

Part VI

Forensic Science and Medicine

Chapter 64

Forensic Pathology

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Forensic pathology is a unique and fascinating medical specialty. The training to become a forensic pathologist, as with any medical specialty, is highly specific and comprehensive, including 1 year of formal instruction in medicolegal investigation after completion of 4 years of residency training in anatomical and clinical pathology. Although scientifically specialized, the actual practice of forensic pathology cuts across a wide spectrum of everyday life, from the investigation of sudden, violent, unexplained, and medically unattended deaths (the basic jurisdiction of the forensic pathologist) to sex crimes, paternity lawsuits, child abuse, drug abuse, and a variety of public health problems. The range and diversity of such a practice provide constant intellectual stimulation and challenge.

AUTOPSIES

Autopsies should be performed for many reasons, including a variety of benefits to the family of the deceased (e.g., identifying familial disorders, assisting in genetic counseling), information for insurance and other death benefits, and indirect help to assuage grief. Benefits to the public welfare include discovering contagious diseases and environmental hazards, providing a source of organs and tissues for transplantation and scientific research, and furnishing essential data for quality control and risk assessment programs in hospitals and other health care facilities. Autopsies benefit the overall field of medicine through the teaching of medical students and residents, the discovery and elucidation of new diseases (e.g., legionnaires' disease, acquired immunodeficiency syndrome [AIDS]), and the ongoing education of surgeons and other physicians regarding the efficacy of particular operations and medications. Additional benefits to the legal and judicial systems include determining when an unnatural death (accident,

suicide, or homicide) has occurred and enabling trial attorneys and judges to make valid decisions pertaining to the disposition of civil and criminal cases.

In light of the significant medical contributions and substantial scientific data that have been derived directly and indirectly from postmortem examinations over the past three centuries, it is unfortunate that in the United States the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), in 1970, dropped its long-standing requirement that hospitals perform autopsies in a certain percentage of patient deaths (teaching hospitals, 25%; other, 20%) to maintain JCAHO certification. Moreover, this is disturbing considering the increasing number of wrongful death cases involving medical malpractice and other personal injury and product liability claims, as well as the thousands of homicides, suicides, and drug-related deaths occurring each year, all of which require definitive and complete autopsy findings

Areas of Concern

A surprisingly high percentage of clinicians, hospital administrators, and even pathologists have expressed a general reticence toward any new, concerted effort to increase the number of hospital autopsies performed. The reasons usually given are economic, educational, and legal. Hospital executives and other nonmedical administrative personnel are constantly seeking ways to cut costs, and postmortem examinations cost money. Pathologists are busy with their other responsibilities and are not paid extra for performing autopsies. Attending physicians and house staff rarely attend autopsies and usually do not even seek information later concerning the autopsy results.

Attending physicians and hospital administrators are concerned that autopsies may reveal evidence of malpractice

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and may provide additional data for plaintiffs' attorneys in medical malpractice lawsuits. Their reasoning is that in the absence of pathological evidence, the plaintiff will have a difficult or even impossible task of proving that the death was directly and causally related to any alleged errors of omission or commission in the diagnosis and treatment of the patient (i.e., that there was any deviation from acceptable and expected standards of care on the part of the attending physicians or nurses that led to the patient's demise). In most cases, however, forensic pathologists actually find that autopsy results help to demonstrate that no medical negligence occurred in the patient's treatment.

The idea that new technology and improved diagnostic skills have made autopsies obsolete is incorrect and naïve at best and intellectually arrogant and scientifically dangerous at worst. Although certain death cases are so well understood and unequivocally documented that it is not necessary to perform an autopsy, many clinical questions still need to be asked and answered in a majority of deaths. Regardless of the treating physician's degree of competency and experience, and despite highly sophisticated equipment such as computed tomography (CT) scans and magnetic resonance imaging (MRI), no substitute exists for examining organs and tissues at autopsy in the documentation of definitive diagnoses.

FORENSIC PATHOLOGY VERSUS HOSPITAL PATHOLOGY

Hospital pathology and forensic pathology, although sharing many training and scientific procedural factors, are significantly different in their approach to death investigation. Hospital pathologists are charged with ascertaining pathological findings and correlating them with the existing clinical data; in other words, they find morphological changes to explain particular clinical signs and symptoms. A hospital autopsy therefore seeks to verify the diagnosis made before death and evaluate the treatment rendered pursuant to that diagnosis. The purposes of this exercise are to increase the storehouse of medical knowledge and to provide a certain degree of quality control. Philosophically, therefore, hospital pathologists tend to approach their examinations with verification and academic discovery as their objectives. This predisposition can lead the hospital pathologist to overlook subtleties that contraindicate clinical background, diagnosis, and treatment rendered.

Forensic pathology, on the other hand, approaches a death in an entirely different manner. Frequently the clinical history of the deceased does not exist or is not available so that, even if forensic pathologists were intellectually disposed to match their findings with clinical observations, diagnosis, or treatment, it often would be impossible to do so. More importantly, hospital and forensic pathology are distinguished by their jurisdictional spheres. Forensic pathology goes beyond the hospital setting and investigates any sudden, unexpected, unexplained, violent, suspicious, or medically unattended death. The term *investigation* distinguishes these two disciplines

because hospital pathologists usually limit themselves to an autopsy and review of available clinical data. Forensic pathologists, however, engage in an investigation that routinely addresses the following:

1. Who is the deceased? This information, particularly in a criminal situation, is often unknown. Factors such as gender, race, age, and unique characteristics are evaluated.
2. Where did the injuries and ensuing death occur?
3. When did the death and injuries occur?
4. What injuries are present (type, distribution, pattern, cause, and direction)?
5. Which injuries are significant (major versus minor injuries, true versus artifactual or postmortem injuries)?
6. Why and how were the injuries produced? What were the mechanisms causing the injuries and the actual manner of causation?
7. What actually caused the death?

The scope of such a medicolegal investigation is necessarily broad and comprehensive. The information generated may determine whether a person is charged with a crime, is sued civilly for negligence, or receives insurance benefits. The information also may determine other critical issues. These applications depend on a general determination in addition to the cause of death that is alien to hospital pathology, namely, the manner of death.

The term *alien* is used because manner of death is a legal question that only forensic pathologists, armed with the results of their medicolegal investigation, are prepared to address. Hospital pathologists have little opportunity to develop a fair understanding, satisfactory appraisal, and high index of awareness of the medical, philosophical, and legal problems related to the determination of the manner of death. For them, essentially every death is natural, and even medical negligence may go undetected or may be labeled as a natural complication of disease. Drafting and signing hospital death certificates is primarily the responsibility of the attending physician, which accentuates this trend. The hospital physician often is not inclined to include in the autopsy report a specific cause of death or the full causal chain of events, especially when a possible cause for litigation might be suggested or several causes of death may be present.

The manner of death differs from the cause of death. The cause of death refers to the mechanisms that ultimately result in demise. Manner of death refers to a mechanism of death that was natural or unnatural (suicidal, accidental, or homicidal). This legal conclusion by a forensic pathologist is derived from an integration and analysis of the medicolegal investigation, including the history, the autopsy findings, and the cause of death. It can be a complicated and difficult conclusion to reach because natural and unnatural factors often intermingle and combine to cloud the ultimate cause and thus the manner of death.

Also, hospital pathologists usually are not concerned with the determination of the time of death and the timing of the tissue injuries. For forensic pathologists, however, time of death and time of injuries are crucial to many civil and criminal cases and must be specifically addressed.

Forensic pathologists also focus on the crime scene and the circumstances of death in the scientific reconstruction and understanding of the autopsy findings. Unlike hospital pathologists, forensic pathologists frequently visit the scene to determine possible inconsistencies with their scientific findings.

The approach to the forensic autopsy is also different. Forensic pathologists, who are frequently exposed to the pathology of trauma, recognize the importance of a careful external examination, including the clothing, to determine the pattern of injuries and their relationship to the identification of the injurious agent. Hospital pathologists, because their subjects usually die in the hospital, generally have no need to be concerned about these factors and are satisfied with a cursory and superficial external examination. Hospital pathologists, however, are more inclined to detect and diagnose microscopic changes of rare natural diseases because of the direction of their work and the academic environment in which they function. Forensic pathologists are more familiar with subtle microscopic changes caused by poisons, noxious substances, and environmental diseases, that is, with the microscopic profile of unnatural death.

Gunshot Wounds

Investigations of deaths caused by gunshot wounds are used here to illustrate some of the nontraditional means, processes, and findings employed to determine the probable manner of death. Although quite specific, the techniques discussed offer insight into the scope of any comprehensive medicolegal investigation.

Firearms account for a large proportion of unnatural deaths in the United States, most notably in homicides, but in suicides and accidents as well. Questions in such cases include the following:

1. How is the wound size or pattern related to range, direction of fire, and type of bullet?
2. Can the range of the shooting be estimated from the characteristics of the gunshot wound?
3. Can the relative positions of the victim and the source of fire be determined from the pattern and path of the wounds?
4. When several wounds are present, which was inflicted first?

Gunshot wounds are inflicted by rifled firearms, including revolvers, pistols, and rifles, that have the inside of the barrel grooved spirally to give a screwing, stabilizing motion to the ejected bullet. The pattern of the gunshot wound is produced on the target area by the elements ejected from the gun's barrel. Besides the bullet, these elements are other components of various weights and velocities, all falling behind the bullet and dissipating in the air with the increase in range. The elements ejected are the bullet, gases of combustion, primer components, soot, and burned and unburned powder.

Once inside the body, the bullet's path throughout the tissues is obviously indicative of the direction of fire. In perforation-type wounds (those entering and leaving the body), however, this determination may be more difficult

and often requires correct identification of the entrance and exit wounds.

Entrance wounds on the clothing often leave soot and gunpowder residue and can be identified by visual inspection or by special techniques, such as infrared photography or microscopic examination. On the skin, entrance wounds usually can be recognized by their round or oval shape, with contused or abraded margins or with a stellate-shaped configuration if they are overlying bone. The shape of the abrasion or contusion rim should be carefully noted. This rim indicates the area where the bullet brushed against the skin and may be helpful in determining the direction of fire. A circular rim of equal width indicates a blast directed perpendicular to the skin surface, whereas in any other situation the rim is wider in the area facing the incoming direction of the bullet.

Exit wounds tend to be more atypical, irregular, or slit-shaped, mimicking a stab wound or blunt trauma tears. Gunshot wounds of exit usually lack external bordering bruises because the bullet emerges from the inside. Interestingly, however, if the bullet exiting the body encounters a material tightly attached or compressed against the skin, such as a belt, the exit wound may show bruising.

The identification of the wound of entrance, the track, and the wound of exit are critical in determining the manner of death. Simply knowing the range of fire is often insufficient to rule out one or another manner of death. The direction of fire, however, can be most helpful, especially in potential suicide and self-inflicted accident situations. Angles and entry wounds that would be most difficult to attain by oneself can eliminate these possibilities and direct the pathologist's investigation toward homicide or accidental infliction by another.

RAPE

Forensic pathologists often deal with victims of violent crimes and are called on to assist the state in investigating and prosecuting such cases. Comprehension of the legal requirements for a successful prosecution makes the forensic pathologist a uniquely qualified medical expert, and a medical expert is often essential to the identification and successful prosecution of a rape case.

In the most basic medicolegal terms, rape is the penetration of a woman's genitalia by the penis of a man without the woman's consent. Ejaculation is not a necessary component, and neither is force. Rape is difficult to prosecute because it pivots on the woman's consent, and usually only the victim and the assailant are present during the commission of the crime; thus the only witness as to consent is the "prejudiced" woman herself. Thorough scientific examinations of the victim and the accused by a forensic pathologist, however, can generate substantive evidence for trial that can assist greatly in accurately determining whether a crime occurred.

Penetration

The condition of the hymen can provide evidence of penetration. Fresh injury to the hymen is usually evidenced by

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blood clots or hemorrhaging, but the inflammatory process that generally results from injury to other tissues is absent. Although hymenal injury may occur without penetration by way of masturbation or heterosexual sex play, fresh rupture and hemorrhaging of the hymen, especially when combined with testimony of rape, is probative evidence of rape.

The presence of seminal fluid in the woman's vagina is usually considered conclusive evidence that penetration has occurred. This finding neglects, however, the case in which ejaculation occurs while the man is in the mounting position, and the only penetration of the vagina is by the seminal fluid itself. On the other hand, the absence of ejaculatory material at the time of examination is not unusual even when the crime of rape has occurred. Interruption of the act after penetration but before ejaculation can occur, and the rapist is often incapable of achieving ejaculation. The woman's fear of impregnation and disease frequently results in rapid washing with strong antiseptic solutions after the act. These solutions may completely remove all seminal material or introduce factors that interfere with the detection of the constituents of seminal material.

Pathologists factor in all the evidence before reaching a conclusion of penile penetration. The emotionally charged circumstance of an allegation of rape and the resultant pressure to prosecute the rapist demand the utmost restraint and care in investigation by the pathologist to prevent a miscarriage of justice. Physiologically plausible and noncriminal explanations exist for each finding.

Consent

The next component of rape, which is much more difficult to prove, is whether the victim consented to the penetration. When the woman offered little or no resistance, the forensic pathologist is unable to offer much assistance because the investigation focuses on physical findings as opposed to mental intent. Rape, however, is usually accompanied by violence, and the evidence of violence tends to indicate that penile penetration was nonconsensual.

If force was used, there is usually evidence of this on the person or clothing of the victim. Lacerations may occur from fingernails or other objects, particularly on surface areas of the body where clothing was forcibly removed. Contusions may result from blows by fists or other objects about the face, neck, and forearms in particular. Contusions on the woman's throat caused by throttling attempts are also quite common. Bite marks on the breasts, neck, and face occur frequently, and areas on the woman's thighs may show contusions or lacerations caused by forcible spreading of the legs to achieve penile entry. Signs indicating that the woman actively resisted also may be present. The fingernails may be broken or bent from using them as defensive weapons, and debris, such as clothing fibers, hair, or skin fragments from the assailant, may be

present under the nails. Beard hairs and facial epithelium are most common, but any part of the assailant's body surface may be represented.

The absence of wounds may not indicate that consent was given, as when (1) the victim offers no resistance because of fear or resignation to being raped and (2) drugs are involved, e.g., gamma-hydroxybutyrate (GHB), the "date rape drug," a potent tranquilizer that causes central nervous system (CNS) depression, or flunitrazepam (Rohypnol), a benzodiazepine that can cause CNS depression, with the development of euphoria, hallucinations, and memory loss.

Investigative Process

The forensic pathologist can aid in the prosecution and investigation of a case of alleged rape in many specific ways, as shown in the following step-by-step review of the investigative process:

1. Examination of the scene. The position of the victim and the state of the victim's clothing at the scene should be carefully noted. Efforts should be made to prevent contamination of the anus or vagina.
2. Photographs of the body at the scene.
3. Examination of the victim and the surrounding area at the scene using UV light or an alternate light source.
4. In fatalities, identification photographs of the body in the autopsy room.
5. Examination of the victim completely undressed using UV light or an alternate light source. Swabs are taken from any suspicious areas.
6. Large and close-up photographs of the injuries, especially of the sexual areas (mouth, vagina, anus).
7. Gentle glove examination of the mouth, vagina, and anus. To prevent contamination, gloves should be changed or washed when moving from one area to another. The physical condition of the hymen should be noted and recorded.
8. Cotton swabbing and aspirates taken from the mouth, vagina, and anus for preparation of microscopic slides, for acid phosphatase testing, and for detection of seminal fluid. A "hanging drop" slide preparation is examined immediately for motile spermatozoa.
9. Speculum examination of the vagina under adequate light to detect the presence of blood, contusions, lacerations, or presence of foreign bodies (e.g., fragments of wood sticks, glass, metal). In fatalities, microscopic sections should be taken from the areas of injury to determine their age, according to the patterns of tissue reactions.
10. Careful examination of the anus to check for presence of injuries. The presence or absence of a patulous or scarred anus indicative of chronic anal intercourse should also be noted.
11. At least 20 hairs plucked in their entirety (and not cut) from the head, axillary areas, and pubic area.
12. Fingernails cut or scraped and marked accordingly, left and right. Examination of the fingernail scrapings may

reveal the presence of skin, cloth fibers, or blood that may be matched to that of the assailant.

13. Thorough external examination. Suspected bite marks should be swabbed for saliva typing and imprints lifted if possible.
14. In fatalities, a full internal autopsy, with special attention to the pelvic area, to perforation or other injuries, and to evidence of pregnancy.

A full toxicological examination, including analyses for alcohol, barbiturates, sedatives, and narcotics. Specific screening tests for ethanol, GHB, flunitrazepam, and other drugs should also be included.

PATERNITY

An area peripherally related to rape in which the practicing forensic pathologist becomes involved is the identification of the father of a child. Paternity actions were once extremely charged legal actions; the only mode of proof was the testimony of the parties and their witnesses. The high emotion associated with paternity actions has not changed, but the forensic pathologist's ability to contribute to positive identification has increased greatly. The present scientific determination of paternity tends to limit or eliminate the once-common practice of the accused producing a number of men (true or false) who had sexual intercourse at or near the time of conception. Paternity, not promiscuity, is the issue, and scientific testing provides virtually positive proof of fatherhood.

Since the combination of genes peculiar to each person is found in all cells of the body (excluding the egg and sperm), an analysis of blood cells generates the information necessary to establish or exclude paternity. The first approach to scientific proof of paternity is through exclusion techniques, as follows:

- A man can be excluded when both he and the mother lack a gene that the child has, because a child cannot possess a gene lacking in both the parents.
- A man can be excluded when the child does not possess a gene that must have been inherited from the father. (A man with AB blood type cannot have a child with blood type O, because having no other blood genes to contribute, either type A or type B is present in the child of a type AB father.)

Exclusion techniques are reasonably well accepted in U.S. courts because of their finality and long-standing scientific basis. Unfortunately, newer techniques to prove paternity based on both statistical probability and scientific examination are not as well accepted.

Because of the many genetic characteristics that have been identified, sampling only a few of them in the child provides a virtually positive identification index of the father. The subsequent application of mathematical techniques can statistically show whether a given man is the child's father. For example, if one identifies 20 genes in a child that have a frequency of occurrence in the general population of five, and the accused man has

those same genes, it is 99.7% likely that the accused is the father.

CHILD ABUSE

The forensic pathologist enters the child abuse drama at the epilogue. The pathologist must identify the pattern of trauma and differentiate abuse from a true accident. This is a great responsibility because the decision of whether to prosecute a suspect often turns entirely on the pathologist's conclusion. A false accusation of child abuse is a traumatic experience, but it is equally distressing to free an abuser. Forensic pathologists therefore must show that the documented injuries are the result of abuse. They also must be able to exclude more natural explanations for their findings.

Recognition and Categories of Abusers

An association between chronic subdural hematoma and multiple limb fractures of varying ages in young children was first identified in the mid-1940s. Pathologists were unable to correlate the findings with any known disease and were looking for an exotic new disease. The medical profession was psychologically unprepared to accept that parents could seriously maim their children. Not until the mid-1950s was parental violence identified as the responsible modality for these observations. Since then, multiple studies worldwide have clarified the battered child syndrome.

Child abusers can be separated into several categories. *Intermittent child abusers* periodically batter a child but provide appropriate care between episodes. These parents do not intend to hurt their children, but they are driven by panic or compulsion and tend to be sincerely remorseful afterward. Often they are motivated to reform and can be successful in time. The child-victim of these episodes is usually grabbed by an arm or a leg and shaken forcefully, resulting in broken bones and joint dislocations.

One-time child abusers may be distinguished from the previous group, but more likely they are potential repeaters and were only restrained from further abuse by some particular circumstance.

Constant child abusers deliberately beat and mistreat the child. Their intent is to cause harm, usually with the rationalization that they are dispensing appropriate discipline. Such abusers are indifferent to the child's suffering. They often have personality disorders, are detached from the destructive nature of their actions, and are not inclined toward reform.

In this age of alternative lifestyles and broken families, many young mothers have live-in boyfriends. Often these men are affectionate to their girlfriend's children and contribute to their growth and well-being. Frequently, however, the child becomes the innocent victim of an emotional struggle. When resentment builds, either toward the mother or the children, men can become *intermittent habitual child abusers*, with the woman's children becoming the target of hostility.

A child's life generally includes multiple bumps, bruises, lacerations, fractures, and dislocations caused by accidents,

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making differentiation difficult for the pathologist. Child abuse cases, however, tend to have common findings on examination or autopsy and similar perplexing problems of differentiation.

Common Findings

In regard to the hemorrhage produced in the battered child, the pathologist must determine that the trauma resulted from more than one application of force. With head trauma, for example, it may be difficult to surmise that a unilateral subdural hemorrhage is not a result of a fall. If the hemorrhage is multicentric, however, associated with several external lesions (particularly contusions or lacerations) or more than one abrasion, the implication is that the child fell more than once after receiving an initial severe craniocerebral injury, was hit several times, or bounced repeatedly. The pattern and multiplicity of injury help the forensic pathologist reach a conclusion.

Typically, thoracic damage results from a combination of blows and squeezes. Multiple ribs may be fractured, either posteriorly or anteriorly, and may be displaced, resulting in perforated lungs, heart, or liver. These internal injuries can cause excessive hemorrhage into the chest cavity and, if air is sucked into the chest cavity, can produce respiratory difficulty from pneumothorax. With the exception of a pure squeeze, the chest wall contuses more easily than the abdominal wall because the skin is closer to the semirigid ribs. These contusions are common in situations involving an ignorant abuser because the injuries can result from excessive though seemingly innocent squeezing.

The internal organs can receive trauma from any direction, and an unmarked epidermis can hide extensive internal bleeding and disruption of internal organs. The areas most vulnerable are the points of attachment of an internal organ, especially at the sources of blood supply and at points at which blood vessels change direction. One such area is the middle of the superior half of the abdomen, which contains several blood vessels changing direction, particularly the vessels of the celiac trunk and their branches; the hepatic, splenic, and gastric arteries and their branches; and the accompanying veins. The loop of duodenum, the ligament of Treitz, and the pancreas are in the retroperitoneal space, and the stomach and transverse colon are in the triangle located in the peritoneal cavity. *Compression*, whether prolonged, as in a hug or squeeze, or momentary, as from a blow, is the mechanism of trauma. A stretch-stress force of sufficient acceleration and deceleration detaches the jejunum from the ligament of Treitz, lacerates the liver, contuses the intestines or stomach, or ruptures blood vessels crisscrossing the area. Other direct blows include a "kidney punch," which may lacerate the kidney from behind, with bleeding into the space around the kidney and usually surface contusion.

Final Determination

The pathologist's ability to explain whether one blow or many caused the damage is more important than being

able to explain all the lesions by mechanism. A child dying of multiple internal injuries and manifesting bruises over the entire body, especially if the injuries are of different ages, is more likely to have been beaten than a child with one contusion in an exposed portion of the body, with internal injuries in the same area. A problem arises when the parents allege that the child fell down a flight of steps. In this case, a careful cataloging of all lesions and an on-site study of the premises may resolve the issue.

DRUG ABUSE

The forensic pathologist's task of determining the cause and manner of death is complicated by the problem of drug excess. So many drugs are available and used (illegally or legally) that a demise is often the result of drug combinations rather than the abuse and overdose of a single agent. This problem has become significant in the medical profession and on the street.

Physicians are bombarded on an almost daily basis with new, improved, and modified drugs. The volume of drugs available for use in treatment makes it virtually impossible to remain current with every agent and, more significantly, to be aware of and understand the ramifications of drug combinations. By themselves, most drugs are therapeutic, but when prescribed along with other drugs, potentially lethal combinations and synergisms can result. This is an especially insidious problem when a team of physicians or specialists treats a patient. Although the specialists may be completely familiar with the drugs used within their narrow focus, they may be totally unfamiliar with commonly prescribed drugs for treatment outside their specialty. The result can be an adverse drug reaction or a synergistic action causing untoward effects or death.

Drug Death—or Not

The frequently subtle differentiation between natural and drug-induced death, or between the death of a person undergoing legitimate medical drug treatment and death from drug abuse, may be impossible to achieve in the absence of some forewarning to the investigating pathologist. Pathological findings that could properly be attributed to natural or non-drug-related etiology may be natural medical complications arising from drug use or abuse. Unawareness of drug-related possibilities could make the forensic pathologist's opinion as to manner of death completely inaccurate. A properly conducted investigation, however, tends to reveal certain factors that alert the pathologist and usually eliminate inaccuracies in the determination.

The pathologist's first hint may come from the deceased. Unexplained coma followed by death or irrational behavior before a bizarre act resulting in death, especially in younger people, raises the possibility of a drug-related death. An investigation of the scene of death often reveals evidence such as needles, tourniquets, spoons for heating or measuring drugs, discarded plastic bags, syringes, burned matches, and other drug-related paraphernalia that

may point to a drug-related demise. Even the location of the body when discovered, such as the bathroom (a common place for intravenous injection), may be helpful when combined with other information. Although the autopsy in a suspected drug-related death follows the usual scientific routine, certain findings and observations peculiar to drug users and abusers are often found.

During external examination, special care is taken to find and identify needle marks indicative of drug injection. These marks are often concealed by the abuser to reduce obvious evidence of drug use and may be found interspersed with tattoos, between the toes, in the gums, and in creases and folds of skin anywhere on the body. Abscesses, scarring, and sores are common as a result of scratching of the skin surface with contaminated paraphernalia to inject drugs intradermally (skin popping). Stains on fingertips from capsule dyes may indicate drug abuse, and the color may help identify the abused drug. Froth from the nose and mouth is a common indicator of severe pulmonary edema and congestion, which may result from death caused by depressants.

Internal examination usually generates limited information. The most common finding is pulmonary edema and congestion that, although nonspecific, is almost always present and thus helpful in identifying a drug-related death. The gastrointestinal contents may reveal traces of pills and capsules, and the dye from capsules may tinge the mucosa with an unnatural color. Examination of the nasal passages and nasopharynx may reveal irritation or even traces of drugs (usually cocaine) inhaled through the nose (snorted).

Microscopic examination tends to be nonspecific in drug deaths, but certain findings are more common in drug deaths than in other kinds of deaths. These findings include pulmonary edema, congestion, focal hemorrhage, bronchitis, and peculiarly, granulomas. Granulomas result from the intravenous injection of foreign substances such

as starch, textile fibers, or talcum, either because these substances were used to dilute or cut the drug or because the injection picked up clothing fibers. Other evidence includes thrombosis, thrombophlebitis, and viral hepatitis from the use of needles.

As expected, the most significant finding is made during toxicological analysis. Using GLC, TLC, SPF, and other sophisticated techniques, the forensic toxicologist can identify the presence and concentration of drugs. The samples of choice in these analyses are blood and urine, although nasal secretions, gastric contents, bile, and tissue from the liver, kidneys, or lungs may be necessary to make a definitive determination of drug type and concentration.

CONCLUSION

Virtually any situation involving an interface between law and medicine may call for the expertise of a forensic pathologist. With a background in both law and medicine, forensic pathologists are uniquely qualified to stand at the nexus and serve as the necessary bridge between these two fields.

Court decisions in various jurisdictions have conferred the benefit of governmental immunity on coroners and medical examiners in lawsuits alleging administrative or professional negligence relating to the determination of cause and manner of death. These judicial rulings are based on the premise that both elected coroners and appointed medical examiners are public officers. Therefore, even if their decisions are subsequently proven to have been incorrect, as long as they were made in "good faith" with no evidence of "malice," the pathologist, acting in an official capacity as coroner or medical examiner or their agent, is entitled to governmental immunity. These decisions are consistent with long-standing concepts set forth in administrative law and common law.

