

Standardized intraoperative assessment of meningioma invasion and sampling - results of part 1 of the INVADER study [Abstract]

Felix Behling, Hannes Becker, Hanna Gött, Jonas Tellermann, Christina Fodi, Darius Kalasauskas, Florian Ringel, Clemens Sommer, Johannes Wach, Erdem Güresir, Alonso Barrantes-Freer, Karl-Michael Schebesch, Julius Höhne, Miriam Weiss, Christian Musahl, Lukas Anderegg, Ingeborg Fischer, Mahmoud Messerer, Guilia Cossu, Alberto Vandenbulke, Benjamin Brokinkel, Uta Schick, Michael Glatza, Henry W. S. Schroeder, Gleb Dashevskii, Josefine Radke, Samir Jabari, Dimitrios Paraskevopoulos, Thomas Millner, Guido Caffaratti, Georgios Georgountzos, Jiri Fiedler, Barbora Musilova, Luigi Maria Cavallo, Teresa Somma, Roberto Colasanti, Luigino Tosatto, Daniela Bartolini, Alina Itter, Paulina Günzerodt, Quratul Ain, Peter Baumgarten, Dorothee Mielke, Jens Schittenhelm, Marcos Tatagiba

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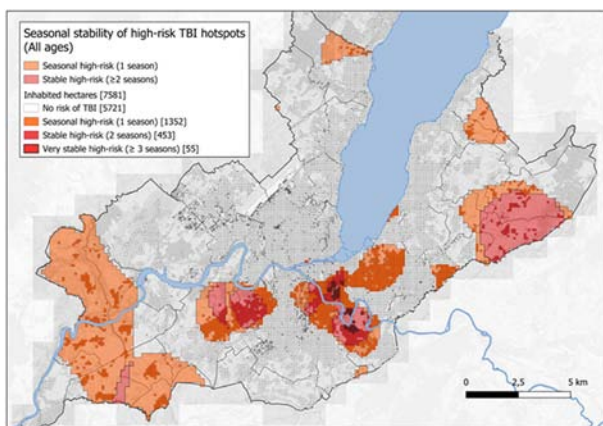
Traumatic brain injury (TBI) risk emerges from dynamic interactions between environmental exposure, biological vulnerability, and social context. Yet traditional neurosurgical surveillance remains largely severity-centered, with limited integration of territorial, climatic, and psychosocial determinants that drive preventable exposure and downstream care needs. We developed a transdisciplinary spatial epidemiology framework that links high-resolution geospatial/environmental analytics with neurosurgical clinical data and care pathways, aiming to generate actionable prevention and neurotrauma service planning.

Methods: The framework combines: (1) high-resolution geocoding of hospitalized TBI cases; (2) kernel-based spatial relative risk mapping; (3) season-specific climatic stratification; and (4) hotspot stability analysis, defined as the number of seasons in which a spatial unit is classified as high-risk. Such framework was applied to 1,706 anonymised moderate-to-severe TBI hospitalizations (Glasgow Coma Scale [GCS] ≤ 12) managed by the neurosurgical service between 2012 and 2024 at the Geneva University Hospitals, a public tertiary-care center serving a defined catchment population. Age-stratified incidence (≥ 60 vs < 60 years), neighborhood-level revenue indicators, and care pathways (provenance and discharge destination) were integrated at hectometric resolution for TBI globalization analysis.

Results: Seasonality did not uniformly increase incidence; instead, it reshaped where TBI risk clustered across space and socioeconomic context. A dose-response relationship was observed between hotspot stability and TBI risk (RR 2.66 for ≥ 3 seasons). Among adults ≥ 60 years, stable hotspots demonstrated marked risk amplification (RR 6.89), territorial concentration of elderly residents, more admissions from care facilities, and higher rehabilitation utilization, indicating environmentally anchored and psychosocially mediated vulnerability. Socioeconomic patterns varied by season and age, with lower-revenue neighborhoods disproportionately affected during transitional seasons. Younger adults showed more spatial volatility and summer predominance (RR 2.09), consistent with behavior-driven exposure patterns.

Conclusions: Hotspot stability mapping provides a climate-sensitive, income-stratified, and age-specific readout of territorial vulnerability that is not captured by clinical severity alone. By linking spatial risk to provenance and discharge destinations, this framework supports equitable prevention, geriatric neurotrauma preparedness, and climate-adaptive resource allocation across trauma systems, making it directly relevant to neurosurgical planning.

Optional Image



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Session 55: Increasing the evidence base in Surgical Neuro-Oncology through clinical trial, October 2, 2026, 11:00 AM - 12:30 PM

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Combating Glioblastoma: Enhancing anti-EGFRvIII CAR T Cell Therapy with a Paracrine SIRC -derived CD47 Blocker – A Proof-of-Concept Preclinical Study Translating into a First-in-Human Phase I Clinical Trial

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Glioblastoma (GBM) is a highly aggressive primary brain tumor and the current standard therapy has shown limited success in improving patient's outcome. This highlights the urgent need to come up with more effective therapeutic strategies for this hard-to-treat cancer. In the past few years, GBM immunotherapy has shown promising results. However, the majority of ongoing and finished immunotherapy trials are not effective when used alone, which has been attributed to the high level of heterogeneity in GBM at multiple levels, as well as the immunosuppressive tumor microenvironment (TME).

Methods: We engineered a CAR T cell construct against EGFRvIII with constitutive secretion of SGRP, a protein with high affinity to CD47, therefore co-targeting multiple cell populations. Different groups of mice received immunotherapeutic treatment regimens, which were later on compared in regard of overall survival, progression free survival and safety. The clinical trial protocol has been written according to good clinical practice guidelines and based on this proof-of-concept preclinical study.

Results: Anti-EGFRvIII-SGRP CAR T cells eradicated orthotopic EGFRvIII-mosaic GBM in mice, simultaneously restoring microglia- and macrophage-mediated tumor cell phagocytosis. Consequently, mice treated with anti-EGFRvIII-SGRP CAR T cells showed significantly longer overall survival and progression-free survival compared to mice treated with other immunotherapeutic modalities. During the study, no relevant toxicities were observed. The clinical trial protocol for the first-in-human phase I clinical trial has been completed.

Conclusions: The combinatorial strategy of anti-EGFRvIII-SGRP CAR T cells, co-targeting the main cell populations in GBM, showed promising effects in a preclinical proof-of-concept study. These promising results are being translated into a first-in-human phase I clinical trial, whereas the clinical trial protocol has now been completed, hoping to set a milestone in the treatment of GBM.

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Session 55: Increasing the evidence base in Surgical Neuro-Oncology through clinical trial, October 2, 2026, 11:00 AM - 12:30 PM

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Standardized Intraoperative Assessment of Meningioma Invasion and Sampling - Results of Part 1 of the INVADER Study

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In the WHO classification of meningiomas brain invasion (BI) remains a stand-alone criterion for atypia. Several retrospective analyses have demonstrated that BI alone does not seem to have any independent prognostic relevance. However, non-standardized intraoperative sampling of meningioma tissue and loose adherence to the histopathological criteria of BI may influence the quality of retrospective data among different institutions. To further address this topic, the INVADER Study was initiated. The first part focuses on gaining a deeper insight into the sampling methodology and factors influencing the diagnostic yield of BI among different neurosurgical centers.

Methods: In this multicenter observational trial 13 neurosurgical centers included patients surgically treated for meningioma in the course of 12 months. Two assessment sheets were used to document the intraoperative assessment of the surgeon (intraoperative signs of invasive growth, extent of resection, completeness of sampling, sampling of suspicious areas) and the histopathological work-up by the pathologist (sufficient tissue, BI, criteria used for BI assessment). Overall, 572 cases were included after exclusion of incomplete datasets.

Results: BI was detected in 5.1% of all assessed cases. Between different centers, the detection rate varied from 0.0 to 11.8%. Meningiomas that received prior surgery and radiation treatment had a significantly higher rate of BI (44.4%) compared to virgin meningiomas (3.5%) or prior surgery alone (5.3%, $p < 0.0001$). Intraoperatively, adhesion and invasion of CNS tissue was observed in 6.4 and 25.3%, respectively. Both observations were associated with a higher detection rate of BI ($p = 0.0135$ and $p < 0.0001$, respectively). A separate sample suspicious of BI was taken in 10.8% of cases and was also associated with a higher rate of BI detection ($p = 0.0177$). The diagnostic sensitivity and specificity of intraoperative suspicion of CNS invasion were 58.9 and 76.5%, respectively. The positive and negative predictive value were 11.9 and 97.2%. There was no difference in the detection rate of BI when the complete brain-meningioma interface was sampled.

Conclusions: BI was present in 5.1% of meningiomas. While intraoperative features suggestive of invasion were significantly associated with BI, the diagnostic performance of intraoperative assessment was limited, primarily due to the prevalence of BI. Complete sampling of the brain-meningioma interface did not improve diagnostic yield.

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Session 57: Rise Europe, October 2, 2026, 2:00 PM - 3:00 PM
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The Cranial Subdural Empyema

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Cranial subdural empyema remains a neurosurgical emergency with potentially preventable mortality and disability. We quantified contemporary outcomes and identified outcome-relevant clinical, microbiological, and surgical factors.

Methods: PRISMA-guided systematic review including cohort studies plus individual-patient data (IPD) from case reports/series. Random-effects meta-analysis pooled mortality and key proportions; IPD analyses evaluated outcome by age group and surgical strategy, and informed an evidence-based prognostic score/algorithm.

Results: We included 87 cohort studies ($n = 3,300$) and 676 IPD cases. Overall pooled cohort mortality was ~17–18% (random-effects), with lower mortality in modern series (post-1990 pooled mortality ~11% in the epidemiology dataset). Microbiology synthesis (subset reporting cultures) showed empyema culture positivity 66.4% (95% CI 60.3–72.0); among identified pathogens, *Streptococcus* spp. 70.3% and *Staphylococcus* spp. 29.7%, with polymicrobial infection 18.1%. Blood culture yield was low (16.2%), supporting the need for direct empyema sampling.

Surgical strategy strongly tracked outcomes in IPD ($n = 458$ with surgical + outcome): mortality was 17.6% after burr-hole drainage versus 6.6% after craniotomy and 4.9% after craniectomy ($p = 0.001$), with burr hole vs craniotomy OR 3.03 (95% CI 1.60–5.74); this association persisted after confounder adjustment using IPTW (adjusted OR ~2.99).

Age-stratified IPD ($n = 571$) showed lower pediatric mortality than adults (9.6% vs 15.8%, OR 0.56), and within pediatric cases, craniotomy remained associated with lower mortality than burr hole (IPTW-weighted 3.1% vs 13.0%; adjusted OR 4.68 for burr hole vs craniotomy).

An evidence-based SDE-ALGO score (burr hole, brain herniation, otitis etiology, age > 40) stratified poor outcome risk; higher scores correlated with higher poor outcome rates and supported a management decision pathway emphasizing definitive surgery and intensified monitoring in higher-risk patients.

Conclusions: Across decades of literature, cranial SDE still carries substantial mortality, but outcomes appear improved in contemporary practice. Direct empyema sampling is diagnostically critical, *Streptococcus* predominates microbiology, and craniotomy is consistently associated with better survival than burr-hole drainage, including in children. A simple prognostic score/algorithm may support risk-adapted surgical choice and postoperative surveillance.

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Evolution of Research Focus, Academic Networks, and Geographic Landscape of European Neurosurgery: A Multi-Year, AI-Driven Analysis of EANS Conference Abstracts

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The European Association of Neurosurgical Societies (EANS) Annual Congress serves as a key avenue for disseminating European neurosurgical research, and may offer insight into the field's evolving landscape. This study seeks to describe scientific priorities, academic networks, and research trends through a five-year analysis of EANS abstracts.

Methods: All abstracts from the 2021-2025 EANS Annual Congress were accessed; this preliminary analysis includes the previous four years of abstracts. Full abstract books, author lists, and institutional affiliations were processed using ChatGPT for data extraction and descriptive analysis, with manual verification to ensure accuracy.

Results: A total of 2,282 EANS abstracts were analyzed. Abstract volume rose annually (+2.9% to +19.9%), totaling a 47% increase overall. Representation spanned about 60 countries yearly with modest year-to-year variation. High-income country (HIC) affiliations consistently represented >75% of abstract submissions, while submissions from low- and middle-income countries (LMICs) consistently represented <5% of abstracts. International collaboration increased modestly, though cross-income authorship collaborations remained uncommon, representing <5% of abstracts across specialties. Germany, Italy, and