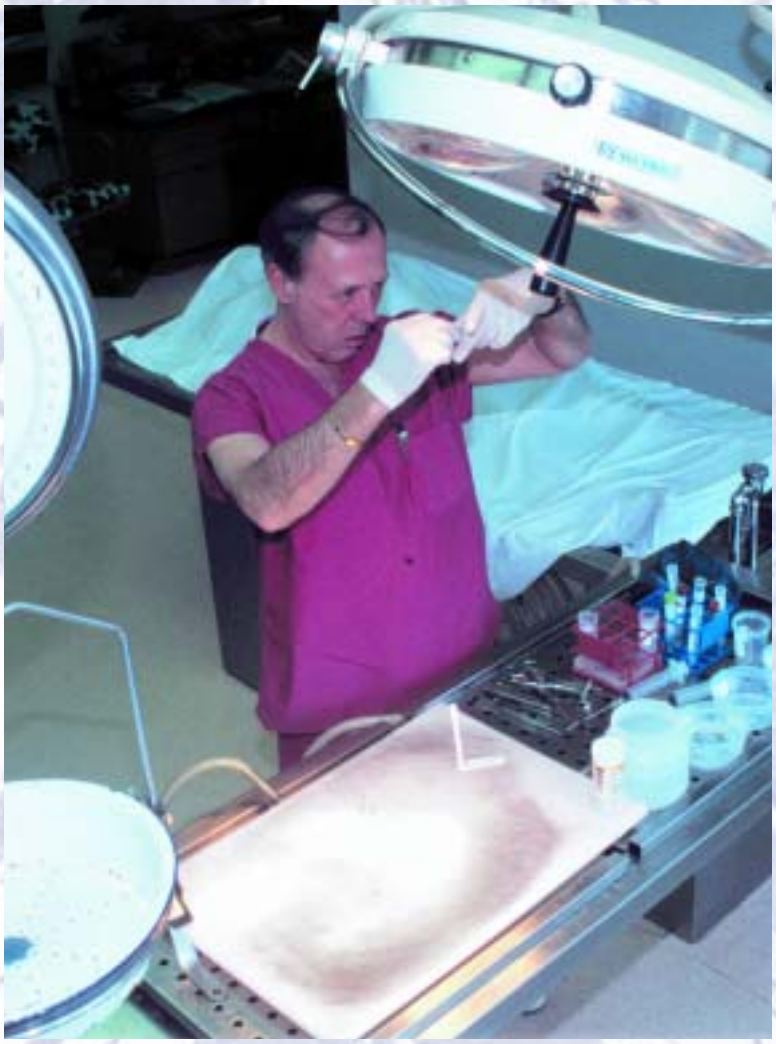
FEATURE

Karen Dalton-Beninato, BA

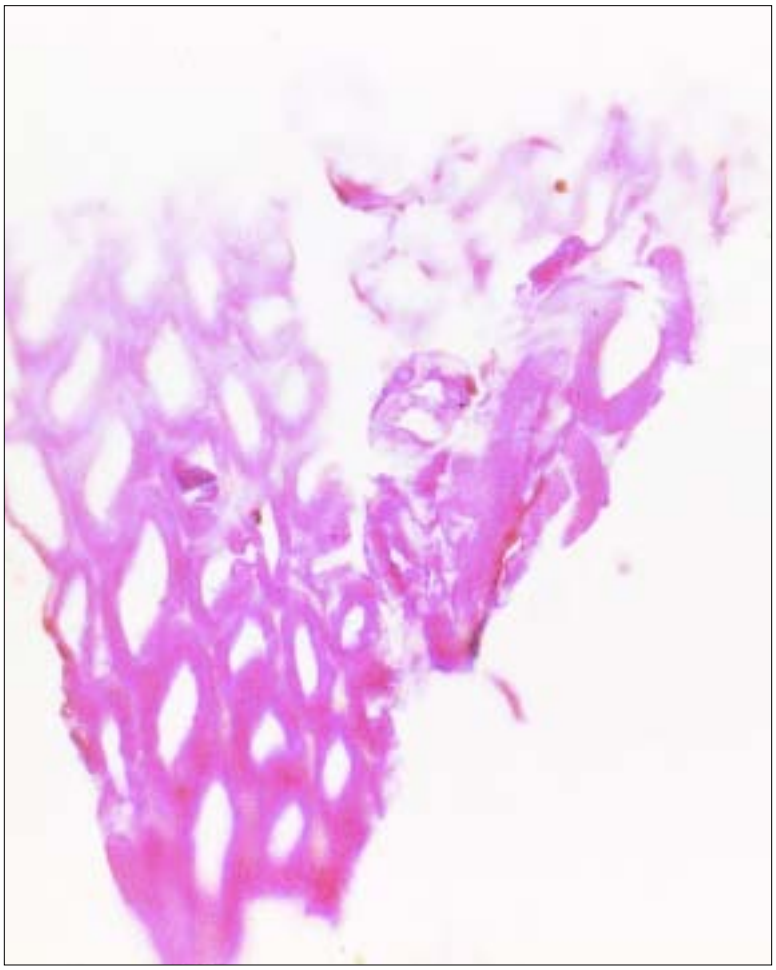
From the Untouchables to DNA Testing



The smoking gun of the 1920s has given way to the weapons of forensic pathology—DNA testing, trace analysis, serologic and cytologic testing, and other technological leaps.

Using modern technology, forensic pathologist Charles Wetli, MD, FASCP, accomplished an unprecedented feat in 1996. He and his staff identified every victim of an airline tragedy, in this case the explosion of TWA Flight 800 over Long Island. "We used fingerprints, dental X-rays, CAT scans, and DNA analysis to get an incredible amount of information from relatively small samples of material," says Wetli. In another case, police found a note written on the palm of a murder victim's hand. Using ultraviolet light, Wetli was able to decipher the words.

As chief medical examiner in Suffolk County, NY, Wetli determines the causes of unnatural death (suicide, homicide, or accident) by studying injuries resulting from stabbing, gunshots, poisoning, and forceful blows. He also directs a crime laboratory.



Microscopic examination of a fragment of wood obtained from a bullet. SOURCE: Nichols CA, Sens MA. Bullet Cytology. *Forensic Pathology Check Sample*. FP 91-4. Chicago, IL: ASCP;1991.

The Quantum Leap

James Wisecarver, MD, PhD, FASCP, serves the Department of Pathology, University of Nebraska Medical Center, Omaha. According to Wisecarver, his DNA testing relies on polymerase chain reaction procedures, capillary gel electrophoresis, and the ABI 310 sequence analyzer (P.E. Biosystems, Foster City, CA). Test results, which previously required 2 to 4 weeks to generate, are available in 2 to 3 days with the streamlined process. "We just generate electropheragrams from which we read the different-sized DNA fragments," says Wisecarver. Helping police match the DNA of blood or semen (found at a crime scene or taken from a crime victim) with that of a suspect makes up more than 90% of Wisecarver's forensic identity work.

According to Wisecarver, the identification procedure begins when a police officer delivers specimens taken as evidence to the laboratory. Items range from clothing to personal effects and are accompanied by a chain-of-custody form. "We ask the officers to fill out exactly what they're leaving with us," says Wisecarver. "Then we log it in, photograph it, and find out what the agency is looking for before we start to test."

Wisecarver's technologists test pieces of evidence for DNA, then look for genetic markers by amplification and run the amplified sample on the sequence analyzer. If DNA is present, they determine the genotype. They check their results by testing another sample to make certain its DNA type matches the type found in the first sample. "We analyze the pattern, estimate how commonly the pattern occurs in the population, and report the results" Wisecarver explains.

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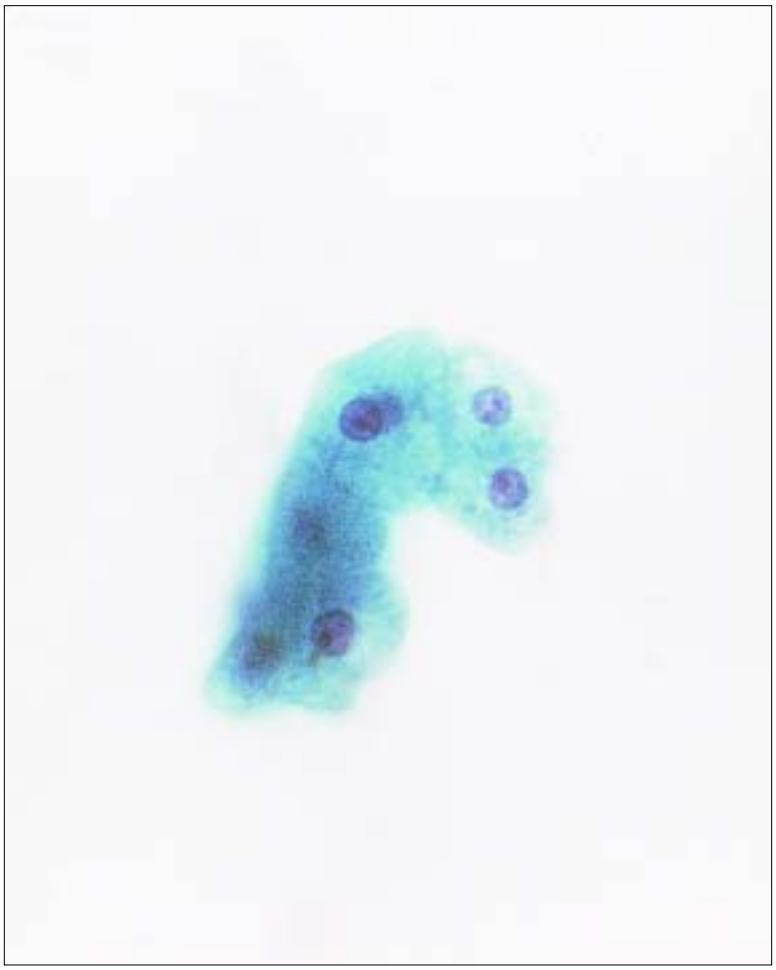
Wisecarver states that a genotypic match has up to a trillion-to-1 level of accuracy. "Essentially it's a unique genotype," he says. "The new testing we're bringing on board next year will generate essentially a unique genotype with a 'one in something with 20 zeros behind it' level of accuracy." He adds that although the testing will still require short tandem repeat analysis, it will use 16 unique genetic markers.

Irrefutable identifications? "It's headed in that direction," says Wisecarver. "I don't know that the lawyers have agreed on that yet, but I suspect that once those numbers are put before a jury, they will be hard to dismiss."

According to Wisecarver, DNA testing is a more expensive crime-solving option than matching the remains of the victim's jaw with dental records. "When we do these DNA tests it can run a couple



Hepatocytes obtained from washing of bullet that passed through the liver. Source: Nichols CA, Sens MA. Bullet Cytology. *Forensic Pathology Check Sample*. FP 91-4. Chicago, IL: ASCP;1991.

thousand dollars," he says. With the new developments, he adds, "you're getting a lot better data than you used to get for the same money. It's like buying a computer for your home. You still spend about the same as you did several years ago, but you get a lot more computer."

Wetli agrees that DNA testing is a revolutionary technique in forensic pathology. He cites a case in which a woman was raped and murdered in California during 1969. Although the police found a likely suspect, the evidence against the man was only circumstantial. "Years later," says Wetli, "somebody realized this guy was in San Quentin and that he had to give a blood sample." According to Wetli, a pathologist obtained the blood sample and analyzed it for DNA. The pathologist then searched the crime laboratory archives for specimens taken as evidence for the 1969 crime. Sure enough, the pathologist found pubic hair that probably contained semen. After analyzing the aged sample for DNA, the pathologist compared the results with the DNA profile of the San Quentin suspect. "We found an identification with a 1 in 37 trillion [level of] accuracy," says Wetli. With no statute of limitations on first-degree murder, the suspect was charged with the crime 30 years after he committed it.

Wetli states that before DNA testing became available, analyzing specimens taken from rape cases was of no value unless the police could find a suspect in the geographic area of the crime. "Now with data banks and computers," says Wetli, "specimens will be analyzed immediately and the results fed into computers across the country."

As an example of a successful cross-country investigation, Wetli recounts a case involving a child's skull found in the Florida Everglades. Police came to Wetli with a report that a woman in North Carolina had accused her husband of murdering their child and throwing the body into the Everglades. By analyzing the DNA from the woman's blood and comparing it with the DNA found in the teeth of the child's skull, Wetli's crime laboratory staff proved that the woman was the child's mother. "The DNA results enabled the police to arrest the father and charge him with first-degree murder," says Wetli.

Biting the Bullet

According to Wetli, cytologic examination of bullet washings (developed by Clay Nichols, MD, and Sanda Conradi, MD, of Charleston, SC) helps to determine what materials or body tissues the bullets penetrate, even when several bullets traveling different paths are involved. "We can pick up clothing, wood, cartilage, bone, liver, intestine, and so forth," says Wetli.

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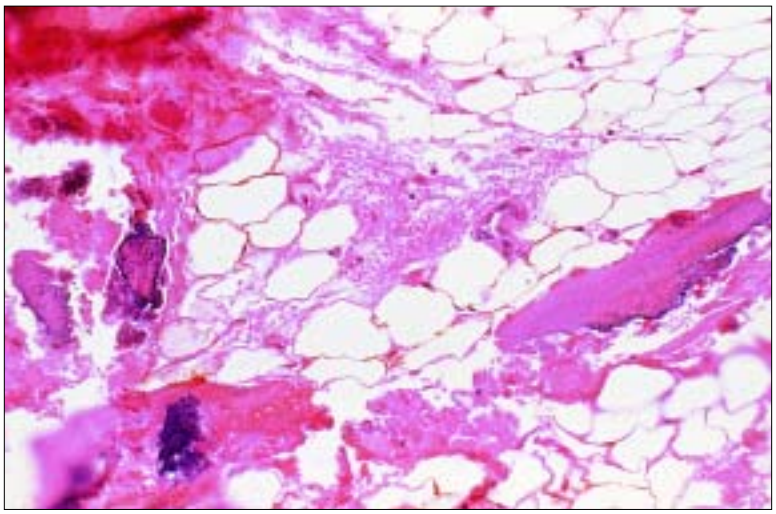
In some investigations, bullet holes and the bullet itself are two of the best sources of evidence. "With one homicide victim, we never found the body," says Wetli, "but we were able to prove what happened to her by analyzing the DNA in body tissue found in and around the bullet holes on the ceiling and under the mattress of her home." He adds that microscopic studies gave clues to the path of the bullet through her body and showed she was shot at close range. Trace analysis revealed the kind of gun and bullet used in the crime, and analysis of the material trapped inside the nose of the bullet showed the characteristics of the layers of clothing worn by the victim. "We knew that the last time she was alive she went to a costume party dressed as a bunny," says Wetli. "We were able to show she was wearing layers of clothing consistent with this costume when she got killed."

Wetli states that forensic pathologists have a new technique that allows them to dissect a face without mutilation. "It's like plastic surgery," says Wetli. "By the time we're finished you can put the face back and nobody will know anything was done. The technique allows us to pick up fractures and injuries not detectable by X-rays." He adds that in some cases, facial dissection turned what appeared to be an accidental death into a homicide. The technique was developed by Geetha Natarajan, MD, Newark, NJ.

Other advances include the ability to detect a metabolite (other than morphine) of heroin, which allows toxicologists to distinguish between a person's taking pharmaceutical morphine and a person's being injected with heroin which, according to Wetli, is immediately metabolized to morphine.

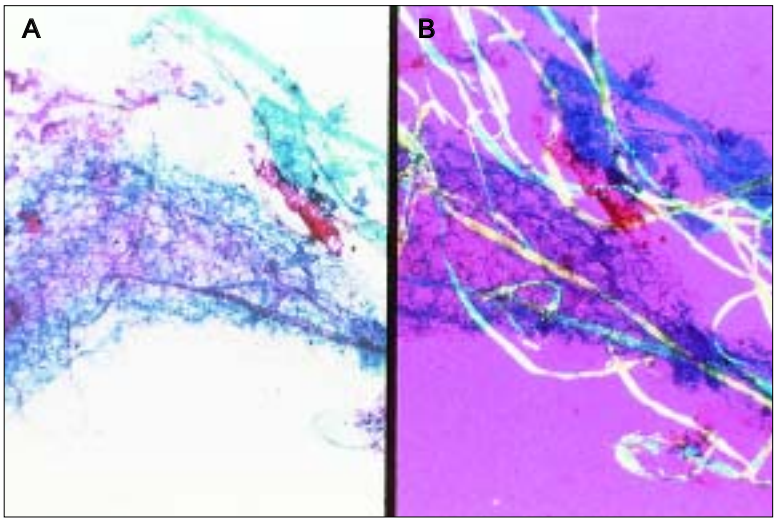
Gel electrophoresis and related laboratory equipment at the Molecular Epidemiology Laboratory, Northwestern Memorial Hospital, Chicago.



Cell block preparation of a bullet washing contains adipose tissue, small vessels, fragments, and cellular debris. Some adipose tissue cell borders are finely crumpled and irregularly stained, suggesting ballistic trauma. SOURCE: *Check Sample*. FP 91-4, Bullet Cytology.

Old Reliable

Wetli insists that postmortem examination (autopsy) is still the best jumping-off point in most investigations of sudden and unexpected death. "Autopsies are still superior to MRIs, CAT scans, and other techniques which sometimes give erroneous results," he says. In addition to the time of death, autopsy can shed light on the history of a deceased drug user. For example, the ability to identify drug metabolites allows pathologists to observe various metabolite patterns associated with taking a drug such as cocaine. "We can distinguish people who have an overdose of cocaine from those who suddenly drop dead from psychotic reaction to cocaine," says Wetli. To determine metabolite patterns, pathologists send a frozen portion of the victim's brain to a research laboratory for testing.



Light microscopy of a preparation from a bullet retrieved from a victim's back, after penetrating a fiber synthetic shirt, breast, and thorax. In A, the bright-field preparation shows some of the synthetic fibers, but they are more clearly shown in B by polarized illumination. SOURCE: Nichols CA, Sens MA. Bullet Cytology. *Forensic Pathology Check Sample*. FP 91-4. Chicago, IL: ASCP;1991.

Wetli states that such deaths often occur while the drug user is in custody. "These people all of a sudden go berserk, rip their clothes off, and die while handcuffed in a police car," says Wetli. "You frequently get allegations of police brutality." According to Wetli, the analytical techniques help to either thwart the allegations at the beginning or defend the police and municipality in a lawsuit.

Preventing Deaths

Sudden infant death syndrome, a silent killer, can be studied by techniques used in forensic pathology, says Wetli. "We can analyze a few drops of a deceased child's blood for about 30 different metabolic (genetic) disorders," he states. If the tests show the presence of a genetic disorder, Wetli says physicians can test the infant's siblings for the same disorder to ensure that the family members receive proper medical attention.

Forensic pathology also provided preventive medicine in a case involving a man who died of heart disease in 1972. The man's wife asked Wetli for her husband's autopsy report shortly after the woman's son, while completing a medical history form to change health plans, wrote that his father had died suddenly and unexpectedly at age 35 years. The person who did the autopsy knew only that some type of heart disease had caused his father's death. "When I looked up the microscopic examination results on this case," says Wetli, "it became evident that the father had something not known then but could be identified now." According to Wetli, there was a large amount of fatty infiltration into the right side of the man's heart. Wetli realized that approximately 50% of these cases are associated with a congenital condition. "I wrote a letter to the mother suggesting she get her children checked for this condition," says Wetli, "because there are medications and things that can be done to prevent sudden death."

Sometimes knowledge of autopsy results can save a person's life. "Last year I picked up this (same congenital heart) disease on a woman in her forties," recalls Wetli. After the woman's husband learned the cause of his wife's death, he told Wetli that the woman's daughter from a previous marriage had palpitations similar to those of his wife. "He had her checked by a cardiologist," says Wetli, "who found that the daughter had such massive involvement that they put an automatic defibrillator in her."

"It kind of makes you feel good to save somebody's life," says Wetli.

Entering Forensic Pathology

Although forensic pathology is a growing and dynamic field, Wetli states that "what scares people away is that they have to go to court and deal with lawyers, reporters, and things they feel uncomfortable with. But it's like anything else; you walk into their world and you have to abide by their rules." l

Karen Dalton-Beninato is a New Orleans-based freelance journalist and legal assistant.

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