CHRONIC SUBDURAL HEMATOMA – DIAGNOSIS, TREATMENT AND PERSPECTIVES

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Summary

Introduction. Chronic subdural hematoma has become an important entity in radiological, neurological and neurosurgery practice. Classification. The classification of chronic subdural hematoma is most often done in relation to the time of the disease onset (acute, subacute and chronic), whereas the second classification is based on hematoma density using computed tomography. Clinical presentation. The clinical presentation may mimic a spectrum of various diseases and chronic subdural hematoma can be easily overlooked without radiological verification. Diagnosis. The diagnosis of chronic subdural hematoma is partly clinical and partly radiological. In most cases, computed tomography is the initial diagnostic method for detection of this disease. Many studies point to different management strategies in the diagnosis and treatment of the disease. Therapy. The therapy of chronic subdural hematoma depends on the patient’s neurological deficit, but generally it is divided into conservative and surgical treatment. Conclusion. The aim of this paper is to review chronic subdural hematomas with reference to their clinical and radiological characteristics for better understanding of these phenomena.

Key words: Hematoma, Subdural, Chronic; Tomography, Spiral Computed; Radiology; Diagnosis; Signs and Symptoms; Treatment Outcome; Trauma Severity Indices

Sañetak

Uvod. Hronični subduralni hematom postaje značajan entitet u radiološkoj, neurološkoj i neurohirurškoj praksi. Klasifikacija subduralnog hematoma se vrši najčešće u odnosu na vreme nastanka bolesti (akutni, subakutni i hronični) i druga klasifikacija je zasnovana na denzitetu hematoma korišćenjem kompjuterizovane tomografije. Klinička prezentacija može imitirati različit spektar oboljenja i hronični subduralni hematom se lako može prevideti bez radiološke verifikacije. Dijagnoza je delom klinička i delom radiološka. Kompjuterizovana tomografija je u najvećem broju slučajeva incijalna metoda za dijagnostiku ovog oboljenja. Mnoge studije ukazuju na različitu strategiju u dijagnostici i tretmanu ovog oboljenja. Terapija hroničnog subduralnog hematoma se sprovodi u odnosu na neurološki deficit pacijenta i generalna podela obuhvata konzervativni ili hirurški tretman. Cilj ovog rada je revijalni prikaz hroničnog subduralnog hematoma sa osvrtom na njegove kliničke i radiološke karakteristike zbog boljeg razumijevanja ovog fenomena.

Ključne reči: hronični subduralni hematom; CT; radiologija; dijagnoza; znaci i simptomi; ishod lečenja; ocena težine traume

Introduction

Subdural hematomas are extra axial, semilunar accumulations of blood located between the dura and arachnoid. They are caused by stretching of very thin cortical bridging veins because of acceleration/deceleration forces [1]. There are several hypotheses and data in literature that explain formation and progression of chronic subdural hematoma (CSDH) such as inflammatory process, bridging vein trauma, osmotic pressure gaps, conversion of acute subdural hematoma to CSDH, and membrane neovascularization in the subdural space [2].

Depending on the timing of presentation and symptoms duration, subdural hematomas are classified as acute (to 7 days after trauma), subacute (8 - 22 days) and chronic type (over 22 days after injury) [3]. This type of classification was made without clear criteria and consensus in literature [4]. Another classification of subdural hematomas was made based on the texture of the hematoma on plain computed tomography (CT) scan as hyperdense, mixed, isodense and hypodense [5] (Figure 1.1. - 1.6). The CSDHs mostly occur in the elderly whose number is increasing every year. The index of demographic aging in 2010, in the North part of Serbia (Vojvodina Province) was 1.06, according to Petrović et al. 2011 [6]. As the population is aging rap-
The CSDHs may mimic various neurological diseases. When we are dealing with elderly patients with CSDH, sometimes it cannot be recognized by clinicians alone, because many symptoms and signs in patients may be consequences of atherosclerotic changes and degenerative brain diseases, so CSDH can be overlooked without additional radiological diagnosis [10]. Classification of CSDH was made by Nakaguchi et al. based on internal architecture, density, and hematoma expansion on CT [11]. However, density of the hematoma on brain CT is not strictly connected to older age, namely, hyperdense hematoma on CT is usually acute, but isodense hematoma is not only subacute, and hypodense is not strictly chronic [5]. Acute subdural hematomas are usually caused by traumatic events, but CSDHs can appear without previous trauma (in 30 – 50% of patients) [12]. The CSDHs may be unilateral and bilateral with the assumption that the cranial morphology plays an important role in determination of the site [13, 14]. Potentially, repeated hemorrhage is connected to different density of the subdural hematoma on CT, and it depends on coagulation status and other risk factors and comorbidity in older patients. Extravasation of blood and cerebrospinal fluid into the subdural space causes local aseptic inflammation and inflammatory induced angiogenesis. Consequently, dura mater produces granulation tissues and inflammatory cells leading to neomembrane production i.e. the capsule of the hematoma [15]. Fibrinolytic activities cause microhemorrhage and increase the subdural hematoma [16].

Clinical features

The clinical course of this type of disease includes three phases: initial phase, which includes formation of subdural hematoma presenting with several symptoms and episodes; the second phase involves biochemical mechanisms of subdural hematoma growth with clinically asymptomatic period (or latent period) lasting from a few days to several weeks; and the third phase with expanding hematoma and disturbance of compensatory mechanism which leads to symptomatic period of the disease [2]. Also, the interval from trauma to clinical presentation of CSDH is different in younger and older patients. Younger patients may have promoting factors for CSDHs such as ventriculoperitoneal shunts, intracranial hypotension, and history of coagulopathy, alcohol consumption, vascular malformation or arachnoid cyst and have shorter duration from trauma to surgery treatment [17, 18]. Delayed clinical presentation of CSDH in elderly occurs due to wideness of extra axial liquor spaces, as a result of cortical atrophy [17, 19]. The literature data show numerous different symptoms and signs in patient with CSDH [10]. In the thesis of Juković, which included 83 patients with CSDHs treated at the Clinical Center of Vojvodina in...
the period of three years, the following symptoms were found: headache, dizziness, seizures, vomiting, hemiparesis, mental changes, confusion, speech and visual disturbances or facial paresis. According to Juković, the highest percentage of patients with CSDH in Vojvodina had comorbidities such as high blood pressure (33%) and heart diseases (16%). Alcohol consumption was recorded in 16.9% of patients and coagulability disorders in 13.2%. A previous trauma was found in 67.5% of patients, but 32.5% of patients had no traumatic event, or they did not remember prior head injury [13]. Falls and fall-induced injuries are the most important injuries in elderly people and represent one of the major causes of disability and morbidity and about 20% need medical attention [20].

On admission, Glasgow Coma Scale (GCS) is the most widely used scoring system used in assessing level of consciousness and neurological deficit [21]. The patient’s clinical outcome is based on Glasgow Outcome Scale (GOS) [22]. Although the history of trauma is the major cause of subdural hematoma, non-traumatic subdural hematomas can be diagnosed after lumbar puncture causing intracranial hypotension, after long term usage of antiplatelet or anticoagulant drugs or due to coagulation disorders [23].

**Diagnosis**

Computed tomography and magnetic resonance imaging (MRI) play an important role in the diagnosis of subdural hematoma. The MRI has a higher sensitivity for evaluation of internal structure and neomembrane of CSDH that is important for optimal surgery treatment [23]. As a rapid, non-invasive and widely available method, CT is the first line modality of choice in diagnosis of subdural hemorrhage [24]. Some dural and leptomeningeal metastases, sarcoidosis, histiocytosis and subdural empyema [25, 26] may mimic or may be associated with CSDHs, therefore the use of contrast CT is justified in such cases.

In the thesis of Juković, clinical and CT parameters are used to give more information about the prognosis and outcome of patients with CSDH [13, 17, 27–30]. Isolated CT parameters - midline shifts (MLSs) and hematoma width (HW) fail to show a high prognostic value for the outcome. However, MLS and hemiparesis show a high prognostic value when MLS exceeds the threshold level [27]. Clinical parameters included the age of patients and neurological state on hospital admission evaluated using GCS. The GCS showed to be most significant for the outcome estimated by GOS. The combination of these parameters using multiple regression analysis is used for predicting unknown values to a certain extent ($R^2 = 0.33$).

$$GOS = 0.166-0.018 \times A + 0.013 \times W + 0.313 \times \text{GCS} + 0.040 \times \text{MLS}$$

Although only about one third of outcomes can be explained by the created model, more cases and application of advanced statistical models could lead to improved treatment and outcome of patients with CSDH.

The newest techniques, such as MR, MR spectroscopy, MR perfusion, diffusion tensor imaging (DTI) and 18F-fluorodeoxyglucose positron emission tomography have an important role in the diagnosis of traumatic brain injuries. Although not all of these techniques are routinely implemented in daily radiological practice, their relevance is growing, and they are given importance due to the possibility of individual approach to each patient and thus better diagnosis and treatment [31–33].

**Therapy**

The treatment of subdural hematoma depends on the type of hematoma and clinical presentation. Acute subdural hematoma is more common in younger patients and requires urgent treatment because of brain edema, existence of MLSs diagnosed by CT and more severe clinical symptoms and signs. The CSDH requires prompt surgical treatment in cases of significant neurological deficit, after the latent period has passed. Surgical treatment of CSDH includes different principles of evacuation (Figure 2) such as one or two burr hole drainage, twist drill craniotomy, craniotomy and the subdural evacuating port system [34, 35]. Santarius et al. showed that burr hole is the superior method than twist drill craniotomy [36]. Patients that were treated with burr hole had lower risk for recurrence of hematoma and small percentage of complications after surgery [36, 37]. Craniotomy is a more invasive method and it requires an extended time of surgery and recovery period [38]. According to Juković, the average hospital stay of patients who were treated with craniotomy was 13.3 days and in patients treated with burr hole it was about 10 days [13]. In exceptional cases, the surgical treatment of patients with CSDH is postponed, although there are positive radiological parameters. If the general clinical status of the patient is poor, due to comorbidities (liver disease, chronic pulmonary obstructive disease, cardiac decompensation) or there are risk factors for surgical treatment (thrombocytopenia, coagulation disorder) the surgery is delayed with constant monitoring [39]. Mori and Maeda showed that patients with surgical treatment had good clinical recovery and that surgical

**Figure 2.** Types of surgical treatment in patients with CSDHs (single burr hole drainage/left side, two burr holes drainage, craniotomy/right side)

**Slika 2.** Tipovi hirurškog tretmana kod pacijenata sa HSDH (jedan ovalni trepanacioni otvor/leva strana slike; dvostruki ovalni trepanacioni otvor, craniotomija/desna strana slike)
therapy is safe even in patients above 90 years if their clinical and physical condition is appropriate [19]. The recurrence of CSDH after surgery is possible and factors that contribute to recurrence of CSDH are multi-factorial involving independent predictors, such as laminar type of hematoma, thicker hematoma, and larger post-operative drainage amounts of CSDH [23, 40]. Stanišić et al. showed that hematoma volume before surgery, laminar and separated types of CSDH and residual CSDH post-surgery on the CT scan were independent predictors for recurrence of CSDH [41]. Obha et al. showed that pneumocephalus after surgery treatment had a tendency to be associated with recurrence of CSDH [42]. Posturgical complications may be related to tension pneumocephalus, anesthesia, cerebral inflammation, intraparenchymal hemorrhage or neurological deficits, more frequently in recurrent CSDH [43, 44].

In Juković’s research, the postoperative complication rate was low. One of the patients had ischemic stroke, one had intraparenchymal hemorrhage. Extracranial complication in the form of pneumonia was noted in one patient [13]. According to literature records, the data about spontaneous resolution of CSDH [39, 45] and nonsurgical treatment are isolated cases [46, 47]. Asymptomatic patients, mild headache or patients without neurological deficits are candidates for conservative treatment. It is considered that small volume of the CSDH without significant mass effect on brain parenchyma, MLS below 5 mm on the CT scan or frontal localization of CSDH have tendency to resolve spontaneously. The “wait and see” approach is justified in patients with a low volume of CSDH and in patients without neurological deficit [48]. Hemiparesis and speech disturbance in elderly patients with large midline shifts and unilateral CDSH were most common signs that required surgery [49].

**Trends in diagnostic radiology and clinical outcome of CSDH**

Neuroimaging modalities, supported by computer technology, are becoming more and more significant in healthcare [50]. The CT modality has a remarkable role in fast preoperative diagnosis of CSDH as well as in follow-up. The MRI and DTI could be implemented as additional imaging techniques, because of detailed evaluation of internal characteristic of CSDH and determining the significance of mass effect on corticospinal tracts and other brain structures which could be potentially involved in the manifestation of neurological symptoms. Clinical signs and symptoms, GCS on admission, biochemical and laboratory analysis, and neuroimaging data provide precise information about every patient. The clinical and radiological input data about patients with CSDH may be the basic information for optimal strategies in individual clinical treatment protocols. Today, machine learning techniques, based on computer softwares, can optimize protocols and improve patient treatment and outcome [51, 52]. The implementation of advanced methods for neuroimaging data analysis could contribute to better diagnosis and give overall performance of outcome. Literature suggests the use of computer assisted system, which is integrated with a medical imaging machine, provides a quick diagnosis and reduces the number of diagnostic errors [53]. New technical and statistical methods can be implemented in radiological imaging analysis for better detection and expanded diagnosis systems [54].

**Conclusion**

Chronic subdural hematoma is a disease of the elderly, but it has a great potential to become one of the most common diseases in radiological, neurological and neurosurgery practice due to the increase of the aging population. Recognition of this disease is essential for proper treatment and reduction in mortality. Clinical evaluation associated with radiological imaging allows better understanding of this phenomenon providing correct diagnosis and better prognosis of the patients. We strongly believe that a larger sample of patients, together with a comprehensive database of clinical and radiological signs evaluated through the prism of modern data mining techniques and predictive models, may significantly improve the treatment and final outcome of various types of brain diseases in the future.

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