OPTIMIZATION OF ACTINIDE ANALYSIS PROCEDURE FOR FECAL SAMPLE IN RADIATION EMERGENCY

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Feces analysis procedure of Pu-238, Am-241, and U-238 was reviewed. Bioassay for rapid internal dosimetry of victims during radiation emergencies is important. Feces contains materials cleared from the lung, systemic material excreted into the GI tract, etc. and it should be purified to extract the target radionuclide. The comparison of sample preparation method was reviewed. In addition, making the counting source using rare earth co-precipitation method and electrodeposition method were discussed. The optimal analysis procedures of Pu-238, Am-241, and U-238 were established.

I. OBJECTIVE

The internal dosimetry of victims is important information for medical treatment during radiation emergencies. Many international organizations have recommended taking samples from victims such as urine and feces to evaluate internal dose for decision making of medical treatment (Ref. 1, 2). In some cases, feces analysis for several actinide radionuclides such as Pu-238, Am-241, U-238, etc. should be conducted for the special monitoring to perform the internal dosimetry (Fig.1).

II. METHOD

In general, fecal samples consist of waste products transferred through the GI tract cellular debris sloughed from the walls of the intestines. It contains materials cleared from the lung, and systemic material excreted into the GI tract (Ref. 3). Therefore, the extraction and purification techniques are main issue to perform the accurate measurement. The analysis method for the target radionucldes has been improved for the long time. Especially, rapid analysis method has been recently reported in order to respond the emergency situation. In this study, the comparison of sample preparation method between wet-ashing and fusion method was reviewed. In addition, the counting source by rare earth co-precipitation method was compared with electrodeposition method. The optimal analysis procedures of Pu-238, Am-241, and U-238 were established.

III. RESULTS

The reference fecal samples were used for the validation of analysis procedure for Pu-238, Am-241, and U-238. Reference fecal samples consist of 20 chemical reagents, which were similar with the real feces according to ANSI standard (Ref. 4). Based on the results, real fecal ash samples were analyzed and the results were reviewed. Pu-238 and Am-241 using fusion preparation method were well agreed with the reference values, while the results of U-238 were not well matched. Moreover, chemical efficiency of co-precipitation method using cerium fluoride was compared with eletrodeposition method. However, considering the time efficiency for rapid response, the comprehensive sample analysis procedure was reviewed.

IV. CONCLUSIONS

In the present study, actinide analysis method of fecal samples in emergency situation was performed and reviewed. Fecal samples collected from victims can offer a lot of information on internal contamination and dosimetry. Moreover, the measurement results can be used for medical treatment for some radionuclides. However, fecal samples contain many kinds of obstacles to extract the target radionuclides. The advantages of each preparation method (fusion and wet-ashing) were discussed and the effective analysis procedure was proposed following radionuclides. More simple and efficient process for fecal samples should be developed in the future.

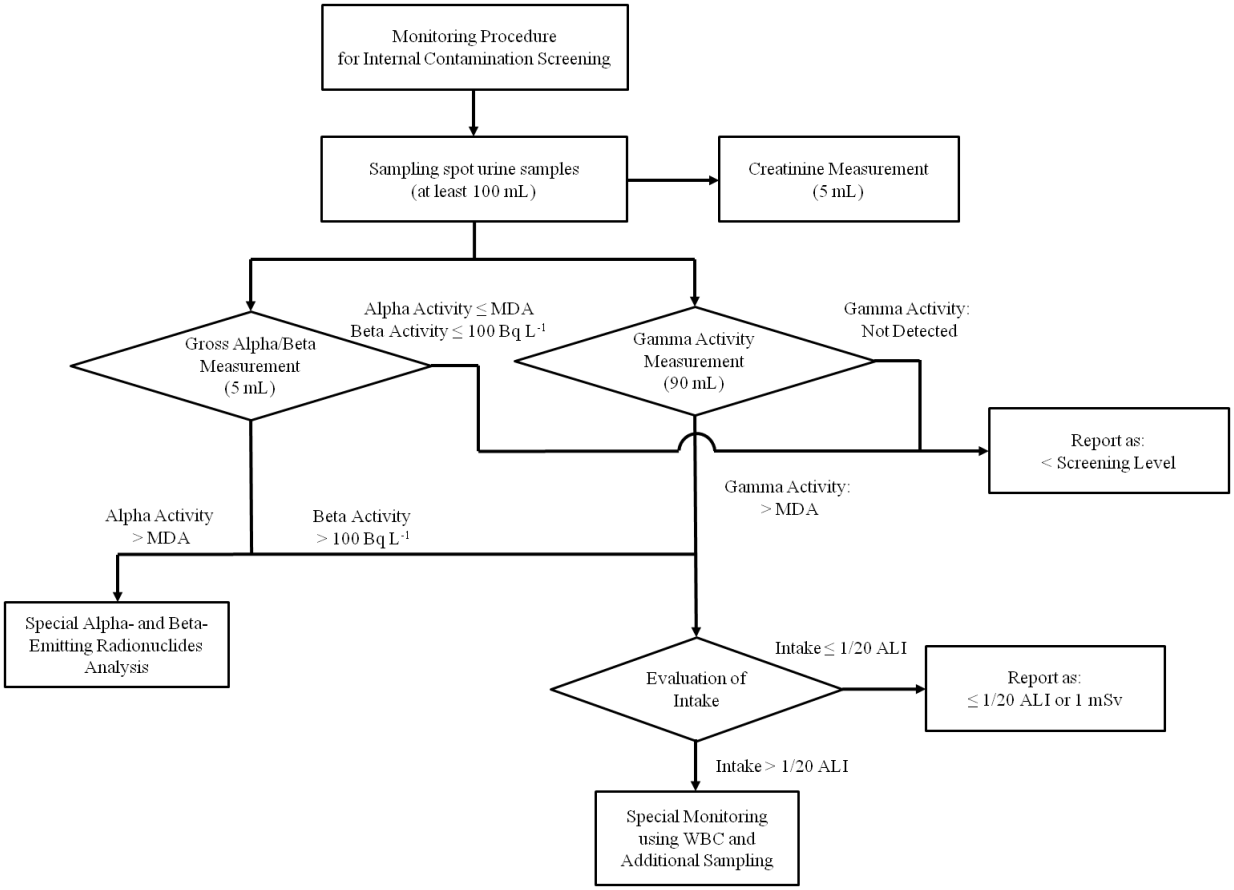

Fig.1. Flow chart of internal contamination screening by alpha-, beta-, and gamma-emitting radionuclides.

ACKNOWLEDGMENTS

This study was supported by a grant of the Korea Institute of Radiological and Medical Sciences (KIRAMS), funded by Ministry of Science, ICT and Future Planning, Republic of Korea. (1711031808/50581-2017).

REFERENCES

1. INTERNATIONAL ATOMIC ENERGY AGENCY, *Generic procedures for medical response during a nuclear or radiological emergency*, IAEA, Vienna (2005).
2. ROJAS-PALMA C. et al., *TMT handbook: triage, monitoring and treatment of people exposed to ionising radiation following a malevolent act*, NRPA, Norway (2009).
3. INTERNATIONAL ATOMIC ENERGY AGENCY, *Indirect Methods for Assessing Intakes of Radionuclides Causing Occupational Exposure*, IAEA, Vienna (2000).
4. AMERICAN NATIONAL STANDARDS INSTITUTE, *Performance Criteria for Radiobioassay*, ANSI, U.S. (2011).