

Slow Rhythmic Oscillations within the Human Cranium: Phenomenology, Origin, and Informational Significance

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Abstract

Slow rhythmic oscillations in the human cranial cavity were studied using two noninvasive methods: the bioimpedance method (volume ratios between liquid media in the cranial cavity) and transcranial ultrasound Doppler echography (variation in the blood flow in the middle cerebral artery). The combination of these methods made it possible to estimate the intracranial hemodynamics. Simultaneous recording of these parameters and their spectral analysis were carried out in healthy subjects and patients with intracranial hypertension syndrome and disturbed cerebrospinal fluid (CSF) flow. The parameters were recorded at rest and immediately after manual (osteopathic) correction. The recording and analysis were performed using a Macintosh-IIsi PC and the Chart-3.52, Cricket Graph-3.32, and Canvas-3.5 software. It was found that slow oscillations of the bioimpedance (BIM) in the frequency range 0.08–0.2 Hz were of intracranial origin and were related to the mechanisms of regulation of the blood supply to and oxygen consumption by cerebral tissue, as well as with the dynamics of the CSF circulation.

Keywords

Oxygen Consumption Blood Supply Cerebral Artery Middle Cerebral Artery
Doppler Echography

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REFERENCES

1. Magendie, F., *Untersuchungen über die Hirn-und Rückenmark-flüssigkeit*, Paris, 1843.
[Google Scholar](#) (<https://scholar.google.com/scholar?q=Magendie%2C%20F.%2C%20Untersuchungen%20%C3%BCber%20die%20Hirn-und%20Ruckenmark-fl%C3%BCssigkeit%2C%20Paris%2C%201843.>)
2. Salathé, A., Recherches sur le mécanism de la circulation dans la cavité céphaloarachidienne, *Travaux Lab. M. Marey*, 1876, vol. 2, p. 345.
[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Recherches%20sur%20le%20m%C3%A9chanism%20de%20la%20circulation%20dans%20la%20cavit%C3%A9%20c%C3%A9phaloarachidienne&author=A.%20Salath%C3%A9&journal=Travaux%20Lab.%20M.%20Marey&volume=2&pages=345&publication_year=1876)
3. Cooper, R., Crow, C.J., Walter, G., and Winter, A.G., Regional Control of Cerebral Vascular Reactivity and Oxygen Supply in Man, *Brain Res.*, 1966, vol. 3, no. 2, p. 174.
[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Regional%20Control%20of%20Cerebral%20Vascular%20Reactivity%20and%20Oxygen%20Supply%20in%20Man&author=R.%20Cooper&author=C.J.%20Crow&author=G.%20Walter&author=A.G.%20Winter&journal=Brain%20Res.&volume=3&issue=2&pages=174&publication_year=1966)

4. Moskalenko, Yu.E., Demchenko, I.T., and Cooper, R., On the Dynamics of Spontaneous Oscillations of Blood Flow and Oxygen Tension in the Brain, *Fiziol. Zh. SSSR*, 1969, vol. 55, no. 7, p. 809.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=On%20the%20Dynamics%20of%20Spontaneous%20Oscillations%20of%20Blood%20Flow%20and%20Oxygen%20Tension%20in%20the%20Brain&author=Y..%20Moskalenko&author=I.T..%20Demchenko&author=R..%20Cooper&journal=Fiziol.%20Zh.%20SSSR&volume=55&issue=7&pages=809&publication_year=1969) (http://scholar.google.com/scholar_lookup?title=On%20the%20Dynamics%20of%20Spontaneous%20Oscillations%20of%20Blood%20Flow%20and%20Oxygen%20Tension%20in%20the%20Brain&author=Y..%20Moskalenko&author=I.T..%20Demchenko&author=R..%20Cooper&journal=Fiziol.%20Zh.%20SSSR&volume=55&issue=7&pages=809&publication_year=1969)
5. Fedulova, I.P., On the Statistical Characteristics of Slow Oscillations of Blood Flow and Oxygen Tension in the Brain, *Fiziol. Zh. SSSR*, 1971, vol. 57, no. 4, p. 584.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=On%20the%20Statistical%20Characteristics%20of%20Slow%20Oscillations%20of%20Blood%20Flow%20and%20Oxygen%20Tension%20in%20the%20Brain&author=I.P..%20Fedulova&journal=Fiziol.%20Zh.%20SSSR&volume=57&issue=4&pages=584&publication_year=1971) (http://scholar.google.com/scholar_lookup?title=On%20the%20Statistical%20Characteristics%20of%20Slow%20Oscillations%20of%20Blood%20Flow%20and%20Oxygen%20Tension%20in%20the%20Brain&author=I.P..%20Fedulova&journal=Fiziol.%20Zh.%20SSSR&volume=57&issue=4&pages=584&publication_year=1971)
6. Moskalenko, Yu.E. and Khil'ko, V.A., *Printsipy izucheniya sosudistoi sistemy golovnogo mozga cheloveka* (Principles of Studying the Vascular System of the Human Brain), Leningrad: Nauka, 1984.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Printsipy%20izucheniya%20sosudistoi%20sistemy%20golovnogo%20mozga%20cheloveka&author=Y..%20Moskalenko&author=V.A..%20Khil%27ko&publication_year=1984) (http://scholar.google.com/scholar_lookup?title=Printsipy%20izucheniya%20sosudistoi%20sistemy%20golovnogo%20mozga%20cheloveka&author=Y..%20Moskalenko&author=V.A..%20Khil%27ko&publication_year=1984)
7. Moskalenko, Yu.E., Khil'ko, V.A., Weinstein, G.B., *et al.*, On the Relationship between Intracranial Pressure, Blood Content in the Cranial Cavity, and Total Cerebral Blood Flow, *Fiziol. Zh. SSSR*, 1983, vol. 69, no. 1, p. 92.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=On%20the%20Relationship%20between%20Intracranial%20Pressure%2C%20Blood%20Content%20in%20the%20Cranial%20Cavity%2C%20and%20Total%20Cerebral%20Blood%20Flow&author=Y..%20Moskalenko&author=V.A..%20Khil%27ko&author=G..%20Weinstein&journal=Fiziol.%20Zh.%20SSSR&volume=69&issue=1&pages=92&publication_year=1983) (http://scholar.google.com/scholar_lookup?title=On%20the%20Relationship%20between%20Intracranial%20Pressure%2C%20Blood%20Content%20in%20the%20Cranial%20Cavity%2C%20and%20Total%20Cerebral%20Blood%20Flow&author=Y..%20Moskalenko&author=V.A..%20Khil%27ko&author=G..%20Weinstein&journal=Fiziol.%20Zh.%20SSSR&volume=69&issue=1&pages=92&publication_year=1983)
8. Moskalenko, Yu.E., Weinstein, G.B., Demchenko, I.T., *et al.*, *Biophysical Aspects of Cerebral Circulation*, Oxford: Pergamon, 1980.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Biophysical%20Aspects%20of%20Cerebral%20Circulation&author=Y..%20Moskalenko&author=G.B..%20Weinstein&author=I.T..%20Demchenko&publication_year=1980) (http://scholar.google.com/scholar_lookup?title=Biophysical%20Aspects%20of%20Cerebral%20Circulation&author=Y..%20Moskalenko&author=G.B..%20Weinstein&author=I.T..%20Demchenko&publication_year=1980)
9. Grechin, V.B. and Borovikova, V.N., *Medlennye neelektricheskie protsessy v otsenke funktsional'nogo sostoyaniya mozga cheloveka* (Slow Nonelectric Processes in the Estimation of the Functional Status of the Human Brain), Leningrad: Nauka, 1982.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=%20Medlennye%20neelektricheskie%20protsessy%20v%20otsenke%20funktsional%27nogo%20sostoyaniya%20mozga%20cheloveka&author=V.B..%20Grechin&author=V.N..%20Borovikova&publication_year=1982) (http://scholar.google.com/scholar_lookup?title=%20Medlennye%20neelektricheskie%20protsessy%20v%20otsenke%20funktsional%27nogo%20sostoyaniya%20mozga%20cheloveka&author=V.B..%20Grechin&author=V.N..%20Borovikova&publication_year=1982)
10. Sutherland, W.G., *The Cranial Bowl*, Mankato, Minn.: The Free Press, 1939.

Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20Cranial%20Bowl&author=W.G..%20Sutherland&publication_year=1939)

11. Frymann, V., A Study of the Rhythmic Motions of the Living Cranium, *J. Am. Osteopath. Assoc.*, 1971, vol. 70, no. 5, p. 928.
Google Scholar (http://scholar.google.com/scholar_lookup?title=A%20Study%20of%20the%20Rhythmic%20Motions%20of%20the%20Living%20Cranium&author=V..%20Frymann&journal=J.%20Am.%20Osteopath.%20Assoc.&volume=70&issue=5&pages=928&publication_year=1971)
12. Moskalenko, Yu.E., Kravchenko, T.I., Gaidar, B.V., *et al.*, On the Rhythmic Motions of Cranial Bones in Humans, *Fiziol. Chel.*, 1999, vol. 25, no. 1, p. 62.
Google Scholar (http://scholar.google.com/scholar_lookup?title=On%20the%20Rhythmic%20Motions%20of%20Cranial%20Bones%20in%20Humans&author=Y..%20Moskalenko&author=T.I.%20Kravchenko&author=B.%20e..%20Gaidar&journal=Fiziol.%20Chel.&volume=25&issue=1&pages=62&publication_year=1999)
13. Khayutin, V.M. and Lukoshkova, E.V., Spectral Analysis of Heart Rate Oscillations: Physiological Mechanisms and Complicating Phenomena, *Ross. Fiziol. Zh.*, 1999, vol. 85, no. 7, p. 893.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Spectral%20Analysis%20of%20Heart%20Rate%20Oscillations%3A%20Physiological%20Mechanisms%20and%20Complicating%20Phenomena&author=V.M.%20Khayutin&author=E.V.%20Lukoshkova&journal=Ross.%20Fiziol.%20Zh.&volume=85&issue=7&pages=893&publication_year=1999)
14. Moskalenko, Yu.E. and Naumenko, A.I., On the Theory of the Electroplethysmographic Methods, *Fiziol. Zh. SSSR*, 1956, vol. 42, no. 3, p. 94.
Google Scholar (http://scholar.google.com/scholar_lookup?title=On%20the%20Theory%20of%20the%20Electroplethysmographic%20Methods&author=Y..%20Moskalenko&author=A.I.%20Naumenko&journal=Fiziol.%20Zh.%20SSSR&volume=42&issue=3&pages=94&publication_year=1956)
15. Jenkner, F., *Rheoencephalography*, Vienna, 1986.
Google Scholar (<https://scholar.google.com/scholar?q=Jenkner%2C%20F.%2C%20Rheoencephalography%2C%20Vienna%2C%201986>.)
16. Moskalenko, Yu.E., Vulsei, T., Rovainen, K., *et al.*, Blood Flow Dynamics in Different Layers of the Sensorimotor Cortex of the Rat Brain during Mechanical Stimulation of Vibrissae, *Ross. Fiziol. Zh.*, 1996, vol. 83, no. 4, p. 67.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Blood%20Flow%20Dynamics%20in%20Different%20Layers%20of%20the%20Sensorimotor%20Cortex%20of%20the%20Rat%20Brain%20during%20Mechanical%20Stimulation%20of%20Vibrissae&author=Y..%20Moskalenko&author=T.%20Vulsei&author=K.%20Rovainen&journal=Ross.%20Fiziol.%20Zh.&volume=83&issue=4&pages=67&publication_year=1996)
17. Koepchen, H., History of Studies and Concepts of Blood Pressure Waves, *Mechanisms of Blood Flow Waves*, Miyakawa, K. *et al.*, Eds., Berlin: Springer, 1984, p. 3.

Google Scholar (http://scholar.google.com/scholar_lookup?title=History%20of%20Studies%20and%20Concepts%20of%20Blood%20Pressure%20Waves&author=H.%20Koepchen&pages=3&publication_year=1984)

18. Vartbaronov, R.V., Moskalkenko, Yu.E., and Weinstein, G.B., On the Correspondence between Intracerebral and Peripheral Blood Circulation during Transverse Overload, *Izv. Akad. Nauk SSSR, Ser. Biol.*, 1969, vol. 6, p. 863.
Google Scholar (http://scholar.google.com/scholar_lookup?title=On%20the%20Correspondence%20between%20Intracerebral%20and%20Peripheral%20Blood%20Circulation%20during%20Transverse%20Overload&author=R.V.%20Vartbaronov&author=Y.%20Moskalkenko&author=G.B.%20Weinstein&journal=Izv.%20Akad.%20Nauk%20SSSR%20Ser.%20Biol.&volume=6&pages=863&publication_year=1969)
19. Vern, B., Leheta, B., Vern, J., *et al.*, Interhemispheric Synchrony of Slow Oscillations of Cortical Blood Volume and Cytochrome aa3 Redox State in Unanesthetized Rabbits, *Brain Res.*, 1997, vol. 775, p. 233.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Interhemispheric%20Synchrony%20of%20Slow%20Oscillations%20of%20Cortical%20Blood%20Volume%20and%20Cytochrome%20aa3%20Redox%20State%20in%20Unanesthetized%20Rabbits&author=B.%20Vern&author=B.%20Leheta&author=J.%20Vern&journal=Brain%20Res.&volume=775&pages=233&publication_year=1997)
20. Shakhnovich, A.R. and Shapiro, D.A., *Matematicheskie metody v izuchenii reguliruyushchikh sistem* (Mathematical Methods of Study of Regulatory Systems), Moscow: Nauka, 1973.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Matematicheskie%20metody%20v%20izuchenii%20reguliruyushchikh%20sistem&author=A.R.%20Shakhnovich&author=D.A.%20Shapiro&publication_year=1973)
21. Miyakawa, K., Takeuchi, T., Shimuzu, T., *et al.*, Mechanisms of Blood Pressure Waves of the Third Order, *Mechanisms of Blood Flow Waves*, Miyakawa, K. *et al.*, Eds., Berlin: Springer, 1984, p. 85.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Mechanisms%20of%20Blood%20Pressure%20Waves%20of%20the%20Third%20Order&author=K.%20Miyakawa&author=T.%20Takeuchi&author=T.%20Shimuzu&pages=85&publication_year=1984)
22. Siegel, G. and Ebeling, B., Vascular Smooth Muscle Rhythmicity, *Mechanisms of Blood Flow Waves*, Miyakawa, K. *et al.*, Eds., Berlin: Springer, 1984, p. 319.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Vascular%20Smooth%20Muscle%20Rhythmicity&author=G.%20Siegel&author=B.%20Ebeling&pages=319&publication_year=1984)
23. Moskalkenko, Yu.E., Beketov, A.I., and Orlov, R.S., *Vnutricherepnoe krovoobrashchenie: fizicheskie i khimicheskie priemy izucheniya* (Intracranial Circulation: Physical and Chemical Methods of Examination), Leningrad: Nauka, 1989.
Google Scholar (http://scholar.google.com/scholar_lookup?title=Vnutricherepnoe%20krovoobrashchenie%20fizicheskie%20i%20khimicheskie%20priemy%20izucheniya&author=Y.%20Moskalkenko&author=A.I.%20Beketov&author=R.S.%20Orlov&publication_year=1989)

24. Cushing, H., Concerning a Definite Regulatory Mechanism of the Vasomotor Center Which Controls Blood Pressure during Cerebral Compression, *Bull. Johns Hopkins Hosp.*, 1901, vol. 12, p. 290.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Concerning%20a%20Definite%20Regulatory%20Mechanism%20of%20the%20Vasomotor%20Center%20Which%20Controls%20Blood%20Pressure%20during%20Cerebral%20Compression&author=H..%20Cushing&journal=Bull.%20Johns%20Hopkins%20Hosp.&volume=12&pages=290&publication_year=1901) (http://scholar.google.com/scholar_lookup?title=Concerning%20a%20Definite%20Regulatory%20Mechanism%20of%20the%20Vasomotor%20Center%20Which%20Controls%20Blood%20Pressure%20during%20Cerebral%20Compression&author=H..%20Cushing&journal=Bull.%20Johns%20Hopkins%20Hosp.&volume=12&pages=290&publication_year=1901)
25. Roitbak, A.I., *Gliya i ee rol' v nervnoi deyatel'nosti* (Glia and Its Role in Nervous Activity), St. Petersburg: Nauka, 1993.
[Google Scholar](http://scholar.google.com/scholar_lookup?title=%0AGliya%20i%20ee%20rol%27%20v%20nervnoi%20deyatel%27nosti&author=A.I..%20Roitbak&publication_year=1993) (http://scholar.google.com/scholar_lookup?title=%0AGliya%20i%20ee%20rol%27%20v%20nervnoi%20deyatel%27nosti&author=A.I..%20Roitbak&publication_year=1993)

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