

The Vanishing Nonforensic Autopsy

Kaveh G. Shojania, M.D., and Elizabeth C. Burton, M.D.

We've all heard about cases in which a patient presumed to have died from acute myocardial infarction was discovered at autopsy to have had an aortic dissection, or a patient who presented with decompensated liver failure from presumed alcoholic cirrhosis but proved at autopsy to have widely metastatic hepatocellular carcinoma. Indeed, an extensive literature documents the frequency with which autopsy reveals clinically significant diagnoses that were missed before death.¹ Autopsies also generate more accurate vital statistics, provide pathological descriptions of new diseases, and offer powerful tools for education and quality assurance (see table). Yet despite these benefits, autopsies are performed after less than 10% of all U.S. deaths (see graph).² Moreover, national averages reflect high autopsy rates at a small proportion of hospitals; at the majority of nonacademic institutions, few or no autopsies are ever performed.

The scientific, educational, and public health benefits of the autopsy, though generally acknowledged, remain difficult to quantify. However, autopsy plays a demonstrably important role in confirming or overturning diagnoses entertained by treating physicians. One classic study examined 100 autopsies performed in each of three decades at a Boston teaching hospital to determine the frequency with which autopsy identified missed diagnoses (e.g., the missed aortic dissection) that would have

resulted in a change in therapy and might have prolonged survival if identified earlier.³ These errors — categorized as class I errors — were found in approximately 10% of autopsies in all three decades. The authors also found class II errors — missed diagnoses that didn't affect survival but were nonetheless clinically important (e.g., the advanced hepatocellular cancer) — in an additional 12% in each decade.

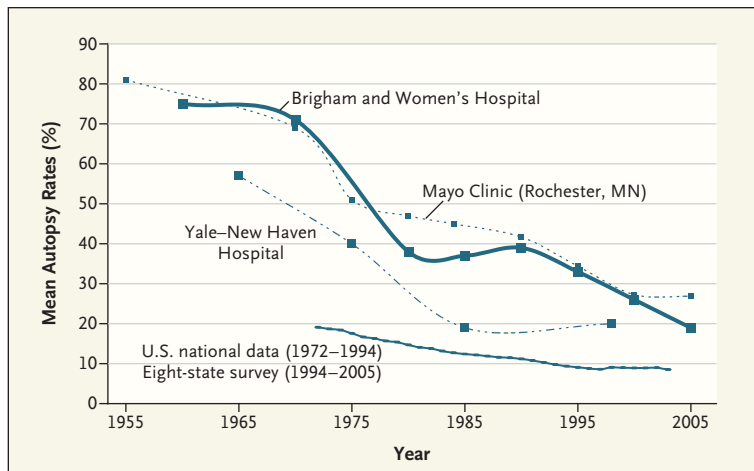
Physicians have generally attributed such results to selection bias, arguing that the cases physicians select for autopsy are those with the greatest diagnostic uncertainty. Such selection would leave the rates of diagnostic errors detected at autopsy relatively unchanged, despite true gains in diagnostic accuracy. But evidence suggests that physicians actually have little ability to accurately select cases for which autopsy will have the greatest diagnostic yield. Indeed, if selection bias were the main factor, one would expect

studies from institutions with high autopsy rates to report substantially lower rates of errors in antemortem diagnosis. We found only modest evidence of such an inverse relationship in 40 years' worth of autopsy studies.¹ Controlling for autopsy rate, case mix, year, and country, we estimated that in 2000 an average U.S. hospital that had performed autopsies after all deaths would have detected class I errors in approximately 4% of cases and class II errors in an additional 4%.

Admittedly, some so-called errors reflect accepted limitations of current diagnostic methods or represent particularly challenging cases. On the other hand, the errors include only missed diagnoses, not overdiagnosis or diagnostic delays. As long as clinicians entertained the correct diagnosis at some point, the studies we reviewed did not categorize the case as involving an error.¹ Moreover, determination of the correct diagnosis in difficult cases could

Benefits of Nonforensic Autopsies.

- Education for practitioners and trainees (e.g., demonstration of pathological findings in advanced illness and uncommon conditions)
- Identification and elucidation of emerging and re-emerging diseases (e.g., AIDS, legionnaires' disease, and West Nile virus)
- Local quality assurance for all aspects of antemortem diagnosis (clinical evaluation, diagnostic imaging, laboratory testing, pathology), procedure performance, and functioning of medical devices
- More accurate vital statistics
- More accurate ascertainment of causes of death in research studies
- Improved postmarketing surveillance for adverse effects of drugs, devices, and procedures
- Identification (or exclusion) of conditions of interest to family members



Trends in U.S. Autopsy Rates.

Rates are from various published sources contained in a systematic review,¹ publicly available national data, a survey of centers performing autopsies in eight states (Illinois, Indiana, Louisiana, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin),² and personal communication with pathologists at individual institutions. Autopsy rates at many institutions are inflated by the inclusion of forensic cases and stillbirths.

increase physicians' awareness and understanding of atypical presentations of certain conditions.

Cases in which autopsies are not performed so far outnumber those in which they are performed that many missed diagnoses probably go undetected. We considered three conditions that commonly appear among missed diagnoses in autopsy studies — aortic dissection, pulmonary embolism, and active tuberculosis — and estimated the rates at which they are missed in patients whose bodies do not undergo autopsy.⁴ We found that the expected prevalence of missed cases among patients whose bodies were not autopsied reduced the rate of antemortem detection from a reported 93% to 82% for aortic dissection, 96% to 83% for active tuberculosis, and 97% to 91% for pulmonary embolism.

The decline of the autopsy at least partially reflects the absence of incentives for performing it.

Medicare stopped paying directly for autopsies in 1986, and the Joint Commission on Accreditation of Healthcare Organizations eliminated the requirement for a minimum autopsy rate from its accreditation process in 1970. Equally important, the majority of physicians have lost interest in autopsies. Rather than examining the dead using a procedure that has changed remarkably little in the past century, pathologists increasingly occupy their time with ever more sophisticated (and reimbursable) molecular-based diagnostic testing performed on tissue from the living. Among clinicians, the mistaken belief that sophisticated diagnostic tests have rendered the autopsy obsolete combined with reluctance to ask bereaved families to consent to autopsy has substantially reduced interest in the procedure.

Educational efforts could overcome these and other barriers, including the misperception that

autopsies increase physicians' exposure to malpractice claims. However, an important remaining impediment concerns the quality of the autopsy process. In many institutions, there is little attempt to coordinate autopsies with the schedules of requesting physicians. In addition, autopsy reports often appear only after considerable delay and contain difficult-to-interpret findings that fail to resolve diagnostic questions.

These deficiencies partially reflect a lack of sufficient resources for performing autopsies, but the shrinking number of autopsies has probably also contributed to a reduction in requisite expertise. Since many pathology programs must now rely heavily on forensic autopsies when training residents, a growing proportion of pathologists may not have received adequate training in the performance of useful examinations after diagnostically complex natural deaths.

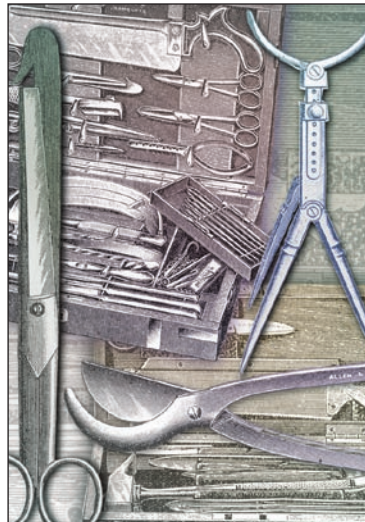
Unfortunately, it is not financially feasible to completely reverse the trend in autopsy use, and small increases at all hospitals would do little to improve the quality of the autopsy process or stimulate improvements in clinical performance. An alternative solution might be the creation of regional autopsy centers, which would receive funding to maintain high autopsy rates in their own hospitals and to perform autopsies of patients from other institutions. This approach could produce economies of scale that would reduce costs. It could also provide opportunities to improve autopsy quality, to develop strategies for using autopsy results to improve clinical performance, and to improve training for pathology residents as well as education for medical

students. Autopsies performed for outside centers could be broadcast in video over the Internet, educating the referring practitioners. Under such a system, referring hospitals would pay less in autopsy fees than they would to maintain on-site autopsy capabilities, and the high-volume center could use the revenue from outside autopsies to hire pathologists with appropriate expertise in autopsy and personnel trained in requesting that patients' families allow an autopsy to be done.⁵

In general, physicians do not request autopsy randomly: they are influenced by their acquaintance with the patient or family, demographic factors, and perceived diagnostic need for autopsy. Evidence suggests that these factors correlate weakly at best with autopsy's diagnostic yield. Thus, continuing to allow physicians complete discretion in requesting autopsies amounts to a kind of arbitrary sampling and should continue to detect substantial numbers of important misdiagnoses. Analyses of data from regional centers might enable researchers to identify patterns of missed diagnoses and to generate prediction

rules that would enhance the process of case selection.

Proposed alternatives to autopsy have included minimally invasive



postmortem investigations, such as needle biopsy or endoscopy, and radiologic investigations. These options may be more acceptable to families of the deceased, but they are less accurate than autopsy and require specialized resources or personnel.² It might be more effective to augment autopsy with widespread use of structured death reviews, which often reveal the extent to which an appropriately broad differential di-

agnosis was pursued before death. The recognition that an alternative diagnosis was overlooked can be a valuable lesson in itself. Ultimately, such a process, along with any revival of postmortem examination, must deliver important benefits for the living, including improvements in clinical care and health outcomes.

No potential conflict of interest relevant to this article was reported.

Dr. Shojania is an associate professor of medicine at the University of Ottawa and a clinical epidemiologist at the Ottawa Health Research Institute, Ottawa. Dr. Burton is a clinical scholar in pathology and laboratory medicine in the Baylor Health Care System and the director of autopsy pathology at the Baylor University Medical Center, Dallas.

1. Shojania KG, Burton EC, McDonald KM, Goldman L. Changes in rates of autopsy-detected diagnostic errors over time: a systematic review. *JAMA* 2003;289:2849-56.
2. Nemetz PN, Tanglos E, Sands LP, Fisher WP Jr, Newman WP III, Burton EC. Attitudes toward the autopsy — an 8-state survey. *MedGenMed* 2006;8:80.
3. Goldman L, Sayson R, Robbins S, et al. The value of the autopsy in three medical eras. *N Engl J Med* 1983;308:1000-5.
4. Shojania KG, Burton EC, McDonald KM, Goldman L. Overestimation of clinical diagnostic performance caused by low necropsy rates. *Qual Saf Health Care* 2005;14:408-13.
5. Horowitz RE, Naritoku WY. The autopsy as a performance measure and teaching tool. *Hum Pathol* 2007;38:688-95.

Copyright © 2008 Massachusetts Medical Society.