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The Autopsy, Medicine, and Mortality Statistics

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention • National Center for Health Statistics

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The Autopsy, Medicine, and Mortality Statistics

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The Autopsy Committee of the College of American Pathologists

The year 2001 charge statement for the Autopsy Committee of the College of American Pathologists is: ‘‘To improve the performance and reporting of the autopsy and to promote utilization of the autopsy for quality improvement, research, education, and public health.’’

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Foreword

Comments from the National Center for Health Statistics

The series of articles in this report document the value of autopsy in health care and health statistics and provides educational information about completing cause-of-death statements. Autopsy information has long been an essential tool for quality control of medical care and for enhancing the quality of cause-of-death information reported on the death certificate. Recognizing that the use of autopsy has declined considerably in the past 50 years as documented in vital statistics, the autopsy is nevertheless regarded as an important tool in medical practice and in improving the cause-of-death data. An ample body of literature shows not only the medical values of autopsy, but also its importance in bench marking the quality of cause-of-death data.

Death certificate information is a major source of statistical data to identify public health problems, to monitor progress in public health, to allocate research funds, and to conduct scientific research. For these reasons, good reporting of cause of death is very important. The articles illustrate many of the basic principles in cause-of-death reporting: intellectual process of determining the best medical opinion of cause of death, separation of contributing causes in Part 2 of the medical certification from the sequence of conditions reported in Part 1, report of a single condition per line, avoidance of abbreviations, and amendment of the record if additional information becomes available later. This report provides additional examples of cause-of-death statements to supplement those available from State and Federal vital statistics programs (e.g., http://www.cdc.gov/nchs/about/major/dvs/handbk.htm).

Dr. Hanzlick, the editor of the report, continues his important contribution to the National Vital Statistics System and in particular to the quality of national mortality data. NCHS is pleased to assist the College of American Pathologists in promoting the distribution of these articles, which previously appeared in *Archives of Internal Medicine*.

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Preface

The Autopsy Committee of the College of American Pathologists undertook the ''Autopsy and Medicine'' series in 1997 with two major goals in mind:

- To illustrate the continued value of the autopsy to the practice of medicine; and
- To provide educational material and discussion concerning cause-of-death statements and completion of the death certificate.

These goals arose out of recognition that autopsy rates in the United States, especially in medical institutions, had fallen to unacceptable levels for quality assurance/improvement purposes. Studies also show a need for improving our national mortality data derived from death certificates, which, in turn, should reflect information obtained at autopsy.

The committee is grateful to Dr. James Dalen, Editor of *Archives of Internal Medicine*, who agreed to publish the series which began in August of 1997 and ran through November 2000. Twenty-nine case reports and one summary article were published during that time.

The committee also wishes to thank *Archives of Internal Medicine* and The American Medical Association for authorizing reproduction of the articles that appear in the Autopsy and Medicine Series. Some of the articles have been edited slightly or given subtitles since their original publication. Also deserving thanks is the National Center for Health Statistics (NCHS), which agreed to print the series as a freestanding publication. Comments from NCHS are printed on the following page.

Finally, the committee wishes to thank Joe Schramm, Ayrika Gunn, and Jessica Troup of the CAP for their dedicated service in producing the draft for publication.

The Autopsy Committee feels that this publication will be especially useful for the following individuals:

- Physicians in medical specialties in which the deaths of some patients will occur, making knowledge of the autopsy and cause-of-death statements a desired attribute;
- Pathologists and other physicians who have a need to educate others on the value of the autopsy; and
- Legislators and policy makers whose duties include analysis of the autopsy and its role in the practice of medicine and public health.

Authors who reference the articles included in this publication should cite the original reference from *Archives of Internal Medicine* when possible. Complete references are included in ''Wrapping Things Up,'' the last case report in this collection.

Contents

The Moribund Autopsy: DNR or CPR?

The decline in the performance of autopsies in the past three decades is remarkable: from 41 percent of hospital deaths in 1961 (1) to 5 percent to 10 percent in the mid-1990s! (2) House officers in the 1960s were urged to ''get the post'' on every patient dying in a teaching hospital. Observing the postmortem examination of patients whom they had taken care of was a critical part of the training of residents in internal medicine. Currently, the residency review committee for internal medicine requires autopsies in at least 15 percent of deaths on the medical service in accredited residency programs. From 1991 to 1994, less than half of the internal medicine programs reviewed for accreditation met these minimal requirements (3).

Numerous reasons for the abrupt decline in autopsies have been cited. In 1971, the Joint Commission on the Accreditation of Hospitals eliminated autopsy requirements for hospital accreditation. Autopsies have become very expensive, and these costs are not reimbursed by third-party payers. The process for obtaining consent for autopsies remains cumbersome. However, the most likely explanation for the decline is that physicians do not request autopsies because they believe that the examinations have lost their value. The most obvious value of the autopsy is quality assurance: to compare the clinician's premortem clinical diagnosis with the precise, anatomical cause of death. Did the patient receive the correct treatment for the correct disease?

Cabot's (4) classic paper in 1912 based on 3,000 autopsies quantified the percent of correct clinical diagnoses for a variety of diseases. Diabetes and typhoid were correctly diagnosed before death in more than 90 percent of the cases examined after death. However, common diseases such as cirrhosis, acute endocarditis, bronchopneumonia, and acute nephritis were missed in more than 50 percent of the cases.

Obviously, clinical medicine has made massive strides since 1912. Some clinicians may believe that our current sophisticated high-tech diagnostic tests render the autopsy superfluous. Many pathologists do not agree that the autopsy has been rendered superfluous by modern technology. Perhaps they are justifiably alarmed at the imminent demise of the autopsy.

Landefeld, et al. (1) in 1988 found that by performing autopsies, major unexpected findings were detected. A premortem diagnosis of these findings would probably have improved survival in 11 percent of the cases examined at a university hospital and 12 percent of the cases at a community hospital.

Shanks, et al. (5) reported the value of the autopsy in 213 cases of perioperative death. They found major discrepancies in clinical diagnoses that were treatable and could affect survival in 21 percent of the cases.

In a review of 1,000 autopsies performed between 1983 and 1988, Sarode, et al. (6) found ''major discrepancies'' between the autopsy findings and the clinical diagnosis in 317 (32 percent) of the 1,000 autopsies. Two recent studies found major discrepancies in the diagnosis of malignant tumors. Veress and Alafuzoff (7) reported that 15 percent of all major cancers were not diagnosed before autopsy. Manzini, et al. (8) reported that 34 percent of tumors with metastasis were missed before the autopsy.

Given these reports, it may be more appropriate to save the autopsy, rather than pronounce it ''DNR''!

In an attempt to begin CPR of the autopsy, the Autopsy Committee of the College of American Pathologists has prepared a series of brief case reports for the *Archives of Internal Medicine*. In this series, ''Autopsy and Medicine,'' a brief case report will be presented that illustrates modern uses of the autopsy for improving patient care, analyzing potential legal and health risks, meeting regulations, reducing unnecessary litigation, and benefiting the public.

NOTE: Volume 157, August 11/25, 1997. James E. Dalen, M.D., M.P.H. Editor.

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What Killed the Patient: The Disease or the Experimental Treatment?

A 38-year-old woman underwent excision of a nodular malignant melanoma of the right scapular region (level III; Breslow depth, 1.6 mm). Right axillary lymph node dissection a month later showed metastases in five of six nodes with extracapsular spread. Six months later, the patient had a dental abscess associated with a dental implant; the abscess was treated with removal of the implant and six days of antibiotic therapy with metronidazole and amoxicillin. The next day, the patient got a new pet dog; she already had cats.

The day after acquiring the dog, the patient was enrolled in a ganglioside adjuvant vaccine study (for treatment of melanoma) and received her first dose (1,2). After receiving the vaccine, the patient developed progressive dyspnea. At first she had dyspnea only after she walked up a flight of eight stairs, but it worsened until it occurred after only minimal effort such as blow-drying her hair.

On the fifth day, she presented to the outpatient clinic. Her oxygen saturation while breathing room air was 96 percent, but when she was walked up and down the hall on a level surface, her saturation decreased to 85 percent. Her pulse was 120 per minute, and her blood pressure was 95/60 mm Hg. Her chest was clear. Blood hemoglobin concentration was 148 g/L with a hematocrit of 0.43. The white blood cell count was 9.2 10^9/L (neutrophils, 0.70; lymphocytes, 0.17; monocytes, 0.12; eosinophils, 0.01), and platelets numbered 120 10^9/L. Findings from electrocardiography revealed a normal sinus rhythm with some T-wave flattening in leads III and a VF. Chest radiography results were negative and findings on computed tomographic scan of the chest showed no evidence of pulmonary embolus, no pulmonary nodules, no evidence of infiltrate or effusion, and no hilar, mediastinal, or axillary adenopathy. Two deep pectoral muscle lymph nodes were noted on the right, and there were multiple low attenuation lesions throughout the liver.

The patient was hospitalized overnight and had no dyspnea in the hospital. Her dyspnea was attributed to an allergic reaction to her new pet dog. She was discharged the next day, but was rehospitalized the day after that with progressive dyspnea without reexposure to the dog, so her dyspnea was then attributed to adverse effects of the ganglioside adjuvant vaccine. The patient also had severe epigastric pain and right upper quadrant tenderness. She developed marked elevations of her serum transaminase levels, and liver biopsy results showed metastatic melanoma. A diagnosis of *Escherichia coli* urinary tract infection was made on the eighth hospital day. The patient had persistent epigastric pain requiring progressive narcotic analgesia and worsening dyspnea requiring progressive supplemental oxygen therapy. A decision was finally reached to provide comfort measures only. Terminally she had a leukocytosis with a left shift and a white blood cell count of 30.6 10^9/L. The patient died on hospital day 18.

Autopsy Findings

Postmortem examination revealed metastatic malignant melanoma involving lymph nodes, liver, spleen, bone marrow, lungs, pleura, epicardium, myocardium, gallbladder, duodenum, pancreas, kidneys, uterus, adrenals, and left breast. There were extensive lymph node metastases with nodes measuring up to 4 cm. The liver was mildly enlarged, and metastases replaced approximately 70 percent of the parenchyma. There were multiple spleen metastases up to 0.6 cm, multiple lower thoracic spinal metastases up to 0.5 cm (with extensive bone marrow necrosis), visceral pleural metastases up to 0.8 cm, and epicardial metastases up to 0.3 cm. Histologic sections from all five lobes of the lung each showed extensive interstitial, lymphangitic, and perivascular tumor. Postmortem blood culture results were positive for *E. coli.*

Based on these findings, a cause-of-death statement was prepared as follows:

Part 1.
A. **Pulmonary lymphangitic carcinomatosis**

Due to or as a consequence of:
B. **Metastatic malignant melanoma (skin of back)**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Escherichia coli sepsis

Comment

The autopsy findings suggest that stretching of the liver capsule by metastatic tumor was the reason for the patient's epigastric pain and right upper quadrant tenderness. The autopsy findings also support the conclusion that pulmonary lymphangitic and interstitial tumor was the cause of the patient's dyspnea with pulmonary metastatic tumor being below the limits of radiologic detection. Although dyspnea initially coincided temporally with the administration of the experimental tumor vaccine and the patient's exposure to a new dog, the subsequent sequence of events and the autopsy findings point toward tumor-related restriction in pulmonary expansion and diffusion capacities as a more likely cause of the patient's dyspnea, especially since dyspnea had worsened without continued exposure to the dog. Further, there was no morphologic evidence of an adverse drug reaction, pulmonary tumor necrosis or hemorrhage, or other finding to explain the progressive dyspnea.

The question arises whether performing a lung biopsy might have yielded the diagnosis of lymphangitic carcinomatosis. This case also suggests that pulmonary function testing, rather than radiologic imaging, may be a helpful way to assess the likelihood of lymphangitic carcinomatosis. Such questions, which grew out of the autopsy in this case, could prompt future study of the clinical utility of alternative methods of testing for the diagnosis of lymphangitic carcinomatosis. Failure to recognize lymphangitic carcinomatosis (lymphangiosis carcinomatosa) as a cause for dyspnea, and its misdiagnosis as pulmonary embolism, was the subject of another ''Case of the Month'' in which the autopsy findings explained the lack of response to anticoagulant therapy (3).

The autopsy was also valuable in this particular case because it provided a likely explanation for the patient's shortness of breath that was being attributed to other causes, including the experimental vaccine therapy she had received. If an adverse event occurs following experimental therapy, the adverse effect may be wrongly attributed to the experimental therapy (even without any hypothesis about possible or likely pathogenetic mechanisms) unless a better explanation

is available. The autopsy in this case provided a much sounder explanation for the progressive dyspnea: pulmonary lymphangitic carcinomatosis. Thus, the autopsy saved an experimental therapy from being falsely blamed for an adverse reaction, and the patient seems to have died from progression of her disease rather than a complication of the treatment she received. We recommend the performance of an autopsy when experimental therapy has been used or when death is suspected to have resulted from a complication of treatment, even if an autopsy is not required by protocol.

NOTE: Volume 160, August 14/28, 2000. Larry Nichols, M.D., University of Pittsburgh Medical Center, Pittsburgh, PA; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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The Autopsy and New Technology: All That Glitters Is Not a Gold Standard

A 66-year-old woman with metastatic uterine leiomyosarcoma involving nearly the entire left lung was admitted to the hospital for evaluation of dyspnea. On day 3 of her hospitalization, while undergoing a computed tomographic (CT) scan, she reportedly fell from the CT table, landing between the table and the scanner. Computed tomographic scans of her head, neck, and chest were performed to evaluate her condition and determine if any injuries were sustained from the fall. She suffered a cardiopulmonary arrest while still in the CT scan room. Resuscitation efforts were not performed because she had been placed on do-not-resuscitate status. Her death was reported to the medical examiner because of the fall and possible injury. When the death was reported to the medical examiner, information obtained by the medicolegal death investigator from the hospital indicated that the CT scan showed upper cervical spine fracture with spinal cord compression. The medical examiner assumed jurisdiction and performed a complete autopsy.

Autopsy Findings

The autopsy showed a small left frontal scalp hematoma. There was near total replacement of the left lung by hemorrhagic neoplasm, which was histologically confirmed to be leiomyosarcoma. There was evidence of acute hemorrhage within the tumor, which was viewed by the pathologist as a probable explanation for the acute exacerbation of the patient's dyspnea. Autopsy also confirmed that a hysterectomy and salpingo-oophorectomy had been performed, consistent with the reported history of a uterine primary tumor site. Examination of the neck with both anterior and posterior neck dissections revealed no fractures or soft tissue hemorrhage in the paravertebral tissues. The upper cervical spinal canal was easily visualized through the foramen magnum, and the spinal cord was unremarkable without evidence of cord compression or spinal canal stenosis. Moderate atherosclerotic cardiovascular disease was also found. In the absence of significant trauma, the cause of her death was attributed to the following:

Part 1.
A. **Uterine leiomyosarcoma with extensive metastasis to the left lung**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions: **Atherosclerotic coronary artery disease**

Comment

Because of the discrepancy between the autopsy findings and the initial report of spinal column and cord injury, a review of medical records was performed and the CT scans were reviewed with the attending radiologist. The initial interpretation of the CT scan by the radiologist was that of a nondisplaced fracture of the second cervical vertebral pedicles (bilateral) without spinal cord compression. The original report of spinal cord compression was in error and resulted from misinterpretation of the ''without'' symbol $\overline{O}$ as meaning ''with'' ($\overline{c}$). Thus, the lack of spinal cord compression at autopsy was actually consistent with the original medical record, and the apparent discrepancy was explained as a result of the autopsy and retrospective review of the case.

The lack of vertebral fracture at autopsy was a second discrepancy that needed explanation. The hospital had recently acquired a new CT scanner with resolution capabilities to the millimeter level. The CT scans of the patient presented in this case report were among the first scans performed with the new equipment. Defects were observed with the CT scan in the lamina of the C2 cervical spine and were initially interpreted by the radiologist as fractures. As more experience was gained with the CT equipment, similar defects were observed in other patients. On reevaluation of this patient's CT scans, it was determined that the defects did not represent fractures but instead

were perforating vascular foramina. These foramina could not be visualized with older equipment because of the bone-density averaging methods used by the older equipment.

As new technologies enhance our abilities to visualize smaller objects and to detect smaller quantities of various substances, we must be careful in our interpretation of the data. In some instances, as in this case report, we are not detecting new or abnormal entities, but now have the ability to measure, see, or detect ''normal'' entities that we previously could not.

This case highlights potential pitfalls of new technology with enhanced resolution and the continued value of the autopsy in serving as a ''gold standard'' for validating new and emerging technology. (1,2) Regarding the present case in particular, because of the initial diagnosis of cervical spinal fracture, the hospital was open to potential criticism, accidental or wrongful death claims, and litigation. The confusion about the spinal cord compression also illustrates the potentially serious legal risks that may be imposed by a simple misinterpretation and/or miscommunication of or about the medical record. The retrospective medical record review and discussions with the radiologist, done in conjunction with the autopsy and death investigation, clarified the problem and also provided useful information to the radiologists. Although the initial misinterpretation of the CT scan was rectified by the radiologists, the autopsy (by an independent agency in this case) served as the ultimate medical quality assurance measure, and was useful to provide further knowledge about a new technology. The autopsy was also very valuable to the hospital in providing information that could be used to rebut or disprove legal claims that could arise about the fall and possible injury.

NOTE: Volume 160, July 10, 2000. Eric Kiesel, M.D.; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists, Northfield, IL.

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Elder Abuse and Neglect

An elderly white woman died in the care of a male friend who was her caretaker for the past year. She was found in her bed, unresponsive, and the police were notified. Upon arrival, the police found her in the bed on top of dirty, soiled linens. Fecal material and areas of urine staining were present, each in excess of what would be expected from agonal defecation and urination. Her physician refused to sign the death certificate because he had not seen her in two years, and previously she had been doing well. He could not think of a clear cause of death since her medical history was significant only for senile dementia and osteoporosis during the past four years. The male friend was considered the next of kin, and he desperately wanted to complete the paperwork for burial and insurance purposes. The physician agreed to sign the death certificate if a complete autopsy was performed. The body was taken from the home to the autopsy room.

Autopsy Findings

At autopsy, the decedent was noted to be cachectic, with dried fecal material between her buttocks. She appeared dehydrated, with tenting of the skin and sunken eyes. Decubitus ulcers were present over the sacral and inferior buttocks regions. The ulcers extended through the skin, subcutaneous soft tissue, and skeletal muscle down to the bone. The femoral head could be visualized on the right side. The surrounding tissue was friable and necrotic, and necrosis and inflammation were confirmed by microscopic examination. A yellow-tan exudate was present within the ulcers and was cultured by the pathologists. Blood was also drawn for culture. Both the blood culture and wound exudate culture were positive for *Pseudomonas aeruginosa*. Vitreous was drawn for analysis of electrolytes and the results showed dehydration with an increase in sodium, chloride, and urea nitrogen levels. Other findings included cerebral atrophy with remote ischemic changes microscopically.

The cause of death statement was prepared as follows:

Part 1.
A. ***Pseudomonas* sepsis with dehydration**

Due to or as a consequence of:
B. **Decubitus ulcers associated with senile dementia**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:

Comment

Each year approximately 10 percent of adults 65 years and over are abused, and 4 percent experience moderate to severe abuse (1–4). Elder abuse has been recorded since the 19th century, but it was not brought to the forefront until 1980, by the U.S. House Select Committee on Aging. By 2030 the U.S. population will consist of about 70 million older Americans, which is more than twice the number in 1990. Thus, an increase in the number of older victims of abuse can be expected (5).

In 1987 the American Medical Association's Council on Scientific Affairs defined *elder abuse* as an act or omission that results in harm or threatened harm to the health or welfare of an elderly person (3). Elder abuse can be classified into six categories: physical abuse, sexual abuse, neglect, psychological abuse, financial and material exploitation, and violation of rights (5).

Physical abuse is an act carried out with intention of causing physical pain or injury, such as hitting, slapping, or stalking with objects. *Sexual molestation* includes contact with genitalia, anus, or mouth. *Neglect* is one of the more common forms of abuse and is characterized by a failure of the caregiver to provide the goods or services that are necessary for optimal functioning or to avoid harm. *Medical neglect* was the form of neglect in the case reported above because there was failure to seek medical care appropriate for the patient's condition. *Psychological abuse* may include threats, insults, harassment, harsh orders, and behavior designed to increase social isolation. Stealing pension checks, not using funds for support of the elder, and/or inappropriate use of the elder's personal property constitute *financial and material abuse*. This latter form of abuse/neglect could also be alleged in the current case since the caretaker was using the decedent's funds, but not for her support. *Violations of rights* occur when the caregiver deprives the individual of his or her inalienable rights, such as freedom of choice, life, or privacy.

Often, several types of abuse occur simultaneously. A family member who may initially take in an elderly patient may not be aware of the work and sacrifice involved and may become subject to the stress of the situation, which can lead to neglect or abuse (6).

The abused elder most often has a cognitive impairment, lives in close proximity to the abuser, lives in social isolation, and is older than 75 years (7). Characteristics of the abuser often include a history of mental illness and/or substance abuse, excessive dependence on the elder for financial support, and a history of violence or antisocial behavior outside the family (7). Awareness of these factors can assist health care workers in identifying those individuals at risk.

Abuse is like disease: if it is not considered in the differential diagnosis it probably will not be diagnosed (7). Recognition of elder abuse/neglect is difficult for several reasons, such as the lack of structured training in screening for abuse and the discomfort of discussing the topic with patients. Many of these elders will even deny help. Elders may deny abuse because they are ashamed of being abused or fear reprisal (7). Medical assessment of the victim should include a complete history, complete physical examination, and documentation of all injuries. Multiple injuries at various stages of healing, unexplained injuries, delays between illness or injury onset and treatment, ''doctor hopping,'' and multiple emergency department visits are a few of the findings. Pressure ulcers are often present in the elderly who are ill, and these should be thoroughly examined with all the dressings removed. Evidence of foul-smelling or necrotic pressure ulcers that have not been brought to the attention of the physician should raise suspicion of neglect (6).

Adult Protective Services is an agency that exists by law in every State to investigate cases of possible abuse (6). States require the reporting of elder abuse, and the physician can be held responsible if he/she is aware of possible abuse but fails to report it. It is important to understand the avenues of referral when elder abuse is suspected. If an elderly victim with a possible history of abuse dies, a complete investigation is needed, including reporting the death to law enforcement, the coroner, or the medical examiner as required by statute.

Abuse of the elderly occurs everywhere in the United States, and education is the key to detection. Elder abuse is often difficult to identify and occurs in all races and all socioeconomic groups. In addition to clinical evaluation, the autopsy can play a major role in the evaluation of suspected abuse or neglect of the elderly. The nature and extent of specific injury can be documented. Some evaluation of hydration status and metabolic status may be performed. The possibility of causes of death other than abuse/neglect may be evaluated, sometimes exonerating those falsely accused of abuse or neglect. Intoxication, overmedication, or poisoning may be detected. Some evidence may be obtained as to the duration of specific conditions, such as injuries. The interplay between external factors and intrinsic disease may be explored. Information is obtained and documented that may be used in any legal proceedings that may follow cases of alleged abuse and neglect.

Autopsy findings in cases of elder abuse and/or neglect may be subtle, and the diagnosis is often difficult for pathologists to establish because of the almost invariable presence of some chronic or debilitating disease that puts the patient at risk for abuse and/or neglect in the first place. The autopsy pathologist cannot always answer questions or address allegations about abuse/neglect decisively. However, the autopsy does provide one last chance to collect and document findings that may be useful not only for identifying abuse/neglect but also for refuting false claims and protecting the innocent. Whenever it is suspected that abuse/neglect may have caused or contributed to the death of an elderly person, the medical examiner or coroner should be notified. In most such cases with some foundation for suspicion, a formal medicolegal death investigation, including autopsy, will be conducted. If this does not occur but suspicion remains, consideration should be given to approaching the legal next-of-kin for performance of an autopsy.

In the case reported, the death was certified as shown because it was believed that the decubiti were beyond what would be expected with adequate medical care and were the primary cause of death, associated with senile dementia, but also based on some degree of medical neglect. Whether the certifier of death reports ''neglect'' on the death certificate or classifies deaths from neglect as ''homicide'' varies among jurisdictions. In contrast, most deaths due to intentionally inflicted physical abuse would be classified as homicide when the relationship between physical abuse (injury) and death is clear. However, these fine points are not of major legal import because criminal prosecution may occur if there is sufficient evidence of criminal neglect, regardless of how the manner of death is certified on the death certificate. The important factor is that those persons having knowledge of possible

abuse/neglect report the facts to the appropriate authority so appropriate investigation and legal actions may occur.

NOTE: Volume 160, June 12, 2000. Kim A. Collins, M.D.; Allan T. Bennett, M.D., Medical University of South Carolina, Charleston; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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The Autopsy and the Living

A 62-year-old white woman was found dead in her bed one morning. She had gone to bed the night before complaining of a headache. Her medical history included hypertension, mild obesity, and recent headaches; otherwise, her health had been good. A complete autopsy was requested by her family and physician.

Autopsy Findings

The autopsy showed diffuse subarachnoid hemorrhage caused by a ruptured berry aneurysm of the middle cerebral artery. Her heart weight was increased to 500 g, the left ventricular wall thickness was increased to 2.0 cm, and both kidneys showed granular surfaces consistent with nephrosclerosis. Microscopic examination of sections of the heart showed hypertrophic myocytes and enlarged barrel-shaped nuclei; the kidneys showed scarred glomerular tufts typical of nephrosclerosis. All of these findings are typical in patients with a history of hypertension.

A 1.5-cm nodule in the left breast was an incidental finding. Histologic analysis of sections showed the tumor to be an invasive ductal carcinoma.

Based on these findings, the cause-of-death statement was prepared as follows:

Part 1.
A. **Subarachnoid hemorrhage**

Due to or as a consequence of:
B. **Ruptured berry aneurysm of the middle cerebral artery**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Systemic hypertension

Comment

The majority of nontraumatic subarachnoid hemorrhages occur sporadically, but a large proportion are associated with hypertension. Heart disease is the leading cause of death in the United States, and hypertension is one of the most prevalent contributors (1,2). The autopsy provided good clinicopathologic correlation between the decedent's history of recent headaches and hypertension and the anatomic findings of berry aneurysm, subarachnoid hemorrhage, cardiomegaly with left ventricular hypertrophy, and nephrosclerosis. The cause-of-death statement was prepared as shown, with hypertension listed in Part 2, because the berry aneurysm probably existed independently of hypertension but was probably predisposed to rupture because of the existence of hypertension. The breast carcinoma was not reported in the cause-of-death statement because it did not cause or contribute to death.

Carcinoma of the breast may be familial or hereditary. Research has shown that a family history of breast cancer is an important risk factor for development of carcinoma of the breast (3–5). The term *familial breast cancer* is used to describe the appearance within a family of multiple cases of breast cancer (4). Many breast cancers are now known to be associated with specific genes, notably *BRCA1* and *BRCA2*, and some are known to be inherited by autosomal dominant transmission (4,5). Therefore, the diagnosis of breast cancer is important not only to the patient with the disease but perhaps to family members as well. In this case, the decedent had three sisters, two daughters, and one son. The diagnosis of breast carcinoma in the decedent should result in specific communication of the diagnosis to family members so that appropriate follow-up measures may be taken.

Above some autopsy room entrance doors is the Latin phrase *hic locus est ubi mors gaudet succure vitae* (this is the place where death delights to serve the living). Indeed, the autopsy does serve the living, especially when diseases are detected at autopsy that may be inherited or familial. In addition to the breast cancer discussed in this case, other common examples encountered at autopsy include hypertrophic cardiomyopathy; serum lipid disorders; inborn errors of metabolism, such as medium chain acyl-coenzyme A dehydrogenase deficiency; and hereditary hemochromatosis, to name just a few. Informing the family that such conditions have been detected at autopsy can literally be lifesaving since appropriate diagnostic tests and follow-up may then be initiated. For example, we have seen a case of medium chain acyl-coenzyme A dehydrogenase deficiency (first diagnosed at autopsy) that caused the unexpected death of a child. The deceased's two siblings were then tested; both were found

to have the condition and were then treated. As more genetic, familial, or hereditary conditions are being elucidated, failure to detect these conditions at autopsy is a concern among pathologists because of potential ramifications for family members. Also of concern, however, is the fact that necessary tests may not be readily available and the costs of these tests may be very high. Lack of reimbursement for autopsy-related procedures compounds the problem in today's atmosphere of medical cost containment. Basically, a pathologist may wish to perform specific tests but may not have the necessary laboratory facility or funds available. This is a particular problem outside of academic teaching hospitals and when death investigations are funded by government agencies, as commonly occurs with the medical examiner and coroner systems.

Despite its ''low-tech'' nature, the autopsy remains valuable as a quality assurance measure in medical practice and as a tool in preventive medicine (6,7). The autopsy's role in medicolegal death investigations performed by medical examiners and coroners benefits society in many ways related to law enforcement, criminal justice, and public health. The old Latin phrase has probably never been more true; death, through the autopsy, does delight to serve the living.

NOTE: Volume 159, November 8, 1999. Kim A. Collins, M.D.; Allan T. Bennett, M.D.; Medical University of South Carolina, Charleston; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Pathologic Findings in a Transplant Donor

A 43-year old white man was admitted to the hospital with a one-year history of severe headache, extraocular muscle paresis, upper airway obstruction, and blindness. Eight years previously, a nonfunctioning pituitary adenoma was diagnosed and the patient underwent two transsphenoidal resections and radiation therapy for recurrent tumor. Eight months prior to admission, the patient underwent an attempted third transsphenoidal resection for recurrent headache, followed one month later by an attempted resection via an open craniotomy. Postoperatively, the patient lost all vision; steroid therapy failed to restore his sight. A magnetic resonance image scan showed a large pituitary tumor extending into the paranasal sinuses. During the patient's final admission, endoscopic resection was again attempted. The procedure was complicated by intraoperative bilateral internal carotid artery compression, which occurred during attempts to lift and remove the interposing tumor mass. Subarachnoid hemorrhage and bihemispheric stroke also developed. Life support measures were withdrawn the following day and the patient died, after which the next of kin donated the heart for transplantation and the liver for research.

Autopsy Findings

Postmortem examination confirmed the diagnosis of bilateral internal carotid artery occlusion caused by mechanical compression by the partially extricated tumor mass. Extensive subarachnoid hemorrhage was also confirmed. Marked cerebral edema with cerebral uncal and cerebellar tonsillar herniation were also present. Microscopic and ultrastructural examination of the partially calcified sellar tumor revealed high-grade fibrosarcoma extending into the nose. The tumor demonstrated multiple foci of necrosis and focally brisk mitotic activity, with an MIB-1 proliferative index of greater than 50 percent. No residual pituitary adenoma was identified. The optic and oculomotor nerves showed marked atrophy and fibrotic encasement. Microscopic examination of the lungs showed a single, small, noncaseating granuloma but no metastatic tumor. No metastatic tumor was identified within the gastrointestinal tract, spleen, adrenal glands, kidneys, or bone marrow.

Based on the findings, a cause-of-death statement was prepared as follows:

Part 1.
A. **Intraoperative bilateral internal carotid artery compression/occlusion**

Due to or as a consequence of:
B. **Attempted resection of pituitary tumor**

Due to or as a consequence of:
C. **Pituitary sarcoma**

Due to or as a consequence of:
D. **Radiation therapy of a previous pituitary adenoma**

Part 2. Other significant conditions:

Comment

Sarcoma of the sella turcica is a rare but recognized type of malignant neoplasm that occurs in virtually all reported cases after therapeutic radiation to a preexisting adenoma or craniopharyngioma (1). Following a variable latent period of 2 to 27 years, the

tumors usually grow to a substantial size and cause optic nerve compression, as occurred in this patient. The autopsy procedure enabled the medical staff to detect this clinically unsuspected tumor that led to the complications described.

Performance of an autopsy was valuable in this case for several reasons. The transplant surgeons who transplanted the heart were alerted to the existence of the sarcoma and the possible risks of incipient cardiac metastasis and/or granulomatous infection, illustrating the value of performing an autopsy on organ donors. Although the timing of organ transplantations is such that organs are transplanted before the availability of autopsy results, the autopsy does provide information that is useful for the follow-up of the transplant recipient. When tissues other than whole organs are donated for transplantation (bone, skin, etc.), they may often be stored and transplantation delayed until the autopsy results are available.

The autopsy also revealed a clinically unsuspected diagnosis, raising awareness among medical staff of a rare but known neoplastic complication of radiation therapy. The autopsy also provided the physicians and family with an explanation for the patient's blindness and for the failure of steroid therapy. Finally, the demonstration at autopsy of a malignant tumor invading the base of the skull was useful in elucidating that the patient had a grim prognosis, a rare and serious malignant neoplasm, and that the complications related to surgery would not be unexpected in the setting of extensive invasive tumor. These findings were helpful in consoling the family and alleviating concerns of malpractice and wrongful death.

Finally, the pathologist may obtain useful information from the organ procurement and transplantation team. Extensive serologic and laboratory testing is performed on donor specimens, including tests that evaluate the possibility of human immunodeficiency virus and viral hepatic infections. The results of such tests are usually reported to the pathologist, who may not have performed these tests as part of the autopsy procedure. The results may be useful in interpreting autopsy findings and in assessing risks of performing the autopsy.

NOTE: Volume 159, October 11, 1999. Linda M. Dallasta, M.D., Ph.D.; Julio Martinez, M.D.; Larry Nichols, M.D., University of Pittsburgh Medical Center, Pittsburgh, PA; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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History Repeats Itself (Sometimes)

A 28-year-old man was ''punished with the rope'' (hanged) for criminal acts. His body was then transferred to a local physician for postmortem study, with emphasis on examination of the brain, ostensibly to search for possible reasons for the deceased's prior criminal behavior.

Autopsy Findings

Specific postmortem findings are not available because the report cannot be located. However, based on the circumstances, a cause-of-death statement could be completed as follows:

Part 1.
A. **Hanging**
_____
Due to or as a consequence of:
B. **Judicial Execution**
_____
Due to or as a consequence of:
C.
_____
Part 2. Other significant conditions:

Comment

The events described occurred in 1656 and were portrayed in a painting by Rembrandt titled *The Anatomy Lesson of Dr. Joan Deyman* (1). Dr. Deyman was praelector at the Surgeon's Guild and was also inspector of the Amsterdam medical colleges. The painting showed Dr. Deyman, a group of students, and a cadaver with the calvaria removed and the brain exposed.

A more specific cause-of-death statement cannot be completed with reasonable certainty because it is unknown whether the man's death actually resulted from asphyxia caused by neck compression or as a result of the hangman's fracture, involving a fracture of the odontoid process (2). We also do not know how accurately causes of death were recorded in Amsterdam at that time; we do know that registers of death were maintained in London in the early 1600s. As judged by later records in London, however, when the causes of death were recorded, they did not always appear in a format that would be acceptable by today's standards. For example, records from the mid-1800s include such causes of death as ''The King's Evil'' and ''decay of nature'' along with other, more recognizable causes of death, such as cholera (3).

Even half a millennium ago postmortem examination was appreciated for its educational value; history repeats itself today in this sense. Although postmortem examination may have proceeded largely as an educational anatomy exercise in Dr. Deyman's case, Dr. Deyman was compensated for the specific services he rendered. He reportedly was paid 6 silver spoons (valued at 31 guilders and 19 stuyvers) (1). Today, most academic medical institutions do not pay case-specific professional fees for postmortem examination. The Health Care Financing Administration (HCFA) provides some financial support for autopsy services; Part A payments to medical institutions are made in the same manner that HCFA supports other hospital services, such as food and laundry. No Part B professional payment is made to the professional staff on a specific fee-for-service basis, however. Furthermore, the formula for Part A payments does not take into account the number of autopsies performed or their usefulness within the institution. The rationale of HCFA has been that autopsy

services do not provide useful information for treating patients and therefore do not require compensation. However, autopsy findings can have a positive impact on subsequent patients. To cite just a few examples, autopsy can aid in the detection of nosocomial infection outbreaks, determine drug sensitivities of fatal hospital-acquired infections, or detect pharmaceutical problems, such as mislabeled or defective products. Autopsy findings could be used to assess the accuracy of diagnostic related groups, which form the basis of payment for medical care. To date, HCFA has not done this, as far as we know.

Autopsies have been done in one way or another since before the time of Christ. Evidence of knowledge about internal anatomy is clear from Egyptian archeological specimens; however, it is not really known whether organ removal was done for any purpose other than preservation before sometime between 350 and 200 BC in Alexandria, where anatomy and pathology were reportedly taught (4). The word *autopsy* derives from the Greek *autopsia*, which means ''seeing with one's own eyes.'' Autopsies were performed in Greece as early as the fifth century BC and were more formally used by Galen in Greece in the second century. Historical sources also acknowledge the use of the autopsy into the Middle Ages, although autopsies were performed more often for religious reasons (to identify suicide, for example, which was taboo) than for scientific ones (4,5).

Before the anatomy lesson of Dr. Deyman was depicted in 1656, autopsies had been performed in the New World. Autopsies were performed on Siamese twins in Hispaniola in 1553; near the area of the current Maine/Canadian border in 1605 to determine why French explorers were dying (of scurvy, apparently); and in Hartford, Conn., in 1662 to assess whether an 8-year-old had died of witchcraft (4,6).

It was not until the 18th century that autopsy was used more like it is today with an emphasis on the science of pathology. In 1769, Morgagni published *The Seats and Causes of Diseases Investigated by Anatomy*, which correlated autopsy findings with the clinical aspects of diseases, laying the basis for the field of pathology. In 1858, Virchow introduced the cellular aspects of pathology and disease in his work *Cellular Pathology*. Other autopsy-based publications appeared in the intervening years (4).

Several symposia on the history of the autopsy have been published since 1965 (7–10). The most recent of these includes a table of more than 80 disease entities that have been ''discovered or critically clarified through the autopsy'' since 1950 (11). More recently, autopsy has played a critical role in identifying the Hantavirus pulmonary syndrome, pathologic conditions associated with human immunodeficiency virus infection, and emerging infectious and environmental conditions (12).

The autopsy has benefitted society for thousands of years and continues to do so. It has not outlived its usefulness. The nature of the questions to be addressed by postmortem examination have changed over the years, but the ability of the autopsy to address many of them has not. New diseases will continue to emerge. The need will probably always exist to evaluate diagnostic and therapeutic effectiveness and disease patterns on an ongoing basis for quality improvement purposes.

There is little doubt that the autopsy will continue to be among those medical procedures that define significant historical landmarks in the science and art of medicine.

NOTE: Volume 159, September 13, 1999. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; Grover M. Hutchins, M.D., The Johns Hopkins Medical Institutions, Baltimore, MD; and the Autopsy Committee of the College of American Pathologists.

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Incidental and Not-So-Incidental Findings

A 63-year-old Hispanic man was a moderate alcohol consumer with a 50 pack per year history of cigarette smoking. After the onset of acute nonradiating chest pain, he was taken to the emergency department, where his chest pain continued and he became restless and cyanotic. Cardiac arrest occurred within 15 minutes, and resuscitative attempts were unsuccessful. The emergency department physicians requested an autopsy to determine the

cause-of-death, which they suspected was a ruptured aortic aneurysm.

A review of the patient's medical history in preparation for the autopsy showed a hospital admission 5 months earlier for substernal chest pain with radiation to the neck and shoulders. The pain resolved, and an electrocardiogram showed normal sinus rhythm and a normal axis. Neither the electrocardiogram nor the cardiac enzyme levels showed evidence of myocardial infarction, and the findings of a dipyridamole stress test were interpreted as normal, without evidence of significant coronary artery disease.

Autopsy Findings

Autopsy disclosed diffuse three-vessel coronary atherosclerosis with almost complete stenosis of the left anterior descending coronary artery. No thrombi were seen; the heart weighed 430 g; and the left ventricle showed concentric hypertrophy. Microscopically, there was moderate perivascular and interstitial myocardial fibrosis, consistent with chronic ischemia, but no acute infarction was identified. The lungs were normal except for a single focus of pulmonary capillary hemangiomatosis within the right lower lobe, characterized by proliferation of small capillaries in alveolar septal walls and interstitium, along with proliferating capillaries within small pulmonary veins. The capillary lining consisted of uniform, small, flat to cuboidal endothelial cells without atypia. No aortic aneurysms were found, but the aorta and major arteries showed atherosclerosis of moderate degree.

Based on these findings, a cause-of-death statement was prepared as follows:

Part 1.
A. **Atherosclerotic cardiovascular disease**

Due to or as consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:

Comment

Although the patient's symptoms suggested coronary artery disease, the electrocardiogram, cardiac enzyme levels, and dipyridamole stress test results did not provide evidence of coronary artery or heart disease. Death in this case serves as a sobering reminder of the limitations of some methods in detecting serious and life-threatening cardiovascular disease. Normal dipyridamole stress test results do not necessarily exclude the presence of significant coronary artery disease. After infusion of dipyridamole, adenosine concentration increases and has a potent vasodilatation effect that, although having little impact on coronary arteries that show more than 75 percent stenosis, may increase blood flow in normal coronary arteries three to five times baseline levels (1). Even in the face of significant coronary atherosclerosis, however, dipyridamole infusion may cause considerable increase in blood flow to the myocardium supplied by nondiseased or lesser-diseased coronary arteries, and radionucleotide imaging can identify such areas of increased perfusion (1). As may have occurred in this case, false-negative dipyridamole test results may occur in patients with global coronary artery disease, because there will not be heterogeneity of regional myocardial blood flow and the results may appear to be normal (1). The dipyridamole stress test has a reported sensitivity of 86 percent and a specificity of 71 percent in predicting the presence of coronary artery disease, but results may vary on the basis of several factors, including the type of radionucleotide imaging agent used (2,3).

Also, in this case, the autopsy disclosed the rare finding of localized pulmonary capillary hemangiomatosis, which is characterized by a proliferation of small capillaries within peribronchial, perivascular, septal, and subpleural regions of the lungs. Most of the 23 cases reported in the literature showed diffuse involvement throughout both lungs (4–7). The condition may be misdiagnosed as pulmonary veno-occlusive disease during life and may not be correctly diagnosed until autopsy (8). It causes symptoms and signs such as pulmonary hypertension, hemoptysis, and right-sided heart failure, and is usually progressive, with most cases resulting in death (7). Treatment includes pneumonectomy with heart-lung transplantation, and one case showed favorable results with interferon alfa-2a (8,9). In the case reported herein, the lesion was unusual because it was focal, the decedent was apparently asymptomatic, and the finding was basically an incidental one. Nevertheless, this case shows how autopsies may provide ''incidental'' information that may be useful in studying and learning about the natural history of some conditions or in studying what might be an early stage or forme fruste of a particular disease entity. For example, a ''pleural ball'' was described in one case in which the ball was attached to the lung by two fibrous bands, possibly providing an explanation for how pleural balls may first form and then break loose to occur as free bodies in the pleural cavity (10).

The autopsy was valuable in this case for several reasons. It clarified the cause-of-death for death certification purposes, provided possible explanations for why diagnostic tests during life did not detect the fatal condition, disclosed an unusual incidental finding of some academic interest, and provided information with a firm foundation for explaining more fully to the family the patient's clinical course and cause-of-death. The autopsy provided both incidental and not-so-incidental, very relevant information and exemplifies why the autopsy remains the ''gold standard'' in determining causes of death, clarifying clinical issues, and resolving enigmas.

NOTE: Volume 159, August 9/23, 1999. Dean M. Havlik, M.D., University of New Mexico School of Medicine, Albuquerque; Wilbur L. Williams, M.D., University of New Mexico School of Medicine and Albuquerque Veterans Affairs Medical Center; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Outcome Analysis and Quality Assessment

A white male infant was born at 37 weeks' gestation. Soon after delivery, hypoplastic left heart syndrome was diagnosed. A Norwood procedure was performed (a palliative procedure with anastomosis of the aorta to the right ventricle for systemic circulation and an atrial septectomy formed to avoid pulmonary venous hypertension). Reexploration was required for postoperative bleeding, which was controlled surgically. Urosepsis and disseminated intravascular coagulopathy complicated the clinical course and the infant died. The surgeons requested permission for autopsy from the family so that the surgical procedure could be reassessed, but the family declined and stated that the infant had been ''cut on enough.'' However, when the option of a limited autopsy was discussed, the family consented to a postmortem examination limited to the heart and lungs.

Autopsy Findings

Autopsy showed that all suture sites were intact; there were no sutures that compromised vessels or other critical structures, and there were no vascular thromboses. However, there were unexpected infarctions of both cardiac ventricles and infarction and lobular pneumonia within the right lower lung lobe.

Based on these findings, a cause-of-death statement was prepared:

Part 1.
A. **Hypoplastic left heart syndrome**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Biventricular myocardial infarction; right lower lung infarction and lobular pneumonia

Comment

The cause-of-death statement as shown is appropriate because the limited autopsy hampered the ability to fully evaluate possible factors that caused or contributed to death. No doubt, the underlying cause-of-death was hypoplastic left heart syndrome. However, the specific nature of the immediate cause-of-death could not be fully explained because of the limited autopsy. The conditions cited in Part 2 certainly played a significant role and were therefore reported as ''other significant conditions.''

Despite its limited nature, the autopsy showed that the infant's surgical procedure was done without obvious complications, such as breakdown of anastomosis sites, suturing closed a coronary artery, or thrombosis of anastomosed vessels. The pediatric cardiothoracic surgeons, pediatric cardiologists, residents, and medical students involved in the care of the infant attended the autopsy and were able to see the outcome of their work and treatment. They examined their surgical work and explained their decision-making processes and techniques to the pathologists and others at the autopsy; the pathologist was then able to demonstrate and explain the pathological changes to the clinicians. Based on the autopsy findings, treatment modalities were discussed, as well as options available for future patients. The cardiologists educated all those attending regarding hypoplastic left heart syndrome and its clinical findings, correlating clinical features, and postmortem results. Pathology residents gained experience in the dissection of a pediatric heart as well as an understanding of the issues related to the examination of such hearts. Thus, everyone involved learned more about hypoplastic left heart syndrome, acquired useful information about the course and treatment of the infant, and broadened the scope of their medical experience to the extent that it may affect the care of future patients. These benefits exemplify the value of outcome analysis and quality assessment, to

which the autopsy contributed much in this case.

The autopsy findings were discussed at subsequent conferences, with additional discussion of treatment modalities and outcomes. The conferences were attended not only by the infant's clinicians, but also by others who did not attend the autopsy or had no direct involvement in the treatment of this patient. These individuals also benefitted from the information gathered from this autopsy and the thorough review of hypoplastic left heart syndrome. Patients with hypoplastic left heart syndrome are at risk for acidosis, shock, and multiorgan dysfunction secondary to hypoxia. In complicated cases, infarctions may occur in various organs, as in the heart and lungs of this infant (1).

Finally, the analysis of the facts and findings was useful in discussions with the patient's family, providing them with peace of mind and a sense of closure. They were assured that everyone involved in the antemortem and postmortem care of the infant had been thoughtful, diligent, and thorough; that what could have been done was done; and that the institution's staff was comprehensive, professional, and caring in the services provided.

As illustrated by this case, the limited autopsy can be an excellent tool to help physicians perform quality assessment and analyze outcomes. Despite major advances in medical technology, recent studies validate the continued contributions of the autopsy (2–4). When possible, it is desirable to perform a complete autopsy. Attitudes and approach can play a major role in how the results of the autopsy are used (5–7). The preference for complete autopsy should be discussed with families and the possibility of a limited autopsy should be offered to them if they do not wish to consent to the performance of a complete autopsy.

NOTE: Vol 159, July 12, 1999. Allan T. Bennett, M.D.; Kim A. Collins, M.D., Medical University of South Carolina, Charleston, SC; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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The Rest of the Story

A 78-year-old woman with hypertension presented with a gangrenous foot that had kept her from ambulating. During the surgical closure following above-the-knee amputation she developed precipitous hypotension followed by cardiopulmonary arrest and death.

The pathology resident on call to perform autopsies received an authorization to perform an autopsy that had been completed by the patient's physician and the legal next of kin. In the area of the form for notation of restrictions (such as ''autopsy to be limited to chest and abdomen only'') were the words ''please do not disfigure the face.'' Because the face is almost never disfigured during an autopsy (unless dissection is required in a forensic autopsy for medicolegal purposes or special needs have arisen during a hospital-based autopsy and permission has been granted by the legal custodian of the body), the wording caused the resident to wonder whether the physician understood and conveyed to the next of kin the nature of routine autopsy procedures. A review of other autopsy authorization forms showed that similar wording was common, such as ''keep the head intact,'' ''be gentle, would like open-casket funeral,'' ''keep facial features natural,'' and ''be careful to do nice surgical incisions.''

Shortly thereafter, at an introductory session about the autopsy for new internal medicine interns and residents, the participants were asked to raise their hands if they had ever received instruction in medical school about how an autopsy is performed. Very few participants raised their hands; fewer participants had actually seen an autopsy performed; and even fewer participants had received any instruction on how to ask a family member for permission to perform an autopsy or how to explain how an autopsy is performed.

The pathology resident and his supervisor had a discussion in which the idea was put forth that some (or perhaps many) clinicians may be reluctant to request permission to perform an autopsy because they are uncomfortable with their lack of knowledge about autopsy-related issues. If they do not know how the procedure is performed, they may not be comfortable addressing questions that may be asked by the family members. If the clinician is not aware of the routine sequence of events, clinicians may be hesitant to answer questions about the logistics of autopsy performance (such as, How long does it take to perform an autopsy? Will the autopsy preclude viewing the body at the funeral home? Will it cost the family any money if an autopsy is performed?). Clinicians may unknowingly answer questions incorrectly or provide misleading information.

The pathology resident's supervisor thought that it might be helpful to describe some of the basic features of autopsy performance so that clinicians who are unaware of specific details may be better prepared to have discussions with families. This article includes such information.

Autopsy Findings

The autopsy showed extensive bilateral pulmonary thromboemboli that originated in the lower extremities. There was no evidence of fat embolization or adverse reaction to anesthesia.

Based on autopsy findings, a cause-of-death statement could be completed as follows:

Part 1.
A. **Bilateral pulmonary thromboembolism**

Due to or as a consequence of:
B. **Deep vein thrombosis associated with immobility**

Due to or as a consequence of:
C. **Peripheral vascular disease**

Part 2. Other significant conditions:
Hypertensive cardiovascular disease

Comment

The autopsy findings in this case were useful for completing the death certificate, answering questions that were posed by the patient's physician and family, and ruling out untoward effects that could potentially have been directly related to the surgical procedure or anesthesia. However, another major value of the autopsy was that it brought an important issue to light that some clinicians may not be fully prepared to explain the autopsy procedure or answer questions about autopsy performance. Information about autopsy-related procedures is provided below in the form of commonly asked questions with answers. The comments are related mainly to autopsies that are performed in hospitals, with the consent of the next of kin.

How Does One Ask for Permission to Perform an Autopsy?

Guidance on how to request permission for an autopsy was provided previously (1). Templates and pocket cards with specific language have been provided as a model for adaptation to a particular practice setting.

How Long Does It Take to Perform an Autopsy?

The time required depends on the case. In most cases, the part of the autopsy dissection in which the organs are removed and examined macroscopically requires 2 or 3 hours at most. Usually, the body will be available for transport to the funeral home a few hours after the autopsy is begun. In efficient settings, the preparation and examination of microscopic slides, review of the medical record, performance and review of laboratory tests performed as a result of the autopsy, and preparation of the final autopsy report may require a week or less; however, a few weeks is often required. If there is compliance with the inspection and accreditation requirements of the College of American Pathologists, most cases will be completed within 30 working days unless the case is complicated. Preliminary autopsy results should be available within 2 to 3 working days.

What Is a Complete Autopsy?

A complete autopsy generally includes removal and examination of the brain and the organs of the neck, thorax, abdomen, and pelvis, with microscopic sections prepared for major viscera and other tissues, as required (2). Specific postmortem laboratory tests are performed as indicated by the clinical history and autopsy findings.

What Is a Limited Autopsy?

In a limited autopsy, one or more of the components of a complete autopsy are not performed. Limited autopsies are usually performed because the family has restricted the extent of the autopsy. Sometimes, however, the pathologist or clinician may restrict the extent of autopsy; this might occur, for example, in a suspected case of Creutzfeldt-Jakob disease for which professional guidelines advise that only the brain be removed (3,4).

What Is Done With the Organs?

The answer varies with the institution. In the hospital setting, especially if there is a pathology training program, the internal organs may be retained by the pathology department. They may be saved indefinitely for teaching purposes or they may ultimately be disposed of, usually by incineration. In some institutions, the bulk of the organs are returned to the body cavity (in a plastic bag) after the necessary samples have been taken. The latter procedure is especially common in medicolegal (forensic) autopsies. In most hospital settings, however, the organs are retained. If the organs are retained, the autopsy authorization form should clearly indicate that the hospital has the right to retain, use, and dispose of the organs in compliance with applicable laws.

What Parts of the Body Are Incised?

Typically, only two incisions are made on the body surfaces. To remove the brain, an incision is made that extends from behind one ear across the top of the head posterior to the vertex and downward behind the other ear. This incision is such that when it is repaired at the funeral home, even in a bald person, it is not visible when the body is in the supine position with the head on a pillow in the casket. The top of the skull (calvaria) is removed by sawing circumferentially after the scalp has been reflected anteriorly and posteriorly and at an obtuse angle in the posterior skull to keep the skullcap from rotating when it is replaced after removal of the brain. After removal of the brain and inspection of the inside of the skull, the skullcap is replaced and the scalp margins are reapproximated. The other incision is a Y-shaped incision that extends from each anterior shoulder region toward the midline over the lower sternum, then downward in the midline toward the pubis. The soft tissue can then be reflected upward to the underside of the mandible, which allows inspection and removal of the soft tissue

of the neck, and laterally, which allows removal of the anterior chest wall in one piece (sternum and adjacent ribs to the costochondral junction), making the organs of the thorax, abdomen, and pelvis accessible for removal. After the autopsy, the chest plate is replaced and the soft tissue flaps are reapproximated. Usually, the major autopsy incisions are loosely sewn together; at the funeral home, the incisions are tightly repaired with suture and other agents, such as special glue and sealers. Other incisions may be made (for example, in the legs to look for venous thrombi), but such incisions are not routine and may, in some institutions, require special permission depending on the wording in the autopsy authorization form.

Are Any Other Incisions Made?

In general, effort is made not to incise areas of the body that are visible at a viewing of the body at the funeral home (such as the hands and face). Whether such incisions are made depends on how the autopsy authorization (and its informed consent) is worded. Without clearly worded consent for such incisions when needed, most pathologists would not make incisions in unusual areas unless specific permission has been obtained from the family.

Are the Eyes Removed?

Again, whether the eyes are removed is based on the needs and the wording in the autopsy authorization and informed consent. Many pathologists require specific permission from the family for removal of the eyes. In most hospital autopsies, the eyes are not routinely removed for diagnostic purposes. The corneas or globes may be removed by an eye bank if the eye bank has obtained permission from the family or if other laws permit their removal. The eyes may be removed as needed in forensic autopsies performed under the authority of the medical examiner or coroner (for example, to assess the possibility of shaken baby syndrome).

Is the Spinal Cord Routinely Removed?

The spinal cord is not routinely removed, although it is removed routinely in some institutions. The spinal cord may be removed in three ways. In one method, pathologists use a special spinal cord extractor consisting of a long rod with a sharp forked blade on one end, which can be inserted through the foramen magnum to cut the spinal roots. The spinal cord can then be withdrawn through the foramen magnum. The advantage is that additional incisions are not required; however, the extractor should not be used if subtle changes in the spinal cord or roots are being evaluated. Another method is to remove the vertebral bodies with an anterior approach (after the organs have been removed) by sawing through the pedicle of the vertebral arch, which allows the anterior spine to be lifted away from the spinal canal from which the spinal cord may then be removed. The posterior approach involves a midline posterior incision, with reflection of the soft tissues away from the spinous processes and posterior vertebral arches, which are then sawed through, allowing the posterior portion of the spine to be lifted away to remove the spinal cord. Either of the latter two procedures leaves enough spine and soft tissue in place so that the body does not distort or foreshorten.

How Are the Organs Removed?

The brain is removed intact. The thoracic and abdominal organs may be removed en masse (in one large block that may include everything from the tongue to the anus), in sections (in which organ systems are removed in blocks, such as the heart and lungs together), or individually. The method chosen depends on the needs of the case and the pathologist's preference.

What If There Is a Rush to Have Funeral Services?

In most instances, the body may be externally examined, the organs removed (eviscerated), and the body prepared for the funeral home within one to two hours of starting time. This allows for release of the body promptly, while the organs may be retained for later dissection and examination. Such procedures may be used, for example, if a death occurs late in the day and the family does not want to delay transport of the body to the funeral home until the following day.

Are Autopsies Performed 24 Hours a Day, 7 Days a Week?

Most pathology departments perform autopsies during normal business hours during the week. Thus, if a death that occurs late in the afternoon, the autopsy may not be performed until the following day unless a special request is made to expedite procedures as described in the preceding paragraph. Many pathology departments have staff on call to perform autopsies on weekends, but some do not. It is important to be familiar with the staffing procedures at the institution where you work.

Where Is the Autopsy Performed?

Most hospitals have a morgue and an autopsy room, and the autopsy is performed in the hospital. However, some hospitals do not have autopsy rooms. In such cases, the body may be transferred to another location for the autopsy, such as another hospital or a funeral home. Physicians should be familiar with the practice in their institution so that questions by the family may be adequately addressed. It is helpful when autopsies are performed in the hospital where death occurred so that the physician's ability to observe or review the findings is facilitated.

How Long Are the Organs, Tissues, and Other Items Retained?

Unless the organs are specifically kept for teaching purposes, the dissected organs are usually disposed of when the autopsy report has been finalized or within a short time thereafter.

Microscopic slides and the paraffin blocks from which they are prepared are usually kept for a number of years and may be kept indefinitely. Stock tissue or small pieces of organs and tissues that are preserved in formalin may be kept for months or years before they are disposed. Finalized autopsy reports are usually kept indefinitely.

What If the Family Members Want Some or All of the Specimens?

Technically, the remains of the deceased belong to the family (legal next of kin). Thus, the family has a legal right to the various specimens, although such requests are rare. Usually, the wording in the autopsy authorization either implicitly or explicitly transfers ownership of the specimens to the institution or the pathology department. If specimens are transferred out of the institution, it is important that such transfer and storage of body parts or specimens be done in accordance with State laws that pertain to the ownership and storage of anatomical specimens.

Are Implanted Devices Removed During an Autopsy?

Pacemakers and other implanted devices (such as orthopedic appliances) are usually removed, when feasible and when their presence is known or a specific request to remove them has been made. Responsibility for documentation of the disposition of such devices usually rests with the physician (or institution) who implanted the device. Thus, devices that are removed may be forwarded to the appropriate institution or with the body for return to the family, who may then transfer the device to the appropriate agency or institution.

How Are Specimens Used for Research?

In most hospitals, the autopsy authorization form specifically states that organs and tissues removed during the autopsy may be used by the hospital for teaching, research, or other purposes. In general, research on specimens removed during the autopsy does not require approval by an institutional review board, although there are exceptions. However, the major determining factor is the specific language contained in the autopsy authorization and informed consent. In the medicolegal (forensic) setting, in which the family's permission is not usually required to perform an autopsy, the use of organs and tissues is often restricted to determining the cause and manner of death, and the procurement of tissues specifically for research purposes often requires special permission.

When Is Embalming Performed?

If the body is embalmed, the procedure is usually done at the funeral home after the autopsy has been performed and the body has been transported out of the hospital. However, embalming may be done prior to the autopsy either inadvertently because the body was taken to the funeral home before the autopsy was performed or intentionally because there is a known infectious disease that may pose some risk to the autopsy prosectors. Some hospitals have embalming equipment and may routinely embalm bodies prior to autopsy.

Is There a Cost to the Family?

Most hospitals do not charge a fee for an autopsy when an autopsy is performed on a patient who died in the hospital. However, some hospitals charge a fee if the autopsy is requested by the family but the hospital does not have a particular interest in performing an autopsy. Other hospitals charge a fee to perform an autopsy if the deceased was a patient at the hospital but died outside the hospital. Because billing practices for autopsies vary among institutions, it is important for physicians at a given institution to know what those practices are. On occasion, some funeral homes will charge additional fees for body preparation when an autopsy has been performed. However, this is not common, and some funeral directors believe it is not appropriate to levy such additional fees. The family may be instructed to check with their funeral director if they are concerned about possible autopsy-related fees imposed by the funeral home.

Conclusions

We hope that the information provided herein will be helpful to clinicians who request permission to perform autopsies, explain autopsy procedures, and answer questions related to autopsy performance. When needed, questions may be directed to a pathologist in the institution where the autopsy will be performed or to the funeral director, if questions are related to body preparation and other aspects of funeral services (5,6).

NOTE: Volume 159, June 14, 1999. Randy Hanzlick, M.D.; Mario I. Mosunjac, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Education of the Pathologist

A 47-year-old man was admitted to the hospital with complaints of leg swelling and shortness of breath. His medical history included chronic alcohol abuse and diabetes. Serologic testing indicated hepatitis C infection. Evaluation also showed probable cirrhosis and spontaneous bacterial peritonitis due to culture-proven infection with *Escherichia coli.* Antibiotic therapy was administered. While in the hospital, the patient fell from his bed and sustained a head injury on the sixth hospital day. He was conscious and responsive when discovered on the floor near his bed, but within an hour he required intubation after a sudden deterioration in mental status. Neuroimaging showed a subdural hematoma with midline shift. There was transient clinical improvement, but fever, increasing leukocytosis, and a gradual decline in his condition ensued and he died on hospital day 14.

The patient's physician obtained permission for postmortem examination. The pathology resident who was on duty became aware that deaths involving injury are reportable to the medical examiner, and he reported the death accordingly because he realized that the patient's physician had not notified the medical examiner. Because permission for autopsy at the hospital had been obtained, the medical examiner assumed jurisdiction of the case for the purpose of death certification, but permitted the autopsy to be performed at the hospital. The death certificate was not completed by the medical examiner until the hospital autopsy findings were available several days after the autopsy.

Autopsy Findings

At autopsy, liver findings were consistent with hepatitis C infection and additional autopsy findings included cirrhosis and resolving peritonitis (the *E. coli* infection apparently responded to antibiotic treatment). There had been clinical evidence of systemic sepsis while in the intensive care unit following the head injury, and multiple blood cultures at autopsy yielded *Acinetobacter anitratus* without evidence of postmortem contaminants, supportive of the antemortem diagnosis of sepsis. There was residual subdural hematoma over one cerebral hemisphere. Because of the patient's accelerated and continual downhill course after the fall, the medical examiner concluded that the head injury was a significant factor in causing death. Thus, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Acinetobacter anitratus sepsis**

Due to or as a consequence of:
B. **Complications of subdural hematoma**

Due to or as a consequence of:
C. **Blunt force head injury sustained in fall from bed**

Part 2. Other significant conditions:
Alcohoholic cirrhosis, hepatitis C infection

Comment

The conditions in Part 2 were reported because the cirrhosis and hepatitis C infection were ongoing and coagulation disturbance related to liver disease was thought to have predisposed the patient to subdural hematoma following head injury. Listing these conditions in Part 2 is appropriate because the conditions did not, in and of themselves, result in the fall, which may well have been an independent event that could have occurred if cirrhosis and peritonitis had not existed.

The attribution of death to a fall in the hospital may raise the concern that the cause-of-death statement puts the hospital at potential risk for some legal action, but the cause-of-death as stated is the truth to the best of the certifier's knowledge and the truth should not be skirted for fear of litigation.

The pathology resident learned much from the performance of this autopsy. He learned about correlating autopsy findings with the clinical history and practical approaches to formulating opinions about the relative contribution of injury and disease in causing death. He also learned more about the importance of reporting appropriate deaths to the medical examiner, and also gained additional experience with the practical aspects of performing the autopsy and preparing the autopsy report. Adequate experience at autopsy performance and reporting are critical for the pathology resident to become competent and proficient at autopsy performance prior to finishing pathology residency training and entering independent practice. In recognition of this need, the American Board of Pathology requires a resident to perform a minimum of 50 autopsies as part of the qualifications to take the board examination in anatomic pathology (1).

Shortly after this case, the autopsy training director was contacted by the pathology training program administrator, who asked if some adjustments could be made to allow pathology residents in their last year of training to spend additional time on the autopsy service. The reason was that residents needed additional autopsy experience to qualify for the board examination, and time was running short. This problem occurred, at least in part, because the institutional autopsy rate had declined as it has in many other institutions (2). Autopsy rates have declined in some training institutions to the point that the number of autopsies is barely adequate to provide pathology residents with the required number of autopsies. In fact, the required number of autopsies for board qualification was 75 a few years ago, but the number was reduced to 50 because of insufficient autopsy rates in many training institutions. It is now permissible for two pathology residents to share in the performance of an autopsy for the purpose of board qualification, another adjustment necessitated by low autopsy rates. Also, the Joint Commission for Accreditation of Health Care Organizations and the Residency Review Committee for internal medicine residency programs each had minimum autopsy requirements at one

time. No longer is that the case, however, and the tail seems to have ''wagged the dog.'' Rather than enforcing the requirements, the requirements were dropped, presumably because too few institutions were in compliance. Thus, autopsy rates are now almost exclusively dependent on the interest of clinicians, the institution, or the patient's family, and regulations no longer foster autopsy performance.

Clinicians need to recognize that performance of an adequate number of autopsies is not only needed as part of an intellectually honest institutional quality assurance and improvement program, but where pathology training programs exist, also because there must be a sufficient number of autopsies to afford pathologists adequate training and experience. Even if the pathologist ends up in a practice where autopsies are rarely performed, it is still important that the autopsies that are performed are performed and reported well. Adequate exposure to the autopsy during pathology residency training is required to ensure such an outcome, and adequate autopsy rates are an integral part of the equation.

Internal medicine and surgical residents would have a suboptimal training experience if the number of patients they could evaluate and treat was severely restricted. The same applies to pathology residents and the quality of their training relative to the number of autopsies they can perform. Physicians and the public need to recognize that education of the pathologist is one of the many benefits that the autopsy affords to society and the practice of medicine (3). A well-trained autopsy pathologist can be of great value to the clinician and medical practice by providing complete, thorough, and accurate documentation and interpretation of autopsy findings, which are used in conjunction with the clinical history.

NOTE: Volume 159, May 10, 1999. Randy Hanzlick, M.D.; Jesse K. McKenney, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Unavoidable Outcomes versus Misadventures

A 48-year-old man presented at the hospital and described a 22.5-kg weight loss and progressive difficulty swallowing over the past 6 months. The following day, an esophageal biopsy showed squamous cell carcinoma. Radiographic studies indicated liver metastases. The tumor was judged to be inoperable and palliative treatment included placement of an esophageal endoprosthesis (a metallic metal mesh tube) and chemotherapy with fluorouracil and cisplatin. One week later the patient had an episode of major hematemesis and cardiopulmonary arrest that could not be reversed with resuscitation. It was apparent that the underlying cause-of-death was most likely esophageal squamous cell carcinoma, but the patient's physician requested an autopsy to determine the immediate cause-of-death and the cause of the terminal gastrointestinal hemorrhage, with special interest in evaluating whether death resulted from a mechanical complication of the stent or its placement.

Autopsy Findings

Autopsy showed an ulcerating tumor mass in the mid-esophagus with hepatic metastases and local infiltration into the surrounding soft tissues and substernal soft tissue. An aortoesophageal fistula existed between the posterior aortic arch and the anterior mid-upper esophagus. Two additional posterior esophageal perforations were present: one near each end of the stent. The stent was intact and there was no evidence that the stent itself had caused a traumatic perforation of the esophagus. The thoracic cavity did not contain blood but the esophagus and stomach contained copious blood and blood clots. Microscopic sections of each perforation site showed extensive tumor necrosis with multiple areas of tumor ulceration and an acute inflammatory infiltrate. Malignant tumor cells were identified at all levels of the esophagus that were sampled. The aortic fistula site showed acute inflammation extending from the intima through the wall and into the periadventitial soft tissues and tumor infiltrate.

Based on these findings, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Esophageal hemorrhage**

Due to or as a consequence of:
B. **Aortoesophageal fistula**

Due to or as a consequence of:
C. **Squamous cell carcinoma of the esophagus**

Part 2. Other significant conditions:

Comment

The autopsy in this case was valuable for several reasons. First, the specific reason for the fatal hemorrhage was identified and the immediate (esophageal hemorrhage) and intermediate (aortoesophageal fistula) causes of death were accurately determined and reported. Second, it was determined that the esophageal perforations were due to tumor necrosis rather than mechanical perforation related to the stent or its placement. Without an autopsy, the hemorrhage may have been erroneously attributed to

a misadventure or product defect involving the stent or its placement. Instead, it was established that the perforation and hemorrhage was an unavoidable outcome of appropriate therapy. The information obtained from autopsy not only disclosed what actually happened to the patient, but at the same time, it showed that potential claims of misadventure and culpability would not be well-founded. Third, the autopsy demonstrated that the chemotherapeutic agents were probably effective in causing tumor necrosis, but that tumor necrosis can cause untoward effect such as the fatal hemorrhage that occurred in this case.

Although rare, aortoesophageal and esophagorespiratory fistulas have been reported in patients after palliative treatment with metallic stents and chemotherapy and/or radiotherapy (1). One retrospective study of 60 patients, however, did not show an association between previous chemotherapy and perforation (2). Another study reported that the addition of irradiation and chemotherapy in conjunction with stent placement resulted in longer survival (3). Regardless, tumor lysis/necrosis secondary to chemotherapy has been reported to occur as quickly as 38 hours after administration (with great variability), but consistent with the 1-week interval observed in our cases (4,5). It could be argued that mechanical pressure of the stent may have accelerated tumor necrosis by compression of esophageal/tumor vasculature. If so, the outcome could still be regarded as an unavoidable outcome of an appropriate treatment, and thus, could be considered a complication of therapy that would not fall in the domain of the ''therapeutic misadventure.''

NOTE: Volume 159, April 12, 1999. Amanda Davis, M.D.; Angela Fields, M.D., Ph.D.; Charles Hill, M.D.; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Death and Devices

A 49-year-old man had a history of idiopathic cardiomyopathy and had been receiving antiarrhythmic medications for the past several years. He was admitted to the hospital for evaluation of atrial fibrillation with a rapid, uncontrolled ventricular response. Partial ablation of the atrioventricular node was performed, and a pacemaker was implanted. He was discharged from the hospital on the next day with a stable heart rate of 50 to 60 beats/min. He was found unresponsive at home 10 days after discharge, and resuscitative efforts were unsuccessful.

The family, in cooperation with the decedent's cardiologist, requested that an autopsy be performed to determine if there had been a complication related to the pacemaker placement or ablation procedure and if the pacemaker had malfunctioned.

Autopsy Findings

The results of the autopsy revealed marked biventricular hypertrophy (heart weight, 720 g) and moderate-to-severe dilation of all four cardiac chambers. The coronary arteries had atherosclerosis with 80 percent luminal narrowing in the right artery, 60 percent luminal narrowing in the left anterior descending artery, and 25 percent luminal narrowing in the left circumflex coronary artery. The ablation site had endocardial ulceration and underlying hemorrhage. Histological sections showed myocyte hypertrophy and mild fibrosis of the ventricles. The atrioventricular node region had coagulation necrosis and granulation tissue consistent with the recent ablation. The sinoatrial node appeared normal. As requested by the family, the pacemaker was released to an attorney according to established institutional procedures. The results of the pacemaker testing were communicated to the cardiologist and showed no defects in pacemaker function.

Based on these findings, the cause-of-death statement could be prepared as follows:

Part 1.
A. **Dilated cardiomyopathy**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Coronary artery atherosclerosis

Comment

The family was considering medicolegal action against the cardiologist, the electrophysiologist who performed the atrioventricular node ablation and pacemaker placement, and the manufacturer of the pacemaker. The cardiologist and electrophysiologist were contacted by the family's attorney. The autopsy results disclosed significant

pathologic changes in the heart consistent with dilated cardiomyopathy, along with high-grade stenosis of one coronary artery. No complications were identified from the ablation or pacemaker placement. The autopsy also allowed the pacemaker to be removed and submitted for testing. It seems likely that the autopsy results and pacemaker testing demonstrated to the family that medical care for the decedent had been appropriate, and indications are that no medicolegal actions are being pursued.

The autopsy may be the only source of information about implanted medical devices and the body's reactions to them. Such information may be crucial in understanding the course in individual patients. An autopsy-based series may provide a better understanding of medical device function and complications for many types of devices and implanted materials, such as synthetic grafts. Other medical devices frequently assessed during autopsy include catheter, endotracheal, nasogastric, and feeding tube placement and the location and status of devices, such as intravenous filters inserted to prevent pulmonary embolism.

Pacemaker units and wires can be evaluated and recovered during the autopsy for further testing (1). A transistor radio placed near a pacemaker may allow detection of an audible click when the pacemaker discharges, allowing assessment of pacemaker rate at the postmortem examination. Postmortem radiographs may enable detection of gross breaks in pacemaker wires, and when wires have been implanted for long periods, careful autopsy dissection may be required to remove the wires from adherent fibrous tissue without damaging the wires.

Automatic implantable cardioverters or defibrillators pose a hazard to the autopsy pathologist (2). Some of these devices must be inactivated prior to autopsy to prevent discharge of electric current and potential electric shock. In some cases, the wires can be removed from the power unit or cut close to the power unit before beginning the autopsy. The autopsy pathologist appreciates advance notification that a body contains implanted or exogenous material of potential risk, including radioactive materials, so that appropriate precautions may be taken. Another potential risk is the presence of ''implanted'' material of a different nature, such as fragments of bombs and explosives, which are sometimes encountered during an autopsy and may cause a serious catastrophe (explosion and/or injury) if not recognized and handled correctly (3).

Implanted medical devices, once removed, may be tested by a local electrophysiology laboratory or by the manufacturer. The manufacturer can probably provide the most thorough testing, but there is an inherent concern about possible conflicts of interest. Ideally, a disinterested independent testing agency should be used. It may be necessary, however, to release the device to an attorney who can arrange for testing on behalf of the interested party, especially if medicolegal action seems imminent. In such cases, it would be prudent to involve the attorney for the institution to assure that testing is thorough and unbiased. Institutions and pathology departments should have policies and procedures that address the release of medical devices to attorneys or other third parties while protecting the interests of the institution and department.

NOTE: Volume 159, January 11, 1999. Peter B. Baker, M.D., Ohio State University College of Medicine, Columbus; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Not-So-Obvious Uses of the Autopsy

A 33-year-old black man was admitted with second- and third-degree burns over 50 percent of the total body surface area. The burns were not considered life-threatening and were treated with fluid replacement, debridement, and silver sulfadiazine. Neither fasciotomies nor skin grafts were required. The patient's condition improved initially but then deteriorated slowly during a 3-week course. Chest x-ray films showed increasing bilateral infiltrates with some focal nodularity, and the mediastinum was also perceived to be widened. On the 23rd hospital day, the patient died. There was no clinical evidence of local burn wound infection or systemic sepsis.

Autopsy Findings

The autopsy showed second- and third-degree burns that were healing. Minimal bacterial colonization was identified microscopically. The lungs were heavy and weighed 750 g (left) and 800 g (right) and were firm to palpation, both findings suggestive of pneumonia. Focal spherical lesions as large as 15 mm in diameter with hyperemic rims were identified throughout the lung parenchyma. Examination of the mediastinal lymph nodes showed marked enlargement as high as 10 cm in some locations. The spleen and liver were enlarged, weighing 800 g and 3200 g, respectively. The results of microscopic examination of the lungs showed the spherical lesions to be early fungus balls. A Gomori methenamine-silver stain was performed and showed acutely branching, septate filaments typical of *Aspergillus* species. During the histological staining process, a tissue specimen known to contain fungal hyphae and a tissue specimen lacking fungal elements, both obtained from previous autopsies, were also stained to serve as controls for the procedure. In addition, multiple sections of lymph nodes, spleen, and liver showed

numerous Reed-Sternberg cells with a typical background milieu of Hodgkin disease.

Based on the autopsy findings, the cause-of-death statement was reported as follows:

Part 1.
A. **Aspergillus pneumonia**

Due to or as a consequence of:
B. **Hodgkin disease**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Thermal burns

Comment

The pathologist prepared the cause-of-death statement as shown because she believed that the *Aspergillus* pneumonia would probably not have occurred had the patient not had the underlying Hodgkin disease, but she also believed that the stress of the healing thermal burns probably contributed to the development of pneumonia. The thermal burns were healing with no evidence of significant local or systemic infection. Because an injury (burns) was involved, the death was reported to and certified by the medical examiner, and the injury-related information on the death certificate was also completed specifying how and when the burns occurred (1).

The autopsy is an excellent mode of quality control within the hospital because it may be used to assess the accuracy of disease diagnosis and the effectiveness of treatment (2). There are, however, other uses of the autopsy for medical education, research, technology, and other applications that may not be so obvious (2).

The standard autopsy authorization form used by hospitals usually allows the hospital to retain and dispose of autopsy tissue at its discretion and includes specific provisions that samples derived from an autopsy may be used for the purpose of teaching, diagnosis, and research. As occurred in conjunction with this case, tissues or other specimens from previous autopsies may be used in the pathological workup of other cases, including not only autopsy cases, but also clinical specimens.

Autopsy specimens may serve as positive or negative controls for special histological, immunohistochemical, and immunocytochemical stains. The autopsy also offers an opportunity to retain tissues for educational slide sets for students of histology and pathology. Tissue from tumors obtained during an autopsy may be used for special chromosome and gene studies, to obtain genetic material for synthesis of biologic substances, and postmortem serum samples can be saved for exploration of serological markers of neoplasia (3–6). Control specimens are needed in cytogenetic analysis for procedures, such as fluorescence in situ hybridization (6), and these specimens may be obtained during autopsy. Prospective collection of selected tissues and the measurement of environmental toxins may also be performed in some settings. When appropriate permission is obtained, tissues, such as bone and cardiac valves, can be obtained during autopsy for transplantation. The autopsy provides an opportunity for health care profession trainees to learn procedures, such as fine-needle aspiration, cytology preparations, bone marrow aspiration, and biopsy, and to further refine knowledge of anatomy and dissection methods required for surgical and other invasive procedures. Anatomical variants and anomalies may be studied, and clinical imaging techniques may be correlated with anatomical findings. The autopsy may also be useful for surveillance of emerging infectious diseases (7).

In addition to providing information about the cause-of-death and nature and extent of disease, the autopsy has many not-so-obvious uses that can provide numerous benefits to the medical profession and the practice of medicine.

NOTE: Volume 158, December 7/21, 1998. Kim A. Collins, M.D.; Clay A. Nichols, M.D., Medical University of South Carolina, Charleston; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Death and Distraction

A 13-year-old black youth was living in a foster home. According to the foster mother, he fell in the tub and sustained an injury to the right hip. The boy was described as being sarcastic, belligerent, and a poor historian during the examination at the hospital. He also accused the physician of trying to play with him. The results of radiography of the right hip were negative for fracture. His temperature was 37.6ºC; pulse rate, 82 beats/min; respiration rate, 20/min; and blood pressure, 110/62 mm Hg. The examination was not prolonged, and the boy was sent home with the diagnosis

of a right-hip contusion. Ibuprofen was prescribed for pain. Two days later at a follow-up visit, the boy denied any problems other than some tenderness in the right hip. The foster mother reported a productive cough in the child. Again, he was difficult to examine and had a nonchalant attitude. Examination revealed the following: temperature, 38.7°C; pulse rate, 108 beats/min; and respiration rate, 24/ min. A complete blood cell count showed a white blood cell count of 0.01 10^9/L (11.7/mL). Lungs were described as clear by auscultation. He was described as in no acute distress and sent home with a diagnosis of right-hip strain. Two and a half days later, he was found dead in bed. An autopsy was requested by the coroner, who had been notified of the death pursuant to State death investigation statutes.

Autopsy Findings

At autopsy, the right and left lungs weighed 600 and 520 g, respectively. Numerous white-tan nodules ranging from 0.1 to 1.0 cm in greatest dimension covered the pleural surfaces of both lungs. Several of the nodules were surrounded by a hyperemic rim. Patches of green-gray, fibrinous material were over the diaphragmatic surfaces of both lungs. On sectioning, similar white-tan nodules were present throughout both lungs, with focal necrosis. The surrounding pulmonary parenchyma was dark red and firm. The process involved the majority of the lungs. Several similar-appearing nodules involved both renal cortices. The results of the remainder of the autopsy, including the examination of the right hip, were unremarkable. Microscopic sections of the lungs showed acute pneumonia with hemorrhage, segmented neutrophils, fibrin, necrosis, and bacterial colonies. Similar findings were seen in the sections of the kidneys. Lung cultures were taken and revealed heavy growth of *Staphylococcus aureus*.

Based on these findings, the cause-of-death statement was prepared as follows:

Part 1.
A. **Bilateral Staphylococcus aureus pneumonia**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:

Comment

During the past century, the epidemiologic, clinical, and pathologic findings of staphylococcal pneumonia have been extensively researched and documented (1–4). This potentially fatal disease is associated with fever, an elevated white blood cell count, pleural involvement, necrosis, and often a blood culture positive for *S aureus* (1–4). In this case, the staphylococcal pneumonia was florid in both lungs, with severe pleural involvement, marked necrosis, and hematologic spread to both kidneys. The boy had a fever, an increased respiration rate, an elevated white blood cell count, and was certainly in discomfort. The critical diagnosis was not made probably because the examination was focused on the hip injury and the patient was difficult to examine.

Across the country, many children are in foster homes and temporary living situations. Interviewing these children can be extremely difficult due to learned behavior and coping mechanisms (5,6). Defensive barriers allow such children to claim absence of illness and symptoms (5). When presented with such cases, the examiner must be perceptive beyond the usual interviewing of an adolescent (5).

The autopsy in this case was a learning experience for several reasons. First, it allowed excellent clinicopathological correlation between the child's presentation and examination and the autopsy findings of pneumonia. Second, the autopsy findings emphasized the challenge of interviewing troubled adolescents, a growing segment of our population (6–8), as well as that fatal outcomes may result when a patient is uncooperative. Third, it reminds us that it is not uncommon for the deceased to have been examined by a physician a few days before death. Usually, the causes of death in such cases involve an infectious process that was more aggressive than was recognized clinically or cardiovascular causes, such as coronary artery disease. The former situation emphasizes the need for thorough evaluation of patients with symptoms and signs that are possibly attributable to infectious causes, and the latter situation points out that cardiovascular examination may only reflect the status of the patient at the time of examination. Such unexpected deaths following a recent visit to a physician frequently result in consternation and litigious thoughts among family members and survivors, but it is important to recognize that a given death may not have been related to a medical oversight or error in clinical judgment.

NOTE: Volume 158, November 9, 1998. Kim A. Collins, M.D.; C. Jeff Lee, D.O., Medical University of South Carolina, Charleston; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Allaying Apprehension

A 39-year-old white man noticed a rash on his legs 10 days before death, but he did not seek medical attention. He also experienced increasing fatigue. Two days before death, he went to a primary care physician with complaints of a sore throat. At this time, he was diagnosed as having tonsillitis and pharyngitis and was sent home with a prescription for antibiotics. The medical records did not indicate the presence of a skin rash. On the day of death, he came into the emergency room with a fever and weakness. He quickly became unresponsive to stimuli. The emergency department physicians noted lower extremity petechiae and localizing neurological signs on the right side. Approximately 2 hours after presentation, he was pronounced dead. The patient had no notable medical history. The family and emergency department physicians requested an autopsy to determine the cause-of-death. The physicians were justifiably concerned about meningococcal meningitis and the possibility of infectious exposure of the staff and community.

Autopsy Findings

The results of an autopsy performed under isolated conditions revealed a 4.5-cm hemorrhage within the left basal ganglia that extended into the surrounding white matter. There were external petechial hemorrhages on the head, chest, forearms, and legs. Internally, petechial hemorrhages were identified within the lungs and trachea. Splenomegaly (480 g) was noted. The tonsils and the cervical and para-aortic lymph nodes were enlarged and microscopically showed reactive lymphoid hyperplasia. A peripheral smear of antemortem blood showed a slightly increased white blood cell count ($1.5\ 10^9$/L) and decreased platelet count ($5.0\ 10^9$/L). A manual differential blood cell count exhibited 0.03 blasts, 0.87 promyelocytes, 0.03 myelocytes, and 0.07 lymphocytes. The promyelocytes were characterized by large nuclei and cytoplasm that contained small eosinophilic granules and multiple fine Auer rods. The results of bone marrow examination showed 0.10 blasts and 0.50 promyelocytes. These findings are diagnostic of acute myelogenous leukemia, French-American-British class M3 (acute promyelocytic leukemia). Bacterial and viral cultures of blood, lungs, and cerebrospinal fluid were without growth. The results of a latex agglutination test on cerebrospinal fluid for Neisseria species were negative.

Based on these findings, the cause-of-death statement was prepared as follows:

Part 1.
A. **Intracerebral hemorrhage in basal ganglia**

Due to or as a consequence of:
B. **Thrombocytopenia**

Due to or as a consequence of:
C. **Acute myelogenous leukemia**

Part 2. Other significant conditions:

Comment

Hematopoietic malignancies are a recognized but relatively rare cause of sudden natural death. Patients with acute promyelocytic leukemia typically have coagulopathy at presentation with decreased platelet counts and laboratory tests suggestive of disseminated intravascular coagulation. There is a dramatic increase in the numbers of promyelocytes and blasts within the bone marrow that spill over into the peripheral blood. The classic cytogenetic finding seen in at least 80 percent of cases is a balanced translocation between chromosomes 15 and 17. There is a high rate of remission when treated with conventional chemotherapy, but this therapy often exacerbates the coagulopathy (1).

Autopsy was important in this case for several reasons. It alleviated the emergency department physicians' concerns about the possibility of infectious disease and the potential for infection transmission to close contacts. Autopsies are extremely helpful in identifying or excluding infectious diseases and potential outbreaks. The information in this case was shared with the emergency department personnel and family after the major disease process was identified, which was on the same day of death. It is important for an autopsy pathologist to convey specifics about a case in a timely manner so the information can be used effectively. Procedures, such as frozen sections, touch preparations of tissues for histological examination, and blood or marrow smears, have rapid turnaround times, are often applicable to the autopsy, and may enable rapid answers to questions regarding the death.

This autopsy also revealed an unsuspected diagnosis. In retrospect, the patient had classic symptoms of acute promyelocytic leukemia, but these symptoms are nonspecific and could also be seen in many other disease processes. Probably the most important aspect of this autopsy, and of most autopsies in general, is that the family received an explanation for the sudden demise of their relatively young relative. This important aspect of the autopsy in extending the continuum of care to survivors is sometimes overlooked in a busy medical practice or medical institution.

NOTE: Volume 158, October 12, 1998. Dean M. Havlik, M.D.; Rebecca Irvine, M.D., University of New Mexico School of Medicine, Albuquerque; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Making Amends

A 60-year-old man was diagnosed as having recurrent idiopathic pancreatitis for 3 years. Other medical history included type 1 diabetes mellitus, nephrolithiasis that required lithotripsy, and cholecystitis that required cholecystectomy. He had abdominal symptoms that led to diagnoses of pancreatic abscesses and peritonitis. Medical management and surgical drainage led to the culture of multiple organisms from the inflammatory process, then systemic sepsis and coagulopathy developed and resulted in death. The family initially declined to have an autopsy performed, and the cause-of-death statement on the death certificate was prepared by the attending physician as follows:

Part 1.
A. **Intra-abdominal abscess**

Due to or as a consequence of:
B. **Peripancreatic abscess**

Due to or as a consequence of:
C. **Chronic pancreatitis**

Part 2. Other significant conditions:

The following day the responsible family member contacted the clinician and requested that an autopsy be performed. The family member was referred to the autopsy service and arrangements were made to receive a facsimile transmission of a signed and witnessed autopsy permission form stating the restrictions of autopsy which, in this case, specified that no examination of the head or brain was to be performed.

Autopsy Findings

Autopsy revealed widespread intra-abdominal abscesses. The head of the pancreas contained a 3-cm mucinous cystic neoplasm, which was microscopically proved to be an infiltrating mucinous cystadenocarcinoma. Metastatic adenocarcinoma was found in the lungs, subcarinal and pulmonary hilar lymph nodes, perirenal soft tissue, and peripancreatic and periportal lymph nodes. The pancreas also showed hemorrhagic cystic spaces consistent with abscesses and pseudocysts with hemorrhage. The location and morphologic characteristics of the tumor indicated that it had obstructed the pancreatic duct, which probably accounted for the pancreatitis and pseudocyst formation.

Comment

After receiving the results of the autopsy, the family member contacted the clinician and requested that the death certificate be changed. The clinician agreed to make a change but did not know the correct process, so he asked the attending pathologist. The pathologist pleaded ignorance on the matter but offered to find out the appropriate way to change a death certificate. She consulted available publications that included generic information on what is referred to as the death certificate amendment process (1,2). She took the advice in the publications and contacted the State's office of vital statistics and learned that in her jurisdiction, death certificate amendments within 3 years of the patient's death simply require that the original certifier of death submit a letter to the vital statistics office requesting and specifying the desired changes. Accordingly, a letter was composed making the request and indicating that the cause-of-death statement be amended to read as follows:

Part 1.
A. **Sepsis**

Due to or as a consequence of:
B. **Peritonitis**

Due to or as a consequence of:
C. **Pancreatic abscess**

Due to or as a consequence of:
D. **Metastatic cystadomocarcinoma of the pancreas**

Part 2. Other significant conditions:

The clinician sent a copy of the letter to the family and the office of vital statistics, which made the requested amendment. Both the family and the vital statistics system benefitted because the cause-of-death was accurately recorded after the amendment.

In this case, the family's initial refusal to authorize an autopsy led to the clinician's prompt completion of the death certificate based on information that was available at the time, which is the correct procedure to follow. Then, the unexpected reversal of the family's wishes and unexpected autopsy findings led to the need for death certificate amendment. In such instances, knowledge of death certificate correction procedures is required.

When it is known that an autopsy is going to be performed and the cause-of-death is not known prior to autopsy, it is prudent to delay filing of the death certificate until the provisional autopsy findings are available, which is usually a matter of only a day or two. If the provisional autopsy findings are insufficient to complete the death certificate, a certificate may then be filed as pending further study. Then, when the final autopsy report is completed, a supplemental report must then be filed with the office of vital statistics so the death certificate can be finalized (1).

If a death certificate with a stated cause-of-death has been filed but is later discovered to be in error (such as the case reported herein), the correction process is referred to as death certificate amendment.

The regulations for filing supplemental reports and making amendments are determined by each state. The vital statistics office can provide the specific details and procedures for the state it serves. It may be useful for the institution or office to develop a standard letter or in-house procedure to file supplemental reports or make amendments.

Although there was initial speculation that the family's request for a death certificate change may have been based on their pursuing of a possible lawsuit for failure to diagnose the malignant neoplasm, three years have passed and nothing further has

been heard from the family or their attorneys. Apparently, the concerns were unwarranted; as is often the case, the family simply wanted to know what happened and have the record accurately reflect the circumstances and details of death.

Finally, this case shows that the autopsy may answer many questions even when a complete autopsy has not been performed (permission to examine the head or brain was not granted). Limited or partial autopsies were the topic of discussion in an earlier Case of the Month (3).

NOTE: Volume 158, September 14, 1998. Ann E. Smith, M.D.; Grover M. Hutchins, M.D., The Johns Hopkins Medical Institutions, Baltimore, MD; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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3. Hanzlick R, and the Autopsy Committee of the College of American Pathologists. Case of the month. Arch Intern Med. 1997;157:2557. MEDLINE.

Addressing the "Red Herring"

A 53-year-old white woman was admitted to the hospital with a 3-day history of cough and dyspnea. Two years previously, a ductal carcinoma of the breast (already with widespread metastases) had been diagnosed. On this admission, significant arterial hypoxia was noted. The results of echocardiography showed right ventricular dilatation. An electron beam computed tomographic scan was interpreted as negative for pulmonary embolism.

Despite the interpretation, the patient was diagnosed as having pulmonary thromboembolism and was given anticoagulant therapy. She died of progressive respiratory failure 2 weeks after admission to the hospital.

Autopsy Findings

Right cardiac ventricular dilatation, chronic passive visceral congestion, and microscopic metastases in the vertebral column, liver, and pancreas were observed during the autopsy. Careful dissection of the lungs failed to show either pulmonary thromboembolism or metastases. The results of microscopic examination disclosed numerous small pulmonary arterial and arteriolar lumens that were occluded by neoplastic microemboli. In some vessels, fibrin or platelet thrombi were present with tumor cells, and some pleural pulmonary lymphatics contained tumor ("lymphangiosis carcinomatosa").

Based on these findings, a cause-of-death statement was prepared as follows:

Part 1.
A. **Cor pulmonale**

Due to or as a consequence of:
B. **Pulmonary arterial carcinomatous microemboli**

Due to or as a consequence of:
C. **Metastatic ductal adenocarcinoma of breast**

Part 2. Other significant conditions:
Lymphangiosis carcinomatosa of lungs and pleura

Comment

The pathologists concluded that occlusion of the peripheral pulmonary vasculature led to cor pulmonale and that respiratory failure was in part caused by lymphangiosis carcinomatosa. The results of the autopsy uncovered a rare (and in this case clinically unsuspected), but well described entity of tumor microemboli to the lungs, which caused pulmonary hypertension, cor pulmonale, and death (1,2). The metastatic route to the lungs was probably via the vertebral metastatic deposits.

Performance of this autopsy was valuable because the results showed the reason for the patient's failure to respond to anticoagulant thrombolytic therapy for suspected pulmonary thromboembolism. The case was analyzed for similarities and differences to previous institutional experience with the disease entity, and these data were forwarded to the referring clinicians as part of the autopsy interpretation. The postmortem examination provided information of immediate value in several respects. First, the patient's relatives were able to understand the extent of tumor and resultant limitations of possible therapeutic measures. Second, the physicians obtained an explanation for the lack of response to therapy. Third, the imaging analysis better appreciated the limitations of imaging technique resolution in the face of neoplastic pulmonary microembolism. Fourth, an accurate and complete cause-of-death statement could be prepared.

NOTE: Volume 158, January 12, 1998. Eric A. Pfeifer, M.D., Johannes Bjornsson, M.D., Mayo Clinic and Foundation, Rochester, MN; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Requesting an Autopsy

A 28-year-old man with long-standing asthma was admitted to the hospital in status asthmaticus. Necessary treatment modalities included high-dose methylprednisolone, sedation, and succinylcholine-induced paralysis for intubation. Pulmonary infiltrates were noted on a chest radiograph, and the patient could not be weaned from ventilation use. Decreasing consciousness was observed, and the results of a computed tomographic scan of the head showed ring-enhancing lesions in the right frontal and left parietal cerebral lobes. After rapid neurologic decline, the patient died. The attending physician asked the medical house officer, who had recently started her internship, to obtain permission to perform an autopsy. However, the house officer had never been taught in medical school how to request permission to perform an autopsy, had never seen an autopsy performed, and was unfamiliar with the procedures involved, making her unsure of how to field questions from family members. The institution had prepared and distributed to the house officers a small laminated card with instructions for obtaining permission from the legal next of kin to perform a postmortem examination. The house officer reviewed the information on the card and spoke with the responsible family member, the patient's mother. In addition, an informational brochure on the autopsy was made available to the mother, similar to one that has been published (1). The patient's mother consented to the performance of a complete autopsy.

Autopsy Findings

The results of the autopsy showed disseminated aspergillosis with fungal brain abscesses, which had formed in the setting of high-dose methylprednisolone treatment of asthma. The pathology house officer wanted to include a cause-of-death statement in the autopsy report so the clinician could use it to accurately complete the death certificate. However, the house officer, also beginning his postgraduate work, had not received formal training in medical school on how to write a cause-of-death statement. He was provided with an instruction manual (2) and, after reading relevant portions, discussed the cause-of-death with the attending pathologist and completed the cause-of-death statement as follows:

Part 1.
A. **Disseminated aspergillosis**

Due to or as a consequence of:
B. **Steroid therapy**

Due to or as a consequence of:
C. **Asthma**

Part 2. Other significant conditions:

Comment

After the laminated card was introduced at the institution, the autopsy rate rose approximately 30 percent above the previous rate. Obtaining permission to perform an autopsy depends, of course, on asking for permission, and knowledge of how to ask for permission in a professional and compassionate way may facilitate the process. Complete and accurate completion of the cause-of-death statement and death certificate has been compromised because of a lack of formal teaching of physicians. In response to that problem, the College of American Pathologists has produced several publications with instructions and examples of how to write cause-of-death statements (2–4).

The autopsy was valuable in this case because it established the immediate cause-of-death (disseminated aspergillosis) and documented that a recognized potential complication of a necessary and accepted medical therapy (methylprednisolone treatment) had occurred in this patient. Reporting the adverse effects of a medical treatment in the cause-of-death statement does not necessarily connote inappropriate therapy or misadventure but simply explains the sequence of events that caused the patient's death. For quality assurance, medical education, and the advancement of medical knowledge, complications of therapy as factors causing or contributing to death may be as important to document and evaluate as the underlying disease conditions.

Publications are available for purchase from the College of American Pathologists Publications Department, 800-323-4040. The authors have no financial affiliation with the College of American Pathologists.

NOTE: Volume 158, February 9, 1998. Grover M. Hutchins, M.D., The Johns Hopkins Medical Institutions, Baltimore, M.D.; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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PROTOCOL FOR AUTOPSY REQUEST

When a patient dies, determine if the Medical Examiner/Coroner (phone #) must be notified. If the case is declined or is not an ME/C case, we are obligated to offer the family an autopsy. When you pronounce a patient dead, it is your responsibility to inform the patient's family about the autopsy examination. This should not be perceived as an emotionally charged issue. The following information should be communicated to the family:

The person taking responsibility for the body (usually the next of kin) may give permission for autopsy.

The family is not charged for the autopsy.

The autopsy may confirm the clinical diagnosis or uncover additional contributory causes for the patient's death.

The autopsy contributes toward physician education, research, and improved patient care.

An autopsy will not delay the funeral or interfere with viewing of the body.

A packet of forms is available on the wards. Assistance with previous or pending autopsies (e.g., facilitating the process or arranging a gross review) can be directed to the Pathologist-on-call. For further information and reports: Autopsy room (phone #), Pathologist-on-call (phone #), Admitting Office (phone #), Autopsy Pathology Division Office (phone #).

SAMPLE VERBAL AUTOPSY REQUEST

I am Dr. _____, and I am covering for Dr. _____. I'm sorry to inform you that _____, your _____, has just died. We believe that death was _____. It is my responsibility to inform you that you have the right to have an autopsy performed in order to be more certain about the cause of death and to learn more about this type of disease. (If this is unacceptable, a partial autopsy should be recommended, i.e., ''I recommend that we at least examine the _____.'') Although it is an expensive procedure, the hospital does not charge the patient's account or the family for autopsy examinations.

We are grateful when the family gives consent for an autopsy because the hospital physicians will be able to learn more about the disease that caused your ____'s death, and we will be able to evaluate or improve our treatment. An autopsy will not delay the funeral or interfere with viewing of the body.

As the responsible person, do you want an autopsy (or partial autopsy) to be performed? If yes, you will need to sign this form (autopsy consent form) and I will explain it to you before you sign.

OR

If yes, you may give consent by telegram, facsimile, or by phone. Arrangements for this type of consent may be made with the Admitting Office (phone #) or through the hospital operator (phone #).

Sample laminated card that may be distributed to house officers or those physicians who request permission for autopsy performance. The card may be sized to fit in a pocket and has general information on one side (upper frame) and sample text for requesting permission on the other side of the card (lower frame). Specific wording must be designed with institutional needs, policies, and local laws in mind.

''Negative'' Results of Autopsy and Elusive Cause-of-Death

A 91-year-old man was a nursing home resident mainly due to mild dementia. He died suddenly after taking his evening meal. The nursing home staff reported that he had been in his usual state of health when he suddenly collapsed; death was pronounced within minutes of the collapse. His medical history included nodular goiter diagnosed 27 years prior to death, a 6-year history of atrial fibrillation, and a 4-year history of an unspecified type of mild dementia. Mild mitral regurgitation was also noted 2 years before death. Notably absent from the clinical history was any evidence of systemic hypertension, ischemic heart disease, cerebrovascular disease, or diabetes mellitus.

Autopsy Findings

Atherosclerotic luminal stenosis (70 percent) was identified in the distal circumflex branch of the left coronary artery. Other coronary arteries had 40 percent to 50 percent maximum stenosis. Mild floppiness of the mitral valve was present. The heart weighed 340 g (expected mean, 290 g). No gross or microscopic evidence of acute or chronic myocardial ischemia was identified. Other findings included nodular goiter, moderate centrilobular pulmonary emphysema, a diaphragmatic hernia, moderate aortic atherosclerosis, and moderate arterial nephrosclerosis. The brain weighed 1195 g (expected mean, 1270 g) and appeared slightly atrophic. Microscopic examination of the brain revealed mild, nonspecific neurodegenerative changes, including scattered neuritic plaques in the neocortex. Evidence of amyloid angiopathy was absent. A blood screen yielded negative toxicologic results.

Based on these findings, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Sudden witnessed death**

Due to or as a consequence of:
B. **Presumed cardiac dysrhythmia**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Atherosclerosis, floppy mitral valve, atrial fibrillation

Comment

The results of the autopsy were remarkable for the absence of organ changes specific enough to cite with reasonable probability a specific single condition or sequence of conditions that accounted for death. Coronary stenosis was of marginal significance, evidence of acute or chronic myocardial ischemia was absent, and other vital organs lacked sufficient changes to explain death without tenuous assumptions. Biochemical or toxicologic derangements may certainly cause death without corresponding morphologic changes, but there was no clinical or postmortem evidence of such disturbances.

The absence of autopsy findings sufficient to explain death may pose a dilemma for the physician completing the death certificate: this dilemma is not uncommon when causes of death in the elderly are at issue (1–3). Because death certificate data may ultimately be used for epidemiological purposes, it is important that death not be attributed to specific causes that are arbitrarily selected, speculative, or nonexistent. In the case presented herein, it is likely that had autopsy not been performed, death might have been erroneously attributed to myocardial infarction or some other form of ischemic heart disease. Unfortunately, due to the low national autopsy rate, especially among the elderly nursing home population, erroneous reporting of the cause-of-death is undoubtedly frequent.

The cause-of-death statement shown herein states the facts: death appeared to result from a cardiac dysrhythmia, and there were other conditions that likely contributed to death and may have been the basis of the dysrhythmia, but a specific cause of the dysrhythmia could not be determined with reasonable probability.

Atherosclerosis, floppy mitral valve, and atrial fibrillation may each be associated with a fatal cardiac rhythm disturbance, but fatal rhythm disturbances may also occur without these conditions. The word ''presumed'' was included because the results of an autopsy cannot confirm the occurrence of a cardiac rhythm disturbance, which is a functional rather than anatomical derangement.

Each of the causes listed in Part 2 will be included and coded in multiple cause mortality data that are used for statistical purposes. A user of the original cause-of-death statement or death certificate will realize from the wording and structure of the cause-of-death statement that a clear cut cause-of-death was not identified, even after performing an autopsy. Both practical and statistical needs were met by writing the cause-of-death statement as shown. There is bias in some forms of mortality data derived from death certificates as a result of nosologic coding procedures, but certifiers of death can avoid confounding the bias by reporting the cause-of-death as accurately, specifically, and completely as possible and, when needed, in less-specific terms to avoid overreporting conditions for which there is little or no basis (5,6).

Definitive proof of a cause-of-death is not needed to report it on the death certificate. Adequate evidence may consist of a cause being more likely than not. In this case, sufficient evidence was lacking to cite a specific condition or sequence of conditions in Part 1 as being more likely than not, so the cause-of-death statement was prepared using nonspecific terminology in Part 1. In most cases, however, a specific condition or sequence of conditions may be stated in Part 1 with reasonable probability of accuracy based on the clinical history, available medical records, and autopsy findings when needed.

The results of an autopsy do not always reveal the cause-of-death. However, the performance of an autopsy allows better assessment of likely causes and enables exclusion of many possible causes. The results of an autopsy also enable assessment of comorbidity, the identification of conditions that existed but were not the cause of the patient's death. For research, epidemiological studies, and elucidation of the courses of disease and treatments, it may be just as valuable to know the diagnoses existing at death (DEAD) as it is to know the cause-of-death.

NOTE: Volume 158, July 13, 1998. Johannes Bjornsson, M.D., Mayo Clinic and Foundation, Rochester, Minn; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Speculation and Competing Causes of Death

A man in his late forties had been in good general health. He had smoked two packs of cigarettes per day but had recently stopped. He had become an avid exerciser, running about 24 to 32 km and swimming 1.6 to 3.2 km each week. Paroxysmal atrial fibrillation developed and was initially controlled by the use of digitalis. However, during a 2-year period, the episodes of atrial fibrillation became more frequent and required cardioversion and trials of several other antidysrhythmic drugs. Atrial flutter was noted during an office visit with his cardiologist. The next day, he staggered and fell on a jogging path. Emergency services were called, but an attempt to resuscitate the patient was unsuccessful.

Autopsy Findings

An autopsy was performed under the authority of the local medicolegal death investigation system because death was sudden, unexpected, and unexplained. The heart weighed 450 g (average normal weight about 345 g for weight and height). There was calcific atherosclerosis of the left anterior descending coronary artery with luminal narrowings estimated at 70 percent. There was no significant alteration in the left main, left circumflex, or right coronary arteries. The brain was not examined. The remaining organs and tissues showed nothing that was reported as significant.

Based on the gross and microscopic autopsy findings and negative results of a toxicologic screen, the cause-of-death was reported as follows:

Part 1.
A. **Calcific coronary artery sclerosis**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Cardiomegaly

Comment

The widow consulted an attorney; a lawsuit was instigated against several health care providers who had treated the decedent, alleging that they had failed to diagnose and treat coronary artery disease, which was reported as the cause-of-death. The attorneys for the defendants engaged a pathologist to review the case, and the consulting pathologist noted that myocarditis was present focally in the histologic sections, including an area with myocyte necrosis in the atrioventricular node. There was no histologic evidence of acute myocardial ischemia typical of coronary insufficiency or of the type sometimes seen in unstable angina. There was no evidence of sudden changes in the coronary arteries, such as plaque fissuring, hemorrhage, or thrombosis.

Based on these findings, the consulting pathologist indicated that an alternative cause-of-death could be reported as follows:

Part 1.
A. **Myocarditis, undetermined type**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Atrial fibrillation/flutter

The consulting pathologist advised the attorneys that coronary artery disease, especially in the face of demonstrable myocarditis, may not have been the actual cause-of-death in this case. Although coronary artery disease was reasonably included in the differential diagnosis based on the autopsy findings and circumstances of death, the patient's previous athletic activity and exercise tolerance, lack of anatomical and clinical evidence of myocardial ischemia, marginally significant coronary artery stenosis, and histologic evidence of myocarditis indicated that myocarditis may have been a more likely cause-of-death (3,4).

The results of the autopsy in this case, used as a basis to report the cause-of-death on the death certificate, seemed to support the widow's initial lawsuit. However, the autopsy results provided histologic samples that could be reviewed and that ultimately provided an alternative explanation for the cause-of-death. If an autopsy had not been performed, death might have been attributed to coronary artery disease, and the same legal action may have resulted. However, in that scenario the information obtained from the autopsy would not have been available to address relevant issues and adjudicate the case. Also, if an autopsy had not been performed, the additional expense of exhumation might have been necessary to perform an autopsy, in which case the findings may have been more difficult to interpret because of postmortem artifacts.

This case points out the need for certifiers of death to realize the possible ramifications of the wording in the cause-of-death statement as well as the need to evaluate possible competing causes of death. One does not need to be absolutely certain about a cause-of-death to report it on the death certificate. In fact, in many cases it is sufficient if a cause-of-death is ''more likely than not (5)'' and one should not skirt the responsibility of reporting a reasonable and likely specific cause-of-death, when possible. However, a reported cause-of-death should consist of more than speculation, especially when other competent and equally likely (i.e., competing) causes of death may exist.

Medicolegal death investigations performed under the jurisdiction of a medical examiner or coroner, as was done in this case, are often geared toward differentiating natural deaths (due to disease) from unnatural deaths (due to injury or poisoning). For a variety of reasons, including workforce, funding, available resources, and operational strategies and priorities, medicolegal death investigation systems may not pursue a full and comprehensive pathologic workup once death has been determined to be natural in manner. Whether tissue samples are retained for histologic examination and, if retained, processed only to paraffin blocks (and not routinely reviewed) or to

glass slides (which may or may not be routinely reviewed), varies from place to place. Also, some medicolegal death investigation systems may be limited by law or other regulation in the extent to which a death may be investigated when there is no evidence of injury, poisoning, or foul play (6). Thus, it is not surprising that cases like the one reported herein sometimes occur.

It is also important to realize that experienced medical examiners and coroners are used to investigating deaths with anatomical findings that do not fit precisely with well-established concepts and pathophysiologic patterns. Such cases may result in the need to report a cause-of-death in rather generic terms because demonstrable evidence of a specific fatal derangement, immediate cause-of-death, or mechanism of death is lacking. For example, simply attributing death to coronary artery atherosclerosis (or to a somewhat vague condition, such as cardiomegaly, anesthesia-related death, or homicidal violence) without further explanation is appropriate and necessary in some situations.

When a lawsuit involves information derived from the cause-of-death on a death certificate or autopsy report, a first step should be to ascertain the basis and likely accuracy of the reported cause-of-death so that valuable time and resources are not wasted and possible misinformation is not perpetuated.

NOTE: Volume 158, August 24, 1998. Grover M. Hutchins, M.D., The Johns Hopkins Medical Institutions, Baltimore, MD; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Institutional Autopsy Rates

A 35-year-old man with end-stage acquired immune deficiency syndrome was admitted to the hospital for severe abdominal pain, abdominal tenderness, and fever. A computed tomographic scan showed colonic distension, thickening of the colonic wall, and a possible rectal mass. Death occurred within 24 hours of admission to the hospital, and permission to perform an autopsy was requested to evaluate the gastrointestinal tract. Recently, he had been given clindamycin for empirically suspected central nervous system toxoplasmosis.

Autopsy Findings

The results of the autopsy showed pneumonia due to cytomegalovirus infection and massive dilatation of the entire colon, which had a diameter approximately three times the normal size. The colonic wall was thickened and edematous, the mucosa of the distal colon was necrotic, and the remaining mucosa showed numerous ulcerative lesions and a thick fibropurulent pseudomembrane. Microscopically, the colon showed morphologic changes typical of pseudomembranous colitis, normally distributed ganglia (i.e., no evidence of congenital megacolon), and no features suggestive of ulcerative colitis, regional enteritis, ischemic bowel disease, or other infectious bowel disease. The brain showed organizing abscesses consistent with recently treated toxoplasmosis.

Based on the autopsy findings, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Toxic megacolon**

Due to or as a consequence of:
B. **Pseudomembranous colitis**

Due to or as a consequence of:
C. **Clindamycin therapy for cerebral toxoplasmosis**

Due to or as a consequence of:
D. **Acquired immune deficiency syndrome**

Part 2. Other significant conditions:
Pneumonia due to cytomegalovirus

Comment

Although clindamycin-associated pseudomembranous colitis due to Clostridium difficile is a well-known entity (1), it is not commonly associated with toxic megacolon. The findings in this case prompted the pathologist to consider a retrospective review of autopsy cases at the institution to a search for similar cases among the patients with acquired immune deficiency syndrome who had been treated with clindamycin. Unfortunately, the number of autopsies performed in such cases was too small to enable such an analysis. This problem prompted the pathologist to review the overall autopsy rates in the institution.

A review of annual institutional mortality and autopsy data showed that the annual deaths of inpatients remained relatively constant between 1986 and 1995 but the number of autopsies performed had progressively declined from 250 in 1986 to 105 in 1995, resulting in an autopsy rate that declined

from 17 percent to 7 percent of in-hospital deaths. A review of the literature (2) showed that similar trends have occurred nationally and that nationwide autopsy rates gradually declined from 41 percent in 1964 to about 15 percent in 1983. A 1994 survey of 244 hospitals conducted by the College of American Pathologists (3) showed that half of hospitals had autopsy rates at or below 8.5 percent and 75.0 percent had autopsy rates below 13.5 percent. Interestingly, accreditation programs (4) in internal medicine recommend an autopsy rate of at least 15 percent.

Why have autopsy rates fallen so dramatically? This question and other issues have been discussed extensively for 35 years at various symposia in the United States (5–8). In brief, the following are the most commonly mentioned reasons:

Lack of reimbursement—In general, hospitals do not charge families for autopsy services, insurers do not usually pay for autopsy costs, and the Health Care Financing Administration's Medicare reimbursements do not provide payments (Part B) for specific autopsy services. Part A reimbursements, according to the Health Care Financing Administration, include nonline item money to support autopsy services, but the payment is not based on autopsy rate, autopsy use, outcomes assessment, or actual autopsy costs. In essence, the lack of reimbursement makes the autopsy a ''loss leader,'' which hospital financial managers and pathology departments must manage.

Lack of incentive—The autopsy is a labor-intensive and expensive procedure. In most hospital settings, pathologists are not paid on a fee-per-case basis. Managed care has resulted in fewer pathologists who have to work longer and harder, and the autopsy poses workforce burdens with little incentive.

Decreased emphasis in medical school—Medical schools have moved toward clinical problem-solving curricula and away from basic sciences. Time allocated to pathology curricula has dwindled. Many medical students now graduate with no training in autopsy procedure, no instruction on how to request permission for an autopsy, and no opportunity to view an autopsy in progress or the inside of a cadaver. Perhaps as a result of decreased emphasis, it has been shown that clinicians frequently do not ask for permission to have an autopsy performed.

Technological advances—The dramatic and rapid advancements in diagnostic modalities such as computed tomography and magnetic resonance imaging have improved the ability to view images of internal bodily aspects, resulting in the perception among clinicians that the autopsy may be replaced by imaging and other methods.

Changing nature of disease patterns—Changing disease patterns affect the autopsy in two ways. First, some pathologists have become concerned about the increased risk of occupational exposure to potentially fatal and/or drug-resistant, blood-borne, respiratory, and other pathogens, causing them to take a closer look at the risk-benefit ratio of autopsy performance. Second, the increase in deaths involving human immunodeficiency virus infection and survival among patients with terminal diseases of many types have changed the mortality patterns in some institutions. More patients have lengthy illnesses and prolong hospitalization during which many of their disease processes may be elucidated.

Negative feedback—Many pathologists are not interested in the autopsy and have attitudes of indifference, avoidance, and in some cases, antagonism resulting in half-hearted autopsy performance. These attitudes and practices may negatively affect the attitudes and practices of clinicians in the institution who are the suppliers of autopsy authorizations and users of autopsy information.

Despite the use of sophisticated imaging technologies and other new diagnostic tools, recent studies (9–11) demonstrate that 32 to 42 percent of autopsies reveal at least one major unexpected or clinically unconfirmed finding that contributed to the patient's death. In addition, approximately 93 percent of clinical questions made known to the pathologist prior to autopsy are answered in the results of the autopsy (11–12). These studies indicate that the autopsy continues to be a valuable resource for education and quality assurance. The positive contributions of the autopsy have also been recognized by the American Medical Association (2). One of us (R.H.) has educated physician house staff about these data, and the institution's autopsy rate rose nearly 30 percent in one year.

Several reasons cited herein for declining autopsy rates could be addressed by regionalization of hospital autopsies to medical centers with interest in performing autopsies, experience in performing autopsies involving infectious and complex conditions, and adequate facilities for recommended and regulated infection control practices (8).

NOTE: Volume 158, June 8, 1998. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; Peter Baker, M.D., Ohio State University School of Medicine, Columbus; and the Autopsy Committee of the College of American Pathologists.

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Private Autopsies

A white man in his thirties fell from a ladder at work and broke his back (lumbar vertebral fracture). He was taken to a local hospital where he was given supportive treatment while being evaluated for surgical repair of the fracture. About 4 days after admission, he suddenly became dyspneic, underwent cardiopulmonary arrest, and died.

During resuscitation, subxiphoid aspiration using a pericardial needle was performed, revealing blood. The clinicians felt that death resulted from hemopericardium probably due to a ruptured coronary artery aneurysm and certified the cause-of-death as such. The medical examiner was notified of the death but did not investigate, presumably because a natural cause-of-death was reported by the clinicians. An autopsy was not performed at the hospital. The body was buried a few days following death.

The patient's family assumed that death was related to the back injury, which occurred on the job, and they attempted to process a claim for compensation. However, they were told that they did not have a claim because there was no evidence that the death resulted from the work-related injury since the death was certified as being due to a specific natural cause. The family was perplexed and contacted an attorney, who recommended that an autopsy be performed to evaluate whether the stated cause-of-death was correct and whether the fall and vertebral fracture somehow caused or contributed to death.

The attorney contacted a pathologist and discussed the case. After executing a legal authorization for autopsy, signed by the legal next of kin, the body was exhumed and a pathologist performed an autopsy for an agreed upon fee, using a local morgue and paying a user's fee to cover supplies and overhead expenses in the morgue.

Autopsy Findings

The results of the autopsy did not confirm the presence of a coronary artery aneurysm, hemopericardium, or reason for a hemopericardium to exist. Because of the body cavity trocar and aspiration procedure performed during the embalming process (1), which introduces puncture-like artifacts and can remove abnormal fluid collections (1), a specific explanation for blood having been obtained during the subxiphoid aspiration could not be determined; aspiration of intracardiac blood was one explanation. The results of the autopsy showed lumbar vertebral fracture and the presence of multiple, bilateral, pulmonary emboli.

Based on these findings, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Pulmonary embolism**

Due to or as a consequence of:
B. **Lumbar spine fracture sustained in a fall from a ladder**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:

Comment

It is unclear why the medical examiner did not accept jurisdiction and perform an autopsy in this case because the possibility of death due to injury existed based on the close temporal relationship between injury and death. It is also unclear why an autopsy was not performed at the hospital where the death occurred. Oversight, miscommunication, or misunderstanding by one or more parties may have played a role. Fortunately, an autopsy was eventually performed, which allowed the family to proceed with their personal and financial matters. Unfortunately, however, the family had to expend effort and money to arrange and pay for a private autopsy when an autopsy might have been performed earlier in a different setting. In cases such as this one in which the correct cause-of-death was determined after the original death certificate was incorrectly completed and filed, effort should be made to amend (i.e., update or correct) the original death certificate, which usually requires contacting the original certifier. When an injury is involved, the medical examiners or coroners could be contacted (in the jurisdiction where the injury or death occurred, depending on the laws of that State), and they can then assume jurisdiction of the case and amend the death certificate.

In other cases, the family (or the patient's physician) may need or want to have an autopsy performed, but the death clearly does not come under the jurisdiction of the medical examiner or coroner and, for one or more of several reasons, an autopsy cannot be performed at the hospital. Such reasons include the following: the patient did not die in the hospital; the family was not informed in a timely fashion that an autopsy could be performed in the hospital; the facility in which death occurred does not have formal provisions for autopsy services; or the family wants an autopsy to be performed but does not want the hospital to do it because of perceived conflicts of interest or concern about possible coverups. Some hospitals will only perform autopsies when patients

die in the hospital, although some will perform one even if the patient dies outside the hospital if the patient has an active medical record or has recently been admitted and discharged. Procedures and arrangements vary among hospitals with respect to such circumstances.

For all the reasons cited, the physician of a patient who dies may be called upon or desire to arrange for a private autopsy performed on a fee-for-service basis. The following are several approaches to finding such a service:

- If the family has an attorney, the attorney may be aware of a pathologist who will perform autopsies on a private basis on behalf of the family.
- The pathology department at a local hospital may be contacted. In many instances, the pathologist may be able to provide such services or recommend a pathologist who provides such services.
- The office of the medical examiner or coroner may be contacted. Many pathologists who work in the offices of the medical examiner or coroner provide private autopsy services independently from their duties as medical examiner, coroner, or coroner's pathologist or will be able to recommend a pathologist who provides such services.
- The College of American Pathologists (800-323-3040) may be able to provide names of several pathologists who practice in the area where the service is needed.
- There are an increasing number of commercial and private autopsy service companies that have a nationwide network of people who will provide autopsy services on a private basis (2). Information about some companies can be obtained through the Internet or perhaps from a local pathologist, medical examiner, or coroner's pathologist who may be familiar with advertisements for such services.

Regardless of the ultimate arrangement, the autopsy service provider will probably require a legally executed authorization for autopsy, completed and signed by the legal next of kin and/or their authorized attorney. A sample, generic authorization form has been published (3). It may be necessary to transport the body across long distances or State lines, which may require embalming before transport. Most hospitals do not bill the family when an autopsy is performed, but few private autopsies are performed free of charge, and the fee may be considerable. Financial arrangements should be clear to all parties prior to the performance of a private autopsy.

Organized, commercial autopsy service enterprises are relatively new and growing in number. How they perform and interface with medical professional guidelines and standards, facility inspections, and accreditation and certification procedures remains to be seen.

NOTE: Volume 158, May 11, 1998. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; Grover M. Hutchins, M.D., The Johns Hopkins Medical Institutions, Baltimore, MD; and the Autopsy Committee of the College of American Pathologists.

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Complications of Therapy, Nursing Homes, and the Elderly

Following several cerebrovascular strokes, an elderly man was placed in a nursing home for long-term care because of his immobility and paresis. Regular sessions in a heated whirlpool were part of his therapeutic regimen. One day, shortly after being placed in the whirlpool, he moaned and thrashed. He was promptly removed from the whirlpool and noted to have erythematous skin extending from the nipples to the feet. The on-call physician was notified and observed blistered and erythematous skin. Treatment consisted of burn wound management, and death occurred several days later from burn wound sepsis.

Autopsy Findings

The results of the autopsy showed patterned thermal injury (burns) involving most of the skin surface of the trunk and extremities below the level of the nipples and included erythema sloughed epithelium in a distribution typical of an immersion scald burn. Autopsy results also showed old cerebral infarcts, nonspecific changes related to aging; and no apparent immediate cause-of-death other than the burns. An investigation of the scene and an examination of the whirlpool disclosed that the hot water coming into the whirlpool could exceed scalding temperature (the thermostat on the hot water heater was set too high) and that the temperature sensor on the whirlpool measured the temperature of the water in the incoming water pipe, not the water in the whirlpool basin. Thus, the water faucet could be operated in such a way that the temperature indicator would indicate a safe temperature (when cool water was running in the line) when, in fact, the tub contained scalding water that had previously been run into the tub. There was no indication that the burns were intentionally inflicted.

Based on the results of autopsy and investigation, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Burn wound sepsis**

Due to or as a consequence of:
B. **Scald burns of torso and extremities**

Due to or as a consequence of:
C. **Whirlpool treatment with overheated water**

Part 2. Other significant conditions:
Remote cerebral infarctions, cerebral artery atherosclerosis

Comment

Because death was related to an injury, the medical examiner was notified of the death and assumed jurisdiction for the investigation and autopsy. The manner of death was classified as accidental because the death was caused by an unintentional injury (i.e., burns, an external condition). An appropriate cause-of-death statement is shown, which reports the injury information in Part 1. The cerebrovascular conditions are appropriately reported in Part 2 because they explain why the man was in the whirlpool; however, these conditions were not directly linked in a causal relationship with the thermal burns, which essentially were an independent event (1). Had the burns not occurred, the man most likely would not have died when he did.

Performance of the autopsy was valuable because it allowed documentation of the event of injury and evaluation for the presence of other plausible, competing causes of death that were ruled out. The autopsy provided information that could be used to confidently address issues of injury and death causation without relying on incomplete information or speculation.

The associated investigation of the scene and circumstances provided information that was potentially valuable in preventing subsequent patient injuries. The whirlpool and water heating system could be modified to make them safe, including a reduction in the thermostat setting on the water heater to below 48.8°C. Information from the autopsy and investigation was used by the State licensing board (which conducted an investigation) and also forwarded to the whirlpool manufacturer and could be used for training employees on whirlpool and water temperature safety. Data in the literature about the relationship of time, temperature, and thermal scald burns were validated in that the ultimately fatal burns occurred within seconds of immersion in the scalding water. (Water temperature of 54.4°C can scald within a few seconds (2).) Because the information discovered through the performance of the autopsy and investigation was thorough, potential legal claims could be promptly and accurately addressed.

There is little doubt that the autopsy is underused as a method for evaluating mortality patterns, the health of the aging population, and the subset of such patients in nursing homes or long-term care facilities. Approximately 20 percent of deaths occur in nursing homes; however, in New York State, for example, the autopsy rate for nursing home patients during a 5-year period was only 0.8 percent (3). During a 7-year period in a teaching nursing home, the autopsy rate was only 3.5 percent, but it did increase to 10.8 percent after an extensive educational effort (4). The Centers for Disease Control and Prevention's National Center for Health Statistics data tapes indicate that in the United States autopsies were performed on fewer than 1 percent of patients who died in nursing homes between 1990 and 1994. Deaths in nursing homes sometimes raise concerns about unsuspected injury, patient management, and possible abuse or neglect. The performance of an autopsy can address these issues. Unfortunately, many nursing homes lack full-time physician staff, autopsy rooms, pathology services, or formal affiliations with hospital-based autopsy services, posing some obstacles to autopsy performance. The fact that the patient was old and seemed to die of senescence or other ill-defined natural causes (5) may also serve as a deterrent to requesting permission for autopsy, as does the lack of an established method of payment or reimbursement for autopsy services related to nursing home patients.

In the case presented herein, an autopsy was performed because the medical examiner was notified and death involved an injury. In many cases, however, death may clearly have resulted from natural disease processes, and even if reported to the medical examiner or coroner, the death may not be investigated. Whenever injury (such as falls, fractures, burns, etc.), abuse, or foul play are suspected, or the death seems sudden, unexpected, and not explained with reasonable certainty, medical examiners or coroners should be notified and they will usually accept the case for investigation. In cases that do not involve medical examiners or coroners, those caring for the elderly are responsible for arranging for an autopsy with the legal next of kin. Gerontologists and nursing home physicians need to recognize that performing an autopsy may be valuable in selected cases, and it may be useful to pursue planned arrangements for the provision of pathology and autopsy services when they are indicated.

This case also points out that patients may die of medical procedures and therapies. Such cases need to be fully evaluated and pose special needs when completing the death certificate, including the reporting of the complication in the cause-of-death statement (1).

NOTE: Volume 158, April 13, 1998. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists. We thank Norman W. Staehling, M.S., and Steven S. Yoon, Sc.D., M.P.H., of the Centers for Disease Control and Prevention, Atlanta, GA, for their assistance in accessing and tabulating the nursing home autopsy data.

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Protecting Those at Risk

A 59-year-old woman presented with a 13.5kg weight loss, malaise, and chronic cough of 2 months' duration. The results of a chest x-ray examination suggested a cavitary lesion of the left upper lobe, and based on empirical evidence, she was given antituberculous medications. Sputum cultures had not yet been obtained when, 2 days after admission, she was found dead on the floor in the bathroom of her hospital room with copious amounts of blood emanating from the nose and mouth. A family member with human immunodeficiency virus infection had been living in her home, but the deceased patient had no serologic or clinical evidence of human immunodeficiency virus infection. Six months earlier, she had been admitted for respiratory symptoms and was diagnosed as having bacterial pneumonia in the left upper lobe, which was treated with antibiotics during a short hospital stay.

Autopsy Findings

The results of an autopsy showed excessive involvement of the left upper lobe of the lung with tuberculosis, including an apical lesion (Simon foci) that infiltrated into the chest wall and eroded into pulmonary arteries and bronchi causing massive hemorrhage into the pulmonary airways.

Based on the autopsy findings, a cause-of-death statement could be written as follows:

Part 1.
A. **Pulmonary hemorrhage**

Due to or as a consequence of:
B. **Broncial-pulmonary artery fistula**

Due to or as a consequence of:
C. **Pulmonary tuberculosis**

Part 2. Other significant conditions:

Comment

In the institution where this death occurred, a considerable number of patients with human immunodeficiency virus, mycobacterial, and opportunistic infections are treated. Of concern is a trend toward tuberculosis infection among patients who are not known to be immunocompromised. An autopsy may be necessary to establish such diagnoses when a patient dies before a definitive diagnosis can be made clinically.

The emergence and re-emergence of fatal infectious diseases and unexplained deaths due to possibly infectious causes should cause a resurgence in the use of the autopsy as a diagnostic procedure (1–3). Although the usefulness of postmortem cultures is sometimes limited because of postmortem growth of bacterial contaminants or antibiotic treatment during life (which may result in cultures negative for infectious agents), new methods, such as DNA-based tests and immunohistochemical studies, will facilitate and improve the identification of infection causing agents in postmortem specimens. However, cultures will still be required to identify many infectious agents and test for drug sensitivities, when indicated, to fully evaluate the nature of an important infectious agent. Although universal precautions dictate that all cases be regarded and managed as potentially infectious, it is helpful for the clinician to provide information in advance to the pathologist who will perform the autopsy on likely or known infectious conditions and the specific nature of the conditions.

Following the demonstration of Mycobacterium tuberculosis infection in the results of the autopsy in this case, the hospital infection control department was notified of the findings so that appropriate followup could occur with the county health department, as required, potentially exposed physicians, hospital staff, and family members. The autopsy enabled a definitive diagnosis that was suspected but not confirmed clinically because death occurred before sputum analysis was performed, emphasizing the potential value of promptly identifying patients who harbor M tuberculosis infection. The autopsy findings were forwarded to the department of medicine for mortality and management review processes in light of the patient's earlier admission with pneumonia of the left upper lobe.

NOTE: Volume 158, March 9, 1998. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; Larry Nichols, M.D., University of Pittsburgh Medical Center, Pittsburgh, PA; and the Autopsy Committee of the College of American Pathologists.

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Partial, Limited, or Restricted Autopsies

A 17-year-old girl had a 7-year history of neurologic decline that appeared to be related to a familial degenerative neurologic disorder. She developed chronic malnutrition, decubitus ulcers, marasmus, and repeated episodes of aspiration pneumonia. Her status was placed on do not resuscitate, and she died with a clinical picture of acute respiration distress syndrome.

Autopsy Findings

The extent of the autopsy was restricted by the family to removal and examination of the brain and spinal cord. The permit also restricted making incisions into the back or torso. The findings of an extensive neuropathologic workup of the brain were most compatible with a familial olivopontocerebellar atrophy.

Based on these findings, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Familial olivopontocerebellar atrophy**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:

Comment

Although the spinal cord may be removed during an autopsy through the foramen magnum using a special tool, the removal may be difficult without causing considerable artifactual damage. Removal of the spinal cord from a posterior or anterior approach was not possible because a request by the next of kin to avoid incision into the back was specifically stated on the autopsy permit and permission for opening the chest and abdomen, which could have enabled anterior removal of the spinal cord was also not obtained. Thus, examination of the spinal cord was complicated in this case.

Limited (restricted or partial) autopsies are appropriate in some cases, such as cases that necessitate identifying the nature of a lesion lacking definitive diagnosis before death when other aspects of the clinical course and death are well explained or cases when the next of kin will give permission for a limited autopsy but not a complete one. Effort should be made in cases of a limited autopsy to ensure that all parties realize that information derived from a limited autopsy will also be limited. ''Partial autopsies, partial answers'' is the phrase sometimes quoted to make the point (1). When arranging for an autopsy, it may be appropriate for the clinician or family member who is requesting the autopsy to discuss with the pathologist whether the autopsy can address specific issues that have arisen and, if a limited autopsy is being considered, to what extent the ability to address relevant issues in the case might be limited (2). Regardless of its limited nature, the autopsy in this case did provide information that could be used to further define the pathologic basis of the familial nervous system atrophy that affected this patient and others in her family. However, because the lack of a complete autopsy precluded identification of a specific immediate cause-of-death (such as pneumonia, pulmonary embolism, diffuse alveolar damage, metabolic derangement, or other plausible cause), the cause-of-death statement was prepared using the single line, Part 1 format shown herein (i.e., only the underlying cause-of-death is stated). The evaluation of visceral and other nervous system changes was also precluded.

NOTE: Volume 157, December 8/22, 1997.
Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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A Tale of the Unexpected: Finding a Zebra

A 56-year-old woman was admitted for nausea and projectile vomiting of several days' duration. A review of her medical history failed to provide significant information, and the physical examination showed only marked obesity. During the course of the patient's workup, a computed tomographic scan of her head indicated ring-enhancing lesions in the frontal and parietal lobes of the brain, each 2.5 cm in greatest dimension and reported as being consistent with metastases. The patient was transferred to the neurosurgical service, where she suddenly died. An autopsy was requested by the physician with the goal of determining the primary site of the patient's presumed carcinoma.

Autopsy Findings

Postmortem fine-needle aspiration biopsy of the cerebral lesions showed only neutrophils and necrotic debris. Cerebral herniation was evident. Subsequent histological study indicated that the lesions were abscesses, not metastases. An assiduous postmortem search for a source of infection revealed suppurative gingivitis and no other source of infection.

Based on these findings, the cause-of-death statement was prepared as follows:

Part 1.
A. **Cerebral herniation**

Due to or as a consequence of:
B. **Intracerebral abscesses**

Due to or as a consequence of:
C. **Bacteremia**

Due to or as a consequence of:
D. **Suppurative gingivitis**

Part 2. Other significant conditions:

Comment

Although the clinical and imaging studies in this case clearly were consistent with a carcinoma, the autopsy proved that an infectious, rather than neoplastic, process was responsible for the patient's death.

Performance of this autopsy was valuable for several reasons. First, although sophisticated imaging technology is available and continually improving in quality, an autopsy often indicates clinically unsuspected or unobserved findings or clarifies the nature of lesions known to exist clinically. Second, the class of disease causing death was different from that clinically suspected, and the death certificate could be accurately completed. Third, information useful to the medicine and neurosurgery departments and hospital quality improvement offices was generated.

The autopsy findings were immediately reported to the medicine and neurosurgery departments at an afternoon postmortem conference and more formally presented at respective morbidity/mortality conferences the following month. At those conferences, the fact was reiterated that 10 to 41 percent of autopsies reveal previously unsuspected diagnoses (1).

NOTE: Volume 157, November 10, 1997. Gregory J. Davis, M.D., University of Kentucky College of Medicine, Frankfort; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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An Intoxicating Case: The Importance of Toxicology

A 60-year-old man had a history of hypertensive heart disease with congestive heart failure, chronic alcohol abuse, prior pontine lacunar infarcts, and remote head trauma from an auto accident that occurred 30 years before. He complained of decreased urine output and suprapubic tenderness and was admitted with a diagnosis of prostatism and possible pyelonephritis. About 24 hours following admission, he experienced a cardiac rhythm disturbance and a seizure and then died. Concern was expressed by the survivors that there had been some mistake on the part of the hospital staff or physicians since his death was perceived to be sudden. The medical examiner was notified but declined to investigate because of the patient's significant medical history. The permission to perform an autopsy was obtained from the legal next of kin.

Autopsy Findings

Autopsy findings included prostatic hyperplasia with chronic prostatitis, hepatic steatosis with early cirrhosis, a 570 g heart with concentric left ventricular hypertrophy and dilatation, and old pontine lacunar infarcts with no demonstrable acute central nervous system findings. Pyelonephritis was not present. The postmortem blood alcohol level was 24 mmol/L (112 mg/dL), and the postmortem vitreous humor alcohol concentration was 1 mmol/L (30 mg/dL).

Comment

The postmortem alcohol studies indicated that the patient consumed alcohol at the hospital (1). Alcohol had not been prescribed, and it was presumably provided by a visitor. Findings from an examination of the liver at autopsy were consistent with long-term alcohol use. There was no history of posttraumatic or other seizure disorder. Acute intoxication from alcohol consumption can lead to cardiac rhythm disturbance (and seizures), and the timing of death in regard to alcohol consumption suggested that alcohol consumption may have played some role in this death. Furthermore, long-term alcohol use is associated with hypertension and unexplained dysrhythmias. A seizure due to alcohol withdrawal was viewed as extremely unlikely because of the blood alcohol concentration, which was probably rising based on the blood vitreous humor alcohol ratio (1).

Although the autopsy did not clearly identify a cause-of-death, many conditions were ruled out, and the findings confirmed the clinical diagnoses except for pyelonephritis, which was included in the clinical differential diagnoses.

The discovery that the patient had consumed alcohol shortly before the fatal events provided information that could be used to address some legal claims that might arise. The tests for alcohol could not have been performed legally in the jurisdiction of the hospital without permission to conduct a postmortem examination since invasive procedures were required to obtain the specimens. As illustrated by this case, toxicologic tests may play an important role in evaluating hospital deaths. When deaths occur suddenly or unexpectedly in the hospital, it is prudent (or perhaps legally required) to report the death to the local medical examiner or coroner. Although the medical examiner declined to investigate this case, the hospital fulfilled its legal obligation to report the death.

Based on all the available information, the most likely explanation for death was that the patient's

underlying hypertensive heart disease caused a cardiac rhythm disturbance with agonal seizure disorder, probably influenced to some degree by alcohol consumption. Thus, a cause-of-death statement could be prepared as follows:

Part 1.
A. **Hypertensive heart disease**

Due to or as a consequence of:
B.

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Acute alcohol intoxication, long-term alcohol (ethanol) use, agonal seizure

NOTE: Volume 157, September 7, 1997. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Multiple Benefits from an Autopsy

A 47-year-old white man, diagnosed as having human immunodeficiency virus (HIV) in 1989, was admitted in 1996 for nausea and vomiting of 4 days' duration. He had several previous episodes of pneumonia and cutaneous Kaposi lesions. During hospitalization, he became confused. A lumbar puncture was performed: following the procedure, the headache and confusion worsened with development of hypotension.

The patient died 8 hours following the lumbar puncture. The patient's medical history included an appendectomy 30 years previously and a hiatal hernia repair in 1994. An autopsy was requested by the physician, with the major goal of assessing the possibility of opportunistic meningitis or brain herniation following lumbar puncture.

Autopsy Findings

The major autopsy findings included multiple abdominal adhesions resulting in small bowel obstruction, perforation, and peritonitis; bacterial bronchopneumonia; and no evidence of meningitis, brain herniation, or HIV encephalopathy.

Based on these findings, a cause-of-death statement was prepared as follows:

Part 1.
A. **Perforation of jejunum with peritonitis**

Due to or as a consequence of:
B. **Obstruction of jejunum**

Due to or as a consequence of:
C. **Postoperative intra-abdominal adhesions**

Due to or as a consequence of:
D. **Delayed complications of appendicitis**

Part 2. Other significant conditions:
Human immunodeficiency virus infection, bacterial pneumonia

Comment

The pathologist thought that the location of adhesions corresponded to the appendectomy procedure rather than the hiatal hernia repair. Pneumonia and HIV infection were listed as other significant conditions because pneumonia was thought to have contributed to death and HIV infection may have increased susceptibility to peritonitis and/or pneumonia, but these conditions did not result in the underlying cause-of-death reported in Part 1 (1).

Performance of this autopsy was valuable because it enabled accurate completion of the death certificate; alleviated clinical concern about possible brain herniation; explained the patient's nausea and vomiting; and provided information that should be useful in the medical department and hospital quality improvement programs.

A copy of the autopsy report was forwarded to the medical department and hospital quality improvement offices because in the institution where this death occurred deaths resulting from unexpected findings or complications of medical procedures are subject to quality assessment review, even if management seems appropriate. Such a program helps meet the requirement of the Joint Commission on Accreditation of Healthcare Organizations (2) that institutions have a policy stating how autopsy findings are used to improve care in the institution.

NOTE: Volume 157, August 11/25, 1997. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Clarifying an Untoward Outcome

A 20-year-old man who was a college baseball player in excellent health complained of back pain and malaise. His symptoms became progressively worse despite being prescribed several medications. Nausea, bloody diarrhea, submandibular lymphadenopathy, hemoptysis, blurred vision, and dizziness developed. On presentation to an emergency department, the results of laboratory studies showed marked leukocytosis and disseminated intravascular coagulation. The patient was transferred to a university hospital, where the possibility of an unusual viral illness was considered. He appeared stable on admission to the hospital but suddenly became unresponsive and apneic 4 hours later. A cardiac monitor indicated electromechanical dissociation, and the advanced cardiac life support protocol was unsuccessful. An autopsy was requested by the physician primarily to identify the etiologic agent of the presumed fatal viral illness.

Autopsy Findings

Major autopsy findings included severe hypersensitivity myocarditis, acute respiratory disease syndrome, interstitial nephritis, and centrilobular hepatic necrosis. All the organs examined showed marked eosinophilia and features of disseminated intravascular coagulation. Bacterial and viral cultures and the results of serologic tests and a drug abuse shown were negative. A review of the drug use history indicated that the patient had been taking several medications including cephalexin, trimethoprimsulfamethoxazole, phenylbutazone, and an unknown antihistamine, for approximately 2 months.

Based on these findings, the cause-of-death statement was prepared as follows:

Part 1.
A. **Hypersensitivity myocarditis**

Due to or as a consequence of:
B. **Drug-related hypersensitivity—specific drug unknown**

Due to or as a consequence of:
C.

Part 2. Other significant conditions:
Disseminated intravascular coagulation

Comment

The autopsy findings not only confirmed the clinical diagnosis of disseminated intravascular coagulation, but also indicated the clinically unsuspected origin of disseminated intravascular coagulation, a severe drug hypersensitivity reaction. Several of the drugs the patient took have been implicated in such hypersensitivity drug reaction so it is impossible to determine which drug or combination of drugs was responsible. The cardiac findings were typical of hypersensitivity myocarditis, a condition associated with a variety of drugs. Hypersensitivity myocarditis is rarely recognized clinically and is often first discovered in the results of a postmortem examination. Most patients with this condition do not appear critically ill but may die suddenly, presumably because of an arrhythmia (1,2). The autopsy in this case was useful for important reasons. First, it provided an explanation of the cause-of-death to the family, eliminating to some extent the attendant frustration and bewilderment in such a death. Second, it dispelled the fear of an exotic, fatal contagious disease within the community in this well-publicized case. Third, information was disclosed that is appropriate for reporting to the Food and Drug Administration's MedWatch Reporting System for adverse drug reactions and problems with medical devices and for review by the patient's physicians. The case also illustrates how commonly prescribed drugs can be associated with fatal adverse reactions that need be considered and explained when prescribing medications.

NOTE: Volume 157, October 13, 1997. Eun Young Lee, M.D., Michael L. Cibull, M.D., University of Kentucky College of Medicine, Lexington; Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists.

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Wrapping Things Up

Introduction

This is the 30th and final installment in the Autopsy and Medicine Case of the Month series, which has been published in Archives since the first Case Report of August 1997. The Autopsy Committee of the College of American Pathologists is grateful to Archives Editor James Dalen for providing the opportunity to re-emphasize the value of the autopsy to the practice of medicine and society.

In his editorial titled ''The Moribund Autopsy: DNR or CPR?'' (August 1997), Editor Dalen introduced the series and correctly pointed out the moribund condition of autopsy utilization in the United States in virtually all spheres but the medicolegal (forensic) one (1). He advocated CPR for the autopsy rather than letting the last several decades of declining autopsy rates and utilization relegate the autopsy to DNR status. We agree with his recommendation and we hope that the series has convinced others to think and act similarly.

Over the past 3 years, numerous values and contributions of the autopsy have been emphasized in the series using a Case Report presentation. The cases presented are only a small sample

of those encountered in everyday practice in which the autopsy provides a benefit to the practice of medical science and society. We cannot touch on every point made, but in this article, we present a capsule summary of the major issues addressed in the series.

Case Report Summary

The various case reports in the Autopsy and Medicine Series emphasized the following information about the autopsy and/or the value and contributions made by the autopsy:

1. improvement in the accuracy and completeness of the cause-of-death as reported on the death certificate; alleviation of concern about possible untoward outcomes that could have adversely impacted upon the institution or physician in terms of potential liability; elucidation of findings that more precisely explain the patient's symptoms and signs; and the value of autopsy findings for required and voluntary hospital quality improvement programs (2);
2. detection of undesirable, unacceptable, or contraindicated patient behavior (such as drinking nonprescribed alcoholic beverages in the hospital) which may have contributed to death, and, if undetected, might allow erroneous conclusions or unfounded allegations (3);
3. detection of drug hypersensitivity reaction causing fatal myocarditis that provided information for reporting to the FDA and allayed clinical and public concern about a possible fatal exotic infectious process in the community (4);
4. clarification that cerebral ring-enhancing lesions observed on CT were abscesses rather than metastases as suspected and that the cause-of-death was suppurative gingivitis that had not been recognized clinically (5);
5. recognition that ''limited autopsy'' may sometimes be needed and appropriate but that the information obtained is also limited (6);
6. explanation that lymphangiosis carcinomatosa of lungs and pleural existed rather than pulmonary thromboemboli, thus explaining to clinicians and survivors the patient's lack of clinical response to anticoagulant thrombolytic therapy (7);
7. provision of suggested wording for use by physicians who request permission for autopsy from the legal next-of-kin (8);
8. detection of previously undiagnosed tuberculosis in a hospitalized patient who died suddenly from a bronchial-pulmonary fistula, with discussion of the use of the autopsy for diagnosing emerging infectious diseases and infectious disease of concern to institutions (9);
9. provision of information about the cause and circumstances of death when death possibly results from medical devices that malfunction or which are not used appropriately (10);
10. discussion of the ''private autopsy'' in which a pathologist, for an agreed-upon fee, may perform an autopsy for a third party (such as the family) outside of the usual institutional setting for hospital deaths or medicolegal (forensic) cases (11);
11. listing of possible reasons for the decline in institutional autopsy rates over the past several decades in the United States (12);
12. recognition that the autopsy may be ''negative'' (i.e., not demonstrate specific findings) and not necessarily answer questions that have arisen, or identify a specific cause-of-death (13);
13. recognition that the autopsy provides reports, tissues, and other specimens that may be re-examined at a later time if legal or other controversial issues arise; that such information helps avert the need for speculation; and that some findings and their significance can be interpreted in more than a singular way (14);
14. discussion of the use of autopsy findings to amend (correct) a death certificate that was incomplete or originally in error (15);
15. recognition that autopsy findings can be used to allay concern among medical professionals and the public when a death presents as one that could have public health ramifications (such as meningococcemia), but is proven to be of other causes that are of little or no concern (16);
16. illustration of how the autopsy allows excellent clinico-pathologic correlation when the clinical course is atypical or involves unusual causes (17);
17. discussion of autopsy utilization for not-so-obvious procedures such as providing control tissue for special histologic stains, or to obtain genetic material from neoplasms, for example (18);
18. discussion of the use of the autopsy to investigate deaths that involve implanted medical devices such as pacemakers (19);
19. recognition that the autopsy may be used to distinguish whether death resulted from an unavoidable outcome (20);
20. recognition that the autopsy is not only a valuable teaching tool for clinicians, but is also needed as an educational and training tool for pathologists who are training in a pathology residency program (21);
21. presentation of answers to numerous commonly asked questions about the autopsy, which may be helpful to clinicians who are often asked such questions by family members (22)
22. discussion of the use of the autopsy for outcome analysis and quality assessment of therapeutic interventions (23);
23. recognition of the value of the autopsy in detecting findings incidental to the cause-of-death, and findings that may better explain to the family the patient's clinical course or lack of detection of serious disease by routine diagnostic tests (24);
24. discussion and historical review of the use of the autopsy, including considerations that deal with inadequate financial support from

health care payment agencies (25);
25. recognition of the value of the autopsy in evaluating transplant donors and in evaluating complications of radiation treatment for neoplasms (26);
26. discussion of how the autopsy may disclose previously undiagnosed conditions that may have impact on survivors, such as breast cancer that may have a familial occurrence (27);
27. discussion of the value of the autopsy in evaluating suspected or alleged elder abuse and neglect, which serves to protect patients, institutions, and health care workers (28);
28. discussion of the use of the autopsy in bringing about clinical recognition of limitations, idiosyncrasies, or possible interpretive errors when new technologies are implemented (29); and
29. discussion of autopsy utilization to help determine the relative roles of the underlying disease and/or its treatment in causing or contributing to death (30).

Comments

The autopsy has been used in North America for nearly 400 years. Although disease patterns have changed and new technologies have emerged during that time, human anatomy, cellular, and subcellular structure and function have not changed much to our knowledge. Although our understanding of these things continues to deepen, there is still much to learn from the scientific standpoint. On the practical side, there are often relatively simple questions that arise when death occurs which the autopsy may easily and reliably answer. Thus, from both the scientific and practical viewpoints, the autopsy remains a useful tool to ''see things for one's self.''

Many medical technologies (diagnostic and therapeutic devices and methods) have come and gone completely, yet the autopsy persists. Its withstanding of the test of time—albeit on occasional shaky ground—is testimony to its place as an essential component of the practice of medicine. Take, for instance, the recent growth in the clinical use of laparoscopic procedures, which are not always without untoward complication. Information has been obtained from autopsy that has prompted rethinking about the safe uses of laparoscopic surgery. Thus, an old procedure (the autopsy) remains valuable to evaluate newer ones.

Recent reports of large numbers of in-hospital deaths due to complications of diagnostic and therapeutic procedures provide good reason to perform more autopsies if for no reason other than to enable the collection and documentation of objective postmortem findings to refute or support claims that arise. Who knows, we could find out that many such deaths are being incorrectly attributed to medical procedures and treatments. Of course, we could find out otherwise. Regardless, there would be some objective information available beyond that which would exist if an autopsy were not performed.

Even if technologies were to emerge (let's call it an ''autopsy machine'') which could replace part or all of the autopsy procedure, such as scans or other imaging procedures, robotic procedures, or less invasive methods such as fiber-optic scope procedures, classical autopsies will still need to be performed as the standard to which these emerging methods are compared, and in cases where the newer technologies may have limitations. Certain lesions or objects will still need to be physically removed for analysis. And, in the foreseeable future, an autopsy performed by a pathologist will probably remain more reliable and cost/time effective than automated or hands-off procedures.

It's easy to advocate the use of the autopsy. But what specific things can be done to revitalize its use? We have a few suggestions.

To be sure, not all pathologists wish to perform autopsies, and that fact is undoubtedly part of the reason for the historical decline in autopsy utilization. In fact, an autopsy attitude adjustment is probably indicated within parts of the pathologist community. For institutions in which there is a need to perform autopsies, steps need to be taken to ensure that pathology departments include pathologists who are not only willing, but who take professional interest and pride in performing autopsies. Regionalized (or centralized, depending on how one looks at it) autopsy centers, established through partnerships or consortia, may be one workable option.

Clinicians, through their informing of families about the autopsy and requesting permission to perform one, play a key role in the use of the autopsy to investigate deaths which occur in medical institutions. We believe that families should always be offered the opportunity for an autopsy when death occurs in the hospital and that one should be performed if the family requests or consents to it, even if the physician or medical staff has minimal or no interest in the case. This may even include autopsies on patients who die outside the hospital but who have an ongoing medical record in the institution.

Part of medical practice is to help prepare families and patients for death. It seems reasonable to recommend that physicians discuss the role of the autopsy with patients and their families, and to encourage family members to discuss, prior to death, the patient's wishes regarding autopsy. Remember, family consent is usually needed to perform an autopsy after the death of a hospitalized patient. If the family does not know the patient's wishes, their decision is made more difficult. Many patients desire that their death bring about some good. That's why many are willing to donate their bodies for study or to donate organs and tissue for research or transplantation. The autopsy is another way for a patient or family to contribute to medicine and society, or to provide information that may be helpful to the family or other survivors.

Agencies and organizations who pay for health care need to shift their thought process from one which only recognizes treatment of living patients toward one which recognizes that the autopsy can contribute to the overall quality of medical practice. The autopsy could provide information that might be

used to rethink certain treatments or procedures to modify their use, redefine the indications for certain procedures, or even evaluate payment strategies for clinical procedures. These agencies would be wise to come up with a cohesive plan to ensure that pathology departments and pathologists are adequately funded and staffed to perform an appropriate number of autopsies based on the number and types of deaths at a particular institution, or in a particular region.

Summary

Having not changed in recent history, the human body continues to lend itself well to the autopsy procedure and the documentation and interpretation of postmortem morphologic, cellular, and chemical changes. The use of autopsy findings in conjunction with other scientific methods and investigative techniques remains as valuable today as it was centuries ago, both in daily practice and for scientific endeavor. Although the rate of our learning through the autopsy may have slowed, the quality of information obtained remains high. The values and uses of the autopsy are limited mainly by our lack of imagination or our passive or active unwillingness to find facts in pursuit of scientific truth.

CPR or DNR for the autopsy? DNR status is reserved for those situations in which hope has been lost and the chance for meaningful survival seems over. The autopsy meets neither criterion. CPR, therefore, seems indicated. Successful CPR for the autopsy will require the effort of pathologists, clinicians, institutions, and payers. It is our ethical, scientific, and medical obligation to revive the autopsy to an appropriate level of utilization. Let the CPR begin! Breathing life into the autopsy will also revitalize the practice of medicine.

NOTE: Volume 160, November 13, 2000. Randy Hanzlick, M.D., Emory University School of Medicine, Atlanta, GA; and the Autopsy Committee of the College of American Pathologists, Northfield, IL.

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