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Inter-Laboratory Comparison of SPECT Studies with Phantoms

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Recently, the Neuroimaging Committee of the EANM initiated the generation of a database of [^{123}I] FP-CIT SPECT scans of healthy controls through the collaborative effort of many European institutions. In order to maintain the quality of the SPECT imaging in the participating laboratories, the equipment was validated through an interlaboratory-comparison study. A core group of physicists was formed who, in collaboration with the other physicists from the participating institutes, performed the quality control check of the cameras using a total performance and a striatal phantom. The data are currently under evaluation.

This work is an example of the need to maintain quality and confidence in nuclear medicine data, with departments required to implement a quality assurance program. This is especially true for studies that will provide data to multi-centre trials.

The aim of the interlaboratory comparison study is to evaluate the "state of the art" in the individual laboratories, compare the performances, improve the individual practices, and promote more uniform investigation protocols among the NM laboratories in multi-centre trials. The participating NM centres are provided with phantoms, imaging and processing protocols, and report forms, and asked to send the test results to the organising body. The reports showing the individual performances in comparison with those of the group are returned to the participants, enabling them to identify aspects of their own performance and the agreement of their results with those of other centres.

The success of an interlaboratory comparison study depends on several aspects:

Organising the study

- Financing: The cost of such a study is very high. The main organisers of the studies are international (1, 2) or national organisations (3), often with the collaboration of radiopharmaceutical or nuclear medicine equipment-producing companies.
- Selection and acquisition of the quality control device (e.g. phantom): For the brain study, for example, a multiple performance SPECT ECT phantom and a fully tissue-equivalent anthropomorphic striatal phantom were used.
- Organisation of the transport of the device between the sites: The practical work needed to arrange shipment is considerable.

Executing the study

- Creation of a standard protocol for imaging and a reporting form: The protocol has to be fitted to the parameters of the camera to be checked and the possibilities of the phantoms. It has to be detailed and precise, defining the acquisition and processing techniques. The reporting form has to be simple and the format of the images has to be fixed in advance.
- Performance of the measurements: One option is to ship the phantom to the participants and leave them to perform the protocol, including the handling of the phantom, the acquisition and processing of the images, the completion of the reporting form, the saving of the data and the sending of the results to the organisers. The alternative is to have a responsible person from a "core lab" who would visit each site and help the centres performing the tests, so minimising the interobserver variability.
- Collection and evaluation of the data: A core lab has to be created, which analyses the results of the different centres with the same method, in a comparative way.

- Informing the participants about the performance they achieved and how it compares with the other centres: Quick feedback of the results is vital, in order to maintain the interest of the participants. Confidence is an important feature. The participants receive their own results and also those of the others, but the others' names remain anonymous. It is important that the core lab should give help for the participants to establish the causes if their performance is lower relative to the others.
- Sharing the information with the other NM centres: The reports should be published, so as to be accessible for the members of the NM community in order to propagate quality in the field.

Critical points and recommendations

The phantoms have to be sturdy enough to survive transportation and handling. The radioisotope has to be ordered well in advance, and the camera time has to be booked, causing the least possible inconvenience for the normal patient investigations.

It is essential that a responsible person from the participating centres is designated in advance, in order to be involved in the local management of the study and to liaise with the core lab staff.

The performance of the SPECT cameras should be checked by local staff before the core lab visit, to ensure that the camera is working well, and to arrange for engineering correction if needed.

The other equipment necessary during the tests must also be considered (e.g.: the dose calibrator, well counter, and analytical balance) and different containers have to be acquired in advance. The participants must check in advance that the specified acquisition and processing protocols can be used since this may require investigation which must be done before the study.

The processing is equally important. To save time, the processing parameters, the file format and the archiving method have to be checked in advance. After receipt of the evaluated data from the core lab, the causes of the discrepancies must be investigated, with assistance from the central laboratory.

All of this work takes considerable effort and commitment, by local and core lab staff, but will improve the data quality from Multi-centre clinical trials.

References

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