

## Chronic Subdural Hematoma Treated By Two Burr-Hole Craniostomy and Closed-System Drainage in Elderly Patients

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✓ **Objective:** This is a retrospective study of a series of 45 patients older than 60s years with chronic subdural hematoma treated by two burr-hole craniostomy and closed drainage.

**Methods:** Case records were evaluated for etiology, preoperative, postoperative and early follow-up neurological status, Karnofsky performance score, computerized tomography (CT) scan results, and complications.

**Results:** The series included 32 males and 13 females, with a mean age of 76,3 years. The principal symptom was altered mental status, gait disturbance, and headache. 11 patients had no known etiological factors. Karnofsky performance score was 64,89 preoperatively, and 70,67 postoperatively. The mean thickness of the hematoma was 2,14 cm preoperatively, and 0,9 cm postoperatively. 6 patients died in hospital due to systemic complications. A second operation was performed in 8 cases.

**Conclusion:** Two burr-hole craniostomy and closed drainage system is a simple, safe and efficient method for the treatment of CSDHs. In this series, the worst prognostic factors were the preoperative neurological status and additional systemic diseases at the time of surgery.

**Key words:** Chronic subdural hematoma, burr-hole, drainage, outcome, and recurrence

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### Yaşlılarda Kronik Subdural Hematomun İki Adet Burr-Hole Kraniostomi ve Kapalı Sistem Drenaj ile Boşaltılması

✓ **Amaç:** Kronik subdural hematomlar (KSDH) günümüzde en sık karşılaşılan intrakraniyal kanama çeşitlerindedir. Özellikle yaşlılarda uygun tedavi ile prognozu iyidir. KSDH'ların tedavisinde birçok farklı cerrahi teknik uygulanmaktadır. Bu çalışmada iki adet burr-hole kraniotomi ve kapalı sistem drenaj ile tedavi edilmiş 60 yaş üzeri KSDH'lu 45 olgu incelendi.

**Yöntem:** 1995 ile 2007 yılları arasında Gülhane Askeri Tıp Akademisi Nöroşirürji bölümünde iki adet burr-hole kraniotomi ve kapalı sistem drenaj ile tedavi edilmiş 60 yaş üzeri 45 KSDH'lu olgunun etiyojileri, ameliyat öncesi ve ameliyat sonrası erken dönem takiplerinde belirti ve bulguları, Karnofsky performans değerleri, bilgisayarlı beyin tomografi (BBT) bulguları ve komplikasyonları incelendi.

**Bulgular:** Olguların 32'si erkek, 12'si kadındı. Olguların yaş ortalaması 76,3'dü. En sık rastlanan belirti şuur bozukluğu, baş ağrısı ve yürüyüş bozukluğuydu. On bir olguda etiyojistik faktör belirlenemedi. Ortalama Karnofsky performans değerleri ameliyat öncesi 64,89 iken, ameliyat sonrası 70,67 idi. BBT'de hematom kalınlığı ameliyat öncesi ortalama 2,14 cm iken ameliyat sonrası 0,9 cm oldu. 6 olgu hastanede sistemik nedenlerle öldü. 8 olgu ikinci kez ameliyat edildi.

**Sonuç:** Burr-hole kraniotomi ve kapalı sistem hematom drenajı KSDH'un tedavisinde basit, güvenli ve komplikasyon riski az olan bir yöntemdir. Deneyimlerimize göre KSDH'lu yaşlı hastalarda kötü prognozun nedeni cerrahi sırasında hastanın kötü nörolojik durumu ve sistemik hastalığının olmasıdır.

**Anahtar kelimeler:** Kronik subdural hematom, burr-hole, drenaj, sonuç, rekürrens

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**C**hronic subdural hematoma (CSDH) is one of the most common types of intracranial hemorrhage, particularly in the elderly. Its incidence has been reported to be approximately 0,001-0,002 %<sup>(37)</sup>. Despite multiple management strategies, no definitive treatment protocol exists<sup>(9,10)</sup>. There is general agreement that a combination of clinical and radiographic findings, suggesting a CSDH with mass effect, indicates surgical treatment<sup>(8,14,19,20,30,39,44,49,54,56,59,63)</sup>. CSDH is approached with a variety of surgical techniques: twist-drill and spontaneous hematoma efflux<sup>(43)</sup>, twist-drill craniostomy and catheter drainage<sup>(7)</sup>, small craniostomy and endoscopic removal<sup>(45)</sup>, subduro-peritoneal shunt as an alternative for infants<sup>(37)</sup> and elderly patients<sup>(41)</sup>, large craniotomy, hematoma removal and membranectomy<sup>(19)</sup>, or burr-hole craniostomy with or without continuous closed-system drainage<sup>(30,31)</sup>. Some authors support the use of minimal invasive intervention (burr hole or twist-drill holes) because these techniques offer equivalent efficacy to craniotomy with lower mortality and morbidity and a shorter operating time and hospital stay<sup>(7,30,54)</sup>. However, burr hole outcome varies widely with a percentage of reoperation from 3 % to 37 %<sup>(2,3,19,24,30,32,49,59,63)</sup>. These failures are due mainly to residual thick hematoma membranes<sup>(19,49,54,62)</sup>. The choice of the surgical technique to treat CSDHs must be dictated by the degree of organization of the hematoma. Burr hole and drainage is mandatory for non-septated and mostly liquefied CSDHs. Conversely, craniotomy with membranectomy is the sole reasonable approach for CSHs organized in a solid structure.

In our department, two burr-hole craniostomy with closed-system drainage has been the first line operative technique for the treatment of CSDHs in the elderly. The purpose of this retrospective study is to evaluate the causes, surgical results, complications, recurrence rate, and re-expansion of the brain in chronic subdural

hematoma in the elderly.

## **MATERIALS and METHODS**

45 elderly consecutive patients with CSDHs were treated by two burr-hole craniostomy with closed-system hematoma drainage technique in our institute, from 1995 to 2007. All of the patients were older than 60 years.

The neurological and the general status of each patient on admission and at discharge was assessed by the Glasgow Coma Scale (GCS), Karnofky performance score and the neurological grading system for CSDH, proposed by Markwalder<sup>(30)</sup>: grade 0) no neurological deficits, grade 1) patient alert and oriented, mild symptoms such as headache; absent or mild neurological deficits such as reflex asymmetry, grade 2) patient drowsy or disoriented with variable neurological deficits such as hemiparesis, grade 3) patient stuporous but responding appropriately to noxious stimuli; severe focal signs such as hemiplegia, grade 4) patient comatose with absent motor response to painful stimuli; descerebrate or decorticate posturing.

Computerized tomography (CT) scans were performed in all patients to confirm the diagnosis and for follow-up. Lesions were assessed according to the classification described by Lanksch et al., as hypo-dense hematoma, hematoma of varying density, iso-dense or slightly hyper-dense hematoma<sup>(29)</sup>. CT scans were performed after the operation, as needed, and at the last follow up examination. Preoperative and postoperative hematoma thicknesses were measured on CT slices to assess the re-expansion rate of the brain and the evacuation of the hematoma.

Surgery was performed under general anesthesia in all patients. The surgical technique included two burr-holes overlying the subdural collection. The dura mater was coagulated with bipo-

lar cautery and a cruciate incision was made. The rims of the dural opening were coagulated again to leave a permanent defect. The membrane was incised to permit evacuation of the hematoma. Resection of the internal membrane was not attempted. The subdural hematoma was evacuated by repeated irrigation with physiological saline solution followed by closed system drainage with the aid of a silicone tube. The subdural drain was left for 2-5 days postoperatively. Drainage time depended on the amount of subdural fluid and brain re-expansion was verified by CT control. Prophylactic antibiotics were used so long as the drainage continued.

Patients were kept mostly in a sitting position, with the head of the bed elevated to 30 degrees, and the drain was maintained 20-30 cm below the head level.

## RESULTS

The sample consisted of 32 males and 13 females, age range was 63-91 years, mean age was 76,3 years. Thirty-four (75,6 %) patients had a history of head trauma occurring an average of 6,7 weeks before admission (range, 3-16 weeks), and remained unclear in 11. Previous head trauma was investigated with CT scans in 21 patients, and no pathological findings were determined. Predisposing factors included alcohol abuse (8 cases), and the administration of anticoagulant or antiagregant therapy (22 cases). Nevertheless, none of these factors had a significant influence on the outcome. Alcohol abuse affected cognitive functions postoperatively. Other concomitant pathologies are summarized in Table 1.

Using the clinical grading scheme of Markwelder grading system for preoperative grading, 16 cases were grade 0-1, 21 patients were grade 2 and 8 patients were grade 3-4. Patients with poor neurological grade on admission (grade 3-4) had a poor outcome, compared with patients

**Table 1. Etiology, predisposing factors and concomitant diseases.**

Etiology and concomitant diseases	Number of patients
<b>Etiology</b>	
Head trauma	34 (75,6 %)
Unknown	11 (24,4 %)
<b>Predisposing factors</b>	
Anticoagulant-anti-aggregated therapy	22 (48,9 %)
Alcohol abuse	8 (17,8 %)
<b>Concomitant diseases</b>	
Arterial hypertension	30 (66,7 %)
Diabetes mellitus	10 (22,2 %)
Cardiac diseases	10 (22,2 %)
Chronic obstructive lung disease	5 (11,1 %)
Hyperthyroid	5 (11,1 %)
Peptic ulcer	3 (6,7 %)
Alzheimer dementia	3 (6,7 %)
Coagulation disorders	2 (4,4 %)
Benign prostatic hyperplasia	2 (4,4 %)

**Table 2. The clinical stage of patients on admission.**

Markwelder grading system	Number of patient
Grade 0	2 (4,4 %)
Grade 1	14 (31,1 %)
Grade 2	21 (46,7 %)
Grade 3	5 (11,1 %)
Grade 4	3 (6,7 %)

**Table 3. Presenting signs and symptoms.**

Signs and symptoms	Number of patient
Altered mental status	25 (55,6 %)
Gait disturbance	25 (55,6 %)
Headache	24 (53,3 %)
Hemi-syndrome	23 (51,1 %)
High ICP symptoms	9 (20,0 %)
Speech defect	8 (17,8 %)
Cranial nerve lesions	7 (15,6 %)
Seizures	2 (4,4 %)
Incidental	2 (4,4 %)

with good neurological status (grade 0, 1, 2). The leading signs and symptoms were altered mental status, gait disturbance, headache and hemi-syndrome. Two cases were diagnosed as incidentally (Table 3).

There were 3 cases with a GCS score <10, 5 patients with GCS score 10-11, 5 patients with GCS score 12-13, and 32 patients with GCS score 14-15, preoperatively. The mean preopera-

tive Karnofsky performance score was 64,89% (range 30-90) (Table 4).

**Table 4. Preoperative and postoperative GCS and Karnofsky scores.**

	Number of patients	
	Preoperative	Postoperative
<b>Glascow coma scale</b>		
10 ↓	3	0
10-11	5	0
12-13	5	1
14-15	32	38
<b>Karnofsky score</b>		
40 ↓	2	0
50	4	0
60	7	2
70	9	3
80	8	3
90	10	10
90	5	21

All patients had CT at admission. The hematomas were right sided in 25 cases, left sided in 8 cases, and bilateral in the remaining 12 cases. Of the hematomas, 22 were isointense, 21 were hypointense, and 14 were iso-hypointense. There was no density differential in bilateral CSDHs. The mean thickness of the hematoma was 2,14 cm preoperatively (range 0,8-2,8 cm) (Table 5). The lateral ventricles were seen asymmetric, and cerebral sulci were effaced ipsilaterally in all cases.

**Table 5. Thickness and the saturation of the haematoma in CT.**

	Number of the CSDH (n=57)	
	Preoperative	Postoperative
<b>Thickness (cm)</b>		
0	0	11
1 ↓	1	20
1-1,5	15	21
1,6-2	12	5
2,1-2,5	11	0
2,6-3	18	0
<b>Density</b>		
Isointense	22 (38,6 %)	
Hypointense	21 (36,8 %)	
Iso-hypointense	14 (24,6 %)	

Clinical laboratory studies before surgery included bleeding time, platelet count, prothrombin time, and activated partial thromboplastin time.

Surgery was performed under general anesthesia. Mean duration time of surgery was 68,67 minutes (range 50-120 minutes). The initial surgical procedure included two burr-holes and closed system drainage. In 12 cases with bilateral subdural hematoma, these surgical procedures were performed bilaterally.

The postoperative GCS score was 12-13 in one case, and 14-15 in the others. The mean postoperative Karnofsky performance score was 70,67 (range 50-90) (Table 4).

The mean thickness of the hematoma was 0,9 cm postoperatively (range 0-1,8 cm). The thickness of the hematoma had decreased, the cerebral sulci were normal, and the lateral ventricles were symmetric in postoperative CT scans in 49 of 55 cases (Table 5).

No post-operative complications occurred due to surgery. 6 patients died in hospital due to systemic complications (4 cases with pneumonia, and 2 cases with cardiac problems). Three of these were clinical grade 4, and the others were clinical grade 3. The GCS score were <11, and the Karnofsky performance scores were <50 in all 6 cases.

A second operation with craniotomy and membranectomy was performed in 6 cases because of persisting subdural fluid, and insufficient brain re-expansion. Two cases were reoperated with two burr-hole craniostomy and closed-system drainage, due to appearance of a contralateral CSDH, which was very small in the preoperative CT scan.

The average stay in the hospital was 8 days, ranging from 3 to 34 days. 62,2 % of the cases was discharged within the first week, 28,9 % within 2 weeks, and the remainder in over 2 weeks.

## DISCUSSION

CSDH is an encapsulated collection of old blood, mostly or totally liquefied and located between the dura and the arachnoid, which becomes clinically manifest 3 weeks following injury, or later (4). CSDHs occur most frequently in elderly patients. Generalized cerebral atrophy and increased venous fragility associated with aging are the major predisposing factors. With aging, the brain weighs about 200 g less, leading to an approximate 11 % increase in extra-cerebral volume (35). This causes stretching of the bridging veins, and greater movement of the brain within the cranium makes these veins vulnerable to trauma (13,57). The male-female ratio in this series is 2,5:1. Although the male-female ratio is variable in other series, male preponderance may be due to greater exposure of males to injury, fewer females seeking medical advice, or estrogens may have or a protective effect on capillaries (49).

Trauma is an important factor in the development of CSDH. In some series, the incidence of trauma was 65 %, and in most of the patients the trauma was mild with a short period of unconsciousness. The interval between the trauma and surgery ranged from 10 days to 2 years (19,27,49). 75,6 % of our cases had a history of head trauma, and the mean interval from trauma to admission was 6,7 weeks, ranging from 3 to 16 weeks. It is commonly believed that in elderly patients, the period between head trauma and the presentation of clinical symptoms is longer, possibly due to lower brain weight and larger subdural spaces (6).

The first predisposing factor was the use of anti-coagulant and anti-aggregaton treatment in our series. In the series of Jones and Kafetz, the incidence was 20 % (25), and in Asghars series patients taking such medication represented 33% of the cohort (5). Approximately half of our patients were taking either acetylsalicylic acid

or warfarin. The second predisposing factor was alcoholism. Sonne and Tonnesen have studied the importance of alcoholism in the pathogenesis of CSDH, and observed that alcohol abusers have a significantly higher incidence of acute and chronic subdural hematomas, showed increased postoperative morbidity, mortality and a poorer final outcome (52). Alcohol is known to impair the activity of the blood platelets, to increase fibrinolysis, and diminish coagulation. 17,8% of patients had a history of daily alcohol consumption in our series.

The most common presentation in the elderly patients is altered mental status (5,8,17,40), varying in degrees from confusion and coma to behavioral and psychotic disorders. In the series of Mori and Maeda, the most common symptom was gait disturbance followed by hemiparesis (36). In this study, the leading signs and symptoms were altered mental status, gait disturbance, headache and hemi-syndrome. The incidence of headache varies in different studies, ranging from 14 % to 80 % (15,25). This is less common in the elderly when compared to younger patients. It is partly due to large available intracranial space to accommodate the hematoma before creating pressure on the adjacent brain (15).

Computed tomography remains the preferred diagnostic procedure for CSDH scanning for several reasons. It is faster and cheaper as compared to magnetic resonance imaging, and may be used in patients with cardiac pacemakers or metal implants (58). Subdural hematoma has a variety of imaging characteristics that are easily identified in CT. Images may be low, intermediate, or high density relative to brain parenchyma (26,29). The most common type of CSDH is hypointense, followed by hematomas of varying density, isointense, and much less common the hyperintense hematoma (17). We determined that the isointense and the hypointense hematomas were seen equally. There was no hyperin-

tense hematoma in our series. Magnetic resonance imaging (MRI) is useful in patients with isodense hematoma without midline shift and in identifying small collections at the vertex, base of the skull and in the posterior fossa (21,23). However, MRI is better than CT to demarcate the various phases of the subdural hematomas and provide detailed information of the dimensions, age and complexity of the hematoma. We used MRI only in 7 patients with isointense and bilateral hematomas.

Treatment of CSDH has been a topic of controversy. Although spontaneous resolution or medical treatment of CSDH has been well documented, hospitalization range was from 3 weeks to 42 days, and some patients eventually underwent surgery in some reported series (28,61). For many years, treatment of the CSDH by craniotomy was known as an optimal technique in spite of high surgical mortality rates of up to 30 %, described by Putnam and Cushing (42). Craniotomy and removal of the membranes still carry a high rate of mortality and morbidity (12,22,47). This technique is now rarely used except for the treatment of repeated recurrences of the haematoma and solid consistency of the clot. Markwalder described the only indications for craniotomy as a) when the subdural collection reaccumulates, b) solid hematoma is present, c) brain re-expansion insufficient (30).

Mc Kisson et al. were pioneers in the treatment of CSDH by simple burr-hole craniostomy and drainage, with an important reduction in mortality (34). Twist drill craniostomy with slow continuous catheter drainage, described by Tabaddor and Shulman, offered substantial advantages in the treatment of CSDH (55). Twist drill craniostomy was associated with lower mortality and reoperation rate, and duration of inpatient stay compared with burr-hole craniostomy. Smely et al. reported that the recurrence rate was 18,1 % in twist-drill craniostomy groups, and 33,3 % in burr-hole drainage groups, and the infection and

mortality rates were also found to be less in the twist-drill craniostomy groups than in the burr-hole drainage groups (51). On the other hand, Williams et al. found that symptomatic recurrence rate was noted less in the burr-hole drainage groups than in the twist-drill craniostomy groups. Although some authors have advocated the need for postoperative drainage systems, this report revealed no statistically significant difference between the burr-hole groups with drains and burr-hole groups without drains (64). Recently Reinges et al. have described a less invasive bedside technique for treating CSDH (43). They performed twist drill craniostomy under local anesthesia and drained the fluid through a cannula by gravity. The burr-hole evacuation or craniotomy was required in only 9% of their patients. Since these techniques were described, many neurosurgeons have reported using burr-hole or twist drill craniostomy with or without drainage as the first line of the treatment, though similar results have been obtained using either of these techniques (5,7,16,17,31,36, 38,43,58,64). Neuroendoscopic techniques, using flexible steerable endoscopes, have been used for multiloculated and septated haematomas, but these techniques are rarely recommended (22,45).

Reaccumulation of the hematoma is the most common postoperative problem, particularly in haematomas containing a solid or organized clot, which cannot be removed satisfactorily. The main factor contributing to recurrence is poor brain re-expansion. Poor brain re-expansion after hematoma removal is thought to create the potential for reaccumulation of the hematoma because of the absence of a tamponading effect (44). Residual fluid can be detected on CT in as many as 80 % of the patients, a majority of them asymptomatic and clinically insignificant. The incidence of CSDH recurrence with the use of burr-hole and twist drill craniostomy techniques with closed drainage varies from 0 % to 31,6 % (7,11,35,46,50,55,58,65).

In the present study, the recurrence rate was 10,53 %. Many factors, such as age, sex, anticoagulant therapy, brain re-expansion, pneumocephalus, intracranial hypotension, surgical techniques, preoperative CT and MR imaging findings, and multilobulation of the hematoma have been proposed as causative factors for hematoma recurrence (33,53,58). Recurrence of CSDH usually occurred between four days to eight weeks (1,36). These results suggest that patients with CSDH should be followed-up for at least 2 months after surgery to check for recurrences.

The other common complications of surgery are tension pneumocephalus, seizures, hypertensive intracerebral hemorrhages, cerebrovascular diseases and subdural empyemas (1,16,17,18,36). We observed no complications due to surgery.

Neurological status at the time of diagnosis is the most significant prognostic factor (48). Functional results have been satisfactory in 72 % to 95 % of recent cases (16,17,36,64). Patients with poor neurological grades, low Karnofsky scores and GCS on admission had poor outcome compared with patients with good neurological grades, high Karnofsky scores and GCS in this study. We obtained functional and radiological good results in 73 % of our patients.

The mortality of CSDH treated by burr-holes has been reported to range from 1,5 to 25 % (16,17,44,64). Over the last 25 years (the CT scan era) there has been a gradual reduction in the mortality of surgically treated CSDH. In general, morbidity and mortality increase with advancing age and a major contributing factor to a poorer prognosis is the presence of multiple concomitant medical problems (13,60). In half of the who died due to CSDH, the direct cause of death was concomitant diseases (1). In this study, six patients, with poor neurological grade, and low Karnofsky and GCS scores died due to systemic complications.

## CONCLUSION

Chronic subdural hematoma is a common neurosurgical problem that is still associated with significant morbidity and mortality. Two-burr-hole craniostomy with a closed drainage system is a simple, safe and efficient method for the treatment of chronic subdural hematoma. The most common cause of mortality in the surgery of chronic subdural hematomas are concomitant diseases and systemic complications. In our experience, the significant prognostic factors for the outcome of a patient with chronic subdural hematoma are neurological grade, Karnofsky score and Glasgow coma scale score at the time of diagnosis and treatment.

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