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# The bernasconi-cassinari artery: a key vessel in the pathogenesis of dural arteriovenous fistulas

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**ABSTRACT**

This scoping review aimed to explore the anatomical, physiological, and pathological characteristics of the Bernasconi-Cassinari artery (BCA) and its role in dural arteriovenous fistulas (DAVFs). Following the PRISMA-ScR framework, a comprehensive search was conducted across Scopus, PubMed, and EMBASE until January 28, 2025. The review addressed four key research questions: the anatomical features of the BCA, its contribution to DAVF pathogenesis, diagnostic techniques for identifying its involvement, and therapeutic strategies targeting it in DAVF management. Studies were included based on the PICO(S) framework, focusing on human subjects and peer-reviewed literature. Data extraction captured study characteristics, anatomical descriptions, pathophysiological mechanisms, diagnostic findings, and treatment outcomes. Narrative synthesis organized findings into four themes: BCA anatomy, DAVF pathogenesis, diagnostic approaches, and therapeutic interventions. Results highlighted the BCA's critical role as a feeder vessel in DAVFs, particularly in lesions involving the cavernous sinus and tentorial regions. Advanced imaging modalities like digital subtraction angiography (DSA) and high-resolution MRI have provided precise insights into its morphology and clinical relevance. Therapeutic strategies, including endovascular embolization and microsurgical interventions, demonstrated variable success rates depending on individual vascular anatomy. This review underscores the importance of understanding the BCA in DAVF management and identifies gaps in current knowledge, particularly regarding standardized diagnostic criteria and long-term outcomes of interventions.



## INTRODUCTION

Dural arteriovenous fistulas (DAVFs) are complex cerebrovascular malformations characterized by abnormal arteriovenous shunts within the dura mater, the thick membrane enveloping the brain and spinal cord.1 These lesions are relatively uncommon but carry significant clinical implications due to their potential to cause debilitating neurological symptoms, including intracranial hemorrhage, venous hypertension, and progressive neurologic deficits.2 Despite advancements in diagnostic imaging and endovascular treatment modalities, the pathophysiology of DAVFs remains incompletely understood, particularly regarding the specific roles of individual arterial contributors.1,3,4

Among the various arterial feeders implicated in DAVF formation and maintenance, the Bernasconi-Cassinari artery—a branch of the internal carotid artery supplying the anterior cranial fossa—has garnered increasing attention in recent years. This vessel's unique anatomical location and frequent involvement in high-risk DAVFs suggest it may play a pivotal role in the pathogenesis of these lesions.5 However, the current body of literature on this topic is fragmented, with limited systematic exploration of its anatomical, hemodynamic, and pathological contributions. As a result, the full significance of the Bernasconi-Cassinari artery in the context of DAVFs remains underappreciated, creating a critical gap in our understanding of these vascular malformations.6

The rationale for conducting this scoping review lies in the need to consolidate and critically appraise the existing evidence surrounding the Bernasconi-Cassinari artery's involvement in DAVFs.6 By systematically mapping the available literature, we aim to identify key themes, highlight knowledge gaps, and provide a comprehensive overview of its role in the development, progression, and treatment of DAVFs. This review is particularly timely given the growing recognition of the importance of individual arterial feeders in tailoring therapeutic strategies and improving patient outcomes.

This scoping review holds significant importance as it seeks to address a critical unmet need in the field of cerebrovascular medicine. A deeper understanding of the Bernasconi-Cassinari artery's contributions could enhance diagnostic precision, refine classification systems, and inform more targeted interventions. Furthermore, this work aligns with the broader trend toward personalized medicine, where insights into specific anatomical and pathological features guide clinical decision-making. Given the rising incidence of DAVFs—likely driven by improved diagnostic capabilities and an aging population prone to predisposing conditions such as sinus thrombosis or trauma—this review has the potential to influence both research priorities and clinical practice.

## RESEARCH METHODS

The current scoping review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) framework to ensure rigor, transparency, and reproducibility.7

The research questions guiding the review were formulated as follows: What were the anatomical and functional features of the Bernasconi-Cassinari artery? How did the Bernasconi-Cassinari artery contribute to the pathogenesis of dural arteriovenous fistulas? What imaging modalities and diagnostic tools were used to identify the role of the Bernasconi-Cassinari artery in DAVFs? What therapeutic strategies targeted the Bernasconi-Cassinari artery in the management of DAVFs? To address these questions, a comprehensive search strategy was developed and executed across three major academic databases: Scopus, PubMed, and EMBASE until 28 January 2025. These databases were selected due to their extensive coverage of biomedical and clinical literature, ensuring a broad and inclusive search.

The eligibility criteria for study inclusion were defined using the PICO(S) framework. Studies involving human subjects with dural arteriovenous fistulas or anatomical studies focusing on the Bernasconi-Cassinari artery were included. The intervention or exposure of interest was the role of the Bernasconi-Cassinari artery in DAVF pathogenesis, diagnosis, or treatment. No comparator was required, as scoping reviews typically did not involve comparative analyses. The outcomes of interest included anatomical descriptions, pathophysiological mechanisms, diagnostic findings, and therapeutic outcomes related to the Bernasconi-Cassinari artery. Peer-reviewed articles, case reports, case series, reviews, anatomical studies, and clinical studies were deemed eligible for inclusion, while non-peer-reviewed sources, conference abstracts, and animal studies were excluded unless directly relevant.

The search strategy was designed to maximize sensitivity and capture all relevant studies. A combination of keywords and Boolean operators was utilized, including terms such as "Bernasconi-Cassinari artery," "middle meningeal artery," "dural arteries," "dural arteriovenous fistula*," "DAVF*," "pathogenesis," "diagnosis," and "treatment." In addition to database searches, reference lists of included studies were screened, and key journals specializing in neurology, neuroradiology, and vascular surgery were hand-searched for additional relevant articles. Two independent reviewers conducted the study selection process, beginning with a screening of titles and abstracts against the eligibility criteria, followed by a full-text review of potentially relevant articles. Any discrepancies between reviewers were resolved through discussion or consultation with a third reviewer.

Data extraction was performed using a standardized form to collect information from the included studies. Key variables included study characteristics (e.g., author(s), year of publication, study design, sample size, and population), anatomical features of the Bernasconi-Cassinari artery,

pathophysiological mechanisms linking the BCA to DAVF formation, diagnostic techniques used to assess the BCA, therapeutic interventions targeting the BCA, and reported outcomes. Although scoping reviews typically did not involve formal quality appraisal, a basic assessment of methodological rigor was conducted to categorize studies as high, moderate, or low quality based on factors such as study design, sample size, and clarity of objectives and outcomes.

The data synthesis was primarily narrative due to the expected heterogeneity of study designs and outcomes. Themes were organized into four main categories: (1) anatomy of the Bernasconi-Cassinari artery, summarizing anatomical findings; (2) pathogenesis of DAVFs, exploring mechanisms by which the BCA contributed to DAVF formation; (3) diagnosis, detailing imaging techniques and diagnostic criteria; and (4) treatment, describing therapeutic strategies and their effectiveness. Ethical approval was not required for the review, as it involved only published literature. However, adherence to ethical guidelines for reporting and citation was strictly maintained.ew of the current evidence base and inform future research priorities in the field of TN management.

## RESULTS AND DISCUSSION

Anatomy of the Bernasconi-Cassinari Artery

The Bernasconi-Cassinari artery (BCA), also known as the medial tentorial artery, is a branch of the meningohypophyseal trunk (MHT) that originates from the cavernous segment of the internal carotid artery.8,9 This artery courses along the free edge of the tentorium cerebelli and supplies dural structures in this region. Anatomical studies have demonstrated variability in its origin, course, and dominance, with some individuals exhibiting hypoplasia or absence of the vessel. When the BCA is underdeveloped, collateral circulation from other arteries, such as the middle meningeal or occipital arteries, often compensates for its reduced contribution. The artery is roughly 2 cm long and has a wavy appearance on angiography, typically presenting as a single trunk.10 Its consistent origin from the MHT underscores its significance in vascular anatomy, although variations such as shared origins with other branches of the MHT or independent origins from the ICA have been documented in cadaveric and radiological studies.

Historically, the BCA was first described by Bernasconi and Cassinari, who emphasized its role in supplying the tentorial dura. Modern imaging techniques like digital subtraction angiography (DSA) and high-resolution MRI have provided more precise insights into its morphology and clinical relevance. These advancements align with previous findings highlighting the importance of understanding the angioarchitecture of skull base vessels, including the BCA, for diagnosing and treating vascular pathologies. Studies integrating radiological data have described variations in the BCA’s structure and function, emphasizing its contributions to pathological processes such as dural arteriovenous fistulas (DAVFs). Such anatomical knowledge is critical for neurosurgeons and interventional radiologists when planning surgical or endovascular procedures involving the tentorial region.

Recent investigations using advanced imaging modalities have further elucidated the hemodynamic interactions between the BCA and surrounding vasculature during DAVF progression.11–13 Research has demonstrated how hemodynamic stress can alter the BCA’s structure, providing a mechanistic explanation for its involvement in DAVF pathogenesis. These developments underscore the importance of refining diagnostic tools to account for individual anatomical variability and improve patient outcomes. Understanding the BCA's role in normal physiology and pathological states allows clinicians to anticipate potential challenges during interventions, particularly in cases where the artery serves as a collateral pathway in response to compromised primary arterial contributors.

Comparing current knowledge of the BCA’s anatomy with earlier literature reveals an evolution in understanding driven by technological advances. Early anatomical studies relied on cadaveric dissections, which provided foundational insights but lacked the precision offered by modern imaging modalities.14 The integration of radiological data has expanded comprehension of the BCA’s

contributions to both normal vascular supply and pathological conditions. This growing body of evidence supports the need for interdisciplinary approaches combining anatomy, pathology, and interventional techniques to advance the management of vascular disorders involving the tentorial region. As research continues, further refinements in diagnostic and therapeutic strategies tailored to individual patient anatomy are expected to enhance clinical outcomes.

Role in the Development of dAVFs

The BCA plays a significant role in DAVF formation, particularly in lesions involving the cavernous sinus and tentorial regions. Its proximity to these high-risk areas makes it susceptible to involvement in fistulous connections, especially when venous hypertension or sinus thrombosis occurs.15 In response to increased flow demand, the BCA may hypertrophy and contribute to feeding the fistula, acting as either a primary or secondary arterial supplier. This dynamic interaction between the BCA and DAVFs has been documented in case reports and clinical studies, with targeted embolization of the BCA proving to be an effective treatment strategy in certain cases.16 Such findings highlight the need for meticulous evaluation of the BCA during diagnostic imaging and treatment planning.

While pediatric DAVFs are often linked to congenital venous anomalies or birth trauma, adult cases frequently result from acquired conditions such as venous sinus thrombosis or inflammation. The role of angiogenic factors, including vascular endothelial growth factor (VEGF), has also gained attention as a potential contributor to abnormal vessel development.17 Understanding these mechanisms allows clinicians to tailor therapeutic strategies, such as endovascular embolization, to target specific feeding arteries like the BCA. Recent studies have identified multiple major arterial sources feeding tentorial DAVFs, with the BCA being one of the key contributors.

Neurosurgical Perspective

As a branch of the meningohypophyseal trunk, the unique origin of BCA and variable course have been highlighted in numerous studies, underscoring its role as a feeder vessel in these complex vascular malformations. Detailed morphometric analyses have revealed that variations in the caliber and trajectory of BCA may influence the hemodynamic characteristics of DAVFs, thereby affecting both the clinical presentation and the risk profile, particularly regarding hemorrhagic complications.18

The neurosurgical discourse has progressively refined treatment approaches to DAVFs involving the BCA, focusing on both endovascular and microsurgical techniques. Advanced imaging modalities, such as high-resolution digital subtraction angiography and three-dimensional reconstructions, have enabled precise identification and selective catheterization of this diminutive yet critical artery. Case reports and clinical series have demonstrated that endovascular embolization, often employing liquid embolic agents, can effectively target the BCA in select cases.19,20 Conversely, in scenarios where endovascular access is challenging due to the vessel’s deep location or unfavorable angioarchitecture, microsurgical interventions provide an alternative route. This duality in treatment strategy reflects a broader trend towards personalized therapy based on individual vascular anatomy and the specific characteristics of the DAVF.

Looking ahead, emerging technologies and refined neurointerventional techniques are poised to further enhance the management of DAVFs associated with the BCA.19 Intraoperative imaging tools, including indocyanine green video angiography and neuronavigation systems, are increasingly being integrated into both diagnostic and therapeutic workflows, facilitating real-time visualization of vascular structures during surgery. Furthermore, the evolution of endovascular devices and embolic materials is expanding the feasibility of treating complex fistulas while minimizing collateral damage to adjacent neurovascular structures.

## CONCLUSION

Intraoperative near-infrared fluorescence imaging is a valuable tool for improving tumor resection margins in GBM surgery. Current technical note demonstrates its potential to achieve gross

total resection with minimal morbidity. While larger studies are needed to validate these findings, this technique holds promise for enhancing surgical outcomes and prolonging survival in patients with GBM. Future research should focus on optimizing fluorescent agents, refining imaging technologies, and integrating NIR fluorescence with other intraoperative modalities to further improve precision and safety.

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