

Application News

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MALDI-8020

Automated Analysis of Acute Kidney Injury using the MALDI-8020 Benchtop Linear MALDI-TOF MS with SampleStation™ & AuraSolution™ Software

Acute kidney injury (AKI) refers to sudden damage to the kidneys resulting in impairment of their normal function (Table 1). Since the kidneys are the major excretory organs of waste in the body, this is potentially a serious clinical condition, in the absence of early detection and intervention.

Several hospital patient clinical groups, particularly those with hip fractures, have been identified to be at high risk of AKI during treatment⁽¹⁾. Correlations have also been made with long-term mortality⁽²⁾, and the financial burden to the UK National Health Service is £434-620 million annually. These are all indications of a need for monitoring and early prediction of AKI.

In response to this need, a method transfer study is ongoing to screen for AKI biomarkers using matrix assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF MS)⁽³⁾. This would harness the typical advantages associated with this technology, which include the rapid analysis, simple sample preparation and small volume requirement combined with high sensitivity and mass accuracy. MALDI-TOF MS could then become preferable to contemporary methods for AKI including ELISA and CE-MS.

Here, we provide an example analysis of urine samples, from intensive care unit patients at risk of AKI, using the MALDI-8020 mass spectrometer (Fig. 1). The seamless workflow controlled by the SampleStation™ and AuraSolution™ software enables automated analysis with data security and sample traceability, all of which are important for clinical analysis.

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Table 1 Aetiology classification of AKI and examples

• Prerenal	Kidney hypoperfusion from low blood pressure, renal emboli
• Renal	Renal parenchymal disease from drugs (analgesics, antibiotics), glomerulonephritis, IV contrast
• Postrenal	Outflow obstruction in ureter, bladder or urethra from stones, tumour mass, enlarged prostate, surgery, radiation treatment



Fig. 1 Shimadzu MALDI-8020 benchtop linear MALDI-TOF instrument

■ Samples and Methods

Diluted aliquots of urine samples (following SEC desalting) were kindly provided by Professor Bill Mullen of the Institute of Cardiovascular & Medical Sciences department at the University of Glasgow (UK). Samples were analysed on a MALDI-8020 instrument with SampleStation and AuraSolution software as follows: Samples (0.5 µL) were deposited with 1 volume of MALDI matrix (alpha-cyano-4-hydroxycinnamic acid (CHCA), 5 mg/mL in 1:1 acetonitrile/0.1 % (aq.) TFA) and allowed to dry on a disposable barcoded conductive MALDI target slide (FlexiMass-DS (Shimadzu)). The acquisition parameters of the MALDI MS analyses are summarised in Table 2.

Table 2 MALDI data acquisition parameters

Tuning	linear
Polarity	positive
Mass range	400-2500 Da
Laser rep. rate	200 Hz
Accumulation rate (laser shots/profile)	50
Profiles	100
Sampling method	Raster

Results

Fig. 2 shows the easy workflow used for automated MALDI MS analysis using the SampleStation and AuraSolution software.

Fig. 3 shows an example result of a MALDI-MS spectrum of biomarkers of AKI in urine. The well-resolved isotopic peaks of the peptide species demonstrate the outstanding linear mode resolving power of the instrument.

References

- (1) Porter, C.J., et al., 2017. BMC nephrology, 18(1), p.20.
- (2) Hong, S.E., et al., 2017. PloS one, 12(4).
- (3) Carrick, E., et al., 2016. PROTEOMICS-Clinical Applications, 10(7), pp.732-742.

1
Sample Preparation: Urine samples spotted onto multiple slides - each with unique barcode identifiers which can be scanned with hand held scanner

2
Creation of sample worklists with simple 'click and scan' approach in SampleStation: Sample content from each slide is saved to a database using the SampleStation software and a hand held scanner

3
Automated MALDI MS analysis with simple 'insert slide and click start' approach in AuraSolution: Sample worklists are automatically retrieved for barcoded slides, using the internal barcode reader (inset A) in the MALDI-8020. Analysis is performed using pre-defined methods created by the system administrator

Fig. 2 Workflow of steps (1-3) used for automated MALDI-TOF MS analysis of urine samples for AKI screening with SampleStation and AuraSolution software. NB. Whilst data is being acquired (3), further worklists from additional slides (2) can simultaneously be created without interrupting the ongoing acquisition. Worklists which have already been acquired are seamlessly updated (as seen with purple colour code in SampleStation screenshot above). Inset, A: internal barcode reader.

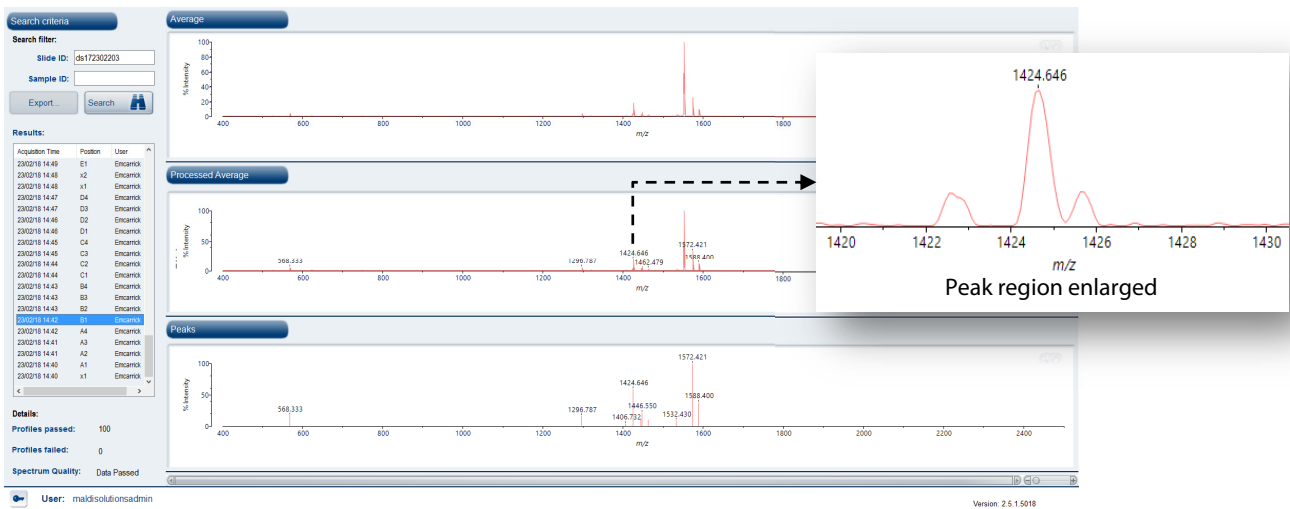


Fig. 3 Screenshot of AuraSolution spectrum window used to review results of AKI sample analysis with MALDI-TOF MS: In this example, AKI biomarker (m/z 1424.67) can be seen. The enlarged mass spectral region shows isotopic resolution (inset) in linear mode.



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