Prostate cancer is one of the most commonly diagnosed cancers in men worldwide—each year, it affects over 1.4 million individuals. When detected early, the prognosis is generally very good, but the chances of successful treatment drop sharply if the disease is diagnosed at a later stage. That's why accurate and reliable diagnostic methods are so important.

Currently, the most widely used test for detecting prostate cancer is the measurement of PSA, or prostate-specific antigen. While this test has played an important role in improving early detection rates, it is not without its shortcomings. PSA levels can rise for reasons unrelated to cancer, which means the test may give a "false alarm." As a result, many men undergo unnecessary biopsies or treatments for conditions that don't actually threaten their health.

To address this issue, a research project has been launched to search for new biomarkers—biological indicators—that point to the presence of prostate cancer. Scientists are focusing on identifying specific chemical substances, especially small molecules (metabolites), that appear in the tissues, blood, or urine of prostate cancer patients but are absent in healthy individuals.

As part of the project, researchers are using advanced technologies such as two- and three-dimensional mass spectrometry imaging (MSI) and ultra-high-performance liquid chromatography combined with high-resolution mass spectrometry (UHPLC-HRMS). These cutting-edge techniques allow scientists to "look inside" tumor tissues and analyze their chemical composition in detail. This helps reveal metabolic changes and determine which biochemical pathways are active during cancer development.

Researchers also plan to compare the metabolic profiles of prostate cancer with those of other urological cancers—such as bladder or kidney cancer—to identify biomarkers that are specific to prostate cancer. Importantly, analyzing the small molecules found in blood and urine could lead to the development of non-invasive diagnostic tests that don't require tissue biopsies.

The ultimate goal of the project is to create tools that will help doctors make more accurate diagnoses and choose the most effective treatments. By using innovative methods like mass spectrometry enhanced with nanoparticles of precious metals (such as gold and silver) and advanced 3D imaging of tissues, scientists hope to gain deeper insights into the biology of prostate cancer and its microenvironment.

In the long term, these studies may help reduce unnecessary medical procedures and support the development of targeted therapies tailored to individual patients—contributing to the advancement of personalized medicine, which is the future of modern oncology.