Clinical diagnosis and the function of necropsy

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The necropsy has a splendid history[1,2]. Two hundred years ago Dr Thomas Beddoes besought the profession: 'The uncertainty of medicine, notwithstanding partial improvements . . . is . . . too likely to continue. Nor do I see how it should cease, till careful observation of the sick be combined, beyond any example, past or present, with early and exact dissection of the dead'[3]. Beddoes insisted that, when he died, a necropsy should be done to test his self-diagnosis of pericardial effusion[4]. Hospitals in the nineteenth century achieved remarkably high necropsy rates, allowing clinicians to enhance their clinical skills. After Thomas Hodgkin in 1826 became Inspector of the Dead and Curator of the Museum of Morbid Anatomy at the new medical school of Guy's he started the first systematic course in morbid anatomy in Britain: 'The practice of examining the dead . . . ascertaining the seat and effect of the disease . . . is absolutely necessary, as the means of detecting that which yet remains to be either wholly discovered or more fully elucidated'[5].

The decline in necropsies was a persistent complaint in the twentieth century, and the topic filled the whole of the August 1996 issue of *Archives of Pathology and Laboratory Medicine*. In 1914 in New York the necropsy rate at Presbyterian Hospital was 35%[6], higher than most in the city, and the average for the USA was about 10%[7]. Yet the new Johns Hopkins University Hospital achieved 63% and rates in Britain and Germany were even higher, approaching 100% in some countries[7].

There were two separate approaches in the USA to promote necropsy. The first was in 1910, when the American Medical Association (AMA) required medical students to attend 30 necropsies, a figure increased to 50 in 1933, but this requirement lapsed after 1944[8]. In 1926 the best single index of selection of a hospital for internship was suggested to be a necropsy rate of at least 25%[9]. However, the reality was different. Of 578 hospitals approved for interns by the AMA in 1927 only one-third had necropsy rates over 20%, and just under a quarter did no necropsies at all[7].

In 1965 the Joint Commission on the Accreditation of Hospitals (JCAH) recommended necropsy rates of 25% for teaching hospitals and 20% for non-teaching hospitals, but in 1970 this recommendation was abandoned[8]. Thereafter, necropsy rates in the USA declined rapidly—for example, in Chicago hospitals the rate was 51% in 1965 and 19% in 1984[10]; in the Mayo Clinic 75% in the 1960s and 50% in 1986[11]; in Brigham Hospital, Boston, 71% in 1970 and 38% in 1980[12]; and at Mount Sinai Hospital, New York, about 70% in 1930 and 20% in 1977[13]. However, there is no certainty that these declines were caused by the abandonment of minimal necropsy target percentages; before 1970 there had long been a downward trend[8].

Similar declines in necropsies have been seen in other countries—for example, in the Edinburgh region from 39% in 1961 to 24% in 1974[14]; in Ferrara from 35% in 1981 to 21% in 1985; in Japanese teaching hospitals from 30–40% in 1983 to 20–30% in 1986; in Malmo from 95% in the 1970s to 50% in 1989; in Zagreb from 64% in 1965–1967 to 31% in 1985–1987[12].

WHY THE DECLINE IN NECROPSY?

Relatives have never been keen on necropsy, for reasons including 'he has suffered enough', fear of mutilation of the corpse, religious objections and likely delay to the funeral arrangements[15–17]. It was easy in eighteenth century Vienna for the university faculty to demand that patients admitted to the new Allgemeine Krankenhaus must accept any recommended treatment while alive and a necropsy if they died[12]. Such authoritarianism achieved scientific renown for Vienna medicine but would be almost unthinkable today. It was tried at the new university hospital in Shiraz, but vigorous objections by relatives meant that the overall necropsy rate was only 64%[12]. The necropsy rates of 95% or more in Stockholm[12] and Malmo[12] in the early 1970s were probably attributable to the Swedish law making hospitals free to do necropsies without consulting relatives. This was changed in 1961.

Another cause of the decline was finance. The cost of a necropsy was estimated as $850 in 1976–78[18], $2000 in 1991[19] and up to $3345 in 1994[20]. There was no agreement as to which hospital budget should pay this sum, nor whether third-party insurers and managed care ought to accept responsibility for the necropsy as a form of quality control. In Belgrade in 1981 the necropsy rate of 22% immediately halved when the insurance fee-per-service payment stopped[21], and the decline in Ferrara was blamed on lack of resources[12].

Necropsy rates decrease with age[22]. In New Jersey in 1979–1980 the rate was 42% in those under 35 years, 17%

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in those 35–64 years and only 6% in the 65s and over. Such ageism was made mandatory in Malmo when the health authorities ordered a reduction in the necropsy rate (it has now halved), especially in those over 80 years[17].

Many professional factors discourage requests for necropsies today. Doctors themselves seldom follow the example set by Osler, who like Beddoes insisted on having a necropsy himself, for the sake of clinical science. Clinicians no longer do necropsies on their own patients and seem to lack enthusiasm for this mode of quality control. When Birmingham clinicians were told that the necropsy rate had fallen from 74% in 1958 to 46% in 1972, over half blamed the resistance of relatives; but one-fifth considered the necropsy outdated[23]. Lack of interest by consultants is transmitted to junior staff, who act accordingly. At St George's Hospital, London, 'firms' with a definite necropsy-seeking policy achieved a mean rate of 23%, significantly higher than the 9% achieved by firms without such a policy[24]. Consultants' lack of interest and even distaste for necropsy is noted by students, some of whom regard the procedure as barbaric[25].

In Edinburgh 72 of 180 clinicians answered a questionnaire[14]. Half believed that unsuspected abnormalities might be found in 1 in 10 necropsies and four-fifths declared that the necropsy had an important part to play in their clinical practice; yet four-fifths did not attend every necropsy on their patients and only two-fifths saw the necropsy as a means of teaching their juniors. Pathologists today do not work like Rokitansky (1804–1878), who supervised 70 000 necropsies in 45 years; he personally performed two necropsies a day, seven days a week. Many pathologists today prefer to concentrate on specimen histology and experimental research.

Necropsy rates of the last hospitals in which I worked are 22%, 10% and 13%. None of these approaches the 35% recommended in 1991 for clinical audit[26].

CLINICAL ERRORS DETECTED AT NECROPSY

There is much published work from the past century on the errors of clinicians discovered by the pathologist—both diseases missed by the clinician, and the absence of diseases that had been diagnosed before death. Yet even when such data have been amassed, collated and tabulated the results are of limited help, because pathologists will almost always find many diseases in a corpse. What one needs to know in audit are the major, therapeutically important, errors. We are indebted to Goldman and colleagues at Brigham Hospital, Boston, for an acceptable classification[27]:

- Class I—major disease that, if discovered in life, might have been cured or controlled to prevent death
- Class II—major disease discovered, unlikely to have altered outcome
- Class III—minor disease discovered, unlikely to have altered outcome
- Class IV—minor disease discovered, unrelated to outcome

In 1960 at the Brigham, class I errors were 8%, class II 14%, class III 47% and class IV 52%[28]. A quarter of a century later, despite all the advances in medical diagnostic technology, the fatal and non-fatal errors were almost identical—11%, 12%, 37% and 36%; the necropsy rate had halved from 75% to 37%[27]. Anderson[29] tabulated twelve studies of such major errors reported between 1974 and 1984; their mean error was 10%, and more recent studies have yielded similar rates, such as 13% in Winnipeg[30] and 20% in London[31].

Among patients ventilated in an American intensive care unit[32], 172 necropsies revealed 12% class I errors including remediable acute abdomen, pulmonary emboli and tuberculous or fungal infection. A further 6% of the examinations revealed carcinomatosis which, if it had been diagnosed, would have been managed differently; thus, 18% of patients proved to have been mismanaged.

CLINICIANS' SELF-SATISFACTION

Some clinicians claim that such high rates of error are spurious because requests for necropsies are limited to those few patients in whom there is uncertainty about the diagnosis. In Edinburgh three-fifths of the consultants attributed the decline in necropsies to increased confidence in their own clinical ability. One wrote, 'I am sure that this merely reflects the increase in . . . diagnostic techniques that allow a definite ante-mortem diagnosis . . . thus happily eliminating the need for necropsy'[14]. This argument has been tested and refuted. In Stockholm, with a necropsy rate of 96%, when the clinicians were 'fairly certain' of their diagnosis, the error rate was 25%; when their diagnoses were only 'probable' the rate of error was 45%[12]. Similarly in Edinburgh, clinicians were 'fairly certain' of the main diagnosis in half their patients, but were shown to be in error in 25% of those necropsies: their diagnoses were 'probable' in a third of the patients, but then the clinicians' error rate was 45%; and when clinicians had been 'uncertain' the error rate was 64%. Overall, half these errors were thought by the pathologist to have been clinically significant[33].

Clinicians have been self-satisfied for centuries. They ignored Bonetus in 1679: 'No less blame is applicable to those delicate physicians who from laziness or repugnance love to remain in the darkness of ignorance than to

scrutinise laboriously the truth'. They ignored Lord Horder's valediction in 1936:

> 'The clinician who relaxes in punctilious attendance at the post-mortems upon his patients, or upon patients of his colleagues, thinking the time could be better spent in the wards or in the out-patient rooms, is not only denying himself the chief correction to his exuberance and to his vanity, he is departing from the bed-rock of medicine itself. What he says at the bedside may or not be the truth; what he sees in the post-mortem room *is* the truth'[34].

Audit by pathologists of the diagnoses of clinicians is worthwhile only if pointers emerge to improve patient management. In a large study of 1106 patients with a necropsy rate of 76%, between 1947 and 1953, there was no improvement in error rates over the seven years (2%, 8%, 7%, 7%, 5%, 5%, 9%)[35]. Gruver and Freis noted a seasonality in the 64 errors, with 19 observed (11 expected) in June and July when the resident staff changed over and the senior staff took their vacations. Their conclusions regarding the causes of the errors bear repetition. Half the patients in the error group were unable to give a history because of acute alcoholism, confusion or toxicity, shock, coma or aphasia. The most commonly overlooked diagnoses were infections, particularly pneumonia and meningitis, followed by neoplasms, especially of the liver and brain, surgical conditions of the abdomen and cardiovascular catastrophes:

> 'Correctable diagnostic errors seemed to be due not so much to lack of medical knowledge as to deficiencies of medical judgment, alertness and thoroughness. These include failure to (a) obtain routine screening tests; (b) investigate abnormal symptoms, signs or laboratory reports that did not fit in with the diagnostic impression; (c) pursue indicated procedures; (d) recognize new illnesses developing in the presence of a previously diagnosed chronic disease; (e) realize that x-ray occasionally may fail to disclose pathologic changes, and (f) periodically review the record in prolonged illnesses and repeat the physical examination'[35].

There have been at least five attempts to stem the seemingly relentless decline in necropsies. In Reykjavik there was a small increase, from 56% in 1976 to 59% in 1986[12]. The overall necropsy rate in Austria increased from 20% in 1953 to 34% in 1987 when new pathological institutes opened outside Vienna[12]. In Trieste the rate of 20% in 1950 was raised to 95% in 1990[12]. Necropsy rates have been doubled in Baden (from 16% to 36%)[36] and in Westchester County, NY, (from 10% to 27%)[37] by training junior doctors in how to seek consent and in Cambridge, UK (from 22% to 55%) by using the non-medical patient affairs officer[12]. Families may be more willing to give permission if they can be promised a prompt report in lay language, and best of all a post-necropsy conference[38]. St Luke's–Roosevelt Hospitals, New York, tried to increase an 11% necropsy rate by offering a gift certificate for medical books to interns for each consent obtained. This reward was inadequate and there is now a prize of $1500 if a target of 100 is reached[39].

Would a reintroduction of minimum necropsy rates for hospital recognition be effective? In Japan, for accreditation of a medical school, the number of necropsies performed each year must be at least twice the number of students; if this target is met, the Ministry of Education provides a grant for these examinations. Training hospitals must have a necropsy rate more than 30% and hold regular clinicopathological conferences. However, as in the USA, necropsy rates have still decreased, and from 1983 to 1986 the rates in the 143 large training hospitals fell from 30–40% to 20–30%[12]. Are clinicians prepared to learn from their diagnostic mistakes? In Birmingham three-quarters claimed that, in the light of necropsy findings, they modified the treatment of subsequent patients[23]. Yet 10 of 59 Edinburgh clinicians were adamant that necropsies never altered their clinical practice; 31 others stated this might happen less than one in fifty times and 18 estimated that changes in practice might result from between one in ten and one in fifty[13]. Are surgeons any less liable to major errors than physicians? In Northern Ireland, which admittedly had a necropsy rate in 1987 of only 12%, the incidence of class I errors in 213 perioperative deaths was 21%[12]. Even for perioperative deaths in children British necropsy rates fell from 72% in 1989 to 44% in 1988/9[40].

Hall asked for evidence that we really need higher necropsy rates given the manpower crisis facing the specialty of pathology and the relative benefits of necropsy as against other activities that pathologists perform[40]. In the absence of clinical audit by high rates of necropsy, clinical diagnoses can sometimes be audited by a combination of tests. Nottingham University neurologists and radiologists studied 70 consecutive patients diagnosed clinically as having anterior circulation stroke syndromes. Three powerful imaging techniques were used, and confirmed the diagnosis of large vessel ischaemia in only 49 (70%). 6 patients had been misdiagnosed (3 metabolic upset, 1 hemiplegic migraine, 1 hysterical, 1 alcohol withdrawal). 15 patients had been misclassified (7 haemorrhage, 5 small-vessel occlusion, 3 posterior cerebral artery occlusion). Thus trials using only clinical entry criteria may have been underpowered or confounded, so that active thrombolysis for strokes has been sometimes misapplied[42].

CONCLUSION

Clinicians must commonly reach decisions for their patients without certainty. The only evidence of a consistent reduction in fatal errors comes from the Medical Clinic at Zurich where class I errors decreased from 16% in 1972 to 9% in 1982 and 7% in 1992 while necropsy rates remained admirably high at 94%, 89% and 89%[43]. In the absence of any general renaissance of the necropsy as the gold standard for the clinician there seems little hope of an improvement in clinical skills. Hippocrates knew this: 'I warmly commend the physician who makes small mistakes: infallibility is rarely to be seen'. Virchow knew this: 'How does all this boasting about exciting advances help if we do not know what we are dealing with?'. Perhaps clinicians should realistically aim in their patient care for what was suggested by the 1998 Nobel Laureate Amartya Sen: 'It is better to be vaguely right than precisely wrong'.

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