



Corrigendum: Amino Acids in Cerebrospinal Fluid of Patients With Aneurysmal Subarachnoid Haemorrhage: An Observational Study

Bartosz Sokół^{1*}, Bartosz Urbaniak², Norbert Wąsik¹, Szymon Plewa², Agnieszka Klupczyńska², Roman Jankowski¹, Barbara Więckowska³, Robert Juszkat⁴ and Zenon Kokot²

¹ Department of Neurosurgery, Poznan University of Medical Sciences, Poznan, Poland, ² Faculty of Pharmacy, Department of Inorganic and Analytical Chemistry, Poznan University of Medical Sciences, Poznan, Poland, ³ Department of Computer Science and Statistics, Poznan University of Medical Sciences, Poznan, Poland, ⁴ Department of General and Interventional Radiology, Poznan University of Medical Sciences, Poznan, Poland

OPEN ACCESS

Edited and reviewed by:

J. Marc Simard,
University of Maryland, Baltimore,
United States

*Correspondence:

Bartosz Sokół
bartosz.sokol@ump.edu.pl

Specialty section:

This article was submitted to
Neurocritical and Neurohospitalist
Care,

a section of the journal
Frontiers in Neurology

Received: 03 May 2018

Accepted: 22 May 2018

Published: 13 June 2018

Citation:

Sokół B, Urbaniak B, Wąsik N, Plewa S, Klupczyńska A, Jankowski R, Więckowska B, Juszkat R and Kokot Z (2018) Corrigendum: Amino Acids in Cerebrospinal Fluid of Patients With Aneurysmal Subarachnoid Haemorrhage: An Observational Study. *Front. Neurol.* 9:416. doi: 10.3389/fneur.2018.00416

Keywords: subarachnoid haemorrhage, amino acids, early brain injury, delayed cerebral ischaemia, biomarkers

A corrigendum on

Amino Acids in Cerebrospinal Fluid of Patients with Aneurysmal Subarachnoid Haemorrhage: An Observational Study

by Sokół, B., Urbaniak, B., Wasik, N., Plewa, S., Klupczyńska, A., Jankowski, R., et al. (2017). *Front. Neurol.* 8:438. doi: 10.3389/fneur.2017.00438

In the original article, there were mistakes in **Table 2**, **Table 3**, **Table 4**, **Figure 1**, **Figure 2**, **Figure 3** and **Figure 4**.

In all mentioned tables and figures, quantity of amino acids was described in mM instead of μM . The corrected tables and figures appear below. The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way.

The original article has been updated.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2018 Sokół, Urbaniak, Wąsik, Plewa, Klupczyńska, Jankowski, Więckowska, Juszkat and Kokot. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

TABLE 2 | Differences in CSF amino acid level at day 0-3, 5, and 10 post-SAH in healthy individuals (control group) and SAH patients (study group).

Amino acid	Control group	Study group, day 0-3 post-SAH	Control group vs. Study group, day 0-3 post-SAH. <i>P</i> -value	Study group, day 5 post-SAH	Control group vs. Study group, day 5 post-SAH. <i>P</i> -value	Study group, day 10 post-SAH	Control group vs. Study group, day 10 post-SAH. <i>P</i> -value
O-phosphoethanolamine (μ M)	3.00	5.95	<0.01	5.15	<0.001	6.60	<0.001
Ethylamine (μ M)	9.80	9.40	0.798	9.65	<0.001	11.10	0.292
Taurine (μ M)	7.00	16.00	<0.001	14.30	<0.001	10.75	<0.01
Asparagine (μ M)	5.70	10.35	0.01	19.50	<0.001	21.75	<0.001
Serine (μ M)	24.20	55.70	<0.001	75.40	<0.001	83.75	<0.001
Glycine (μ M)	8.90	38.75	<0.001	34.85	<0.001	35.20	<0.001
Hydroxyproline (μ M)	0.60	1.00	0.164	1.35	0.658	1.35	0.289
Glutamine (μ M)	407.60	520.65	<0.01	791.10	<0.001	796.30	<0.001
Aspartic acid (μ M)	0.50	1.55	<0.001	0.80	0.175	0.95	0.054
Citrulline (μ M)	1.60	2.75	0.011	2.55	<0.01	3.30	<0.01
Threonine (μ M)	24.80	29.05	0.079	56.10	<0.001	63.40	<0.001
Beta-Alanine (μ M)	20.30	22.00	0.040	29.00	<0.01	27.30	<0.01
Alanine (μ M)	35.00	88.05	<0.001	114.55	<0.001	122.55	<0.001
Glutamic acid (μ M)	1.20	5.40	<0.001	3.00	<0.001	2.35	<0.01
Histidine (μ M)	11.40	28.20	<0.001	43.35	<0.001	40.20	<0.001
3-Methylhistidine (μ M)	0.50	1.00	<0.01	1.40	<0.001	1.05	<0.01
2-Aminoadipic acid (μ M)	0.00	1.65	<0.001	2.10	<0.001	1.45	<0.001
Gamma-aminobutyric acid (μ M)	0.40	0.50	0.699	0.30	0.012	0.20	0.051
3-Aminoisobutyric acid (μ M)	0.50	0.30	0.668	0.30	0.563	0.35	0.806
2-Aminobutyric acid (μ M)	3.20	6.20	<0.01	6.60	<0.001	7.30	<0.001
Arginine (μ M)	15.70	19.25	0.062	26.60	<0.001	24.35	<0.01
Proline (μ M)	0.80	11.80	<0.001	13.95	<0.001	16.15	<0.001
Ornithine (μ M)	4.30	19.80	<0.001	17.95	<0.001	17.75	<0.001
Cystathionine (μ M)	0.30	2.05	<0.001	1.05	<0.001	1.40	<0.001
Cysteine (μ M)	0.40	2.05	<0.001	1.75	<0.001	1.65	<0.001
Lysine (μ M)	22.50	53.80	<0.001	73.05	<0.001	72.40	<0.001
Methionine (μ M)	3.10	6.20	<0.01	11.70	<0.001	13.65	<0.001
Valine (μ M)	16.20	38.65	<0.01	66.20	<0.001	76.30	<0.001
Tyrosine (μ M)	7.80	26.70	<0.001	36.20	<0.001	37.30	<0.001
Isoleucine (μ M)	4.40	9.65	0.001	13.05	<0.001	15.05	<0.001
Leucine (μ M)	11.40	29.20	<0.001	43.50	<0.001	56.80	<0.001
Phenylalanine (μ M)	9.40	26.45	<0.001	43.25	<0.001	44.45	<0.001
Tryptophan (μ M)	1.90	9.70	<0.001	13.60	<0.001	12.85	<0.001

Median levels of the amino acids are presented in the table. *P*-values were calculated either by Mann-Whitney or *t*-Student test. Amino acids increasing significantly during SAH (on day 0-3, 5, or 10) are shown in bold.

TABLE 3 | Differences in monitored parameters at day 0-3, 5, and 10 post-SAH in patients with good (GO-SAH) and poor (PO-SAH) treatment outcome.

Monitored parameter	Day 0-3 post-SAH			Day 5 post-SAH			Day 10 post-SAH		
	GO-SAH	PO-SAH	GO-SAH vs. PO-SAH. P-value	GO-SAH	PO-SAH	GO-SAH vs. PO-SAH. P-value	GO-SAH	PO-SAH	GO-SAH vs. PO-SAH. P-value
C-reactive protein (mg/l)	125.00	130.00	0.715	50.70	115.80	0.020	22.40	109.70	0.139
White blood cell count (10 ⁶ /mm ³)	9.86	17.47	<0.001	10.57	15.03	0.044	9.66	16.84	0.445
Haemoglobin (g/dl)	12.10	13.10	0.212	11.30	10.90	0.262	10.60	11.50	0.672
Temperature (°C)	37.00	37.00	0.736	37.40	37.20	0.273	36.90	35.70	0.512
Fibrinogen (mg/dl)	485.00	550.00	0.879	509.00	676.00	0.257	428.00	698.00	0.014
O-phosphoethanolamine (μM)	4.10	6.80	0.161	4.90	7.70	0.161	5.95	8.50	0.019
Taurine (μM)	13.10	19.40	0.038	14.60	13.40	0.514	12.20	7.35	0.138
Asparagine (μM)	9.00	11.50	0.256	30.20	12.50	0.397	22.90	20.45	0.423
Serine (μM)	45.10	76.50	0.161	77.00	61.40	0.947	79.50	94.75	0.503
Glycine (μM)	29.60	41.00	0.182	30.00	43.00	0.204	35.20	35.65	0.671
Hydroxyproline (μM)	0.70	1.30	0.066	1.70	0.80	0.518	1.35	1.10	0.793
Ethylaminev (μM)	5.80	15.80	0.102	7.90	12.10	0.134	8.85	14.50	0.35
Glutamine (μM)	489.90	602.50	0.182	837.30	505.10	0.585	852.50	715.60	0.483
Aspartic acid (μM)	0.80	2.20	0.038	0.40	1.00	0.071	0.95	1.30	0.551
Citrulline (μM)	1.90	5.90	0.035	2.50	3.10	0.396	3.30	3.30	1
Threonine (μM)	25.90	50.00	0.35	86.30	34.20	0.327	63.40	57.95	0.298
Beta-Alanine (μM)	28.30	22.00	0.07	30.00	28.60	0.497	26.85	27.85	0.893
Alanine (μM)	70.70	138.10	0.109	115.50	113.60	0.447	120.30	141.70	0.954
Glutamic acid (μM)	(μM)3.40	9.30	0.038	2.70	5.80	0.024	2.00	17.10	0.269
Histidine (μM)	18.90	38.10	0.256	63.60	23.70	0.711	43.55	37.45	0.753
3-Methylhistidine (μM)	0.70	1.50	<0.01	1.80	1.20	0.958	1.35	1.05	0.733
2-Amino adipic acid (μM)	1.30	1.70	0.076	1.50	4.10	0.071	1.30	2.45	0.033
Gamma-aminobutyric acid (μM)	0.30	0.90	0.043	0.30	0.30	0.932	0.35	0.15	0.266
3-Aminoisobutyric acid (μM)	0.20	0.40	0.066	0.30	0.30	0.958	0.35	0.45	0.93
2-Aminobutyric acid	4.60	8.20	0.088	11.40	5.50	0.542	10.75	6.50	0.124
Arginine (μM)	18.50	22.30	0.182	30.90	26.00	0.525	24.35	20.45	0.21
Proline (μM)	4.50	14.80	0.204	18.70	10.90	0.672	16.15	18.40	0.759
Ornithine (μM)	7.60	27.50	0.033	17.30	28.30	0.09	17.35	33.05	0.552
Cystathionine (μM)	0.80	2.80	<0.01	1.00	1.80	0.089	1.30	1.50	0.199
Cysteine (μM)	1.60	2.30	0.141	1.50	2.20	0.243	1.95	1.40	0.329
Lysine (μM)	43.00	74.50	0.095	87.10	55.90	0.341	72.40	72.60	0.612
Methionine (μM)	4.60	12.30	0.204	16.20	7.70	0.491	13.65	13.70	0.687
Valine (μM)	31.80	62.40	0.109	102.50	33.60	0.397	87.75	72.20	0.377
Tyrosine (μM)	23.00	32.50	0.083	36.60	35.80	0.876	38.60	37.30	0.676
Isoleucine (μM)	6.00	13.00	0.045	17.60	11.80	0.597	15.05	13.70	0.45
Leucine (μM)	22.90	39.70	0.109	80.30	29.80	0.397	60.95	50.55	0.532
Phenylalanine (μM)	21.20	38.80	0.062	51.30	32.40	0.665	45.40	44.45	0.913
Tryptophan (μM)	8.00	12.20	0.066	13.60	13.60	0.606	12.60	13.55	0.804

Median levels of the amino acids are presented in the table. P-values were calculated either by Mann-Whitney or t-Student test. Significant differences are shown in bold.

TABLE 4 | Amino acid level changes in time in good outcome SAH patients with (GO-SAH).

Parameter	Day 0–3 post-SAH	Day 5 post-SAH	Day 10 post-SAH	Omnibus test <i>P</i> -value	Day 0–3 vs. Day 5 <i>P</i> -value <i>Post-hoc</i>	Day 0–3 vs. Day 10 <i>P</i> -value <i>Post-hoc</i>	Day 5 vs. Day 10 <i>P</i> -value <i>Post-hoc</i>
C-reactive protein (mg/l)	125.00	50.70	27.00	0.049	0.345	0.012	0.073
White blood cell count (10 ⁶ /mm ³)	9.86	10.57	9.34	0.631			
Haemoglobin (g/dl)	12.10	10.60	10.50	0.066			
Temperature (°C)	37.00	37.30	36.90	0.382			
Fibrinogen (mg/dl)	485.00	442.00	423.00	0.327			
O-phosphoethanolamine (μM)	6.20	5.00	5.80	0.325			
Taurine (μM)	13.90	14.60	10.80	0.867			
Asparagine (μM)	8.40	18.30	21.20	0.180			
Serine (μM)	45.10	73.80	76.10	0.031	0.039	0.013	0.566
Glycine (μM)	29.60	32.60	42.50	0.565			
Hydroxyproline (μM)	0.70	1.10	1.40	0.094			
Ethylaminev (μM)	5.70	10.10	9.80	0.039	0.078	<0.01	0.187
Glutamine (μM)	454.30	818.70	828.30	0.001	<0.01	<0.001	0.565
Aspartic acid (μM)	0.70	0.40	1.20	0.215			
Citruline (μM)	1.90	2.40	2.80	0.069			
Threonine (μM)	22.90	52.50	61.20	0.012	0.128	<0.01	<0.01
Beta-Alanine (μM)	28.30	26.80	26.70	0.553			
Alanine (μM)	70.70	106.20	120.30	0.124			
Glutamic acid (μM)	4.50	2.70	2.10	0.898			
Histidine (μM)	16.80	38.10	37.40	0.156			
3-Methylhistidine (μM)	0.60	1.50	0.90	0.369			
2-Aminoadipic acid (μM)	1.30	1.50	1.30	0.129			
Gamma-aminobutyric acid (μM)	0.30	0.20	0.50	0.633			
3-Aminoisobutyric acid (μM)	0.20	0.30	0.30	0.215			
2-Aminobutyric acid (μM)	4.60	11.40	11.40	0.010	0.019	<0.01	0.427
Arginine (μM)	18.50	26.50	24.10	0.050	0.073	0.012	0.345
Proline (μM)	3.40	11.90	15.20	0.062			
Ornithine (μM)	7.60	17.30	14.30	0.368			
Cystathionine (μM)	1.00	1.00	1.20	0.648			
Cysteine (μM)	1.60	1.70	2.10	0.368			
Lysine (μM)	43.00	83.20	70.80	0.017	0.017	<0.01	0.735
Methionine (μM)	4.60	10.00	11.90	0.008	0.029	<0.01	0.200
Valine (μM)	28.20	61.60	78.10	0.015	0.017	<0.01	0.683
Tyrosine (μM)	23.00	35.10	28.50	0.020	0.023	<0.01	0.647
Isoleucine (μM)	5.90	11.10	13.60	0.024	0.081	<0.01	0.219
Leucine (μM)	22.60	39.70	60.50	0.024	0.022	0.013	0.801
Phenylalanine (μM)	20.90	35.20	37.50	0.038	0.040	0.018	0.700
Tryptophan (μM)	8.00	11.80	11.10	0.072			

Median levels of the amino acids are presented in the table. Omnibus statistical test (Friedman or repeated measures ANOVA) revealed significant changes in concentration of 13 amino acids (shown in bold). Next, post-hoc analysis (Conover–Iman for Friedman test and Fisher for repeated measures ANOVA) was run for those 13 amino acids to specify between what time points (day 0–3, 5, or 10 post-SAH) the differences in concentration were significant (shown in bold).





