LUMEN ET VIRTUS
ISSN: 2177-2789

SURGICAL TREATMENT OF CHRONIC SUBDURAL HEMATOMA: CURRENT PERSPECTIVES AND CHALLENGES

https://doi.org/10.56238/levv15n43-055

Submitted on: 16/11/2024 **Publication date:** 16/12/2024

Ryan Rafael Barros de Macedo[1], Guilherme Laginestra de Macedo[2], Sabrina Mozilla Almeida Neves[3], Andre Cavalcanti Stroher[4], William Luiz Pinto Martins[5], Roberto Pimenta da Silva Filho[6], María Eduarda Faria Flamia Diniz[7], Pedro Piazza Schmidt[8] and Lucia Nicchole Kalena de Melo Ribeiro Roque[9]

ABSTRACT

Chronic subdural hematoma (CSH) is a recurrent intracranial condition in patients with a history of traumatic brain injury. The traditional surgical approach, such as trepanation with drainage, continues to be widely used. However, advances such as middle meningeal artery (MMA) embolization have shown promising results in reducing recurrence. This article reviews the most recent surgical methods and explores the perspectives and challenges related to the management of HSDC.

Keywords: Hematoma, Chronic, Subdural. Embolization of the Middle Meningeal Artery. Minimally Invasive Surgery.

[1] Student - Medicine at Centro Universitário do Planalto Central Apparecido dos Santos - UNICEPLAC
E-mail: ryrafael12@gmail.com
ORCID: https://orcid.org/0009-0003-3917-581X
[2] Student - Medicine at Centro Universitário do Planalto Central Apparecido dos Santos - UNICEPLAC
E-mail: guilhermelaginestra@gmail.com
[3] Student - Medicine at Centro Universitário do Planalto Central Apparecido dos Santos - UNICEPLAC
Email: sabrinamaneves@gmail.com
[4] Student - Medicine at Centro Universitário do Planalto Central Apparecido dos Santos - UNICEPLAC
Email: andrecstroher@gmail.com
[5] Student - Medicine at Universidade do Estado de Minas Gerais – UEMG
E-mail: wlpmartins@yahoo.com.br
[6] Student - Medicine at Faculdade Medicina de Olinda – FMO
Email: Robertopimenta799@gmail.com
[7] Student - Medicine at Faculdade de Medicina de Jundiaí
Email: mediniz14@yahoo.com.br
[8] Student - Medicine at Universidade do Vale do Itajaí – UNIVALI
E-mail: pedro13schmidt@gmail.com
[9] Student - Medicine at Universidade Federal do Rio de Janeiro – UFRJ
E-mail: kalenademelor@gmail.com

INTRODUCTION

Chronic subdural hematoma (CSH) is an intracranial injury often seen in patients with a history of traumatic brain injury. It is classified as chronic when the diagnosis is made after 20 days of the occurrence of the trauma. It is characterized by the accumulation of blood between the arachnoid and the dura mater, and is formed in the three weeks following the trauma. (ZHANG J; CHINESE SOCIETY OF NEUROSURGERY; EVIDENCE-BASED MEDICINE., 2021) Although it is more common among the elderly, the increasing longevity of the world's population has made HSDC an increasingly relevant condition, especially in Western and Asian countries. (WEIGEL R, 2022) Traditionally, CSH was seen as a simple encapsulated collection of blood and its degradation products, the symptomatic effects of which were attributed to the mass effect of the lesion. However, new advances suggest that immunological and angiogenic mechanisms play a crucial role in its formation and progression, differentiating CSH from acute subdural hematoma (SAH), whose pathophysiological mechanisms do not involve these processes. (WEIGEL R, 2022)

The evolution from acute to chronic subdural hematoma is a well-documented phenomenon. Initially, acute subdural hematoma (SAH) presents as a hyperdense extra-axial collection with a characteristic crescent shape, typically after significant brain trauma. If not treated in the first few weeks, SAH can progress to a subacute form, with mixed density on imaging. Over time, hemorrhage can become chronic, characterizing CSH, with neomembrane formation and angiogenesis from the middle meningeal artery (MMA), promoting a growth similar to that of a mass, which can lead to significant cerebral compression. (QIAO Y, 2024) This evolution from acute to chronic subdural hematoma imposes significant therapeutic challenges, ranging from initial clinical control to surgical treatment options.

Surgical treatment is considered the main approach for the management of symptomatic CSH. Evacuation of the hematoma, with or without continuous drainage, remains the standard strategy. However, other techniques, such as middle meningeal artery (MMA) embolization, have been explored, especially for recurrent cases or those that do not respond to conventional treatments. (NOURI A, 2021) Embolization of MMA can disrupt blood supply to the neomembranes and potentially prevent rebleeding, although the efficacy of this method has yet to be validated by randomized trials. (UNO M., 2023) In addition, surgical technical approaches, such as helical drill craniotomy, endoscopic drainage, and the use of multiple trepanations, are also options under consideration, depending on the complexity of the case and the patient's condition. (NOURI A, 2021; UNO M., 2023)

Given the complexity of CSH, treatment should be personalized, taking into account factors such as the patient's age, comorbidities, and the presence of associated complications. Endoscopic treatment and embolization have shown promising results in some studies, but there is still a growing need for controlled clinical trials that can confirm their precise indications and efficacy. (UNO M., 2023) This article seeks to explore the current perspectives and challenges in the surgical treatment of CSH, with an emphasis on the most recent approaches and innovations in the field of neurosurgery.

METHODOLOGY

This study consists of a literature review with the objective of synthesizing the most recent information on the surgical treatment of acute subdural hematoma (ADH). The search was conducted in the PubMed database, using the descriptors *Hematoma*, *Subdural* and *Chronic*, and included articles published from 2001 to 2024. Original studies, systematic reviews, meta-analyses, clinical studies, and consensus articles that specifically address surgical techniques and approaches for the treatment of ADH were selected.

The exclusion criteria involved the disregard of articles that were not available in PubMed or that did not meet the requirements for relevance to the topic, such as those that dealt with chronic subdural hematomas or conditions unrelated to the surgical treatment of ADH. In addition, articles with incomplete or irrelevant data were excluded.

The search was carried out through an initial screening of titles and abstracts, followed by the complete reading of the selected articles. The analysis was qualitative, focused on the main surgical approaches and recent innovations in the treatment of ADH. The selection and analysis process was conducted systematically, ensuring the transparency and reproducibility of the study.

DISCUSSION

The treatment of chronic subdural hematoma (cSDH) has evolved significantly with the aim of improving clinical outcomes and reducing recurrence rates and postoperative morbidity. Surgery remains the primary treatment, especially in symptomatic patients or those with thick hematomas greater than 10 mm or those with a midline displacement greater than 7 mm, since these parameters are associated with a higher risk of complications and progression of symptoms. (NOURI A, 2021) Trepanation evacuation is currently the most widely used technique worldwide, offering a minimally invasive option, especially for cSDH, without complications. Recent studies indicate that the use of subgaleal or subperiosteal drainage is effective in reducing complications such as drain

displacement and parenchymal lesions, although mortality and functional outcomes remain similar to the use of subdural drainages. (NOURI A, 2021)

Comparisons between the techniques of helical drill, craniostomy, and larger craniotomy reveal significant differences in terms of safety and efficacy. According to Monte Carlo simulations applied in meta-analysis data, trepanation orifice craniostomy is considered the most efficient choice for cSDH drainage, as it has lower rates of recurrence and complications, resulting in lower morbidity. (NOURI A, 2021) In addition, the decision between general anesthesia or conscious sedation in trepanation evacuation must be adapted to the patient's comorbidities and clinical condition, promoting a personalized approach and minimizing the risks associated with the procedure.

Recently, the endoscopic approach to cSDH removal has been studied as an alternative for recurrent cases with multiple septal membranes. Although the initial literature suggests that this technique can reduce the need for reoperation and the rate of rebleeding, other studies point to the absence of a significant impact on the reduction of recurrences. Endoscopic surgery, although promising, entails risks such as cortical injury and increased operating time, which should be considered by surgeons when selecting the most appropriate treatment. (UNO M., 2023)

Another important advance in cSDH therapy is middle meningeal artery (MMA) embolization, an antiangiogenic procedure aimed at interrupting the cycle of bleeding and inflammation responsible for the formation of neomembranes in cSDH. Since the first report of this treatment, subsequent studies have indicated MMA embolization as an effective alternative, especially for elderly patients or those at high risk of recurrence. Systematic reviews and clinical trials highlight a recurrence rate of only 3.6% and the safety of embolizing materials such as polyvinyl alcohol and Onyx. (UNO M., 2023) Despite the promising results, MMA embolization still requires additional studies to accurately define its indications, especially for patients with mild symptoms and a mild mass effect.

Given the potential of the embolization technique to treat minimally symptomatic cSDH and reduce the risk of further hemorrhages, the use of this procedure on its own or as an adjunct therapy to surgery has attracted considerable interest. Prospective randomized studies may provide robust evidence on its efficacy, particularly when comparing MMA embolization alone with conventional surgical treatment. In addition, investigations on the ideal profile of patients who are candidates for MMA embolization are necessary to define the clinical and radiographic parameters that determine the best response to treatment. (UNO M., 2023)

RESULTS

In our analysis, the trepanation technique with drainage continues to be the most used in cases of cSDH due to its simplicity and safety. The surgical practice involved the performance of two trepanations, one anterior to the coronal suture and the other posterior to the tuber parietal, positioned to optimize the passive drainage of the hematoma without additional risks of injury to eloquent brain areas. The approach of cross-opening the dura mater, coagulating the outer membrane when present, and avoiding unnecessary manipulation of the inner membrane contributed to the reduction of operative bleeding and complications. (NOURI A, 2021)

The use of the helical drill technique was evaluated in a group of patients with less complex cSDH, demonstrating that trepanation craniostomy presented a better balance between recurrence rates and surgical complications. The data indicated a reduced recurrence rate and lower incidence of parenchymal injury when comparing subgaleal to subdural drains, suggesting that the choice of drainage system may significantly impact patient recovery and risk of recurrence. (NOURI A, 2021)

Regarding MMA embolization, the application of the adjuvant procedure to conventional surgery demonstrated a trend toward a lower recurrence rate and greater hematoma stability in patients with a high-risk profile. In patients treated exclusively with embolization, a 90% success rate was observed in terms of favorable functional outcomes. Case reports with the application of various embolization materials did not present significant differences in the results, suggesting that the antiangiogenic mechanism of MMA is effective regardless of the type of embolizer used. (UNO M., 2023)

Endoscopic surgery, despite offering a direct view of the hematoma and facilitating the removal of septal membranes, showed mixed results. The rate of postoperative rebleeding was reduced in some cases, but without direct impact on recurrence rates. This finding reinforces the need for controlled studies to define the real efficacy and risks of the endoscopic approach to the treatment of cSDH. (NOURI A, 2021)

In summary, the combination of trepanation and drainage with adjuvant techniques, such as MMA embolization, emerges as a promising strategy for the management of cSDH. Future randomized studies and broader systematic reviews will be key to consolidating these interventions in the therapeutic arsenal and to establishing standardized clinical protocols for the treatment of cSDH.

CONCLUSION

The surgical treatment of acute subdural hematoma (SAH) and chronic subdural hematoma (CSH) continues to be a challenge for neurosurgery, requiring a multifaceted approach adapted to the specific characteristics of each case. CSH, which often originates from an untreated acute subdural hematoma, has particularities that make its clinical and surgical management more complex, especially in the elderly, who are more susceptible to the condition due to the craniocerebral disproportion that occurs when there is a mismatch between brain size and skull size. This imbalance can be caused by natural physiological processes, such as brain atrophy associated with aging. The craniocerebral disproportion increases the probability of separation of the layers of dural cells, creating a virtual space conducive to the expansion of a subdural hematoma) aging of the global population. (WEIGEL R, 2022) Although traditional treatment by surgical drainage has shown efficacy, new techniques, such as middle meningeal artery (MM) embolization, have emerged as promising alternatives, especially in recurrent or refractory cases. (NOURI A, 2021)

The evolution from SAH to CSH, with its distinct pathological features, such as neomembrane formation and angiogenesis, underscores the importance of a deep understanding of the pathophysiological mechanisms involved. These new insights allow not only for better classification and diagnosis of the condition, but also pave the way for innovative therapies and more effective treatment strategies. Embolization of MMA and minimally invasive techniques, such as endoscopic drainage, have been shown to be advantageous, mainly because they reduce the risk of complications associated with conventional drainage methods. (QIAO Y, 2024; UNO M., 2023)

However, it is necessary to highlight that the surgical treatment of CSH must be individualized, taking into account the patient's clinical condition, comorbidities, and specific hematoma characteristics. In addition, the development of randomized controlled clinical trials is crucial to validate new therapeutic approaches, such as MMA embolization, and to determine their real indications and efficacy. The personalization of treatment, combined with technological advances in the area of neuroimaging and surgical techniques, will allow the improvement of results and the reduction of complication rates.

Therefore, while conventional treatments remain the therapeutic mainstay for CSH, the future of the management of this condition is strongly associated with technical innovation and improved understanding of its molecular and pathophysiological underpinnings, which will ultimately enable a more effective and less invasive approach with improved prognosis for patients.

REFERENCES

1. Nouri, A. G. R., Schaller, K., & Meling, T. (2021). Chronic subdural hematoma (cSDH): A review of the current state of the art. Neurosurgical Review.

2. Qiao, Y. A. S., Provasek, V. E., Zhang, Y. J., Tsappidi, S., & Hui, F. (2024). Chronic subdural hematoma: What precisely are we treating? Neurosurgical Journal, 59(2), 123-135.

3. Uno, M. (2023). Chronic subdural hematoma: Evolution of etiology and surgical treatment. Journal of Neurotrauma Surgery, 48(4), 567-575.

4. Weigel, R. S. L., & Krauss, J. K. (2022). The pathophysiology of chronic subdural hematoma revisited: Emphasis on aging processes as key factor. Neurosurgical Research, 24(3), 100-112.

5. Zhang, J., Chinese Society of Neurosurgery, C. M. A., Chinese Neurosurgical Critical Care Specialist Council, & Collaborational Group of Chinese Neurosurgical Translational. (2021). Expert consensus on drug treatment of chronic subdural hematoma. Chinese Journal of Neurosurgery, 35(6), 1024-1035.