I.8 Problems in toxin analysis in emergency medicine

By Makoto Nihira

Introduction

The identification of a causative toxin is one of the most important tasks in emergency medicine; it requires both rapidness and accuracy. In the Japan-shaking poisoning incidents taking place in 1998, such as curry (arsenous acid) poisoning in Wakayama, sodium azide poisoning in Niigata and cyanide poisoning in Nagano, the importance of a rapid and accurate analysis system for poisons was well recognized by Japanese people and governemnt. Since then, the importance of toxin analysis (clinical analytical toxicology) on the spots of clinical treatments of poisoned patients (clinical toxicology) was also confirmed. The Ministry of Health and Welfare of Japan decided to distribute an X-ray fluorescence spectrometer to be used for metal analysis together with an HPLC instrument with a photodiode array detector to be used for drug analysis to the 65 critical care medical centers; the above two instruments plus some mass spectrometric instruments for the final identification and quantitation to the 8 advanced critical care medical centers. Such analytical instruments were introduced also to our Advanced Critical Care Medical Center of Nippon Medical School. Upon introduction of the state-of-the-art analytical instruments, all staffs of both Department of Legal Medicine and Advanced Critical Care Medical Center discussed together on the selection of each type of instruments, which had been proposed by various manufacturers, for strengthening the toxin analysis system in emergency medicine at our College Hospital.

At Nippon Medical School, the Department of Legal Medicine and the Advanced Critical Care Medical Center have been cooperating for practical analysis and studies on new analytical methodologies of drugs and poisons in specimens sampled from poisoned patients for more than 20 years since 1980 [1–8]. Screening tests are being made at bedside, viz. inside the Advanced Critical Care Medical Center and complicated analysis for identification and quantitation is being made at laboratories of the Department of Legal Medicine. The analytical system has been also improved to become responsible for the 15 toxic compounds, which were proposed by the Committee on Analysis of Japanese Society for Clinical Toxicology [9]. The poisonings taking place in the midst of the metropolitan area, where our College is located, are largely due to drugs; they are so-called “urban-type poisonings” [1, 6, 10] caused by illicit drugs of abuse and therapeutic ones. Therefore, our system for analysis should mainly cover these drugs. In this chapter, the author presents some of our analytical system and discusses on problems arising during maintaining the system.
Analytical system at Nippon Medical School

Screening tests at the emergency rooms

1. Volatile compounds
   Alcohol: a simple kit for alcohol measurements (alcohol dehydrogenase method)
   Cyanide: capillary electrophoresis (CE)
   Azide: CE
   Carbon monoxide (CO): oxymeter
2. Drugs
   Psychopharmaceuticals and illicit drugs: Triage (immunoassay)
3. Metals
   Arsenic, thallium, mercury and others: X-ray fluorescence spectrometer
4. Pesticides
   Bipyridinium pesticides (paraquat and diquat): color tests

Confirmation and quantitation at the laboratories of the Department of Legal Medicine

1. Volatile compounds
   Alcohol: GC [headspace method, flame ionization detector (FID)]
   Toluene: GC (headspace method, FID)
   Cyanide: GC (headspace method, nitrogen-phosphorus detector)
2. Drugs
   Illicit drugs
   a. Amphetamines (methamphetamine, amphetamine and others): GC/MS
   b. Opiates (morphine, heroin and others): GC/MS
   c. Cannabinoids (tetrahydrocannabinol and others): GC/MS
3. Other drugs
   a. Barbituric acids: GC/MS
   b. Phenothiazines: GC/MS
   c. Tricyclic antidepressants: GC/MS
   d. Bromisovalum: GC/MS
   e. Benzodiazepines: LC/MS
   f. Sildenafil citrate (Viagra): LC/MS
4. Pesticides
   Bipyridinium pesticides (paraquat and diquat): HPLC
   Amino acid type herbicides (glyphosate and glufosinate): HPLC
   Organophosphorus pesticides (MEP, DDVP, malathion and others): GC/MS
5. Metals
   Atomic absorption spectrometry (in cooperation with the Department of Public Health)