Optimization of cytogenetic procedures for radiological emergency

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In case of accidental overexposure to ionizing radiation, the scoring of dicentrics in lymphocytes from blood is the current reference method to estimate the dose received. In the particular case of radiological emergency it will be necessary, first to sort highly exposed persons from the others, second to estimate as precisely as possible the doses received by all the exposed victims.

When only few individuals are accidentally overexposed, at least 500 cells are scored to have a good estimation of the dose. But such a practice is too time consuming when many people are exposed such as in radiological emergency. To reduce the analysing time it is possible to have a dose estimation based on only 50 cells analyzed in an hour. Such rough dose estimation can be used to perform the population triage. In such case, the 95% confidence interval of the dose is 1Gy. This strategy was tested in real accidental situation but also with emergency exercises and gave reasonable good results. However the capacity of an individual laboratory is limited to 200 samples. To increase the number of samples to be handled, international and national networks should be established. To be operational, such network must perform intecomparisons and population triage exercises. The methodology of the establishment of such network will be presented. This described strategy seems efficient for the first emergency step which is the population triage phase.

Once the triage phase has been achieved it is required to estimate precisely the dose. This can be done by increasing the number of cells scored. But alternatively to the manual scoring image analysis systems can be used to automatically detect dicentrics. The system proposes to the operator some candidate dicentrics which are verified manually. The only commercially available system is proposed by METASYSTEMS (Germany) with a dicentric detection efficiency of more than fifty percent. By comparing the results obtained after the manual scoring and after the use of the image analysis system in a real emergency situation, it was found that for an equivalent number of cells scored this image analysis system allows a dose estimation not a precise as scoring manually but is nearly 5 times faster. Indeed for 500 cells analyzed in half an hour, the 95% confidence limit of the dose found is 0.4 Gy.

In conclusion the dose estimation in an emergency situation involving more than 200 individuals should be based first on the scoring of 50 cells using a network of trained operators, second on an image analyzing system to estimate more precisely the dose.