Post mortem examinations after cardiac surgery

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Heart 2007;93;761-765
doi:10.1136/hrt.2006.092130

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At present in England and Wales just over 20% of all deaths are followed by a post mortem examination, almost all on the instructions of a coroner. In contrast, in Scotland and Northern Ireland the rates are below 10%. In a wider context overall post mortem rates in the provinces of Canada vary between 5–9% and are probably much lower in France and Germany. The reasons for this variation are unknown. Remarkably there has been no national audit of the indications for, or value of, autopsy examination. In this review we consider:

- why autopsies should be performed after cardiac surgery
- who should perform these autopsies and how they should be reported
- what has been learnt from post mortem examinations performed on patients dying after cardiac surgery
- what the role of these autopsies is in the future.

POST MORTEM EXAMINATION AFTER SURGERY

Pathologists frequently refer to the many published studies which have shown that important new information is detected in autopsies performed in patients dying in hospital.[1] At least two have shown that the rate of unexpected findings has not altered significantly over several decades.[2 3] Methods have been developed to categorise the degree of concordance between pre-mortem clinical diagnoses and post mortem findings.[2] A recent meta-analysis identified discrepancies in 10–20.6% of post mortem examinations where the patient would potentially have survived if the correct diagnosis had been known in life.[4] Although most of these studies have included patients dying after surgery, there have been few that specifically studied the value of post mortem examination after surgery.[5 6]

A retrospective study from Connecticut studied the clinical records and post mortem reports of 150 patients who died in a surgical intensive care unit. There was full agreement in only 58% of cases. The longer the patient was in the unit the greater the chance was of an unexpected finding. Infection was the most common undiagnosed condition, especially in patients who had received a transplant.[6] Impressed by these findings, we made a similar audit of 92 patients dying in our hospital after surgery in 2002 who had an autopsy. We found full agreement in 65%, a major disagreement in 20% and less important discrepancies in 15% of cases. Infection, pulmonary thromboembolism and ischaemic heart disease were the most important conditions diagnosed at post mortem examination. Important discrepancies were identified in 33% of orthopaedic procedures, 31% of neurosurgical, 27% of general surgical operations, but only 5.7% of cardiac operations.[7]

WHO SHOULD DO THESE AUTOPSIES AND HOW SHOULD THEY BE REPORTED?

In virtually all large hospitals in the UK, pathologists have moved towards so called ''specialist reporting''. Individual pathologists report surgical biopsies from only a limited number of systems. Although the value of this approach is still debated, it undoubtedly facilitates clinicopathological communication. Our policy is that autopsies on patients dying after cardiac surgery are performed by only a limited number of pathologists and to a detailed protocol[8] (webtable 1: to view this webtable visit the Heart website—http://heart.bmj.com/supplemental). In some centres these autopsies are performed by forensic pathologists, sometimes in post mortem rooms away from the hospital where the patient died. These pathologists are expert at assessing injuries and estimating the importance of haemorrhage. As they are fully independent they are able to issue critical comments without influencing working relationships. However, they may not be familiar with recent developments in the investigation and surgical treatment of cardiac patients. For this reason, in particular, we consider that these examinations are best performed or supervised by pathologists with a specific interest in postoperative pathology.

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Table 1 Common post mortem findings after cardiac surgery

Pathological finding	Clinicopathological comment
Acute pericarditis	A common finding of doubtful clinical importance (fig 1)
Pericardial, mediastinal or pleural haemorrhage	Up to 500 ml commonly observed and of no haemodynamic consequence. The exact source of haemorrhage is often uncertain at post mortem examination
Bypass graft thrombosis	An important feature that should be confirmed histologically. Most common at distal anastomosis (fig 2)
Acute myocardial infarction	Usually around the site of a previous healed infarct. Often haemorrhagic (fig 3). Small areas of haemorrhage in the myocardium close to distal anastomoses have no clinical significance
Hepatic fatty change and congestion, small bowel infarction, intense pulmonary oedema and congestion	Evidence of multiorgan failure and/or adult respiratory distress syndrome. Common complications in patients who die after prolonged periods on an intensive therapy unit
Cerebral oedema and infarction	Changes that are difficult to evaluate in the early postoperative period. Ideally require brain fixation and assessment by a neuropathologist
Pulmonary embolism	Probably less common than after other forms of surgery

So called minimum datasets are now used by surgical histopathologists for a wide range of cancer resection specimens. The Royal College of Pathologists has recently produced similar guidelines for different types of post mortem examinations. These give clear information on how different types of autopsies should be performed and reported. While an experienced pathologist can complete a reasonably thorough examination in a sudden unexpected death in 30–45 min, a postoperative case will often require 2 h. The common abnormalities that are found are summarised in table 1.

WHAT HAS BEEN LEARNT FROM AUTOPSIES PERFORMED ON PATIENTS DYING AFTER CARDIAC SURGERY?

Five centres have reported their findings[9–13] and these are summarised in table 2. Although the pattern of surgery and the post mortem rate differed, there were some consistent findings. Inevitably the majority of patients die of cardiac disease. In 5–19% of cases important information was obtained, which if appreciated in life would have influenced management. Notably the Papworth group has documented the importance of acute mesenteric ischaemia and established a relationship with peripheral vascular disease, intra-aortic balloon pump use and postoperative renal failure.[14] A recent retrospective study from Auckland showed that the overall incidence of mesenteric ischaemia was 0.6%. The diagnosis was confirmed by laparotomy or post mortem examination and the mortality rate was 76%.[15]

Many other abdominal complications have been reported, including acute pancreatitis and cholecystitis, but in our experience these are rare. In two studies unexplained deaths were assumed to be cardiac in origin. In others these were categorised separately and accounted for 9% and 13% when the post mortem rate was high and 25% when it was low. In our

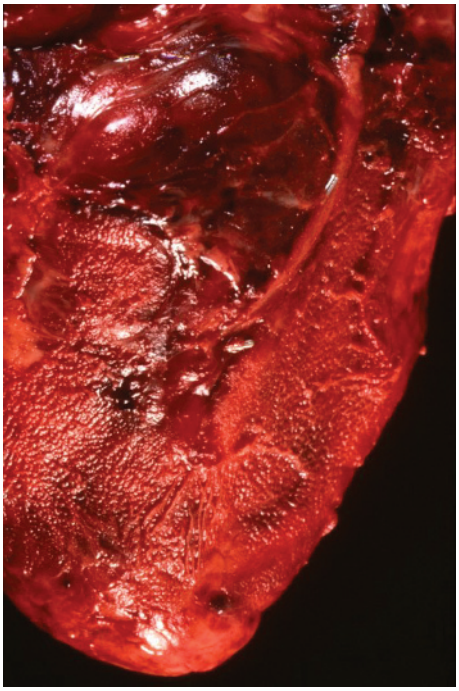

Figure 1 Postoperative pericarditis. This patient died of stroke 5 days after coronary bypass surgery. This degree of acute fibrinous pericarditis is not unusual.

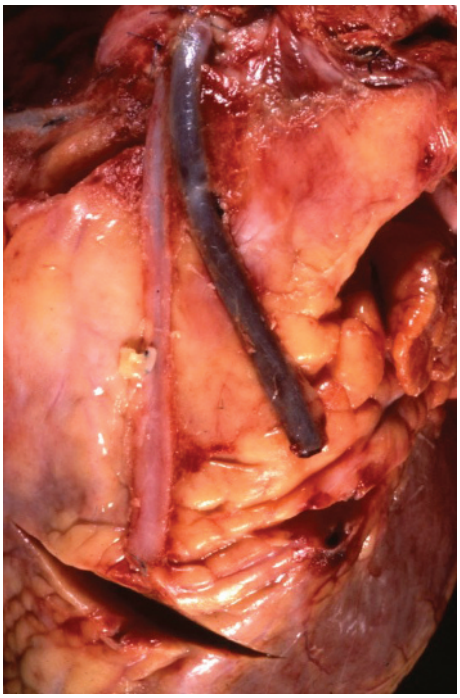

Figure 2 Saphenous vein graft thrombosis. The graft on the right is thrombosed. Pathologists must carefully examine the distal anastomosis as this is the first point at which a thrombus usually forms.

Figure 3 Myocardial infarction. The patient presented with chest pain and died 4 days after subsequent emergency coronary artery grafting. There was a history of previous myocardial infarction. The haemorrhagic appearance of the infarct is typical and is the result of reperfusion of necrotic heart muscle. Accurate dating of these infarcts is difficult and requires histological confirmation. Infarcts occurring <24 h before death may not be detected either by naked eye or histological examination.

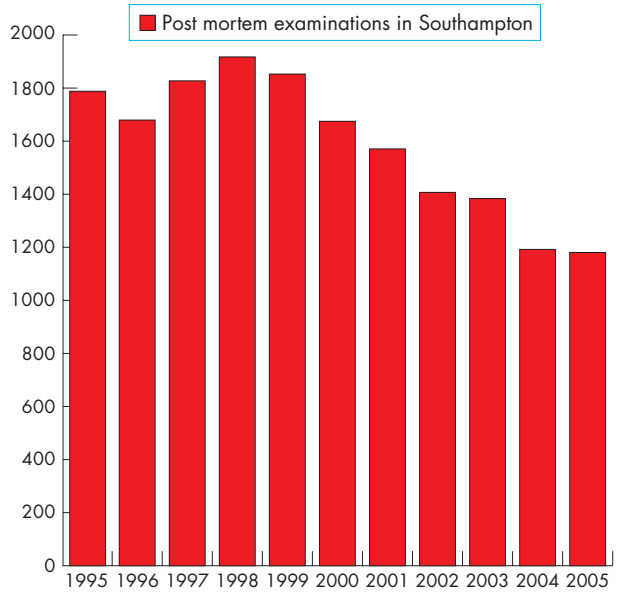

Figure 4 Post mortem examinations performed annually at a large regional teaching hospital. Numbers have declined progressively but have probably now stabilised. About half of the cases are out-of-hospital unexplained deaths. Approximately 100 of the cases (~10%) are postoperative deaths.

experience these are usually sudden unexplained deaths in the immediate postoperative period. In the absence of technical complications and without evidence of fresh myocardial infarction these are assumed to be arrhythmic.

We have recently re-audited our findings, comparing results with those obtained in the early 1990s. The mortality and post mortem rates and incidence of technical complications were virtually unchanged. There were no deaths from pulmonary embolism. The most striking difference was in the pattern of death certification by pathologists. Between 1999 and 2002 the cause of death was given as multi-organ failure in 25% of cases, though this was not used in the earlier period. In the same context 15% of deaths after cardiac surgery in Leipzig between 2000 and 2003 were ascribed to multi-organ failure.[13] The use of histology had declined from 77% to 48%, even though it is recognised that lack of histology detracts from the value of perioperative autopsy reports.[2 16]

Recent, more focused autopsy studies have examined changes in specific organs in patients dying after cardiac surgery. Proximal aortic atherosclerosis, intracardiac thrombus and intermittent aortic clamping were associated with major cerebral outcomes[17] in one study. A detailed neuropathological study of 262 fixed brains showed that macro- or micro-haemorrhages, infarcts or hypoxic brain damage could be detected in 49% of cases. In 33 cases (12.6%) the neuropathological changes were felt to be the direct cause of death.[18] Predictably coronary artery surgery and unstable angina were the major risk factors for perioperative myocardial infarction in a Swedish study.[19] A Johns Hopkins study emphasised that atheroembolism can cause death from coronary embolism, stroke and gastrointestinal infarction.[20]

FUTURE ROLE OF POST MORTEM EXAMINATION AFTER CARDIAC SURGERY

Post mortem examinations after cardiac surgery are complex and time consuming. Are they justified at a time when pathologists are in short supply throughout Europe and when the clinicopathological value of surgical histopathology is of growing importance?

In the UK most autopsies are performed on the instruction of a coroner, most of whom are legally rather than medically

Table 2 Post mortem findings after cardiac surgery

	Centre (reference)					
	Baltimore (Zehr *et al*)	Southampton (Lee *et al*)	Southampton (unpublished)	Cambridge (Goodwin *et al*)	Munster (Deiwick *et al*)	Leipzig (Rastan *et al*)
Period of study	1985–95	1991–94	1999–2002 *re-audit*	1996–99	1990–91	2000–3
Number of operations	13029	2781	2511	5103	2407	14313
% of deaths	4.6%	4.4%	4.7%	3.9%	3.1%	6.3%
Autopsy rate	24%	88%	86%	84%	46%	52%
Cardiac cause of death	27%	52%	61%	68%	69%	50%
Haemorrhage or technical reason	10%	14%	12%	5%	Not stated	8%
Important new information	10%	15%	7%	11%	23%	19%

qualified. Major changes have been proposed and are likely to be put in place in the near future.[21] It is intended that all deaths will be reported to an American style medical examiner (statutory medical assessor). This doctor will be able to allow the certification of death without autopsy and will specifically select cases that will come to post mortem. It is thought that the overall numbers of autopsies will reduce. In our centre the number of post mortem examinations has declined progressively in recent years but has now stabilised (fig 4). Our subjective impression is that the majority of cases now warrant post mortem examination and that a further reduction in numbers may not be desirable. In the majority of postoperative autopsies death is the result of natural causes. There is therefore no need for a formal inquest, an often disturbing experience whose value is now seriously questioned.[22] Naturally most relatives prefer to obtain information about the autopsy findings from their general practitioner or the relevant hospital consultant. However, in some centres pathologists meet directly with relatives in so called ''Next of Kin Clinics''.[23] These are particularly successful in departments of forensic medicine.[24]

Under the new system that has been proposed, coroners and their medical examiners will make contracts with their local pathologists, defining for the first time standards of practice and reporting. Detailed guidelines for the different types of examination have been drafted by the Royal College of Pathologists and will shortly be published. These various changes should enhance the standards of post mortem practice and improve the value of complex postoperative autopsy examinations. The most recent and by far the largest study of the value of autopsy after cardiac surgery[11] has concluded ''A high overall discrepancy rate between premortem and autopsy diagnoses was recognised. Autopsy revealed clinically relevant information in a significant number of cases. Therefore autopsy remains essential for quality assessment in perioperative treatment''.

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Post mortem examinations after cardiac surgery: key points

- A recent meta-analysis has shown that in 10–20% of unselected autopsies there were findings that could have affected the clinical outcome if they had been appreciated before death
- In six studies of post mortem examinations after cardiac surgery there were important unexpected findings in 7–23% of cases
- Bypass graft thrombosis and perioperative myocardial infarction are the most important changes that the pathologist should attempt to identify
- 12.5% of patients die of cerebral complications and in 50% of these there is evidence of haemorrhage, infarction or hypoxic brain damage
- Proposed changes in the UK medico-legal system may lead to improvements in post mortem practice

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In compliance with EBAC/EACCME guidelines, all authors participating in Education in *Heart* have disclosed potential conflicts of interest that might cause a bias in the article. We declare no conflict of interest.

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