as noted on the autopsy report);
- Whether or not it **should** have been taken (as assessed by the advisors);
- The quality of the tissue retention reports supplied.

The following section presents the results of the above points in addition to data taken from the organisational questionnaire relating mortuary facilities to process and store retained tissue.

Whole organs

Whole organs (or major parts) were retained at autopsy in <1% of cases (10/1,691); in four cases the lungs were retained, in three cases the brain was retained and in an additional three cases the heart was retained.

In 49% (835/1,691) of cases, a positive statement was made in the report that no whole organs or major parts were retained. The remaining 846 cases made no comment about the retention of whole organs or major parts.

The reasons for organ retention were:

- Lung (4) - mesothelioma confirmation and asbestos studies;
- Heart (3) - cardiomyopathy investigation;
- Brain (3) - case 1) paediatric neuro-developmental abnormality; case 2) traumatic brain injury in an elderly person who had a fall in the community; and case 3) to confirm suspected Lewy body dementia in an elderly male.

All these listed situations of organ retention were deemed appropriate, but they took place in <1% of all the cases in the study. The advisors considered that more organ retention should be undertaken to ensure more accurate evaluation of causes of death and further discussion follows in later sections of this report.

Histology

In 65% (1,093/1,691) of cases, a positive statement was made in the report about whether or not histology was taken. And in 19% (314/1,691) of cases, it actually was taken. The proportion of cases taking histology in this study was markedly lower than in previous NCEPOD reports, which since 2000 have ranged between 24% and 55% of cases (bearing in mind that previous NCEPOD reports have examined hospital deaths only).

In this study, 35% (598/1,691) of cases no comment was made about the retention of samples for histology. Thus in nearly half of the autopsy reports there was no positive indication that tissues were or were not retained. It is not a requirement under Schedule 2 of the Coroners Rules to indicate if tissues have been retained. However, one standard text on the coronial system notes that 'the report should make specific mention of any tissues that were retained'⁴.

The advisors believe that all autopsy reports should now state unequivocally whether or not organs or tissue and blood samples were retained. If they are retained, they should be listed; if whole organs or significant parts thereof are retained, there should be in the final autopsy report an indication of the ultimate disposal of this material. With public concern over the fate of autopsy tissues, this is a minimum requirement.

The Codes of Practice issued by the Human Tissue Authority in Jan 2006 indicate that there must be secure documentation of tissue retention, samples and organs, following autopsy examinations. It will become the duty of the designated individual named on the Licence for each mortuary to ensure that appropriate procedures are followed. One straightforward means for part of this documentation is to note in each autopsy report whether or not tissues were retained.

Recommendation

Autopsy reports must clearly indicate whether or not tissues were retained, and what they comprise, if retained.

What was taken for histological examination?

Histopathological examination was undertaken in 19% (314/1,691) of the cases in the study. Most commonly, sections of lungs were taken for histological examination (Table 16).

Table 16: Samples taken for histology (answers may be multiple $n=314$)		
	<i>n</i> =	%
Brain	78	25
Lungs	231	74
Heart	178	57
Liver	175	56
Spleen	83	26
Kidney	131	42
Other*	147	47

* There were 'at least' 147 samples taken that were categorised as other. This is an 'at least' figure because more than one sample could have been listed as free text under 'Other' by the advisors.

Case study 10 illustrates how significant histopathological examination can be, not just for the cause of death in the deceased, but for the next of kin also.

Case study 10

An elderly patient with known emphysema developed pneumonia and, despite admission to hospital, died. The well described autopsy identified significant ischaemic heart disease and bilateral lung abscesses, as well as confirming the severe emphysema. The liver was cirrhotic (which was not previously known), and the histological features in the liver further indicated the diagnosis of alpha-1-anti-trypsin deficiency, an inherited disorder that causes both cirrhosis and emphysema.

The cause of death was given as:

- 1a. Lung abscess*
- 1b. Bilateral bronchopneumonia*
- 1c. Chronic obstructive pulmonary disease*
- 2. Cirrhosis and coronary artery atheroma*

The clinicopathological correlation discussed this inheritable disease and suggested that the family may wish to seek medical advice and screening.

There has been no nationwide surveys of tissue sampling in coronial autopsy practice, and so this figure of 19% of cases is a baseline datum for practice in early 2005. From the previous NCEPOD reports, which focused on investigation of perioperative deaths and where it might be supposed that the complexities of the cases would demand a higher level of autopsy histopathology examination, the range was 13-55% for tissue sampling. A recent survey by the RCPATH of hospital departments in England and Wales enquired into proportions of coronial autopsies that had histology taken and also asked about problems in the interactions with coroners over this issue²⁰. The sample size was small, but it did show the expected trend over time. In 1998, the overall tissue sampling rate was 33%, dropping to 21% in 2002 (after Bristol

and Alder Hey) and remaining at 20% in late 2005 (after the introduction of the amended Coroners Rules). This is consistent with the results of this more representative study.

Another impression coming from the RCPATH survey confirms the experience of the advisors; that there is pressure from coroners' offices not to take organs or tissue samples if a reasonable diagnosis can be made without them, and that this pressure has increased since 2000. The same point was also made in the Shipman Inquiry²¹. As indicated previously, the work that is required to observe the regulations on tissues with regards to the relatives of the deceased are time consuming, and the coroners' offices, coming under local authority financing, are not well resourced (the study did not investigate aspects of office organisation, but the fact of under resource is not disputed at coroner or government level). A self-imposed reduction of tissue taking by pathologists, because of the increased bureaucracy over tissue retention, is a factor suggested by a recent, partial survey of current practice²².

Should tissues have been retained?

For each case, the advisors were asked if the lack of tissue retention in any way detracted significantly from the autopsy report in determining the cause of death. In 6% (93/1,691) of cases it was considered that lack of tissue retention did detract from the autopsy report in determining the cause of death, and in a further 18% (307/1,691) of cases, the advisors felt that tissue retention "would have been informative". This was defined for this study in the following manner: "Tissue retention may have assisted in elucidating particular features of the death, but may not necessarily have been required to determine the cause of death".

The advisors indicated the following major issues where they believed that diagnostic histopathology was important in the case but not done:

- Cancer primary diagnosis or confirmation (41 cases);
- Liver - cirrhosis and/or alcohol related disease (20 cases);
- Heart - cause of hypertrophy and/or cardiomyopathy (17 cases);
- Tuberculosis and other pneumonias (6 cases);
- Epilepsy (5 cases);
- Stroke and other CNS disorders (7 cases).

Thus in a proportion of cases, the cause of death as given cannot be known to be correct unless there had been histological confirmation, or exclusion, of diseases suspected grossly. Gross examination identifies the pathological processes going on in some but not all cases. Even standard diseases like bronchopneumonia are not accurately diagnosed by the naked eye in more than 70% of cases when compared with the histological ascertainment²³. The histological type of cancers may be guessed at, but not ascertained, by gross examination. Since the general advice for completing medical certificates on cause of death encourages entering the histological type of cancer as well as its primary site, it should be incumbent on pathologists to examine previously unknown tumours under the microscope. The coronial system needs to consider this for a national standard rather than for pathologists to do such evaluations on an individual basis. To repeat, according to the regulations, tissue retention is formally permitted only when necessary to provide a cause of death in a coronial autopsy. The coroner does not at present have a formal role in public health outside accidents. For example, he/she is not obliged to confirm or rule out possible notifiable and serious communicable diseases such as

tuberculosis and hepatitis C (a diagnosis of 'pneumonia' and 'chronic liver disease' respectively would be acceptable as a cause of death). The only specific medical disease that he/she does attempt to ascertain through the autopsy and pre-death medical data is malignant mesothelioma; this is associated with asbestos exposure, often related to industrial employment, and may involve compensation claims from the next of kin.

Case study 11 encapsulates the whole issue of tissue retention in the coronial autopsy.

Case study 11

A middle-aged patient was admitted with a history of confusion to a neurosurgical unit. The CT showed enlarged cerebral ventricles with a possible focal cerebral lesion and the cerebrospinal fluid analysis showed lymphocytosis. Whilst in hospital the patient developed colonic pseudo-obstruction which necessitated a hemicolectomy. Then a drain was inserted through the skull to relieve hydrocephalus. Unfortunately the patient suffered a cardiac arrest and died before a definite diagnosis could be made.

The autopsy revealed a massive thromboembolism in the lungs and found deep vein thrombosis in the calf veins. The spleen was moderately enlarged and although there was no generalised lymphadenopathy, lymphoma was considered. The skull burr hole for the drain was noted, the meninges were normal, the brain oedematous and on slicing the brain there was no evidence of focal abnormality to the naked eye. No tissues were taken and there was no comment apart from "Death was due to natural causes".

The cause of death was given as:

- 1a. Massive pulmonary embolism*
- 1b. Deep vein thrombosis*
- 2. Right hemicolectomy for ischaemic colitis and presumed cerebral lymphoma*

Arguably the brain condition resulted in the thromboembolic final event. But what was it? The advisor noted the lack of histology and of the underlying cause of death. If the purpose of the coronial autopsy was to exclude unnatural death, then this autopsy did that. However, if it was to provide a cause of death that has medical meaning, the autopsy was deficient in not making a tissue examination of the brain to determine the pathology.

An autopsy report assessed as excellent or good overall did not need, by definition, to have tissue retained. There are certain conditions, where the gross pathology is so distinctive and where the pathogenesis is reasonably well understood, that do not require histopathological confirmation. Examples are ruptured abdominal aortic aneurysm and unequivocal acute myocardial necrosis associated with an unequivocal acute coronary artery thrombus. Case study 12 provides an example of a good autopsy report that does not include histopathology.

Case study 12

The deceased was found at home; there was no suspicion of foul play. Previous medical history included rheumatoid arthritis, deep vein thrombosis and hypertension.

The autopsy included an external description of operation scars, skin slippage and noted "There were no other signs of external injury".

Internally there was no pulmonary embolism or aspirated vomit in the airways. The heart examination noted its weight (490g) and left ventricular failure. Each coronary artery was described and the lumen narrowed to 1mm (left) and 2mm (right). The skull and brain were carefully described to exclude injury and haemorrhage.

There was a clinicopathological correlation discussing the roles of triple coronary artery disease and the history of hypertension, and noting that pulmonary oedema supported the conclusion of acute cardiac failure as the mode of death.

The cause of death was given as:

1a. Ischaemic and hypertensive heart disease

1b. Coronary artery atheroma

2. Rheumatoid arthritis

While this case is straightforward, it is emphasised because the scenario and the significant pathologies are common (ischaemic heart disease was the single commonest cause of death across the study sample). The detail of the coronary artery dimensions are such that they can be evaluated against the Davies criteria when addressing the question: 'Does the coronary artery disease observed satisfactorily account for the death of the patient?'²⁴.

A report such as this gives confidence that it represents what really happened, and in this case, whilst histopathology would be instructive for the pathologist, it was unlikely to bring out more information than was grossly visible.

Tissue processing and storage facilities

NCEPOD requested whether there were any organisational reasons inhibiting pathologists from taking histopathology samples? In terms of access to facilities for processing histology, toxicology and other laboratory investigations, 98% (190/193) of mortuaries had access to histology, 95% (180/189) to other laboratory investigations and 83% (159/191) to toxicology.

Mortuary contacts were also asked whether they had the facilities to store fixed tissues and organs. Results showed that only 64% (121/188) of mortuaries had such a facility (Table 17). These data are concerning in that one third of mortuaries could not hold fixed organs. If a pathologist wishes to retain a large organ, such as a brain, which is not transportable fresh to a laboratory, and the mortuary cannot or will not store it, what are his/her options? It could be cut and sampled fresh, but that may result in suboptimal examination for diagnostic purposes, as well as removing the opportunity to re-examine the specimen.

In future, when the Human Tissue Authority approves licences for mortuaries (see 'Clinical pathology accreditation' in Appendices), the licence will also cover storage of human tissues. Nonetheless, obtaining accreditation and an HTA licence will cost the host organisations money,

for inspection and annual retention fee.

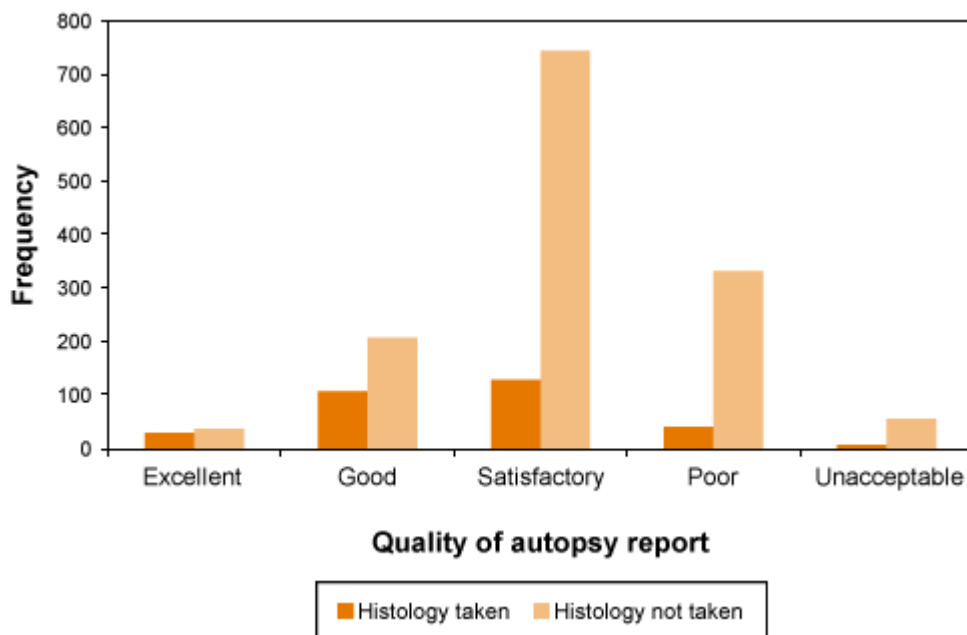
Table 17: Storage facilities for fixed tissues and organs		
	<i>n</i> =	%
Yes	121	64
No	67	36
TOTAL	188	100
Not answered	5	

All but three mortuaries reported having access to formalin for fixation of organs (an additional one mortuary did not answer the question).

How did the retention of tissues affect the overall quality of the report?

When the overall quality of the autopsy report was stratified with whether or not histology was taken for that case, it was observed that a higher proportion of cases were rated as excellent or good in the cases where histology was taken. And conversely, proportionately more cases were rated as poor or unacceptable if histology was not taken (Figure 11).

Figure 11: Overall quality of the autopsy report in cases that did or did not take histology



Histology reports

Of the 316 cases that took histology and whole organs, 251 histology and/or whole organ reports were available to be assessed (either as separate reports or as part of the main body of the autopsy report). This represents 79% (251/316) of all cases that retained tissue.

Generally, the histology or whole organ reports were considered good in 39% of cases, (99/251) or satisfactory in 52% of cases, (130/251) by the advisors. Only 9% (22/251) of histology/whole

organ reports were marked as unsatisfactory. Some of the comments made by the advisors who had assessed the reports as unsatisfactory were:

- "Just says age related change...does not state which organs examined";
- "Type of carcinoma not stated";
- "Report does not describe findings in all tissues sampled";
- "No mention of presence or absence of asbestos bodies";
- "Described findings in stomach only - no mention of findings in other tissues sampled".

Costs of histology

One factor in deciding whether or not histopathology samples are taken is the ensuing administrative procedure, as discussed; another is money. Tissue analysis has laboratory (machine, technician, consumables) costs, though there is no agreed cost per block across UK histopathology departments. The study did not explore histology costs, but several informal surveys have highlighted the issue. One common response in the RCPATH survey²⁰ was that cost considerations impacted on the amount of tissue sampling that pathologists were permitted if tissue was retained.

How coronial autopsy histopathology is funded varies widely. For independent pathologists, there is no choice: they must pass on the costs from a laboratory to the coroner. For hospital department pathologists, there is a choice: the trust or medical school department can carry the costs in whole or in part, or the coroner can be invoiced. A NHS Management Executive document of 1991 on the allocation of pathology costs indicated that certain tests that support a wider public health benefit may be considered as general overhead costs for a hospital; but "there are special arrangements for works requested by coroners", presumably meaning that coroners should always be invoiced²⁵.

The amount that may be charged to a coroner for histopathology is reviewed regularly by a British Medical Association (BMA) committee. When the study was carried out, the rate was £25 per block, up to a maximum of £228.50. (The charge per block was increased to £31.50 in June 2005). No additional charge may be made to cover additional analyses such as immunocytochemistry. In reality it is more complicated, since some pathologists, when taking histology samples, will negotiate the overall fee for the autopsy at a higher rate than the standard basic (currently £87.70 per case for an autopsy performed under Coroners Act section 19) plus any histology. They charge instead the BMA agreed fee for a 'special examination' (undertaken under Coroners Act section 20) which is currently £251.15, and this can include the necessary histopathology costs²⁶. All departments do it differently, as the advisors knew from discussion. The NCEPOD view is that when the whole issue of criteria and practices for taking samples in coronial autopsies is debated, the costs should be calculated and apportioned appropriately, and that the agreed system should be national rather than local.

Autopsy histopathology futures

NCEPOD has consistently called for improving the quality of autopsy examinations, whilst recognising that the majority are performed to a satisfactory standard or better. One of the important means of improvement is to increase the amount of histopathological analysis done.

There is a need for a general debate amongst all interested parties on the level of diagnostic accuracy the coronial autopsy is intended to achieve. As part of that debate, one fact needs to be considered: the amount of autopsy histopathology being performed is currently declining because of the reduced number of consented hospital autopsies as well as from coronial practice changes. Pathological training is an apprenticeship undertaken through experience, rather than learning from instruction. If the number of autopsies performed continue to decline what will the next generation of pathologists be learning on if there is not a reversal in the trend? How will they gain the knowledge and the confidence to diagnose difficult autopsy conditions when the intention is to inhibit the histological examination of autopsy tissues? In the meantime, when there is disagreement between pathologist and coroner over the importance of tissue sampling, one action that pathologists can take - which was not observed in the study sample - is to state, in the autopsy report, that agreement for undertaking histopathology studies to clarify a cause of death was sought, but refused.

Because coronial autopsies are the basis of nearly all adult postmortem examinations, there should be an agreed set of criteria that pertain nationally, over such an important component of the autopsy as tissue retention for diagnosis. At present, tissue taking is only sanctioned to make a diagnosis. NCEPOD argues that there should be a broader approach with more tissue analysis taking place to provide more accurate information to families and for national statistics, specifically:

- To improve the level of accuracy of causes of death, such as specific types of cancer (see also 'Causes of death');
- To enable review of the cause of death if it is questioned later, or new information arises after the autopsy and coronial inquiry;
- To better inform families of the deceased who increasingly want explanations about what happened to cause the death.

Recommendation

There should be national criteria and standards on organ and tissue retention for histopathology in coronial autopsies, in order to provide convincing evidence of the cause of death.

Other samples

In 14% (229/1,691) of cases other samples were taken. These included (in many cases more than one sample was taken):

- Blood (180 cases);
- Urine (44 cases);
- Stomach contents (15 cases);
- Vitreous humour (10 cases);
- Bile (1 case);
- Cerebrospinal fluid (1 case).

The tests undertaken on these samples were mainly for toxicological analysis, where drug overdose or toxicity was suspected, including alcohol. The full range of requested tests was:

- Toxicological analysis of illicit and/or prescribed drugs (140 cases);
- Toxicological analysis for drugs and alcohol (21 cases);
- Alcohol only (18 cases);
- Infection studies e.g. bacteria, viruses, serology (28 cases);
- Biochemical studies, mainly glucose related (9 cases);
- Lung examination for asbestos fibres (4 cases);
- Cytogenetic analysis (in children) (3 cases);
- Carboxyhaemoglobin concentration (carbon monoxide poisoning) (1 case).

These analyses were pertinent to the cases and enabled high quality autopsy results with convincing diagnoses. Case studies 13 to 16 illustrate the appropriate use of toxicology and microbiological investigations.

Case study 13

A middle-aged patient with a past medical history that included excess alcohol intake and possible liver damage called the GP. The GP found the patient to be partially clothed and possibly drunk and called a colleague to accompany them. It was half an hour later that entry to the house was made and by this time the patient was dead.

At autopsy there was psoriasis-like dermatosis over the knees and elbows and there was also congestion of the dermal blood vessels in a marbled fashion across the body.

The macroscopic internal examination revealed the following features: cardiac hypertrophy characterised by slight chamber dilatation and coronary atheroma only amounting to 30-40% stenosis, normal liver with no cirrhosis, and all other organ systems, including the brain and skull, appeared normal.

Histology showed:

Liver: mild fibrosis (not cirrhosis), fatty change, but no alcoholic hepatitis.

Kidney: hypoxic features with scattered bacterial colonies within glomeruli. The pathologist noted that "part of these changes represents postmortem overgrowth, but the number of colonies is suggestive of significant septicaemia".

Spleen: reactive changes with scattered bacterial colonies.

Toxicology and microbiology were also performed revealing trace amounts of alcohol, paracetamol and ibuprofen only. The spleen culture resulted in a heavy growth of streptococcus group A together with a light growth of staphylococcus aureus.

Cause of death was given as:

1a. Streptococcus septicaemia

The pathologist, in the correlation, considered that the cardiac hypertrophy and liver pathology were due to alcohol. These were judged "not to be directly implicated in the

cause of death". The spleen culture and vascular changes identified macroscopically indicated "a significant septicaemia process..associated with a high mortality rate. It is likely that the infection gained entry to the body via abrasions incurred previously or possibly around the areas with psoriasis-like features".

The advisors noted that the diagnosis was made by microbiology investigation. Without it, it is not clear what the pathologist might have said instead. Thus this case highlights the importance of microbiological investigation.

Case study 14

The deceased had a past history of hypertension and psychiatric problems and was found dead face down on a sofa at home. A suicide note was found at the scene.

The autopsy examination noted the following features:

CNS: slightly swollen, no evidence of trauma to the skull or scalp.

Lungs: congested and oedematous, but no focal lesions.

Heart: enlarged and heavy (685g) with thickening and mild dilation of both ventricles. There were no obvious scars or acute changes to the myocardium. The coronary arteries showed patch to moderate atheroma with focal 60% stenosis.

Stomach: watery brown liquid in which several soft tablets and tablet debris were seen.

Liver: enlarged and grossly pale and fatty, but not focal lesions were seen. Histopathology of the liver showed mild steatohepatitis with occasional fibrous septum formation.

Toxicological analysis showed that the blood level of theophylline was high (51µg/ml) and within the range associated with deaths from theophylline toxicity.

The clinicopathological correlation stated:

"Although natural disease processes identified could account for death in isolation, the toxicological findings are in my opinion the major factor in the death. The already diseased heart will however, have almost certainly lowered the threshold of cardiotoxicity of theophylline, which can induce palpitations, arrhythmias and seizures".

The cause of death was given as:

- 1a. Theophylline toxicity
2. Hypertensive heart disease

The report was deemed by the advisor to be excellent.

Case study 15 illustrates what appears to be insufficient toxicological analysis in a death in the community.

Case study 15

A middle-aged known drug addict and alcoholic was found face down at home. There was no history in the autopsy report and in the 'external examination' there was no mention of injection sites or other drug-related marks-or of their absence.

The heart weighed 420g with normal ventricles. One coronary artery had an atheromatous plaque at the origin with superimposed occlusive coronary thrombosis. The other coronary arteries were normal. Lung oedema was present and the brain was not examined. There were no further investigations and the cause of death was given as:

1a. Coronary thrombosis

The advisor commented on the failure to examine and record signs of drug use and to carry out toxicology in a case of a drug addict dying in the community. The coronary thrombosis is not necessarily the only or even the main cause of death since drug toxicity (e.g. cocaine) could equally be relevant in this scenario.

The advisors were again asked whether the lack of samples (being taken) detracted significantly from the report in its account of answering the questions raised by the death.

In 4% (61/1,691) of cases, the advisors considered that the lack of samples being taken did detract significantly from the report and in 6% (96/1,691) of cases, the advisors considered that taking other samples would have been informative in more precisely categorising the cause of death.

The specific investigations that, in the advisors' opinion, should have been done were:

- Alcohol (40 cases);
- Illicit drug toxicology (63 cases);
- Glucose-related, in diabetics (12 cases);
- Microbiological studies (18 cases);
- Mast cell tryptase, to identify acute anaphylactic shock (2 cases).

Case study 16 illustrates a problem in the evaluation of unexpected death in a known alcoholic.

Case study 16

A middle-aged, known alcohol abuser was seen by the landlord to be drunk one evening and was found dead 24 hours later, in an unkempt state. At autopsy no height or weight were recorded and the brain was normal. The heart was 320g, had no coronary artery disease but the left ventricle was described as hypertrophied at 2cm thick. No further investigations were done. The comment was "natural causes" and the cause of death was given as:

1a. Acute left ventricular failure

1b. Left ventricular hypertrophy

The advisor stated that the issue of alcohol was not addressed at all and should have been pursued with estimation of blood and urine alcohol. If these were not significant, the

*measurement of beta-hydroxybutyrate in the blood, may have been helpful as a marker of the keto-alcoholic syndrome that can cause sudden unexpected death in chronic alcoholics*²⁴.

All of these, and other investigations are important in autopsy practice, according to the case, and pathologists are encouraged to request them when the results will confirm or exclude possible causes of death. Inevitably there are costs involved. Toxicology analysis is expensive and the standard screen for drugs of abuse, including alcohol, is invoiced to the coroner at a cost of approximately £250 per case. Microbiological and biochemical investigations are not always billed to coroners as they may be subsumed into the daily laboratory workload, but the standard charge at the time of the study was £25 for each direct examination or culture and should not exceed £228.50²⁷. When toxicology is performed, an inquest is automatically opened and with it are associated cost implications.

Inevitably there is a cost-benefit analysis to be made in all cases where additional tests are contemplated and therein lays much variation in actual practice. It was noted in the study that not all persons who were found dead hanged, or victims of road traffic collisions, or known illicit drug abusers, had toxicological studies performed; whereas the coroner advisors noted that in many jurisdictions, such analyses were mandatory.

Due to the number of cases where it appeared that alcohol and/or illicit drug use may have been relevant to the death, the recommendation is aimed at that group specifically.

Recommendation

Deaths in persons known or suspected to abuse alcohol and/or cases associated with drug toxicity should be properly investigated.