

IS38. MASS SPECTROMETRY TECHNIQUES IN CLINICAL LABORATORY

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Development of the mass spectrometry (MS) techniques became an useful tool for the measuring of analytes in clinical chemistry laboratories. It is obvious that there is an increasing trend in the borderline cases due to early diagnostic techniques and development of the health care systems require more sensitive, specific and reliable techniques than routinely used methods. MS techniques provide higher sensitivity and specificity. Because of having unequalled sensitivity, lower detection limits and diversity of its applications MS has an outstanding position among the analytical methods. MS laboratories become a part of clinical chemistry laboratories during the last decade.

MS main areas are endocrinology, clinical and forensic toxicology, inborn error of metabolism, therapeutic drug monitoring and emerging clinical biomarkers. Steroids measurements are one of the main focus in MS laboratories in endocrinology section. MS analysis recommended hormones are; estradiol in male, prepubertal ages and postmenopausal term, free testosterone, aldosterone, 17-OH progesterone, Deoxicorticosterone, 25-OH vitamin D2 ve D3, 25-OH vitamin D3/3-epi-25-OH vitamin D3, 1,25-dihydroxy vitamin D3 ve 24,25 dihydroxy vitamin D3. MS analysis is also found to be superior against immunoassay in the measurement of free thyroxine and thyrotrone levels.

It has been also demonstrated that MS has several advantages to immunoassay in therapeutic drugs analysis. The chemical structures of therapeutic drugs and their metabolites are quite similar to the parent drug, therefore, it is difficult if not impossible to construct an immunoassay that recognizes the parent compound without some degree of cross-reactivity towards one or more of the metabolites. MS based assays have been developed for immunosuppressants and are widely used in clinical practice.

MS has been used for clinical and forensic toxicology for two main reasons. Immunoassays are platforms used as a screening test because they provide faster results and tests are commercially available. Due to the specificity limitations of immunoassays, MS is used to confirm false positive results from the screening immunoassay systems. As such, these MS assays are designed to find particular drugs or their metabolites. MS analysis is also used for comprehensive drug screening.

For the use of inborn errors of metabolism, analyzing for amino, organic, and fatty acids has undergone a

series of developments to the technology. Tandem MS is now recognized as one of the most definitive analysis procedures for measuring these analytes. Tandem MS system is capable of measuring all of the analytes within a group in a single run. So MS is called a “multiplex” testing.

Development of the MS and chromatographic techniques have led to great success to quantification and characterisation of proteins. Because of MS, a draft of human proteomics was published in Nature in 2014. The diagnosis of infectious pathogens presents the range of application of MS and its growing potential to contribute to clinical diagnostics.

Main advantages of MS can be classified as;

low solvent volumes,
high throughput, providing clinically stable results with deuterated internal standards,
minimizing the specificity problems,
high analytical range,
improved sensitivity,
multiplex testing in a single run,
cost-effective in long term (after 1-2 years after setup).

Main disadvantages of MS can be classified as;

requirement of experience for method development and procedures,
time consuming application, method validation progress,
long turnaround times due to long preanalytical steps,
difference in calibrator and methods,
lack of standardisation of solvents and stability issues.

The cost of analysis is also of critical importance, which is closely related to the number of samples analyzed. Development of analytical techniques is always expensive, time-consuming and needs expertise. However MS instruments are powerful tools and can be cost-effective after 1-2 years in clinical laboratories. The cost of test is lower than other methods for high throughput experiments.

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