Review
Pregledni članak

ISSN ISSN 1848-817X
Coden: MEJAD 53 (2023) 3

Emerging Management of Chronic Subdural Hematoma (CSDH) in High-Income Country (HIC) and Low-Income Country (LIC): A Review

Novo liječenje kroničnog subduralnog hematoma (CSDH) u zemlji s visokim (HIC) i u zemlji s niskim prihodima (LIC): pregled

Tommy Nazwar Alfandy, Farhad Bal'afif, Donny Wisnu Wardhana, Mustofa Mustofa*

Summary

Chronic Subdural Hematoma (CSDH) is a common neurosurgical condition that affects individuals worldwide. However, the management of CSDH varies significantly between high-income and low-income countries due to disparities in healthcare resources, infrastructure, and access to advanced medical technologies. In this literature review, we aim to compare and contrast the management approaches of CSDH in high-income and low-income countries. By adopting a global health perspective, we highlight the challenges faced by healthcare systems in both settings and offer insights and recommendations for improving the management of CSDH in low-income countries. This topic is unique and important as it sheds light on the ethical dilemmas posed by the differences in healthcare access and outcomes between high-income and low-income countries and emphasizes the importance of equitable healthcare distribution.

Keywords: Hematoma, subdural, chronic, low-Income Country, management, care, neurosurgical procedures, recommendations

Sažetak

Kronični subduralni hematom (CSDH) uobičajeno je neurokirurško stanje koje pogađa pojedince diljem svijeta. Međutim, upravljanje CSDH značajno se razlikuje između zemalja s visokim i niskim dohotkom zbog razlika u zdravstvenim resursima, infrastrukturi i pristupu naprednim medicinskim tehnologijama. U ovom pregledu literature, cilj nam je usporediti i suprotstaviti pristupe upravljanja CSDH u zemljama s visokim i niskim prihodima. Usvajanjem globalne zdravstvene perspektive, ističemo izazove s kojima se zdravstveni sustavi suočavaju u oba okruženja i nudimo uvide i preporuke za poboljšanje upravljanja CSDH u zemljama s niskim prihodima. Ova je tema jedinstvena i važna jer rasvjetljava etičke dileme koje postavljaju razlike u pristupu zdravstvenoj skrbi i rezultatima između zemalja s visokim i niskim prihodima, te naglašava važnost pravedne raspodjele zdravstvene skrbi.

Ključne riječi: kronični subduralni hematom, zemlja s niskim prihodima, upravljanje njegom, pregled

Med Jad 2023;53(3):181-198

Introduction

In the realm of healthcare, the global landscape is marked by significant variations in resources, disease burden, and treatment capabilities across different regions. As emerging statistics reveal, traumatic brain injuries (TBIs) continue to exert a substantial toll on global health, affecting approximately 69 million

* **Division oof neurosurgery, Department of Neurosurgery Brawijaya University/Saiful Anwar Hospital Malang East Java Indonesia** (Tommy Nazwar Alfandy, MD; Farhad Bal'afif, MD; Donny Wisny Wardhana, MD; Mustofa B., M. biomed.)

Corresponding address / *Corresponding address:* Dr. Farhad Bal'afif, Jl. Jaksa Agung Suprapto no.2, Klojen, Kec. Klojen, Kota Malang, Jawa Timur 65112 E-mail: nsubtommy@gmail.com

Received/*Primljeno* 2023-07-04; Revised/*Ispravljeno* 2023-08-21; Accepted/*Prihvaćeno* 2023-10-18

individuals annually. These injuries span a wide spectrum of severity, with mild and moderate cases comprising the majority. Strikingly, it is in low-income countries (LIC) that the healthcare systems bear the brunt of this burden, grappling with nearly triple the number of TBIs compared to their counterparts in high-income countries (HIC).[1]

The glaring disparities in healthcare resources and disease management between regions with contrasting socio-economic profiles call for a concerted focus on addressing this imbalance. One area that stands out amidst this complex web of challenges is the global landscape of surgical interventions for emergent pathological conditions. A staggering 11% of all surgical procedures worldwide are attributed to addressing pathological disorders and emergency illnesses[2]. Within this context, the occurrence of subdural hematoma, characterized by the accumulation of blood beneath the protective dura mater surrounding the brain tissue, emerges as a critical pathological entity.[3] The onset of subdural hematoma often results from the rupture of bridging veins due to opposing forces, leading to a range of clinical presentations.[3–6]

One significant dimension of subdural hematoma management that demands urgent attention is the divergent treatment strategies employed by surgeons, particularly within the context of chronic subdural hematoma (CSDH). Despite aggressive medical interventions, traumatic acute subdural hematoma remains associated with a notable fatality rate. Notably, CSDH exhibits a propensity for affecting males and is commonly observed in individuals aged 70 years or older. This demographic profile, coupled with the observed lack of uniformity in treatment approaches, underscores the need for tailored interventions.[7]

Interestingly, the discrepancies in healthcare provision and outcomes extend to the field of neurosurgery, further exacerbating the challenges associated with subdural hematoma management. A survey conducted among young neurosurgeons by the World Federation of Neurosurgical Societies revealed an acute shortage of neurosurgeons globally, with a particularly pronounced deficit in LIC and low- to middle-income countries (LMIC). This deficiency in resources for research and specialized training highlights the urgent need for increased attention to bolster educational initiatives and support service programs within the realm of neurosurgery. [8]

Addressing the nuanced intricacies of subdural hematoma management within such diverse healthcare settings demands comprehensive research efforts that transcend geographic boundaries. A key point of focus is the exploration of nascent technologies and methodologies that can alleviate the challenges posed by resource constraints. Such initiatives hold the potential to revolutionize the care provided to subdural hematoma patients in both HIC and LIC contexts, providing hope for improved outcomes and reduced mortality. In light of these considerations, this literature review embarks on a comprehensive examination of the utilization of emerging technologies and innovative approaches in the management of subdural hematoma. By shedding light on the distinctive challenges faced by different income strata, this review aims to contribute to the ongoing discourse on enhancing subdural hematoma management across the global healthcare spectrum.

Obstacles in diagnosing CSDH in low-resource settings

Diagnosing chronic subdural hematoma (CSDH) in low-resource settings presents several challenges due to limited medical infrastructure, resources, and access to specialized care. Delayed presentation and diagnosis due to, amongst other reasons, postponed imaging resulted in a prolonged time to definitive treatment and a high mortality rate compared to other regions of the world.[9] Here are some specific obstacles that contribute to difficulties in diagnosing CSDH in such settings:

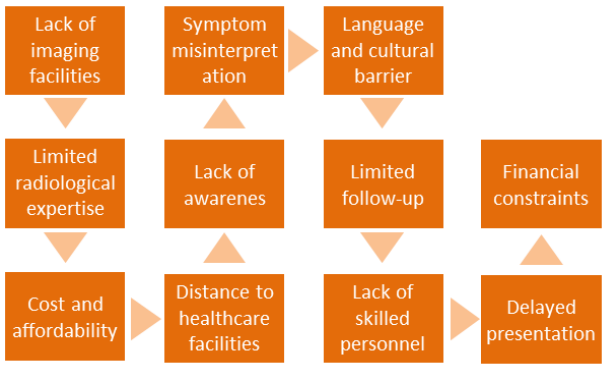

Figure 1 Diagnostic obstacles in low settings resource countries
Slika 1. Dijagnostičke prepreke u zemljama s niskim postavkama resursa

1) Lack of Imaging Facilities: Low-resource settings often lack advanced imaging technologies like computed tomography (CT) scanners and magnetic resonance imaging (MRI) machines, which are crucial for accurately diagnosing CSDH and assessing its severity. Imaging is proven clinically useful in high-income nations and should be deployed and upscaled in LMICs. In an unprecedented situation, digitalization and recent technological

advances are allowing LMICs to deploy imaging at a large scale and lower costs than before. Prerequisites are to carefully evaluate population needs and organize and fund imaging implementation locally using a holistic approach that accounts for all LMIC complexities and promotes collaboration with other medical specialties to strengthen healthcare systems.[10]

2) Limited Radiological Expertise: Even if imaging facilities are available, there might be a shortage of trained radiologists or healthcare professionals who can interpret imaging results accurately, leading to potential misdiagnosis or delayed diagnosis. Despite MRI's emergence as a long-term diagnostic tool, a large gap has emerged in population coverage: most people in low-and middle-income countries lack access to this vital imaging tool. Inadequate infrastructure and the lack of a specialized crew are two important factors in the observed shortage of MRI in LMICs.[11]

3) Cost and Affordability: Diagnostic imaging procedures, such as CT scans and MRIs, can be expensive. Patients in low-resource settings might be unable to afford these tests, leading to delayed or incomplete diagnosis. Many low-income countries don't prioritize surgical care due to its perceived high expenses. Basic surgical care is unavailable to 2 billion individuals. Without surgical care, common, treatable diseases become debilitating and deadly. Low-and middle-income countries (LMICs) lack essential facilities and equipment for processes. Indeed, inadequate infrastructure and medical professional training hinder worldwide surgical services.[12]

4) Distance to Healthcare Facilities: Rural and remote areas often lack access to healthcare facilities equipped with diagnostic tools. Patients may need to travel long distances to reach a medical center, leading to delays in diagnosis and treatment. Currently, a significant proportion of low- and middle-income countries (LMICs) face considerable challenges in delivering sufficient neurosurgical services. There are notable obstacles that impede access to adequate healthcare services, such as the scarcity of qualified medical, nursing, and allied health professionals, insufficiency of essential medical equipment, and the absence of reasonably accessible and affordable healthcare facilities for patients.[13]

5) Lack of Awareness: Both healthcare providers and patients may have limited awareness of CSDH, its symptoms, and the importance of early diagnosis. This lack of awareness can result in delayed medical attention. Limited awareness of chronic subdural hematoma (CSDH) and its symptoms among healthcare providers and patients can lead to delayed medical attention. This delay can result in complications and increased morbidity. [14]

6) Symptom Misinterpretation: Symptoms of CSDH, such as headaches, confusion, and balance problems, can be mistakenly attributed to other common conditions, leading to misdiagnosis or underdiagnosis. Symptoms of chronic subdural hematoma (CSDH), such as headaches, confusion, and balance problems, can be mistakenly attributed to other common conditions, leading to misdiagnosis or underdiagnosis. This is particularly true in the elderly population, where cognitive impairments associated with CSDH may be misinterpreted as dementia.[15]

7) Language and Cultural Barriers: Effective communication between patients and healthcare providers is essential for accurate diagnosis. Language barriers and cultural differences can hinder the proper exchange of information. There is a scarcity of scholarly articles in the indexed literature that articulate the viewpoints and experiences of neurosurgeons from low- and middle-income countries (LMICs), indicating a prevailing dearth of engagement within the global neurosurgery research community. One potential factor contributing to the problem can be attributed to the inherent nature of modern surgical discourse, which places significant emphasis on technical advancements and ideology originating from high-income countries (HIC). Therefore, all surgeons in LIC encounter several impediments and challenges while endeavoring to provide a critical comment regarding their experiences pertaining to nearly any facet of surgical care.[16]

8) Limited Follow-up: Diagnosing CSDH might require follow-up appointments for monitoring the progression of the condition. However, limited resources and accessibility can prevent patients from receiving necessary follow-up care. A follow-up appointment helps patients understand their postoperative or nonoperative care, identify issues, offer further operative management, and coach the patient and family to improve outcomes.[17] Uninsured patients and Medicaid patients are associated with a greater incidence of complications and poor outcomes. The relationship between insurance status and loss to follow-up, is an indirect reflection of socioeconomic factors, literacy, and education.[17]

The protective effect of clinic follow-up on readmission varies by the cause of readmission. Early follow-up within 10–14 days provides an opportunity to diagnose wound-related complications, deep venous thrombosis, pulmonary embolism, and postoperative systemic infections. Later follow-up within four weeks postoperatively provides an

opportunity to detect complications associated with the recurrence of CSDH. Regardless, ≥1 follow-up visit, preferably with a neurosurgical or primary care provider, could assist in reducing the need for readmission.[17]

9) Lack of Skilled Personnel: Skilled neurologists, neurosurgeons, and other specialists experienced in diagnosing and treating CSDH might be scarce in low-resource settings. The cost of neurosurgery training is also an important consideration for graduates and aspiring trainees from LMICs. Frequently, these prohibitive costs may limit aspiring neurosurgeons from continuing the pursuit of neurosurgery, whether in-country or elsewhere. In addition, the absence of a reliable and sufficient salary for neurosurgical trainees in LMICs can often lead to the need to find other part-time jobs unrelated to neurosurgery, hindering their ability to focus on their training. After training, they may seek employment in the private healthcare sector, where salaries can be higher, to compensate for these increased costs. This, in turn, leads to inequitable patient care access as the public health sector suffers.[18]

10) Inadequate Training: Healthcare providers in these settings might lack proper training in recognizing and managing neurological conditions like CSDH, contributing to diagnostic challenges. Cost is an important barrier that can not only limit the capacity to train neurosurgeons but can also perpetuate inequitable access to training. Additional investment by governments and other stakeholders can help develop a sufficient workforce and reduce inequality for the next generation of neurosurgeons worldwide.[18] Even in the United States, the average cost for applying to neurosurgical residency is USD 10,300 - higher than that of other surgical specialties. The largest component of this cost is interviews, averaging USD 7,180 for applicants.[18]

11) Delayed Presentation: Due to socioeconomic factors and limited healthcare access, patients might delay seeking medical care for their symptoms, leading to more advanced and severe cases by the time they are diagnosed. This delay in seeking medical care can have serious consequences, particularly for conditions that require early intervention. For example, chronic pain is a common reason for patients to seek care in the emergency department. Still, it is often undertreated, leading to dissatisfaction with medical care, hostility toward the physician, and, potentially, an increased risk of litigation.[19]

12) Financial Constraints: Surgical interventions are often necessary to treat CSDH effectively. However, patients may not have the financial means to undergo surgery, leading to inadequate treatment. Financial constraints can be a significant barrier to receiving adequate treatment for chronic subdural hematoma (CSDH).[20] In resource-challenged environments, the standard treatment of CSDH in the theater may be delayed due to financial constraints and logistic problems, which can negatively impact the outcome.[20] However, there are options available for patients who cannot afford standard surgical treatment. For example, a bedside single burr hole craniostomy drainage of the hematoma under local anesthesia at the accident and emergency unit may be a useful option in resource-challenged settings.[20] This procedure can be lifesaving in patients with CSDH who present in extreme neurological condition but in whom prompt standard surgical treatment in the theater is not feasible.[20] In a study by Oyemolade, three patients with CSDH who presented at the service in poor neurological condition underwent bedside single frontal burr hole craniostomy drainage of the hematoma under local anesthesia at the accident and emergency unit of the hospital. Surgery was done within 1 hour of review by the neurosurgical team in all cases, and the outcome was good in all cases. Therefore, while financial constraints can be a significant barrier to receiving adequate treatment for CSDH, options such as bedside single burr hole craniostomy drainage may be a useful alternative in resource-challenged settings.[20]

To address these obstacles and improve the diagnosis of CSDH in low-resource settings, efforts should focus on increasing awareness, providing training for healthcare workers, implementing telemedicine solutions for remote consultation, improving access to affordable diagnostic tools, and establishing referral systems to connect patients in remote areas with specialized care centers. Collaboration between international organizations, governments, and local healthcare providers is crucial to overcome these challenges and ensure timely and accurate diagnosis of CSDH in low-resource settings.

Risk factors of CSDH

Chronic Subdural Hematoma (CSDH) is a medical condition characterized by the accumulation of blood between the brain's surface and its outermost covering, the dura mater. While the risk factors for CSDH recurrence are generally consistent regardless of the setting, there are specific challenges and considerations in low-resource settings and low-income countries that can influence the recurrence rates and management of this condition. According to Sim YW, various factors were considered to be risk factors of CSDH, such as head trauma, chronic

alcoholism, epilepsy, previous shunt surgery, underlying disease having bleeding tendency, and medications with ACs/APs such as warfarin, aspirin, clopidogrel, or triflusal.[21] Risk factors for CSDH recurrence include:

1) Advanced Age: Elderly individuals are more prone to CSDH due to age-related brain atrophy and fragile blood vessels. In low-resource settings, where access to quality healthcare and early intervention might be limited, the aging population can contribute to higher recurrence rates. Chronic subdural hematoma (CSDH) is a condition that occurs more frequently in elderly patients due to age-related brain atrophy and fragile blood vessels.[22,23] Elderly patients with CSDH may experience symptoms of cognitive change, memory disturbance, urinary incontinence, and decreased activity, as well as disturbance of consciousness at admission.[22] In low-resource settings where access to quality healthcare and early intervention might be limited, the aging population can contribute to higher recurrence rates of CSDH.[22] The recurrence rate of CSDH has not decreased over recent decades and ranges from 0.36% to 33.3%.[22] Outcomes in patients over 75 years old are significantly worse than those younger than 75, and long-term outcomes for elderly patients with CSDH are poor.[22] However, burr hole surgery with drainage under local anesthesia is the most common surgical procedure, even in elderly patients.[22] Some studies suggest using atorvastatin after surgery in elderly patients with CSDH may reduce hematoma volume and improve neurological outcomes.[24] Middle meningeal artery embolization (MMAE) for CSDH in selected high-risk elderly patients and relapsed patients might also be effective.[25]

2) Trauma: Head injuries, even minor ones, are a significant risk factor for CSDH development and recurrence. In regions with poor infrastructure, inadequate safety measures, and limited access to timely medical care, the likelihood of head injuries could be higher, consequently increasing the risk of CSDH recurrence—factors contributing to the development and recurrence of CSDH including Traumatic Subdural Effusion (TSDE). TSDE is one of the etiological factors for developing CSDH, especially in the elderly. The evolution of TSDE into CSDH is initially a hidden process and may present with nonspecific signs and symptoms.[26] Multiple pathways have been proposed for developing Subdural hygroma (SDG) after traumatic brain injury. The fluid collection might result from damaged vascular effusion and dura-arachnoid interface separation at the dural border cell layer.[27]

3) Coagulopathy and Anticoagulant Use: Conditions that affect blood clotting and the use of anticoagulant medications increase the risk of CSDH. In low-resource settings, where access to regular medical check-ups and monitoring may be limited, individuals with coagulopathies or those on anticoagulants might be at higher risk of recurrence due to inadequate management. In low-resource settings where access to regular medical check-ups and monitoring may be limited, individuals with coagulopathies or those on anticoagulants might be at higher risk of recurrence due to inadequate management.[28]

4) Alcohol Abuse: Chronic alcohol abuse can lead to cerebral atrophy and increase the risk of CSDH. In some low-income countries, alcohol consumption patterns and limited awareness of its health risks may contribute to higher recurrence rates. Chronic alcohol abuse can lead to cerebral atrophy and increase the risk of chronic subdural hematoma (CSDH). In some low-income countries, alcohol consumption patterns and limited awareness of its health risks may contribute to higher recurrence rates.[29]

5) Hypertension: Uncontrolled hypertension can weaken blood vessels and increase the risk of bleeding into the subdural space. Lack of access to regular medical care and medication in low-resource settings could exacerbate this risk factor. Uncontrolled hypertension can weaken blood vessels and increase the risk of bleeding into the subdural space.[30]

6) Diabetes: Diabetes is associated with vascular changes that can make blood vessels more susceptible to rupture. In settings with limited diabetes management and education, this could contribute to recurrent CSDH cases. Vascular changes associated with diabetes can make blood vessels more susceptible to rupture, which could contribute to recurrent chronic subdural hematoma (CSDH) cases in settings with limited diabetes management and education.[31]

7) Surgical Factors: The surgical technique used to evacuate the hematoma can influence recurrence rates. Suboptimal surgical procedures due to lack of resources, infrastructure, or trained personnel in low-resource settings might contribute to higher recurrence rates. In low-resource settings, suboptimal surgical procedures due to a lack of resources, infrastructure, or trained personnel might contribute to higher recurrence rates.[32]

8) Nutrition and Health Access: Malnutrition and poor overall health can weaken the body's ability to heal, potentially impacting the recurrence of CSDH. Limited access to nutritious food and healthcare in low-income countries can exacerbate this risk. The intricate relationship between health status, nutrition, and the healing process holds a pivotal role in the

recurrence of chronic subdural hematoma (CSDH). Malnutrition and compromised overall health can substantially undermine the body's inherent capacity to recover effectively, thereby influencing the likelihood of CSDH recurrence. This concern assumes heightened significance within the context of low-income countries, where access to both nutritious sustenance and quality healthcare services is often severely constrained.

9) Patient Compliance and Follow-up: Successful management of CSDH often requires regular follow-up appointments and compliance with medication. Economic constraints, transportation challenges, and lack of awareness can all contribute to reduced patient compliance in low-resource settings, leading to higher recurrence rates. It is important for healthcare providers to consider these factors and work with patients to develop strategies to overcome them. For example, telemedicine may be a useful tool for follow-up.

10) Limited Access to Neurosurgical Care: Timely and appropriate surgical intervention is crucial in treating CSDH and preventing recurrence. In low-resource settings, there might be a lack of specialized neurosurgical care, leading to delays in treatment or suboptimal surgical outcomes. However, there may be a lack of specialized neurosurgical care in low-resource settings, leading to delays in treatment or suboptimal surgical outcomes.[33]

Addressing these risk factors in low-resource settings and low-income countries requires a comprehensive approach, including improving healthcare infrastructure, increasing awareness of CSDH and its risk factors, providing proper training for medical personnel, ensuring access to essential medications, and promoting safety measures to prevent head injuries.

Surgical Treatment of Chronic Subdural Hematoma Controversies

The literature study on the management of subdural hematoma by Solou et al. reviewed points including indications for surgery, timing of surgery, method of surgery, number of burr holes, irrigation, drainage insertion, drainage location, drainage duration, membranectomy, and MMA embolization.[34] In addition, Solou used the American Academy of Neurology protocol for strength recommendations from the papers selected.[34]

1) Indications for surgery are determined by clinical and radiologic presentation; no studies compare surgical vs. conservative management. However, there is clinical consensus that hematomas greater than 1 cm in thickness, or equal to or exceeding the thickness of the skull, should be evacuated. In general, conservative treatment is usually reserved for patients with mild symptoms.

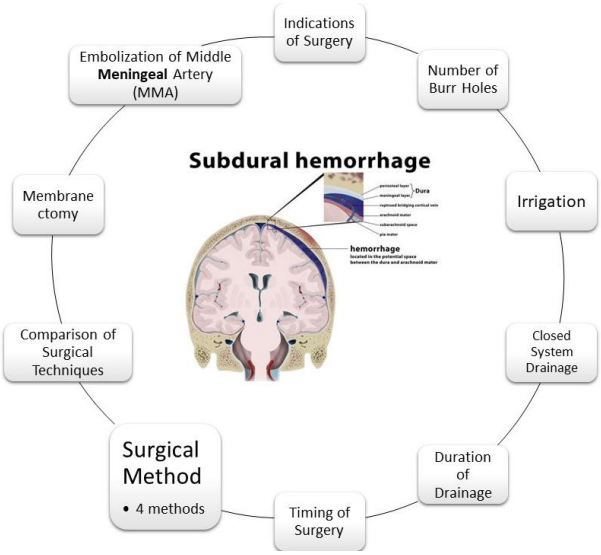

Figure 2 The management of subdural hematoma by Solou et al. reviewed points

Slika 2. Liječenje subduralnog hematoma prema Solou i sur. pregledane točke

2) The timing of surgery in managing subdural hematoma is not too many studies that discuss this subject. Still, according to Venturini, it is better if the above CSDH cases with surgery are less than seven days.[35] But once upon a time, there were occasions when patients had to pause surgery. The European Heart Rhythm Association (EHRA) recommends pausing in patients who are given oral anticoagulants before surgery.

3) Common methods for CSDH management are twist drill craniostomy (TDC), burr hole craniostomy (BHC), craniotomy, and endoscopic evacuation. Although burr hole craniostomy is an option for CSDH treatment, there are still many controversies regarding its operation that remain unanswered.

4) BHC, TDC, and craniotomy are effective in treating CSDH. BHC is considered the first level of treatment and seems to offer a good cure ratio and low complications. TDC is recommended in high-risk surgical patients. TDC tends to be associated with a higher risk of recurrence rate than BHC and is recommended in high-risk surgical patients. For recurrent CSDH, it is reasonable to perform BHC or craniotomy. Craniotomy offers comparable results to BHC but with a higher complication rate. Craniotomy is recommended in patients with significant or recurrent amniotic membranes. Endoscopic-assisted evacuation is safe and effective.

5) The variable number of thorn holes did not

affect recurrence rates when comparing single versus double thorn holes. That there was no significant difference between one and two burr holes in terms of recurrence risk. It was concluded that no difference was seen between one and two burr holes, which falls under the issue of surgeon preference.

6) Intraoperative irrigation in subdural hematoma aims to clear the hematoma elements and reduce the risk of recurrence. The selected summary by Solou et al. explains that there is a controversy between using and not using inflow and outflow irrigation in the use of burr hole craniostomy (BHC) and Twist Drill Craniostomy (TDC) is associated with less recurrence rate.[34] However, it was also concluded that irrigation at BHC for CSDH treatment did not lead to further healing and was associated with short-term complications such as pneumocephalus.

7) The variable closed drainage system concluded that the placement of a continuous drainage system was favorable. However, the complications of acute hemorrhage from the neomembrane, parenchymal injury, tension pneumocephalus, meningitis, subdural empyema, complications associated with prolonged immobility, and seizures need to be considered. In conclusion, subperiosteal or subgaleal drainage placement appears to be as effective as subdural placement, with comparable recurrence rates and potentially lower complication rates (Grade A recommendation).

8) The duration of drainage after surgery is also involved in managing subdural hematoma. According to Solou et al., controversy exists in studies that state there is a significant difference in drainage time affecting the risk of recurrence or the possibility of infection. On the other hand, studies examining the duration of drainage within a few days reduced the risk of recurrence.

9) Membranectomy protocol when craniotomy is used, concurrent membranectomy may reduce recurrence.

10) The application of MMA embolization as a major standalone treatment of primary treatment in recurrent CSDH or as prophylaxis after surgery for CSDH is a safe and efficient method with a low recurrence rate.

Conservative approach on CSDH in low-resource settings

Upon performing a categorization of the data based on countries, it was noted that the management of CSDH) in LIC entailed using diverse surgical techniques such as single burr hole, double burr hole, with or without drainage system, flap craniotomy, and craniotomy. The scientific investigation of the administration of steroids during the perioperative phase for CSDH) has been conducted. As per extant literature, the administration of steroids has been linked to a reduced incidence of CSDH recurrence[36]. Additionally, corticosteroids have been posited to hold potential benefits in the management of CSDH[37]. The administration of dexamethasone significantly improved the functional outcome of patients suffering from symptomatic CSDH at the 6-month follow-up period.[38].

Chan et al.[39] conducted a randomized controlled trial to examine dexamethasone's effectiveness when combined with surgical drainage in reducing the recurrence of reoperation. The research findings revealed that the application of steroids did not result in a statistically noteworthy decrease in the frequency of recurrence.

The successful attainment of clinical and radiological resolution in patients with CSDH) necessitates the implementation of multi-technique management approaches. Recent studies have demonstrated the efficacy of steroid administration [40] and the use of subdural drains in conjunction with burr hole drainage in reducing recurrence rates. Furthermore, surgical treatments utilizing these techniques have been found to have comparable risks of morbidity.[41] Nevertheless, an evidence-based approach that opposes the conventional practice proposes that the customary insertion of a subdural drain may not be essential to perform a burr hole evacuation procedure for chronic and subacute subdural hematoma.[42] The efficacy of subdural drainage in the treatment of CSDH remains a topic of ongoing discussion. The selection of a management strategy is contingent upon the clinical presentation, surgeon's preference, and recurrence rate following previous interventions.

The use of anti-inflammatory drugs

Inflammation plays a role in the development and progression of CSDH. The inflammatory response can contribute to the formation of new blood vessels (neovascularization) within the hematoma capsule, leading to continued bleeding and expansion of the hematoma. Anti-inflammatory drugs are thought to counteract this process and potentially promote hematoma resolution.

Anti-inflammatory drugs like corticosteroids and non-steroidal anti-inflammatory drugs (NSAIDs) are often used to reduce inflammation, which could potentially help resolve the hematoma and improve clinical outcomes. However, the evidence regarding their impact on mortality in surgically treated patients with CSDH is not entirely consistent.

According to Vychopen[43], anti-inflammatory therapy seems to be associated with increased mortality in surgically treated patients with chronic subdural hematoma. However, anti-inflammatory drug treatment seems to reduce the risk of recurrence or the probability of a switch to surgical treatment if it is administered as an adjuvant treatment to surgery or in the case of a conservative regimen.[43]

The utilization of anti-inflammatory medication therapy has shown a notable decrease in the occurrence and expansion of chronic subdural hematoma (CSDH) in patients who underwent surgical or conservative treatment for CSDH. The administration of corticosteroid therapy was found to have a notable impact on mortality rates among patients who underwent surgical treatment. Conversely, the use of anti-inflammatory therapy, specifically atorvastatin or corticosteroid therapy, did not result in an increase in mortality rates among patients who received conservative treatment for chronic subdural hematoma (CSDH).[43]

Vychopen and collegues[43] summarized as follows:

1) Anti-inflammatory medication was observed to increase mortality in surgically treated CSDH patients but not in conservatively treated ones.
2) Anti-inflammatory drug treatment as an adjunct to surgery or a conservative regimen reduces the risk of recurrence or surgical switch. Anti-inflammatory medication did not affect neurological prognosis in surgically or conservatively treated CSDH patients.
3) Anti-inflammatory medication did not affect neurological prognosis in surgically or conservatively treated CSDH patients.
4) Corticosteroid therapy significantly reduced the recurrence of surgically treated CSDHs, but curiously, only a cumulative low-dose regimen was related to death.

In low-resource settings, limited access to timely surgical intervention and postoperative care might influence the effectiveness of any adjunct therapies, including anti-inflammatory drugs. The use of anti-inflammatory drugs in the treatment of CSDH has been studied through clinical trials and observational studies. However, the quality and consistency of the evidence vary. Some studies suggest that anti-inflammatory drugs can reduce recurrence rates and improve outcomes, while others do not find a significant impact on mortality.

Treatment decisions for patients with CSDH should be based on a variety of factors, including the patient's overall health, the size and severity of the hematoma, the presence of neurological symptoms, and the available medical resources. In some cases, anti-inflammatory drugs might be considered part of a comprehensive treatment plan.

Surgical method regarding the surgical treatment of chronic subdural hematoma (CSDH)

An individual's socioeconomic status may impact their ability to obtain neurosurgical intervention for the management of CSDH. A comparative study conducted by Laeke et al.[44] examined the demographics, treatment, and outcome of patients with CSDH in low-income (Ethiopia) and high-income (Norway) countries. According to Mekaj's[45] findings, the preferred technique for burr hole trepanation involved the utilization of a closed drainage system due to its ease and low risk.

A recent study done in the United States from 2016 to 2020 found that inpatient care for CSDH led to higher in-hospital death rates, complication rates, length of stay, and total costs for the surgical group than for the medical group.[46] While this investigation did not explicitly examine the influence of socioeconomic status on the availability of neurosurgical intervention for CSDH, it implies that the modality of treatment administered could have implications for both clinical outcomes and financial burden.

Moreover, a recent investigation in Ethiopia has demonstrated that using single burr hole craniostomy constitutes a facile, secure, and efficacious approach for managing CSDH.[47] The preponderant surgical modality employed for CSDH in low-resource settings is burr hole drainage. The predominant surgical approach employed in Japan involves the utilization of singular burr holes. The predominant therapeutic approach employed in Saudi Arabia is conservative management. In Korea and Germany, a variety of techniques are employed for the treatment of intracranial pathologies via a single burr hole [Table 1 and 2]. These techniques include burr hole trepanation with subdural drain placement and scheduled computed tomography (CT) scans to monitor patient progress. The surgical technique of burr hole craniostomy was predominantly employed in China, while Ireland used this method as well. The United Kingdom, on the other hand, used a different version of this method called burr hole craniostomy with or without drainage. The Belgian medical community has posited that the burr hole technique may be superior to alternative methodologies. The Austria burr hole craniostomy is a surgical procedure used in neurosurgery to create a small opening in the skull to access the brain. The implementation of burr hole craniostomy (BHC) in conjunction with subdural irrigation and closed drainage is also observed in Italy [Table 1 and 2].

Table 1: Subdural hematoma in low-income countries
Tablica 1. Subduralni hematom u zemljama s niskim dohotkom

Country *Zemlja*	**Population** *Stanovništvo*	**Study** *Rad*	**Age** *Starost*	**Gender** *Spol*	**Profile** *Profil*	**Management** *Upravljanje*	**Output** *Učinak*
Gauteng-South Africa *Južna Afrika*	128	Mosadi 2019	43.6 ± 26.5	N/A	Chronic Subdural hematoma *Kronični subduralni hematom*	55% of the surgeries involved burr holes with or without a subdural drain or craniotomy, and 45% did not have steroids given before or after the surgery. *55% operacija uključivalo je rupice sa ili bez subduralnog drena ili kraniotomije, a 45% nije imalo steroide prije ili poslije operacije*.	Good Outcome *Dobar ishod*
Benin- West Africa *Zapadna Afrika*	104	Hode 2015	49.66±14.46	83.65% and 17 women 17 *žena* 16.35%	N/A	52% of the patients had a single burr hole trephination, 47% had a double burr hole trephination, and 1% had a five-hole bone flap. *52% pacijenata imalo je trefinaciju s jednom rupom, 47% imalo je trefinaciju s dvostrukom rupom, a 1% je imalo režanj kosti s pet rupica*.	Good Outcome *Dobar ishod*
Multan-Pakistan	60	Khan 2019	62±14 (range 38-94)	40 (66.7) men and *muškarci i* 20(33.3) women *žene*	Right hematoma 29 (48.3%), *Desni hematom* Left hematoma 24 *Lijevi hematom*(40.0%), Bilateral hematoma 7 (11.7%) *Bilateralni hematom*	Single bur hole 30 and double bur hole 30 (50% each) *Jednostruka rupa za svrdlo 30 i dvostruka rupa za svrdlo 30 (50% svaka)*	N/A
Khatmandu-Nepal	53	Bidur, 2022	61.87 ± 17.35	male 83%) and female 17 *muškarci i žene*	Hematoma: right 19 (35.8%), *Desni hematom* left 27 (50.9% -lijevi and Bilateral 7 (13.2%) bilateralni	35 patients (66%) had a single burr hole, and 18 patients (34%) had a double burr hole. *35 pacijenata (66%) imalo je jednostruku rupu, a 18 pacijenata (34%) dvostruku rupu*	N/A
Mumbai-India	267	Kansal 2010	3-78 (48)	165 males *muškaraca* and 102 females *žena*	N/A	single burr hole 195, double burr hole 72 *jednostruka rupa za svrdlo 195, dupla rupa za svrdlo* 72	N/A

Country *Zemlja*	**Population** *Stanovništvo*	**Study** *Rad*	**Age** *Starost*	**Gender** *Spol*	**Profile** *Profil*	**Management** *Upravljanje*	**Output** *Učinak*
Sierra Leone	23	Russel 2021	65.8 years (ranging from 54-78) *65,8 godina (od 54-78)*	male: female ratio of 3: 2: 1. *Omjer muško-žensko*	right side in 17 patients (73.9%), desna strana kod 17 pacijenta and the left side in 6 patients (22.1%) lijeva strana kod 6 pcijenta.	Flap craniotomy under general anesthesia with subdural drainage left in situ (100%) was done for all patients. *Svim je bolesnicima učinjena kraniotomija režnja u općoj anesteziji sa subduralnom drenažom ostavljenom in situ (100%).*	Good Outcome *Dobar ishod*
Uganda	205	Kitya 2018	63 years (range 11–95). *63 godina (omjer 11-95)*	Male *muškarci* (72.8%, 147/202)	No. (%) SDH laterality *SDH lateralmost* Rt 77 (42.3%) Lt 66 (36.3%) 39% Bilat	burr holes, drain, and 22.4% (46/205) rupe za brušenje, drenaža i 22,4% (46/205)	Good Outcome *Dobar ishod*
Brazil	117	Silva 2012	69 years *69 godina*	male/female ratio of 102/23 *muško/žensko omjer*	64 lt, 42 rt. Bilat 19 cases (15.2%) 19 slučajeva	Drainage systems were used in 93.6% of the cases. Sustavi drenaže korišteni su u 93,6% slučajeva.	Good Outcome *Dobar ishod*
Malaysia *Malezija*	82	Zakaraia 2008	60 years or younger *60 godina ili mlađi*	Men 76.0%, *Muškarc*i and women 24.0% *žene*	persistent subdural hematomas (30.5%), *perzistentni subduralni hematomi* 22 trabecular (26.8%), *trabekularni* 20 separated (24.4%) *odvojeni,* and 15 laminar *laminarin* (18.3%). Bilateral lesions: 1 *Bilateralne lezije* homogeneous -*homogene,* 3 laminar,-*laminarne* 2 separated-*odvojene*, and 4 trabecular-*tabekularne*.	Burr hole drainage with or without irrigation reduces midline shift significantly. 52 (71.2%) of 73 midline shift patients got resolution. *Drenaža rupice sa ili bez navodnjavanja značajno smanjuje pomak središnje crte. 52 (71,2%) od 73 pacijenta s pomakom središnje crte dobilo je povlačenje*	Good Outcome *Dobar ishod*
Kenya *Kenija*	259	Githinj 2010	41.1 years + 19.659	223 (86.1%) men *muškarci*	N/A	functional recovery (47.3%) and a lower mortality (17.6%)	Good Outcome *Dobar ishod*

Country *Zemlja*	Population *Stanovništvo*	Study *Rad*	Age *Starost*	Gender *Spol*	Profile *Profil*	Management *Upravljanje*	Output *Učinak*
				while 36 (13.9%) women *žene*			

GCS = Glasgow Coma Scale Glasgow Com skala, *ICU = intensive care unit* – jedinica intenzivne njege , *CSDH = Chronic Subdural Hematoma* kronični subduralni hematoma, *N/A= not available* – nije dostupno

Table 2: Subdural hematoma in high-income countries
Tablica 2. Subduralni hematom u zemljama visokim dohotkom

Country *Zemlja*	Population *Stanovništvo*	Study *Rad*	Age *Starost*	Gender *Spol*	Profile *Profil*	Management *Upravljanje*	Output *Učinak*
Japan Japan	63,358	Toi H 2018	76.0 ± 12	(68.4%) male, *muškarci* (31.6%) female, *žene*	N/A	(57,345 patients (90.5%) used a single burr hole, 926 patients (1.5%) underwent craniotomy *(57 345 pacijenata (90,5%) koristilo je jednu rupu za brušenje, 926 pacijenata (1,5%) podvrgnuto je kraniotomiji*	Good Outcome *Dobar ishod*
Saudi Arabia Saudijska Arabija	171	Alghamdi F 2021	Median age 31 *Medijan starost 31*	151 (88.3%) males, *muškarci* and 20 (11.7%) females, *I 20 žena*	Thoracic cases (43, 25.1%) and subdural hematoma (47, 27.4%), then spine (40, 23.4%) *Torakalni slučajevi (43, 25,1%) i subduralni hematom (47, 27,4%), zatim kralježnica (40, 23,4%)*	(15.20%) got neurosurgical treatment, whereas (78.4%) received conservative care. 134 (78.4%) are conservative; 37 (21.6%) are active. *Neurokirurško je liječeno (15,20%), a konzervativno (78,4%). 134 (78,4%) su konzervativni; Aktivno ih je 37 (21,6%).*	N/A *Nije dostupno*
Republic of Korea Republika Koreja	293	Jin Oh H 2021	75 (22–95)	208 (71.0) males *muškarci i* and 85 (29.0) females *žena*	77.5% had unilateral hematomas and 46.1% had homogeneous hematoma types. *77,5% imalo je jednostrane hematome, a 46,1% imalo je homogene tipove hematoma.*	70% had general anesthesia, and 74.7% had single burr hole craniostomy surgery *70% imalo je opću anesteziju, a 74,7% imalo je operaciju kraniostomije s jednom rupom.*	Good Outcome *Dobar ishod*
German Njemačka	131	Bronkikel 2013	median of 131, ranging from 32-92	89 (68%) male *muškarci* and	40 (31%), 60 (46%), and 31 (24%).	Enlarged burr hole trepanation and subdural drain implantation, recommended postoperative CT-imaging following drain removal.	N/A *Nije dostupno*

Country *Zemlja*	**Population** *Stanovništvo*	**Study** *Rad*	**Age** *Starost*	**Gender** *Spol*	**Profile** *Profil*	**Management** *Upravljanje*	**Output** *Učinak*
			medijan od 131, u rasponu od 32-92	42 (32%) female *žena*		*Trepanacija proširene rupe i implantacija subduralnog drena, preporučeno postoperativno CT snimanje nakon uklanjanja drena*.	
China Kina	1453	Huang J 2019	60 and 80	85.01% male *muškarci* and 51.91% female *žena*	Headache (58.55%), dyskinesia (36.92%), and dizziness (33.96%) were hospital admission symptoms. Hematoma spread 1001 (78.14%) unilateral hematoma 280 (21.86%) bilateral hematoma *Glavobolja (58,55%), diskinezija (36,92%) i vrtoglavica (33,96%) bili su simptomi prijema u bolnicu. Širenje hematoma 1001 (78,14%) jednostrani hematom 280 (21,86%) bilateralni hematom*	Burr hole craniostomy 1132 (88.37%), Conservative 87 (6.79%), Craniotomy 62 (4.84%). *Kraniostomija s burr hole 1132 (88,37%), konzervativna 87 (6,79%), kraniotomija 62 (4,84%).*	Good Outcome *Dobar ishod*
Republic of Ireland Republika Irska	50	Kaliaperumal 2012	17 to 91 years *Od 17 do 91 godine*	33 (male) *muško*, 17 (female) *žensko*	The SDD group had 9 left-sided, 12 right-sided, and 4 bilateral CSDHs, while the SPD group had 11 left-sided, 10 right-sided, and 4 bilateral SDHs. Fifty-two individuals received surgery for 60 symptomatic CSDHs. *Grupa SDD imala je 9 lijevih, 12 desnih i 4 bilateralna CSDH, dok je grupa SPD imala 11 lijevih, 10 desnih i 4 bilateralna SDH. Pedeset dvije osobe operirane su zbog 60 simptomatskih CSDH*	Subperiosteal and subdural drains after burr hole craniostomy. *Subperiostalni i subduralni dreni nakon kraniostomije s rupom*	Good outcome *Dobar ishod*
UK Uj Kralj	269	Santarius 2009	18 years and older *18 godina I starije*	N/A *Nije dostupno*	symptomatic chronic subdural hematoma with CT-proven burr hole drainage was eligible.	burrhole drainage and without drainage *drenaža s bušilicom i bez drenaže*	Good Outcome *Dobar ishod*

Country *Zemlja*	Population *Stanovništvo*	Study *Rad*	Age *Starost*	Gender *Spol*	Profile *Profil*	Management *Upravljanje*	Output *Učinak*
					simptomatski kronični subduralni hematom s CT-om dokazanom drenažom kroz rupicu bio je prihvatljiv.		
Belgium Belgija	245	Duerinck 2018	19 years and older *19 godina ili stariji*	86 female, *žena* 159 male *muškaraca*	Surgery-required CSDH without contraindication *CSDH potreban kirurški zahvat bez kontraindikacija*	burr hole craniostomy (BHC), minicraniotomy (MC), and twist drill craniostomy (TDC) *kraniostomija s bušilicom (BHC), minikraniotomija (MC) i kraniostomija sa spiralnom bušilicom (TDC)*	Good Outcome *Dobar ishod*
Austria Austrija	52	unterhofer2016	72 years (range, 48-89 years) *72 godine (omjer 48-89)*	The male/female ratio was 3:1	CT/MRI confirms CSDH. *CT/MRI potvrđuje CSDH.*	were prospectively randomized to either partial opening of the inner hematoma membrane (group A) or not (group B) after enlarged burr hole craniotomy and hematoma evacuation bili su prospektivno randomizirani na *djelomično otvaranje unutarnje membrane hematoma (skupina A) ili ne (skupina B) nakon kraniotomije s proširenom rupom i evakuacije hematoma*	Good Outcome *Dobar ishod*
Italy Italija	47	Muzii 2005	N/A *Nije dostupno*	N/A *Nije dostupno*	randomized 47 patients to BHC, TDC, or vacuum drainage. *randomizirano je 47 pacijenata na BHC, TDC ili vakuumsku drenažu*	14 men, 8 women, and a mean age of 78.7 years underwent TDC with closed-system drainage and suction reservoir. 24 more patients had BHC with subdural irrigation and closed drainage (16 men, 8 women, mean age 76.3 years). 14 muškaraca, 8 žena i prosječne dobi od *78,7 godina podvrgnuto je TDC-u sa zatvorenim sustavom drenaže i usisnog spremnika. Još 24 bolesnika imalo je BHC sa subduralnom irigacijom i zatvorenom drenažom (16 muškaraca, 8 žena, prosječna dob 76,3 godine).*	Good Outcome *Dobar ishod*

GCS = Glasgow Coma Scale Glasgow Com skala, *ICU = intensive care unit* – jedinica intenzivne njege , *CSDH = Chronic Subdural Hematoma* kronični subduralni *TDC = twist drill craniostomy,* kraniostomija spiralnom bušilicom *BHC = Burr Hole Craniostomy,* kraniostomija s bušilicom *mRS = modified Rankin Scale,* modificirana Rankin Skala, *CT = Comuted Tomography,* Kompjuterizirana tomografija *N/A= not available,* nije dostupno

The data from several studies conducted in high-income countries show that burr hole craniostomy is commonly used and is non-invasive, and in addition, this method is used in traumatic or non-traumatic recurrence conditions. CSDH and acute subdural hematoma (ASDH) with subdural drainage irrigation. This technique has been found to be both effective and safe, as evidenced by research conducted by Wang in 2016. The burr hole craniostomy is a surgical intervention that entails the creation of a small aperture in the cranium to gain entry to the cerebral tissue and excise the hematoma. The technique in question represents a less intrusive approach compared to craniotomy, which entails the excision of a segment of the cranial bone to gain access to the cerebral tissue.[31]

The burr hole craniostomy is the preferred surgical approach in HIC due to its comparatively lower risk of complications, shorter hospitalization periods, and faster recuperation times when compared to craniotomy. Furthermore, the burr hole craniostomy procedure can be executed utilizing local anesthesia, thereby reducing the potential risks associated with general anesthesia.[48] Burr hole craniostomy represents a cost-effective alternative for managing CSDH and acute subdural hematoma (ASDH), both of which are prevalent neurological disorders necessitating surgical intervention.

Burr hole craniostomy is a frequently employed surgical intervention in the field of neurosurgery. However, it is not exempt from potential hazards and adverse outcomes. Adverse outcomes that may arise subsequent to burr hole craniostomy for subdural lesions encompass acute intracranial hemorrhagic complications, misplacement of the drainage catheter within the brain parenchyma, contralateral surgical intervention, de novo seizure activity, non-surgical complications such as pulmonary and urinary complications, psychological sequelae, and cognitive deficits.[49]

The frequency of complications following burr hole craniostomy and drainage for subdural lesions is greater than previously estimated. These complications include severe events such as acute intracranial hematomas and errors in surgical or management procedures, which cannot be overlooked and may result in legal issues. Lee[49] emphasizes the importance of exercising caution during surgery and the postoperative period. Additionally, Lee suggests that complications should be included in the informed consent form prior to surgery. An adequately positioned solitary burr hole can effectively accommodate small to moderately large craniotomies, while larger craniotomies can be achieved with minimal burr holes, resulting in favorable cosmetic outcomes and preventing bone flap depression.[50] Burr hole surgery utilizing urokinase is a minimally invasive surgical approach for managing acute subdural hematoma. This technique has been found to be as efficacious as craniotomy while also being a safer and less complex alternative. [51]

Importance of Postoperative Treatment in Low-Income Countries

Postoperative treatment is a critical phase of patient care following surgical procedures, including chronic subdural hematoma (CSDH). It plays a crucial role in ensuring the success of the surgery, preventing complications, and promoting patient recovery. In low-income countries (LIC), where healthcare resources and infrastructure might be limited, the importance of effective postoperative treatment becomes even more significant due to the potential challenges and constraints faced by both healthcare providers and patients. Implementing effective postoperative treatment in low-income countries presents unique challenges due to limited resources, inadequate infrastructure, and socioeconomic constraints. Reintegrating patients into their communities after surgery is crucial for their overall well-being and the success of postoperative treatment. In low-income conditions, where social support networks might be limited, the process of patient reintegration faces additional challenges:

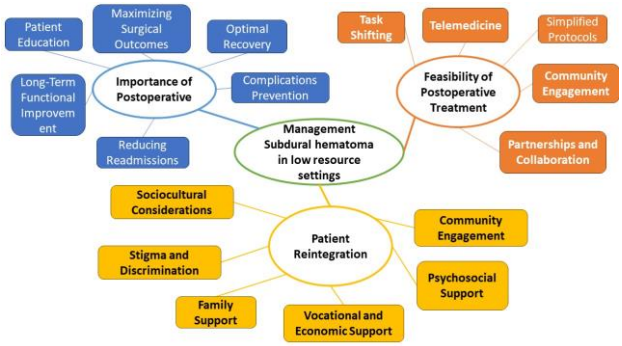

Figure 3 Management importance of postoperative treatment and its feasibility in low-income countries
Slika 3. Važnost upravljanja postoperativnim liječenjem i njegova izvedivost u zemljama s niskim dohotkom

Proper postoperative care helps prevent complications arising after surgery, such as infections, bleeding, and wound breakdown. In LIC, where resources for managing complications might be scarce, prevention becomes paramount. Complications may be caused by coagulation

abnormalities, arterial and venous pressure imbalance, intracranial displacement during surgery, uncontrolled fluid drainage, and intracranial hypotension.

Coagulopathies, blood pressure, and medicines must be corrected to avoid such consequences. According to the study by Rusconi et al., careful and gradual drainage of the subdural hematoma without considerable head movement is recommended during surgery to avoid fast intracranial content shift. Use drains without hoover bulbs at the end of the process. Additional post-operative monitoring of drainage quantities and characteristics, neurologic evaluation, and radiological examination are required.[33,52]

Adequate postoperative care enhances patient recovery by facilitating wound healing, reducing pain, and promoting overall well-being. This can lead to shorter hospital stays and lower healthcare costs, which is particularly crucial in resource-constrained settings.

Surgical procedures, including those for CSDH, can have better outcomes when followed by appropriate postoperative care. This involves monitoring patients for signs of complications and adjusting treatment plans accordingly.

Postoperative care provides an opportunity to educate patients and their families about wound care, medication management, and recognizing warning signs. In LIC, where health literacy might be lower, effective patient education can significantly impact recovery. Postoperative rehabilitation, including physical therapy and cognitive interventions, can improve long-term functional outcomes for patients. This is especially relevant for CSDH cases, as patients might experience cognitive and neurological deficits. Comprehensive postoperative care can help prevent readmissions due to complications, reducing the burden on already strained healthcare systems in LIC. Empower healthcare workers with various levels of training, such as nurses and community health workers, to provide basic postoperative care, freeing up skilled clinicians for more complex cases. Utilize telemedicine and mobile health technologies to provide remote guidance and follow-up care, especially for patients in remote or underserved areas.

Develop streamlined postoperative care protocols tailored to the resources available in LIC, focusing on essential interventions that can be effectively carried out.

Involve communities in the care process by educating them about postoperative care, recognizing complications, and seeking help when needed. Foster partnerships with international organizations, non-governmental organizations, and academic institutions to provide training, resources, and expertise in postoperative care. Understanding and respecting the sociocultural norms of the community is important to ensure that patients are accepted and supported upon reintegration. Patients might face stigma and discrimination due to their medical condition. Community awareness campaigns can help reduce these negative attitudes.

In LIC, family plays a significant role in patient care and reintegration. Providing families with the necessary education and resources can enhance the patient's reintegration process. Providing vocational training and economic support to patients who experience functional limitations can empower them to contribute to their households and communities. Offering psychosocial support through counseling and support groups can help patients cope with the emotional and psychological challenges of reintegration. Involving local leaders, community organizations, and religious institutions can facilitate a smoother reintegration process by building a supportive patient environment.

Postoperative treatment and patient reintegration in low-income countries are complex endeavors that require innovative strategies, community engagement, and collaborative efforts. Despite the challenges, focusing on patient-centered care and utilizing available resources can improve outcomes and successfully reintegrate patients into their communities.

In low-middle income countries, developing cost-effective treatment options can help ensure patients access appropriate care. Additionally, improving access to care can help ensure patients receive timely treatment. It is also important to ask and learn from mentors who are aligned with international standards, and one of the organizations that provide this platform is WFNS and EANS.[8] However, it is important to understand how these resources can be accessed to overcome difficulties in low-income countries. Some of the steps can be attributed to relevant organizations.

Accessing Resources in Low-Income Countries:

1. International Collaborations: Establish partnerships with universities, hospitals, and medical organizations from high-income countries to facilitate knowledge exchange, training programs, and resource sharing.
2. Telemedicine and E-Learning: Leverage telemedicine platforms and e-learning resources to provide remote training and consultations, enabling healthcare workers in low-income countries to access expert advice and guidance.
3. Medical Equipment Donation: Partner with

charitable organizations and medical equipment manufacturers to donate essential surgical and postoperative care equipment to low-income countries.
4. Grants and Funding: Seek grants from international organizations, foundations, and philanthropic individuals to support infrastructure development, training programs, and patient care initiatives.
5. Local Capacity Building: Focus on training local healthcare workers to perform surgeries, manage postoperative care, and provide rehabilitation services.

Role of WFNS and EANS

1. The World Federation of Neurosurgical Societies (WFNS) and the European Association of Neurosurgical Societies (EANS) are prominent international organizations dedicated to advancing neurosurgery and promoting collaboration among neurosurgeons worldwide. While their primary roles are education, research, and professional development, they also play a significant part in assisting low-income countries:
2. Training Programs: WFNS and EANS could develop training programs specifically tailored to the needs of neurosurgeons and healthcare workers in low-income countries. These programs might include workshops, webinars, and hands-on training sessions
3. Scholarships and Fellowships: Offer scholarships and fellowships allowing neurosurgeons from low-income countries to train in well-established centers of excellence in high-income countries, gaining valuable skills and knowledge to return home.
4. Guidelines and Protocols: Develop guidelines and protocols for managing conditions like chronic subdural hematoma in resource-constrained settings, taking into account the available resources and expertise.
5. Advocacy and Support: Advocate for increased funding and resources for neurosurgical services in low-income countries on a global scale, collaborating with international health organizations and policymakers.
6. Collaborative Projects: Initiate collaborative research projects that address neurosurgical challenges specific to low-income countries and develop practical solutions.
7. Resource Sharing: Facilitate the donation of medical equipment, textbooks, and educational materials to institutions in low-income countries through partnerships with manufacturers and organizations.
8. Capacity Building Workshops: Organize workshops that focus on building the capacity of healthcare systems in low-income countries to manage neurosurgical cases, including postoperative care effectively.
9. Networking and Exchange: Foster a network of neurosurgeons from diverse backgrounds, encouraging knowledge exchange and collaboration between high-income and low-income countries.

Conclusion and highlights

Comparing and contrasting the management approaches of chronic subdural hematoma in high-income and low-income countries would adopt a global health perspective, focusing on the challenges faced by healthcare systems in both high-income and low-income countries, discuss the differences in available resources, healthcare policies, and patient outcomes, explore how epidemiological differences factors impact the disease's presentation and management strategies, discuss disparities influence the accuracy and timeliness of diagnosis, management approaches could differ due to the availability of neurosurgical expertise, equipment, and facilities, explore the financial burden of managing CSDH in both settings, due to advanced treatments, while low-income countries might struggle with affordability and resource allocation, explore availability of intensive care units, postoperative care facilities, and rehabilitation services could vary, discuss differences impact patient outcomes and recovery. In contrast, low-income countries might need to adapt their management approaches due to limited resources. The paper could explore how these variations affect patient care. High-income countries may have more resources for medical research and innovation, leading to the development of novel treatment approaches. Explore the potential for collaboration between countries to address healthcare disparities. Understanding the differences can delve into the ethical dilemmas posed by the differences in healthcare access and outcomes between high-income and low-income countries. It could discuss the importance of equitable healthcare distribution and offer insights and recommendations for improving the management of CSDH in low-income countries. This might include strategies for resource allocation, capacity building, and international collaborations.

References

1. Dewan, MC, Rattani A, Gupta S et al. Estimating the global incidence of traumatic brain injury. J. Neurosug 2018; 130:1080–1097.
2. Ologunde R, Maruthappu M., Shanmugarajah K, Shalhoub J. Surgical care in low and middle-income countries: Burden and barriers. Int. J. Surg 2014;12: 858–863.
3. Pierre, L, Kondamudi NP. Subdural Hematoma. In: StatPearls (StatPearls Publishing, 2023).
4. Mehta V, Harward SC, Sankey E.W, Nayar G, Codd P J. Evidence based diagnosis and management of chronic subdural hematoma: A review of the literature. J Clin Neurosci 2018;50:7–15.
5. Yadav Y.R, Parihar V, Namdev H, Bajaj, J. Chronic subdural hematoma. Asian J. Neurosurg 11, 330–342.
6. AbdelFatah, MAR. Prognosis of acute subdural hematoma greater than 10 mm in thickness in head injury patients with an extension or no motor response to pain after resuscitation. Egypt J Neurosurg 2019; 34:9.
7. Suleman M, Tendai J, Lodhia J. Burr hole as a management for extra axial hematomas in a low-resource setting. Int. J. Surg. Case Rep 2023;105:108125.
8. Robertson FC, Gnanakumar S, Karekezi C et al. The World Federation of Neurosurgical Societies Young Neurosurgeons Survey (Part II): Barriers to Professional Development and Service Delivery in Neurosurgery. World Neurosurg 2020; 8:100084
9. Rashid, SM, Deliran SS, Dekker MC. Howlett W P. Chronic subdural hematomas: a case series from the medical ward of a north Tanzanian referral hospital. Egypt. J Neurosurg ;2019; 34:29.
10. Frija G, Blažić I, Frush DP et al..How to improve access to medical imaging in low- and middle-income countries ? EClinicalMedicine. 2021; 38:101034.
11. Jalloul M, Miranda-Schaeubinger M, Noor AM et al.MRI scarcity in low- and middle-income countries. NMR Biomed. 2023 Aug 13:e5022.
12. Liang KE, Bernstein I, Kato Y, Kawase T, Hodaie M. Enhancing Neurosurgical Education in Low- and Middle-income Countries: Current Methods and New Advances. Neurol Med Chir (Tokyo). 2016;56:709-715.
13. Punchak, M, Mukhopadhyay S, Sachdev S. Neurosurgical Care: Availability and Access in Low-Income and Middle-Income Countries. World Neurosurg 2018;112:e240-e254.
14. Dimopoulou A, Yfanti A, Argyropoulos T et al. Time between onset of symptoms and definitive treatment in children with acute appendicitis: How it affects length of hospital stay? Afr J Paediatr Surg. 2022;19:245-250.
15. Ye HH, Kim JH, Kim YS, Cho C W, Kim, D. J. Cognitive Impairment in the Elderly with Chronic Subdural Hematoma. J. Korean Neurotraumatol. Soc 2008; 4:66.
16. Ashfaq A. Lazareff J. Language and style: A barrier to neurosurgical research and advancement in Latin America. Surg. Neurol. Int 2017;.8:308.
17. Tang AR, Lan M, Kelly KA et al. Predicting for Lost to Follow-up in Surgical Management of Patients with Chronic Subdural Hematoma. World Neurosurg 2021; 148:e294-e300.
18. Garba DL, Fadalla T, Sarpong K et al.Access to training in neurosurgery (Part 2): The costs of pursuing neurosurgical training. Brain Spine 2022; 2: 100927
19. Todd KH. Chronic Pain and Aberrant Drug-Related Behavior in the Emergency Department. J. Law. Med. Ethics 2005;33:761–769.
20. Oyemolade TA, Adeolu AA.Bedside single burr hole craniostomy drainage of chronic subdural hematoma in the emergency room: A useful option in resource challenged settings. Surg Neurol Int 2020;11:349.
21. Sim, Y.-W., Min, K.-S., Lee, M.-S., Kim, Y.-G. & Kim, D.-H. Recent Changes in Risk Factors of Chronic Subdural Hematoma. J. Korean Neurosurg Soc 2012; 52:234-9..
22. Uno M, Toi H, Hirai S. Chronic Subdural Hematoma in Elderly Patients: Is This Disease Benign? Neurol Med Chir (Tokyo). 2017;57:402-409
23. Suzuki MTM, Moura MC. Casulari L.A. Comparative Epidemiological Profile of Elderly and Non-elderly Patients Operated on Chronic Subdural Hematoma. JBNC - J Bras Neurocir 2020;31:191–200.
24. Sun T, Yuan YK, Wu K, You C, Guan JW. Effects of postoperative atorvastatin use in elderly patients with chronic subdural hematoma. Eur Rev Med Pharmacol Sci 2021;25: 7211–7217.
25. Seok JH, Kim, JH, Kwon T H, Byun J, Yoon WK. Middle meningeal artery embolization for chronic subdural hematoma in elderly patients at high risk of surgical treatment. J Cerebrovasc Endovasc Neurosurg 2023;25: 28–35.
26. Richard SA., Wu M., Lin D. Traumatic Subdural Effusion Evolving into Chronic Subdural Hematoma. Open J Mod Neurosurg 2015;5:12–22.
27. Ahn JH, Jun HS, Kim JH, Oh JK, Song JH, Chang IB Analysis of Risk Factor for the Development of Chronic Subdural Hematoma in Patients with Traumatic Subdural Hygroma. J Korean Neurosurg Soc 2016;59:622-627.
28. Suarez JI, Kapinos G.Thromboembolism prevention after chronic subdural hematoma in the elderly: A leap in the dark. Neurology 2017; 88:1880–1881.
29. Savage C. Alcohol and Tobacco Related Health Inequity: A Population Health Perspective. J Addict Nurs 2012; 23:72–74.
30. Xu K, Chan NC. The conundrum of resuming anticoagulant therapy after intracerebral bleeding: In whom, when, and how? Vasc. Med 2020;25:60–62.
31. Liu H, Yan R, Xie F., Richard SA. Hematoma cavity separation and neomembrane thickness are potential triggers of recurrence of chronic subdural hematoma. BMC Sur 2022;22: 236.
32. Opsenak R, Hanko M, Benco M, Snopko P,

Ritcherova B, Kolarovszki B. Non-acute subdural hematoma: estimation of recurrence using CT-volumetric measurements. Bratisl Lek Listy 2023; 124: 3–11.
33. Chang CL, Connolly Jr ES. Predictors of Chronic Subdural Hematoma Recurrence Following Surgical Intervention: A Review of the Recent Literature? Arch Neurol Neurosci 2020; 6:1-3.
34. Solou, M, Ydreos I, Gavra M et al. Controversies in the Surgical Treatment of Chronic Subdural Hematoma: A Systematic Scoping Review. Diagnostic 2022;12:2060.
35. Venturini S, Fountain DM, Glancz LJ et al. Time to surgery following chronic subdural hematoma: post hoc analysis of a prospective cohort study. BMJ Surg Interv Health Technol 2019; 1: e000012.
36. Shrestha, DB, Budhathokoki P, Sedhai YR et al. Steroid in Chronic Subdural Hematoma: An Updated Systematic Review and Meta-Analysis Post DEX-CSDH Trial. World Neurosurg 2022; 158:84-99.
37. Blaauw, J. et al. Neurosurgical and Perioperative Management of Chronic Subdural Hematoma. Front Neurol 2020;11:550.
38. Hutchinson, P. J. et al. Trial of Dexamethasone for Chronic Subdural Hematoma. N Engl J Med 2020;383:2616–2627.
39. Chan, D. Y. C., Sun, T. F. D. & Poon, W. S. Steroid for chronic subdural hematoma? A prospective phase IIB pilot randomized controlled trial on the use of dexamethasone with surgical drainage for the reduction of recurrence with reoperation. Chin Neurosurg J; 2015; 1: 2.
40. Olobatoke T, Ekwegbara S, Ayantayo T et al. Multi-Technique Management of Chronic Subdural Hematoma in a Single Patient: A Case Report. Int J Med Stud 2022; 10: (S211): 1787.
41. Tailor J, Fernando D, Sidhu Z, Foley R, Abeysinghe KD, Walsh DC.. Clinical audit effectively bridges the evidence-practice gap in chronic subdural haematoma management. Acta Neurochir (Wien) 2017;159:627–631.
42. Sivaraju L, Moorthy RK, Jeyaseelan V, Rajshekhar V. Routine placement of subdural drain after burr hole evacuation of chronic and subacute subdural hematoma: a contrarian evidence based approach. Neurosurg Rev 2018; 41: 165–171.
43. Vychopen M, Güresir E, Wach J. Anti-Inflammatory Drug Therapy in Chronic Subdural Hematoma: A Systematic Review and Meta-Analysis of Prospective Randomized, Double-Blind and Placebo-Controlled Trials. Int J Mol Sci 2022, 23: 16198.
44. Laeke T, Kalleklev L, Tirsit A, Moen BE, Lund-Johansen M, Sundstrøm T. Surgical treatment and outcome of chronic subdural hematoma: a comparative study between Ethiopia and Norway. Acta Neurochir (Wien); 2023;165: 49–59.
45. Mekaj AY, Morina AA, Mekaj YH. et al. Surgical treatment of 137 cases with chronic subdural hematoma at the university clinical center of Kosovo during the period 2008-2012. J Neurosci Rural Pract 2015; 6:186–190.
46. Hendrix P, Goren O, Dalal S et al. In-hospital mortality rates, complication rates, length of stay, and total costs of >14,000 chronic subdural hematomas treated in the U.S. between 2016 and 2020: Query of the premier health-care database. Surg Neurol Int 2022;13:364.
47. Mersha A, Abat S, Temesgen T, Nebyou A. Outcome of Chronic Subdural Hematoma Treated with Single Burr Hole Under Local Anesthesia. Ethiop J Health Sci 2020; 30: 101–106.
48. Wang QF, Cheng C, You, CA. New Modified Twist Drill Craniostomy Using a Novel Device to Evacuate Chronic Subdural Hematoma. Medicine (Baltimore) 2016; 95: e3036.
49. Lee HS, Song SW, Chun Yi et al.Complications Following Burr Hole Craniostomy and Closed-System Drainage for Subdural Lesions. Korean J Neurotrauma 2018; 14: 68–75.
50. Rai SKR, Dandpat SK, Jadhav D, Ranjan S, Shah A, Goel AH. Optimizing Burr Hole Placement for Craniotomy: A Technical Note. J Neurosci Rural Pract 2019; 10: 413–416.
51. Miyazaki A, Nakagawa T, Matsuura J, Takesue Y, Otsuka, T. Surgical safety criteria for burr hole surgery with urokinase in patients with acute subdural hematoma: Retrospective comparison between burr hole surgery and craniotomy. Surg Neurol Int 2021; 12: 574.
52. Rusconi A, Sangiorgi S, Bifone L, Balbi S. Infrequent Hemorrhagic Complications Following Surgical Drainage of Chronic Subdural Hematomas. J Korean Neurosurg Soc 2015; 57:379.