

Supplementary Information

A new approach to study human perivascular adipose tissue of internal mammary artery by fiber optic Raman spectroscopy supported by spectral modelling

Zuzanna Majka^{a,b,#}, Krzysztof Czamara^{a,#}, Piotr Wegrzyn^c, Radosław Litwinowicz^c, Joanna Janus^{a,b},

Stefan Chlopicki^{a,d} and Agnieszka Kaczor^{a,b,}*

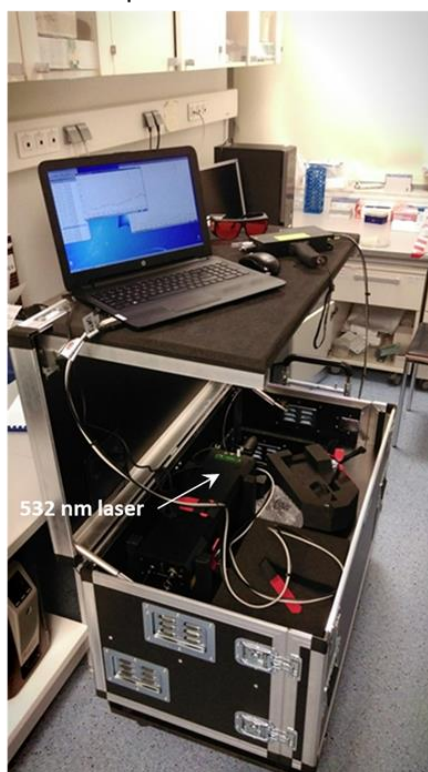
^aJagiellonian Centre for Experimental Therapeutics (JCET), Jagiellonian University, 14 Bobrzynskiego Str., 30-348 Krakow, Poland.

^bFaculty of Chemistry, Jagiellonian University, 2 Gronostajowa Str., 30-387 Krakow, Poland.

^cDepartment of Cardiovascular Surgery and Transplantology, John Paul II Hospital, Jagiellonian University Medical College, 80 Pradnicka Str., 31-202 Krakow, Poland.

^dChair of Pharmacology, Jagiellonian University Medical College, 16 Grzegorzeczka Str., 31-531 Krakow, Poland.

WITec Alpha Cart



Raman fiber probe



Figure S1. The experimental setup of Raman spectrometer WITec Alpha Cart with Raman fiber probe.

Table S1. Detailed characteristics of studied patients.

Patients										
	1	2	3	4	5	6	7	8	9	10
<i>Gender</i>	Male	Male	Male	Male	Male	Male	Male	Male	Male	Male
<i>Age (years)</i>	66	57	68	63	61	69	62	66	73	72
<i>BMI¹ (kg/m²)</i>	31.64	32.93	25.83	27.72	26.12	26.37	34.72	23.88	23.12	25.86
<i>Smoking</i>	NO	YES	YES	YES	NO	NO	NO	YES	NO	NO
<i>Blood glucose level (mmol/L)</i>	8.4	6.1	5.4	5.6	5.6	5	9.1	6.2	6.2	8
<i>Affiliates</i>										
Arterial hypertension	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Type 2 diabetes mellitus	NO	YES	NO	YES	YES	YES	YES	NO	YES	NO
Acute myocardial infarction	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO
Hypercholesterolemia	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Others	Chronic kidney disease		Kidney calculus AAA ³			Gout	Kidney calculus	Gallstone AAA ³	COPD ⁴	Kidney calculus. A lesion in right lung
<i>CCS² scale</i>	II	II	II	II	II	III	III	III	III	III
<i>Number of bypass grafts</i>	3	3	4	3	1	4	3	2	3	4
<i>Drug treatment</i>	Statins.			Statins.	Statins.		Statins.	Statins.	Statins.	Statins.
	ACE-I ⁵	Statins	Statins	ACE-I ⁵ .	Beta-blockers	Statins.	ACE-I ⁵ .	ACE-I ⁵	ACE-I ⁵	ACE-I ⁵ .
	Beta-blockers	Beta-blockers	Beta-blockers	Beta-blockers	Anti-db ⁶	ACE-I ⁵	Beta-blockers	beta-blockers	Beta-blockers	Beta-blockers
				Anti-db ⁶			Anti-db ⁶	Anti-db ⁶	Anti-db ⁶	Anti-db ⁶
<i>Atrial fibrillation</i>										
YES										

<i>Lipid unsaturation degree</i>	0.339	0.349	0.352	0.365	0.369	0.383	0.400	0.405	0.491	0.516
<i>Carotenoid level</i>	4.452	1.591	5.069	2.562	2.059	1.399	3.423	4.440	0.399	0.000

¹BMI – Body Mass Index (kg/m²)

² CCS scale – Canadian Cardiovascular Society scale (I – IV)

³AAA – Abdominal aortic aneurysm

⁴COPD – Chronic obstructive pulmonary disease

⁵ACE-I – ACE inhibitor – An angiotensin-converting-enzyme inhibitor

⁶Anti-db – Antidiabetic drugs

Heterogeneity of population and influence of affiliated diseases

Due to the fact that this study was done on a heterogeneous group of patients. various factors may affect the obtained results and it is impossible to define them. however based on current results it is tempting to speculate that age could be also an important factor. Indeed. two oldest patients (number 9 and 10) have a markedly increased level of unsaturation of lipids in PVAT of IMA (close to 0.50) compared to all other patients (0.34-0.40). Moreover. these patients have also a notably low carotenoid content: for one of these patients carotenoids were not observed in PVAT of IMA. for the other one the relative carotenoid content was 0.4. In the rest of the studied population. the carotenoid content was 1.4-3.4 and 4.4-5.1 for the diabetic patients and non-diabetic individuals. respectively. Moreover. one of the most obvious factors that may influence the results is the BMI of the patients. Although evaluation of the BMI influence on the studied markers in such small population as studied is impossible. it is necessary to underline that the this factor may affect the unsaturation ratio and. in particularly. the PVAT carotenoid level.

Table S2. Experimental and modeled values of lipid unsaturation degree and carotenoid level with relative error.

	Patients									
	1	2	3	4	5	6	7	8	9	10
<i>Lipid unsaturation degree</i>										
Experimental	0.339	0.349	0.352	0.365	0.369	0.383	0.400	0.405	0.491	0.516
Modeled	0.375	0.384	0.362	0.401	0.394	0.404	0.396	0.378	0.460	0.505
Relative error [%]	8.069	8.781	1.685	1.007	6.486	5.483	4.808	7.579	4.959	2.321
<i>Carotenoid level</i>										
Experimental	4.452	1.591	5.069	2.562	2.059	1.399	3.423	4.440	0.399	0.000
Modeled	6.407	2.892	6.916	3.645	2.784	3.047	4.320	6.216	1.226	0.000
Relative error [%]	7.959	20.57	9.795	15.71	0.215	9.153	12.39	8.319	49.69	0.000

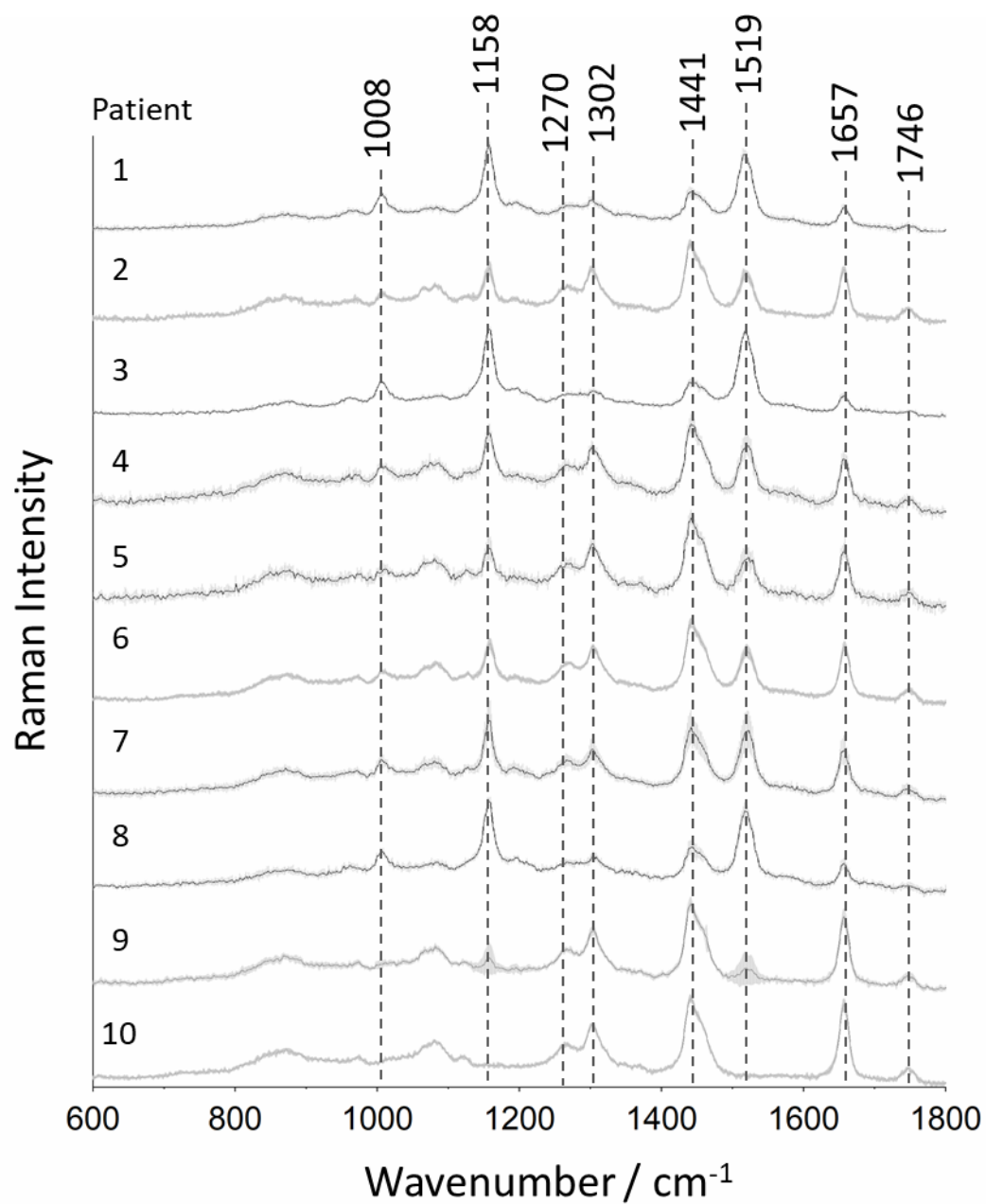


Figure S2. Raman spectra of PVAT of the human internal mammary artery. Averaged Raman spectra of PVAT of IMA of all studied patients with assigned characteristic bands. Spectra were normalized in the 1800-400 cm⁻¹ spectral range and shifted for clarity.