H65 Forensic Bone Toxicology

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The goal of this presentation is to introduce a new direction in bone chemistry research that aims to identify what types of drugs or toxic metals are recoverable from skeletonized remains and how their presence and/or concentration will benefit medicolegal death investigation. The audience will learn the history of published research and case reports on this subject, as well as the development of a pilot study on how drug use affects skeletal and dental health.

This presentation will impact the forensic community by identifying new toxicological data that can be obtained from skeletonized or badly decomposed remains. Such information can aid victim identification and/or determining circumstances surrounding the manner of death. The impact of chronic drug use and abuse on systemic skeletal health has significant clinical applications and will likely benefit future anthropological evaluations of remains in a medicolegal context.

Many forensic anthropologists agree that future research needs to elucidate the meaning of the molecular structure of hard tissues. The appli- cation of stable isotopic bone chemistry, for example, to the identification of geographic origin of deceased Mexican immigrants (Juarez 2007) or potential U.S. war dead (Beard and Johnson, 2000), is a novel use of an investigative tool long used in bioarchaeological research. Bone biochemistry changes continuously from birth to death because of its role in mineral homeostasis, acid-base balance, responses to changing mechanical forces, and hematopoiesis. In addition to digestive byproducts, bone can incorporate drugs and/or their metabolic byproducts as well as trace metals from blood, although the pharmacokinetics of their distribution and uptake into the organic and inorganic phases of bone are not understood.

The first anthropological application of "forensic bone toxicology" of which the author is aware is the case summarized by Stout and Ross (1991). With only small bone fragments recovered, Dr. Stout employed microscopic and histomorphometric techniques (Milch et al. 1958) to identify tetracy- cline (an antibiotic) incorporated for some length of time into the victim's bones. DNA ultimately confirmed identity of the victim, who had taken the drug for several months prior to her murder. Other forensic reports of finding drugs in bone samples are limited. The only published summary of drugs recoverable from bone is McIntyre et al. (2000). Noguchi et al. (1978), who showed that amitriptyline could be recovered from bone, thus confirming that the decedent had committed suicide, published the first paper urging others to analyze skeletal remains for toxicological evidence. Subsequent published case reports mostly document intentional or accidental drug overdoses. These reports include Terazawa and Takatori (1982; aminopyrine, cyclobarbital), Benko (1985; amobarbital, glutethimide), Bal et al. (1989; dextropropoxyphene, chlorazepate potassium), and Horak and Jenkins (2005; citralopram). Chronic alcohol abuse also can be assessed from rib marrow teeth consisted of two incisors, two premolars and two molars. DNA was soon after death (Schloegl et al., 2006). Case studies on overdose and homicide victims buried from seven months to five years show that drugs can still be recovered from bone and/or marrow despite a lengthy postmortem interval (Terazawa and Takatori, 1982; Kajima et al., 1986; Kudo et al., 1997; Maeda et al., 1997; Raikos et al., 2001). Acute metal toxicity has also been determined from bone (aluminum, de Wolff et al., 2002; fluoride, de Menezes et al., 2003; lead, Lech, 2005). Controlled animal studies indicate that certain benzodiazepines (midazolam, Gorczynski and Melbye, 2001) and morphine (Cengiz et al., 2006) can be recovered from bone/marrow. Additional refer- ences for bone marrow research using animal models are listed in Schloegl et al. (2006). Bisphosphonates are the largest class of drugs that target bone mineral, but their use is widespread and less informative to forensic investi- gation (Russell and Rogers, 1999).

Chronic substance use can have systemic effects on skeletal health in living patients. This presentation will address how the long-term use of alcohol, nicotine, statins, NSAIDS, antidepressants/-epileptics/-psychotics, heroine, methamphetamines, and other drugs adversely affect skeletal health in addicts. A developing research project will be outlined. Because drugs can be detected in bone, anthropologists should pursue toxicological analysis of skeletal remains. Further research is needed to assess bone pharmacokinetics, the diagnostic value of bone-drug concentrations, and the effects of the postmortem interval. Skeletal and dental pathology caused by chronic substance use might one day be recognized in human skeletal remains.

Bone Chemistry, Toxicology, Drugs

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