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Study of specimen stability in clinical laboratories: ensuring quality of results and patients' safety

*Estudo de estabilidade de amostras no laboratório clínico: garantia de qualidade
dos resultados e da segurança para o paciente*

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Errors in the pre-analytical phase can account for results that lead to unnecessary clinical laboratory testing, inducing inadequate clinical decisions, bringing harm to patients and increased costs. This justifies higher awareness of the importance and the need for a more accurate management in this step of the laboratory testing cycle. Systematization and monitoring of those variables characterize organized and efficient laboratories, which excel at quality of services and strive to improve their patients' safety.

Some of the major sources of pre-analytical variability are sample transportation and storage, associated with preparation for analysis. Good governance of this phase implies risk assessment, establishment of policies to prevent errors and accidents with the collected biological material, increase and diversification of protection barriers, as well as decrease of the process vulnerability⁽¹⁾.

In practice, the use of reference laboratories became routine for specialized and low-demand tests, performed in diverse materials such as the cerebrospinal fluid (CSF). Transportation with this aim depends on several types of logistics and follows well-defined parameters for sample packaging. These precautions are intended to ensure that results obtained from those samples are comparable with those from measurements carried out just after collection, without undermining quality⁽²⁾. Thus, pre-analytical variations related to sample storage time and temperature, as well as transportation conditions, are relevant⁽³⁾.

Studying sample stability is a good practice in clinical laboratories, as observed in the work by Domingues *et al.*⁽⁴⁾ (2019), which stands out for evaluating stability in a precious material, whose interest has increased in the last decades due to analyses for neurochemical diagnosis in investigations of neurodegenerative disorders: Alzheimer disease is the most common^(5,6). It is also relevant in collaborative studies for investigation of CSF in neuroinflammatory disorders, such as multiple sclerosis, in the search for oligoclonal bands of immunoglobulin G (IgG) or by intrathecal IgG synthesis.

Another application for this type of study is to use biobank long-time stored materials for research purposes, aimed at ensuring that the statistical power obtained by a large number of samples is not affected by pre-analytical factors, allowing comparisons between results from different laboratories. This standardization enables researchers to replicate studies with specimens that match the initial pilot data⁽⁷⁾. The stored CSFs have been used in biomarker researches, as in low-molecular weight proteome analysis^(8,9) or metabolomics, which use of highly accurate techniques (such as mass spectrometry), but demand sample verification, given their necessity of sample integrity⁽¹⁰⁻¹²⁾.

Several authors have quantified the effect of pre-analytical factors in CSF, including: the influence of different types of needle for puncture⁽¹³⁾; time of puncture; site of puncture (lumbar puncture is more commonly employed, as in the article by Domingues *et al.*); collection tubes and specimen storage⁽¹⁴⁾; specimen handling and form of storage. In evaluating stability of CSF, the influence of centrifugation on atraumatic CSF (erythrocyte count < 500/mm³) has been studied, besides types of sample fractionation, transportation temperatures (2°C-8°C, -20°C, dry ice), and the effects of freezing temperatures (-20°C, -80°C, use of liquid nitrogen), stability of specimen freezing time, freezing delay and freeze-thaw cycles⁽¹⁵⁻¹⁷⁾.

For CSF laboratory analysis, pre-analytical standardization is crucial because it ensures the obtainment of specimens with definite quality standard, with reliable results that bring adequate clinical outcomes, improving patient safety.

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