

COMMENTARY TO HABILITATION THESIS

Applicant: MUDr. Ondřej Navrátil, Ph.D.

Habilitation Thesis: Current Position and Role of Microneurosurgery in the Treatment of Cerebral Aneurysms and Arteriovenous Malformations (A Collection of Commented Works)

Institution: Department of Neurosurgery, Faculty of Medicine, Masaryk University Brno and University Hospital Brno

Characteristics of the Investigated Matter

The habilitation thesis presents a comprehensive, structured, and clinically significant investigation in the field of vascular neurosurgery, submitted for the habilitation procedure at the Faculty of Medicine, Masaryk University. It focuses on the contemporary role and position of microneurosurgical techniques in the management of the most frequent cerebral vascular lesions: intracranial aneurysms and brain arteriovenous malformations (AVMs).

The work systematically evaluates the evolution of therapeutic strategies from an era dominated solely by open microsurgery to modern multimodal workflows. These workflows balance surgical excision, endovascular intervention, and arteriovenous malformations radiosurgical occlusion. A special emphasis is devoted to clinical decision-making, operative treatment, and treatment optimization for complex pathological situations. These include ruptured middle cerebral artery (MCA) aneurysms presenting with significant intracerebral hematoma causing mass effect, calcified thick-walled giant aneurysms, and brain arteriovenous malformations, with a tailored look at specific patient populations such as geriatrics in subarachnoid hemorrhage.

Main Objectives of the Thesis

- **Analyze volume and laterality impacts** on clinical outcomes in patients undergoing urgent surgery for ruptured MCA aneurysms with intracerebral hematoma (ICH).
- **Evaluate the utility and safety** of utilizing an atraumatic cardiovascular DeBakey clamp to stabilize and reshape the rigid, calcified bases of thick-walled giant aneurysms.
- **Assess therapeutic results and complications** of surgical versus endovascular treatment modalities in a large, single-center longitudinal cohort of patients presenting with anterior communicating artery aneurysms (ACoAA).
- **Compare clinical efficacy and risks** of surgical clipping versus endovascular coiling in the fragile and growing population of elderly patients (aged 65+) after aneurysmal subarachnoid hemorrhage (SAH).
- **Document and define algorithms** for microneurosurgical management of brain AVMs and cerebral aneurysms in the era of advanced endovascular methods.

Employed Methodologies

The research methodology integrates retrospective clinical cohort studies, prospective single-center specialized databases (specifically the subarachnoid hemorrhage and aneurysm registry of the University Hospital Brno, arteriovenous malformation registry of the University Hospital Brno), and comparative literature reviews. High-resolution neuroimaging modalities — including digital subtraction angiography (DSA), computed tomography (CT), CT

angiography (CTA), and magnetic resonance imaging (MRI)—were uniformly employed for comprehensive preoperative examination in specific situations.

Clinical status on admission and long-term functional recovery were standardized using validated neurological grading systems, namely the Hunt-Hess scale, the Fisher score, the Glasgow Outcome Scale (GOS), the modified Rankin Scale (mRS), and the Spetzler-Martin classification for AVM risk stratification. Advanced statistical software was utilized to perform parametric and non-parametric calculations (including Chi-squared tests, Welch's unpaired t-tests, and Mann-Whitney U-tests). The research heavily incorporates standards developed during the applicant's extensive clinical fellowships at world-renowned institutions, specifically the Helsinki University Central Hospital (Finland) and Sir Charles Gairdner Hospital (Perth, Western Australia).

Obtained Results

- **In urgent neurosurgical conditions (Ruptured MCA Aneurysms with ICH):** Active, prompt surgical evacuation combined with clipping yields favorable functional outcomes (independence) in 40% of critically ill, high-grade patients. A quantitative volumetric threshold of 25 ml was identified, above which the probability of an unfavorable clinical outcome increases significantly. Additionally, the data suggest that the right hemisphere exhibits a higher volumetric tolerance for hematomas compared to the left.
- **In complex vascular cases - thick-walled giant aneurysms:** The application of an atraumatic DeBakey cardiovascular clamp to a rigid, calcified or atheromatous base safely softens and flattens the vessel wall. This modification creates a reliable groove for permanent clips, successfully prevents clip slippage, and completely eliminates the risk of distal embolization of intraluminal thrombi during dome decompression.
- **In anterior circle circulation pathologies (ACoAA):** The projection axis of the aneurysm dome serves as an indicator for the choice of treatment modality. Overall, active intervention secures favorable outcomes in 72.5% of patients with aneurysmal subarachnoid hemorrhage, showing no statistically significant discrepancy in functional outcome or complication rates between surgical (75.5%) and endovascular (65%) techniques.
- **In the elderly population (65+ years):** Seniors face a higher cumulative risk of poor neurological outcomes at 3 months post-SAH, especially when presenting with poor admission status (Hunt-Hess 3–5). Nevertheless, over half of these patients remain independent after treatment, confirming that aggressive care is fully justified. Volumetric statistics demonstrated that elderly patients treated via endovascular coiling (EV) achieve significantly better 3-month functional recovery (mRS 0–2 in 60.61% of cases) compared to those who underwent open surgery clipping (52.88%).
- **In brain arteriovenous malformations (AVMs):** A combined multimodal strategy incorporating targeted preoperative endovascular embolization (e.g., using Onyx) followed by radical microneurosurgical excision of the nidus reduces the risks of intraoperative hemorrhage. This combined procedure under a single anesthesia window successfully increases definitive cure and complete obliteration rates to 89–95% for low-to-moderate grade lesions, serving as a highly effective approach to mitigate cumulative lifetime bleeding risks.

Applicant's Contribution and Fulfillment of LF MU Criteria

MUDr. Ondřej Navrátil, Ph.D. is the principal, first, contributing or corresponding author of the benchmark publications that form the backbone of this habilitation thesis. His individual contribution spans the entire academic workflow, encompassing study design, database conceptualization, statistical data analysis, literature synthesis, and manuscript writing. As a senior vascular neurosurgeon, the applicant personally executed a significant proportion of the microsurgical procedures detailed in the clinical studies.

He successfully helped to implement and further refine advanced intraoperative techniques — microsurgical techniques — into standard institutional protocols at the Department of Neurosurgery, Faculty of Medicine, Masaryk University. Furthermore, his international research fellowships fostered high-impact academic collaborations, enabling the publication of institutional data in peer-reviewed journals.

Detailed Catalog of Publications and the Applicant's Share

(1) NAVRATIL, Ondrej *(corresponding author)*, Kamil DURIS, Vilem JURAN, Eduard NEUMAN, Karel SVOBODA and Martin SMRCKA. Middle cerebral artery aneurysms with intracerebral hematoma-the impact of side and volume on final outcome. *Acta Neurochirurgica* [online]. 2017, 159(3), 543–547. ISSN 0942-0940. Available at: doi:10.1007/s00701-016-3070-3

Document Type: Article; IF = 1,929; median IF SURGERY – 1,811; according to IF SURGERY Q2; according to AIS SURGERY Q2

Experimental (%)	Work Supervision (%)	Manuscript (%)	Writing Research (%)	Direction	Role
0%	90%	80%	80%		Lead Author

(2)] NAVRATIL, Ondrej, Martin LEHECKA, Hanna LEHTO, Reza DASHTI, Riku KIVISAARI, Mika NIEMELAE and Juha A. HERNESNIEMI. Vascular Clamp-Assisted Clipping Of Thick-Walled Giant Aneurysms. *Neurosurgery* [online]. 2009, 64(3), S113-S121. ISSN 1524-4040. Available at: doi:10.1227/01.Neu.0000330400.68015.88

Document Type: Article; IF = 2,862; median IF SURGERY – 1,293; according to IF SURGERY Q1; according to AIS SURGERY Q1

Experimental (%)	Work Supervision (%)	Manuscript (%)	Writing Research (%)	Direction	Role
0%	20%	65%	70%		First (Q1) Author

(3) NAVRATIL, Ondrej *(corresponding author)*, Kamil DURIS, Vilem JURAN, Karel SVOBODA, Jakub HUSTY, Evzen HOVORKA, Eduard NEUMAN, Andrej MRLIAN and Martin SMRCKA. Current Treatment of Anterior Communicating Artery Aneurysms: Single Center Study. *Brain Sciences* [online]. 2020, 10(8, Article 501). ISSN 2076-3425. Available at: doi:10.3390/brainsci10080501
Document Type: Article; IF = 3,394; median IF NEUROSCIENCES 3,627; according to IF NEUROSCIENCES Q3; according to AIS NEUROSCIENCES Q3

Experimental (%)	Work Supervision (%)	Manuscript Writing (%)	Research Direction (%)	Role
0%	90%	70%	80%	Corresponding Author

(4) HOVORKA, E., Ondřej. NAVRÁTIL *(corresponding author)*, K. ĎURIŠ, V. JURÁN, K. SVOBODA, A. MRLIAN, V. VYBÍHAL, J. HUSTÝ and M. SMRČKA. Results of treatment of aneurysmal subarachnoid hemorrhage in the elderly; [Výsledky léčby aneuryzmatického subarachnoidálního krvácení u seniorů]. *Ceska a Slovenska Neurologie a Neurochirurgie* [online]. 2023, 86(4), 256–261. ISSN 1210-7859. Available at: doi:10.48095/ccsnn2023256
Document Type: Review; Category: Surgery – SJR Q4

Experimental (%)	Work Supervision (%)	Manuscript Writing (%)	Research Direction (%)	Role
0%	55%	50%	55%	Key Co-Author / Corresponding

(5) SMRCKA, Martin, Ondrej NAVRATIL, Evzen HOVORKA and Kamil DURIS. The efficacy of surgical treatment of cerebral arteriovenous malformations in a single academic institution: a case series. *Croatian Medical Journal* [online]. 2021, 62(4), 353–359. ISSN 1332-8166. Available at: doi:10.3325/cmj.2021.62.353
Document Type: Article; IF = 2,415; median IF MEDICINE, GENERAL & INTERNAL – 2,982; according to IF MEDICINE, GENERAL & INTERNAL Q3; according to AIS MEDICINE, GENERAL & INTERNAL Q3

Experimental (%)	Work Supervision (%)	Manuscript Writing (%)	Research Direction (%)	Role
0%	25%	30%	40%	Co-author

(6) NAVRATIL, Ondrej **(corresponding author)**, Martin LEHECKA, Vilem JURAN, Andrej MRLIAN, Jaroslav BOUDNY and Martin SMRCKA. Giant intranidal aneurysm associated with the arteriovenous malformation. *Clinical Neurology And Neurosurgery* [online]. 2011, 113(9), 813–815. ISSN 1872-6968. Available at: doi:10.1016/j.clineuro.2011.08.017

Document Type: Article; IF = 1,581; median IF SURGERY – 1,369; according to IF SURGERY Q2; according to AIS SURGERY SCIE Q2

Experimental Work Supervision (%)	Manuscript Writing (%)	Research Direction (%)	Role
0%	70%	85%	70% Lead / Corresponding Author

(7) HERNESNIEMI, J, R ROMANI, M LEHECKA, P ISARAKUL, R DASHTI, Ö CELIK, O NAVRATIL, M NIEMELÄ a A LAAKSO. Present State of Microneurosurgery of Cerebral Arteriovenous Malformations. In: A LAAKSO, J HERNESNIEMI, Y YONEKAWA a T TSUKAHARA, ed. *SURGICAL MANAGEMENT OF CEREBROVASCULAR DISEASE* [online]. 2010, s. 71–76. ISBN 0065-1419. Dostupné z: doi:[10.1007/978-3-211-99373-6_11](https://doi.org/10.1007/978-3-211-99373-6_11)

Document Type: Proceeding Paper

Experimental Work Supervision (%)	Manuscript Writing (%)	Research Direction (%)	Role
0%	10%	20%	10% Co-author