Department of Forensic Medicine

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General Summary

Our main research projects in 2019, in previous years, have focused on forensic pathology, DNA analysis, and forensic toxicology. Much of the research was based on forensic practice. The details of our research are described below.

Research Activities

Forensic Pathology

1. Utility of rapid detection test for heart-type fatty acid-binding protein in postmortem blood

Although the rapid detection tests for heart-type fatty acid-binding protein (H-FABP) are frequently used in clinical practice, their utility for assessing postmortem blood have not yet been reported. Such rapid detection tests of H-FABP (range of detection; 6.2-2,000 ng/ml) were performed to measure serum concentrations in cardiac blood from 72 forensic autopsy cases. In the H-FABP negative group, as detected with the rapid detection test, the H-FABP concentration was significantly higher, and false negative results were shown with H-FABP concentrations greater than 5,200 ng/ml. We conclude that the H-FABP rapid detection test should not be used to assess postmortem blood because the concentrations it found were high regardless of the cause of death and because of the risk of false negative results if the H-FABP concentration is too high.

2. Utility of postmortem measurement of urine N-terminal pro-brain natriuretic peptide

The N-terminal pro-brain natriuretic peptide (NT-proBNP) is reported to be excreted in the urine. However, the utility of urine measurement in the forensic field is still unclear. We evaluated the diagnostic efficacy of NT-proBNP concentration in urine obtained postmortem in a series of forensic autopsy cases. This study suggests the diagnostic efficacy for acute myocardial infarction, congestive heart failure, and sepsis-related fatality in cases in which the postmortem interval was within 72 hours.

DNA analysis

1. Identification of war-dead remains with DNA analysis

We performed identification of war-dead remains that recovered and repatriated from the former Soviet Union and southern area by means of DNA analysis as part of the war-dead remains return project of the Ministry of Health, Labour and Welfare. For genetic markers we used single nucleotide polymorphisms of hypervariable region of mitochondrial DNA and short tandem repeats of nuclear DNA.

2. The detection and analysis of X chromosome short tandem repeats locus

The analysis of short tandem repeats (STRs) located on the X chromosome (X-STRs) is

known to be useful in kinship testing. In the present study we performed a detection and population genetic study of a novel tetranucleotide X-STR locus. We analyzed the sequence structure of novel X-STRs, the appearance frequency of alleles, and forensic statistics data. We registered this data with the International Nucleotide Sequence Databases. We are going to investigate relevance with other X-STRs by linkage analysis.
3. Human height prediction by forensic DNA phenotyping
We examined the prediction of human height with forensic DNA phenotyping. As a result of having analyzed human height and single nucleotide polymorphisms (SNPs), they were weak correlation.
To predict human height, an accurate prediction with the number of the smallest SNP must be performed. We are going to investigate a first-line combination of SNPs for human height prediction.

Forensic toxicology
1. Medicines and poisonous substances (abuse drugs, alcohol, carbon monoxide, cyanide, and agricultural chemicals) suspected to have caused deaths were quantitatively analyzed with gas chromatography, gas chromatography/mass spectrometry, liquid chromatography/tandem mass spectrometry, and spectrum photometry in tissue specimens obtained at autopsy. The fluoride was quantitatively analyzed with the standard addition method.
2. We have constructed methods for drug screening using liquid chromatography/tandem mass spectrometry. The target drugs were added, and approximately 290 types of drugs are targeted. Furthermore, we have considered adding target drugs.
3. Qualitative and quantitative analysis of fluoride was conducted with gas chromatography/mass spectrometry on a forensic autopsy of person who was suspected to have consumed hydrofluoric acid. Analyzed were liquid samples (femoral vein blood and stomach contents) and homogenized organs (muscle, fat, brain, heart, kidney, lung, liver, pancreas, spleen, and stomach). Fluoride beyond the lethal range was detected in the femoral vein blood. Furthermore, high concentrations of fluoride were detected in the stomach contents and such organs as the stomach, spleen, and pancreas. Fluoride was not detected in the fat or brain. Therefore, we concluded that the person who died had drunk hydrofluoric acid.
4. We performed a forensic anatomy of a person suspected of having consumed an alkaline solution of unknown composition. We attempted liquid chromatography/quadrupole time-of-flight mass spectrometry analysis combined with Kendrick mass defect analysis to estimate the components contained in the sample (blood and stomach contents). As a result, a polyethylene glycol compound was detected in each sample.

Radiocarbon analysis
1. Establishing date of birth
We studied the estimation of date of birth from carbon-14 level isolated from tooth enamel or dentin or both. This method was applied to a postmortem examination, and its usefulness and problems were discussed. We also examined the effect of dental caries on the carbon-14 level. To apply this method to forensic practice, we have examined the minimum amounts of enamel and dentin required for analysis.

Publications

Matsumoto S, Iwadate K. Utility of detection test for heart-type fatty acid-binding protein in postmortem blood. *Rom J Leg Med.* 2019; **27**(3): 254-257.
Takasu S, Matsumoto S, Kanto Y, Kodama S, Iwadate K. Postmortem urine concentration of N-terminal pro-brain natriuretic peptide in relation to the cause of death. *Forensic Sci Int.* 2020 Jan; **306**: 110079. doi: 10.1016/j.forsciint.2019.110079. Epub 2019 Nov 26. PubMed PMID: 31812084.
Takasu S, Matsumoto S, Kanto Y, Kodama S, Iwadate K. Utility of biochemical markers in the postmortem diagnosis of ischemic heart disease. *Jikeikai Med J.* 2019; **66**(1-4): 9-15.