CONTAMINATION MEASUREMENTS ON PERSONS AFTER A NUCLEAR ACCIDENT

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ABSTRACT

The purpose of contamination measurements after accidents is threefold: to detect and localize contaminations; to determine the level of contamination as a base for medical decisions; and to check the scope and efficiency of the decontamination measures.

Persons involved in accidents should never measure their contamination themselves. The radiation protection personnel, whether it belongs to the medical team or to the disaster control squads, must be familiar with the measuring instruments and experienced in handling these instruments. A high priority has to be placed on training and constant practice.

The monitors used must meet the special requirements of an emergency situation. This includes resistance against environmental factors - temperature, humidity, vibrations - as well as the simplicity of handling the instrument, and the clear presentation of the results.

CONTAMINATION MEASUREMENTS AND MEDICAL CARE OF PERSONS ADDITIONALLY CONTAMINATED

Several international and national guidelines exist for treating persons exposed to radiation or contaminated after a nuclear accident (1, 2, 3). However, they focus almost exclusively on the medical care, without discussing the necessity, let alone the practical performance, of procedures related to a contamination measurement.

It seems justified, therefore, to clarify the role and purpose of contamination measurements in the medical treatment of contaminated persons. In the course of the decontamination process, four steps can be emphasized for the measuring technique: detecting - preventing - ensuring - documenting.

First, the level and extensions of person contaminations have to be determined. Particularly, if a large number of persons have been contaminated, these measurements serve as a basis for determining where the high level of contamination requires that immediate steps be taken, and where a treatment is less urgent (the treatment itself is beyond the scope of this paper).

A second purpose of the measurements is to prevent immediate harmful effects of the contamination. For the affected person this is a too high skin dose, on the one hand, and the incorporation of the activity through possible wounds.

With regard to the staff one has to make sure that contamination cannot be passed on or neglected. This is equally true for staff, environment and instruments.

Third, contamination measurements should ensure that the provisions taken have been effective. During person decontamination the success has to be checked by measurement until the desired values have been reached. Moreover, the measurement has to rule out any chance that contaminations are missed.

Finally, the results of the measurement are used for documentation purposes. This documentation is required not only for a later analysis and evaluation of the accident and its consequences; it also serves for clarification of possible legal claims of the affected persons.

Regardless of the great importance of contamination measurements in the course of decontamination procedures, one has to say clearly that the medical treatment always has priority in an emergency. In some situations no measuring instruments may even be available at all, but a decontamination has to be performed nevertheless.

However, a professional medical treatment of contaminated persons can only be ensured in conjunction with a professional contamination measuring technique.

TYPE AND NUMBER OF INSTRUMENTS REQUIRED

The most important instrument for measuring contaminated persons is a portable contamination monitor with large-area detector (at least 100 cm^2 area). How many of these instruments are required is dependent upon the planned person throughput of a decontamination facility.

Two aspects should be considered. On the one hand, it is advisable to keep separate instruments for the "hot" entrance area and the "cold" exit area - and to label them accordingly! - in order to avoid crossover contamination between early and late decontamination areas. On the other hand, spare instruments should be available in the event of heavy contamination or when one instrument is defective.

It is also advisable to provide wall holding devices for the portable instruments. There, the monitors can be "parked" when they are not being used; they may also serve as semi-stationary hand monitors for the staff.

Larger facilities should provide one or several stationary hand-foot-monitors at the entrance and exit, which should be equipped with result printers. At least the instruments positioned at the entrance should be provided with a contamination protection (foil). Patients may enter the monitors positioned at the entrance only under the supervision of the staff performing the measurement. The staff enters the patient's ID prior to the measurement which will then be documented together with the result of the measurement.

The contamination monitors should indicate the result as area-related activity in the unit Bq/cm^2 (discussion and reason for this requirement in ( ). A proper calibration is required. The bases for this are national and international standards (4,5). Calibrations are essentially type test which are performed by the manufacturer.

Regardless of the calibration, a regular function check of the monitors is required. This is simply a good laboratory praxis. Suitable test sources are usually supplied by the instrument manufacturers.

REQUIREMENTS FOR CONTAMINATION MONITORS

When checking persons involved in an accident for contamination, who may even be injured, this is usually done under difficult conditions. The difficulties are, on the one hand, of a psychological nature, such as stress, insecurity, improvisation and high time pressure; on the other hand, there are the concerns of the environment in which these measurements have to be carried out. Due to the fact that for decontamination a person has to wash, shower and change clothing all the time, it may be wet, warm, crowded, and noisy. Moreover, the visibility may be quite bad due to vapour or insufficient light. Therefore, contamination measuring instruments have to meet special requirements to make sure that reliable results will be obtained.

These requirements concern the mechanical as well as the electronic construction of the measuring instruments. The key words "robust" and "moisture resistant" characterize the mechanical, and "intelligent" the electronic features. There is, however, an additional requirement concerning the simple and reliable handling of the monitor. It is characterized by the terms "simple and clear".

Of particular importance is the quick response of the monitor. Especially when detecting contaminations it is necessary that the result indication adjust as quickly as possible to the changes of the current measured value, without becoming blurred by random statistical variations. Modern micro-processors can be taught to behave accordingly via software. Furthermore, for the clear readability of the measured value it is quite useful to display only the statistically significant number of decimals.

In general, the requirement is to implement a high level of intelligence into the monitor electronics. This facilitates the user's own decisions and interpretations. It not only helps to avoid errors and mistakes, but enables the operator to focus his attention on the execution of the measurements, rather than on the instrument.

STAFF TRAINING AND PRACTICE

Even if the contamination monitors which are available after an accident meet all the requirements listed above: their professional use still requires well-trained and practised staff.

Persons accidentally contaminated should never measure themselves, not even if they have sufficient experiences in this field. The reason is not only a possible accident shock; it also has to be ensured that all persons involved will be measured according to the same routine and with the same care.

This indicates where training has to start. In addition to the actual handling of the measuring instrument, the execution and procedure of person contamination measurements, the interpretation of measured values and the documentation have to be taught and practised as well.

The importance of constant practice cannot be emphasized enough, although we cannot go into details. This can be combined with a regular function check of the instruments, which is required any way.

This principle is applicable, of course, for all emergency applications and is discussed in detail in (7).

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