TEACHING EDITORIAL

Forensic Radioimmunoassay—A New Area

"Finally, an analysis has shown that the remains of his supper . . . contain an appreciable quantity of powdered opium. . ." A. Conan Doyle, *The Adventure of Silver Blaze*, 1892. Sherlock Holmes, by the addition of Marquis reagent to the food, would have experienced little difficulty in surmising the chemical identity of the powder in it. Unfortunately, for present day sleuths, it is not grossly contaminated food that they must analyze, but various biological samples; and the chemical methods available are neither sensitive enough nor specific enough to detect opiate abuse reliably.

Detection of opiates and their metabolites in biological samples is essential for diagnosing acute heroin overdose and monitoring chronic opiate abuse. The estimated 800,000 chronic opiate users in the United States underscore the need for accurate, sensitive methods for opiate detection. Elsewhere in the *Journal* Baumgartner et al. suggest combining the sensitivity and specificity of opiate radioimmunoassay with the retrospective record of exposure locked into human hair as a means for both the detection and the approximate date of opiate abuse (*1*). Of additional significance, the concentration of opiate in hair is purported to be roughly quantitative of the amount of opiate used.

Urine is the most widely used biological sample for the detection of opiate abuse. For an addict under surveillance or for a soldier undergoing routine screening, however, avoidance of detection through the urine sample is simply a matter of not taking the drug for the preceding 48 to 72 hr or of substituting a false urine specimen. Extraction followed by thin layer chromatography (TLC) can detect about 1 μg morphine/ml urine. As indicated by Baumgartner et al., however, TLC, like other urine-based assays, is not helpful if the last drug use was more than 72 hr earlier. Furthermore, unless the urine is subjected to hydrolysis, morphine glucuronide, a major heroin metabolite present in urine, is not detected; thus, the sensitivity for opiate detection is reduced by about a factor of 10. Because hydrolysis destroys other drugs or metabolites of interest in screening programs, this step is frequently omitted unless heroin use is specifically suspected.

A commercially available homogeneous enzyme assay for morphine, EMIT* (morphine) has a sensitivity of about 0.5 μg/ml of urine and detects both morphine and morphine glucuronide. The antibody currently used, however, has poor specificity; and it detects, as expected, not only codeine, but also nalorphine, meperidine, and apparently even chlorpromazine and dextromethorphan, a common cough suppressant. These problems could be overcome with a more specific antibody.

The radioimmunoassay used by Baumgartner et al., Abuscreen† (morphine), is simple and requires only minutes to complete (*2*). It can reliably detect 40 ng or less opiate per milliliter urine and 2–5 ng opiate in an assay tube, and makes possible the detection of 1 ng or less per milligram hair. The antiserum binds morphine, morphine glucuronide, and codeine with approximately equal avidity but, unlike the current EMIT assay, does not detect other drugs or metabolites. It will detect codeine in quantities present in commonly prescribed cough suppressants, but other related or commonly prescribed drugs (Roche lists some 118) do not appear to cross-react strongly enough to be detected.

Hair as a record of environmental exposure has been of considerable forensic interest. Arsenic, lead, cadmium, mercury, and other metals are incorporated into the hair filament and can be detected with sensitivity by mass spectroscopy or related techniques. Of additional interest, low levels of chromium have been associated with juvenile onset diabetes and low levels of zinc with growth and mental retardation. The hair content of both heavy metals and organic compounds, however, may be altered by cigarette smoking, alcohol, coffee, and other dietary components. In addition, hair is environmentally exposed to

atmospheric pollutants, shampoos, dyes, and oils, components of which may become permanently bonded to the filament. Analysis for any substance, but in particular for drugs of abuse, may be inaccurate because of possible assay interference from any of these environmental substances. Because of the significance of positive findings, the possibility of such interfering substances must be carefully considered.

Baumgartner et al. have used the sensitivity of radioimmunoassay to examine hair and even bits of hair for evidence of exposure to opiates. That the combination of these two concepts may permit detection and dating of exposure to many other substances of interest is an exciting possibility!

LYNN R. WITHERSPOON
JOSEPH S. TRAPANI
Ochsner Medical Institutions
New Orleans, Louisiana

FOOTNOTES

* Syva, Palo Alto, CA.
† Roche Diagnostics, Nutley, NJ.

REFERENCES

1. BAUMGARTNER AM, JONES PF: Radioimmunoassay of hair for determining opiate-abuse histories. *J Nucl Med* 20: 748–752, 1979
2. CLEELAND R, CHRISTENSON J, USATEGUI-GOMEZ M, et al: Detection of drugs of abuse by radioimmunoassay: A summary of published data and some new information. *Clin Chem* 22: 712–725, 1976