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RECURRENCE IN CHRONIC SUBDURAL HEMATOMA (RETROSPECTIVE ANALYSIS)

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ABSTRACT

138 patients had been admitted to neurosurgery teaching hospital, Baghdad, Iraq, diagnosed as a cases of chronic subdural hematoma treated surgically by burr hole irrigation, in the period from Jan.2015 to Dec. 2017. The patients were followed for 3 months. 28 patients reoperated, higher incidence were found in older male and hypertensive with abnormal bleeding profile and a history of head injury. Reoperation done through either the same burr hole or other hole or craniotomy.

INTRODUCTION

Chronic subdural hematoma (CSDH) is a common and relatively benign pathological disease in neurosurgical practice and it is particularly common in elderly male patients. The estimated annual incidence of CSDH has been reported to be as high as 13.3 cases per 100000 persons and, it has increased markedly in the elderly population.[1] Head trauma is the most common cause of subdural hematoma. But, identified history of trauma is obvious in about only half of patients.[2] Common treatment choice of CSDH is a surgical treatment, and several surgical methods included burr hole with or without drainage, and craniotomy with hematoma removal. The surgical outcome of CSDH reported in the previous literatures varies widely with a percentage of recurrence rates from 3% to 30%.[3] In

spite of comparatively simple operative procedure, the recurrence rate is relatively high as compared with other traumatic brain injuries.[4] The patients undergoing a repeated operation have suffered financially and psychically during that period. If we can reduce the recurrence rate by the study of the risk factors that lead to recurrence, there will be an effective care for CSDH patients.[2]

MATERIAL AND METHODS

This study was based on retrospective analysis of 138 surgical cases of CSDH from January 2015 to December 2017. All cases have been treated and followed up in neurosurgery teaching hospital, Baghdad, Iraq. All patients enrolled in this study were treated surgically with one burr hole and drainage and/or craniotomy, and have more than 3 months follow-up period. First, we diagnosed those cases as subdural hematoma by computed tomography (CT) findings. And, we proved that by confirmation of the dark reddish liquefied subdural hematoma, intraoperatively. To check-up, brain CT was performed at the first visit to the institute, immediate postopeatively, and just before removal of drainage tube. Thereafter, we checked-up by CT in only the patients who were having new symptom. We defined recurrent CSDH as the case of the reaccumulation of hematoma on the previously operated side in follow-up brain CT within 3 months after the previous operation. Recurrent CSDH was defined as an increase in the hemorrhage volume in the identical subdural space following a previous surgical evacuation. Computed tomography (CT) was used to diagnose all cases of CSDH. All patients with CSDH following another neurosurgical surgery were excluded. Information regarding patient age, sex, duration from symptoms to operation, type of symptoms (headache, hemiparesis, loss of consciousness, speech disturbance, gait disturbance and memory impairment), initial Glasgow coma scale (GCS), repeated head trauma, cause of CSDH and comorbidities such as hypertension (HBP), diabetes mellitus (DM), liver disease, renal disease, coronary heart disease (CHD), cerebrovascular disease (CVD), hyperlipidemia and alcohol consumption, malignancy and history of anticoagulant or antiplatelet medication was obtained from the medical charts. The following laboratory data were investigated: The liver function was estimated by the examination of SAST/SALT/total bilirubin, protein and albumin in initial serum of the patients, platelet count, prothrombin time percentage and international normalized rate (INR). Patients were considered to have hypertension if systolic blood pressure (BP) >160 mm Hg or diastolic BP >95 mm Hg or if patients used antihypertensive drug. Person who used DM drugs or has initial blood sugar level >200 was considered as DM patients. Hyperlipidemia was defined as abnormally

elevated levels of any or all lipids or lipoprotein in the blood. Person who used anti hyperlipidemia drugs was included. Excessive chronic alcohol consumption was defined as consumption for 3 days/week for 6 months. Malignant neoplasm history was considered if the patients have a history of malignant neoplasm before diagnosis of CSDH.

The initial CT findings were investigated: location of CSDH (unilateral or bilateral), distance of midline shift, initial maximal thickness of subdural hematoma, degree of brain atrophy, density of subdural hematoma and presence of membrane septation. Brain atrophy was classified into four stages: no, mild, moderate and severe atrophy using visual rating of the brain atrophy scale. The density of subdural hematoma was classified into four groups; low density (<25 hounsfield unit [HU]), isodensity (25–35 HU), hyperdensity (>35 HU), and mixed type on the basis of CT scans. The hyperdensity hematoma was excluded from this study, because it is an acute subdural hematoma. The midline shift was measured as the distance from the septum pellucidum point between the anterior horns of the lateral ventricles to a perpendicular line connecting the anterior and posterior insertions of the falx. The hematoma thickness was defined as the maximal thickness of the hematoma on the upper part level of the lateral ventricle.

We reviewed the presence of head trauma history, initial symptoms, time interval between the 1st operation and the 2nd operation and the surgical procedures.

Among the 138 patients, 28 patients experienced reoperation due to recurrence of CSDH within 3 months. We retrospectively evaluated several factors that affect to recurrence of CSDH. Such as age, gender, hypertension (HTN), diabetes mellitus (DM), head trauma, history and drainage tube removal time were reviewed in this study. In the institute in which this study was conducted, a single burr hole trephination and drainage is a first line therapy. In general or local anesthesia, a small single burr hole site is usually on the frontal bone nearby Kocher's point or on the temporal line of parietal bone or double burr hole initially if large size hematoma is present at the beginning. Burr holes were trephined at the region of maximal hematoma thickness on brain computed tomography (CT). Cauterization of the dura was performed with a bipolar coagulator. After opening the dura, dark reddish colored liquefied blood gush out. CSDHs were evacuated and washed out by irrigation with a warm physiological saline solution in all patients. After the surgery, the drainage system was fixed at the level of tragus to prevent rapid drainage of CSDH and the height was changed according to the amount of drainage. A silastic drainage tube was inserted into the subdural

space. And, intraoperative irrigation was done in each case. The drainage tube was currently removed after two days postoperatively. And, early drainage removal time was defined as that removal time was shorter than 24 hours after surgery. In all patients, the time of drainage tube removal was when the drainage volume is less than 20 milliliters in last 8 hours. And, early drainage removal time was defined as that removal time was shorter than 24 hours after surgery. Bed rest was recommended until the drainage catheter was removed. Prophylactic antibiotics were used regularly up to 3 days, unless postoperative wound infection occurred. Follow-up brain CT was performed in all patients. If the midline shift did not exist anymore, or thickness of subdural space was less than 5 mm, we concluded that brain expansion occurred and that resolution of hematoma was complete. And, if the reoperation was needed, we identified a new burr hole site in all recurrent cases if single burr hole has been used at first and /or craniotomy in some cases. Then, we diagnose CSDH exactly.

In some cases a "mini-craniotomy" is done, which is defined as a craniotomy of 5–7 cm in greatest diameter. The choice of operation was based solely on the surgeon's preference and clinical experience. Evidence of multiple loculations and age of the patients had no influence on the surgical technique as none of the surgeons strayed from their normal method of treating chronic subdural hematomas. The surgical technique for the "mini-craniotomy" involved raising a craniotomy flap of about 5–7 c m in greatest diameter centered over the area of maximal hematoma thickness. The outer membrane was opened and excised as far as the craniotomy would allow and then the inner membrane was opened and coagulated as well.

RESULTS

Twenty-eight patients (20.2%) were recurred and all patients underwent a reoperation. Patient's data was similar to other previous articles. 91 men and 47 women were enrolled in this study, and their mean age was 70.0 years (range, 15-93).

	Non recurrence No.=110	**Recurrence No.=28**
Male	68(74.7%)	23(25.3%)
Female	42(89.3%)	5(10.7%)

Patients having DM are 34 (24.7%) and having HTN are 63 (45.4%). Eighty-seven in all patients (62.9%) had remembered their head trauma history in the past few months. There are a few different features between recurrence group and no recurrence group. In recurrence group, mean age (±standard deviation) of patients (74.7±8.9) was older than no recurrence

group (69.1±12.8). And recurrence group'smale/female ratio (4.6:1) was higher than that of no recurrence group (1.6:1).

The recurrence rates of patients having a history of HTN(8/28,27.3%) or DM (9/28, 33.3%) were also higher than those of who do not have (8/110,7.6%),(12/110, 11.0%).

Bleeding tendency had been recorded, by testing prothrombin time and international normalized ratio(PT,INR) and we found a higher incidence of recurrence in the patients who had bleeding tendency in the form: use of anticoagulant (10/33,30.3%), liver disease (2/6,33.3%), chronic renal disease (2/2, 100%).

Headache was the most common presentation in our CSDH patients; 61.5% (68 out of 110) in the non-recurrent group and 64.5% (17 out of 28) in the recurrent group. Other symptoms contained motor weakness, dysarthria and seizure, nausea and vomiting and mental change. The presentations were not significant different between the recurrent and the non recurrent group.

The most common cause of CSDH was history of head trauma (104 patients, 76.0%). History of repeated head trauma was noted in 7 patients (5.2%) and symptom duration was 22.7±23.50 days. Initial GCS score of 15 was noted in 115 patients (83.3%). Twenty-three patients (16.7%) had an initial GCS score below 14 points. Bilateral CSDH was observed in 35 patients (25.6%), whereas unilateral CSDH was observed in 103 patients (74.3%). The most common hematoma density on CT was mixed density (61 patients, 44.3%). Midline shifting was 7.23±5.47 mm (range, 0–21 mm). Initial hematoma thickness was 20.01±6.99 mm (range, 5–40 mm).

We divided our patients into two groups, depending on the thickness of hematoma by 15 mm. The recurrent group patients who had 15 mm thickness or more were 5(19.6%), and the recurrent patients who had less than 15 mm thickness were 3(10.0%). But, there was no statistically significant difference. The degree of midline shift also didn't have a statistical significance in recurrence. The recurrence rates of patients more than 10 mm was (16.7%). The bilaterality had a statistical significance in recurrence. But, there was no significant difference between right side group and left side group. The statistical analysis about the relationship between internal architecture and recurrence shows that heterogeneous hematoma has a tendency of recurrence.

	No recurrence(n=110) No.(%)	Recurrence(n=28) No.(%)
Thickness		
Less 15 mm	50(83%)	10(7%)
More 15mm	60(77%)	18(23%)
Midline shift		
Less 10mm	60(76.9%)	18(23.1%)
More 10mm	50(83.3%)	10(16.7%)
Location		
Unilateral	110(82%)	14(18%)
Right	50(83.3%)	10(16.3%)
Left	60(93.7%)	4(6.3%)
bilateral	0(0%)	4(100%)
Internal architecture		
Homogenous	63(95.4%)	3(4.6%)
heterogenous	47(65.2%)	25(34.7%)

Surgical procedures and the recurrence of CSDH

The number of burr holes was not related to the recurrence of CSDH. Irrigation was also not significantly meaningful to the recurrence of CSDH. Our average recurrence interval was 38.26 (±4.05) days.

Re-operation was primarily due to residual CSDH without symptomatic improvement or secondary to acute hemorrhage(s). Of the twenty-eight patients that underwent reoperation, seven (25%) needed to be converted into craniotomies and the others required re-opening and irrigation of original burr holes.

Relationship between recurrence rate of CSDHs and drainage removal time

Drainage removal in 24 hours postoperatively was usually a little fast time. Early drainage removal was enacted in 16 patients of 138 patients (12.4%) in our study. All the patients' drainage volume in last 8 hours was less than 20 mL, without exception. Half of them are in recurred group.

DISCUSSION

When the veins that bridge the subdural space are excessively stretched, they rupture, and venous blood escapes into the subdural space.[5] Chronic subdural hematomas begin with hemorrhage into the subdural space. The blood becomes encapsulated by a membrane of neovascularization at the inner surface of dura mater. This fragile membrane is caused by an inflammatory reaction to a chemical mediator in the subdural fluid collection. The sinusoidal

channels in the neomembrane lead to frequent micro bleeding. Eventually, it causes encapsulation of unclotted and liquefacted hematoma by splitting of the neomembrane.[6]

Risk factors for CSDH recurrence are divided into three categories. Factors associated with patient characteristics, such as old age, brain atrophy, poor performance status on admission, bleeding tendency, kidney diseases, liver dysfunction, chronic alcoholism, diabetes, epilepsy, dementia, hemodialysis, use of anticoagulants, antiplatelet and chemotherapeutic agents, intracranial hypotension (cerebrospinal fluid shunt surgery), have commonly been reported.[7] Factors associated with the pathogenesis of CSDH include large hematoma, bilateral CSDHs, septum formation or multiple membranes in the hematoma cavity, mixed-density and high-density hematoma on the CT scan.[8] Factors associated with surgery such as 1) insufficient drainage intraoperatively and postoperatively, 2) air collection in the hematoma cavity, 3) early surgery when the hematoma has a poorly developed capsule are thought to increase the risk of recurrence.[9]

The predicting factors for postoperative recurrence of CSDH were researched in several previous articles. But, each article's definition of recurrence is slightly different. And, the predicting factors of recurrence can be influenced by those differences. In consideration of the definition of CSDH recurrence, the time interval between the initial surgery and recurrence varies in each articles from within 3 months to 6 months or more.[10,11,12] And, the recurrent cases of only ipsilateral hematoma were enrolled in the study in most of articles, but both ipsilateral and contralateral hematoma recurrent cases came under the study in several articles.[13] There are also some trivial differences, aside from these two differences. We defined recurrent CSDH as the case of the reaccumulation of hematoma on the only operated side within 3months after the previous surgery.

The internal architecture of hematoma is an important predicting factor of postoperative recurrence in a few previous articles.[3] Nomura et al. previously divided CSDHs into five types according to hematoma 's appearance on preoperative brain CT (known as the internal architecture): hyperdensity, isodensity, hypodensity, mixed-density and layering types.[14] And, Tsutsumi et al. analyzed the difference of recurrence rate among these types. There were no statistical differences in recurrence rate in the report.[12] In our study there was a high recurrence rate among heterogenous hematoma and with more than 15 mm thickness and bilateral cases but no difference in degree of midline shift.

An identical conception in a definition of recurrence is going to be needed for deduction of accurate risk factors. Recurrence of CSDHs generally occurs more in the elderly and male patients group. That was explained by a capacity of brain re-expansion.[3,15,16] Age and sex are not statistically significant in almost articles. In the present study, elderly male patients also had a higher recurrence rate. HTN and DM have been considered to be risk factors of recurrence in previous studies.[15] They are related to recurrence of CSDHs in this study. In most previous literatures, HTN was not significant for a recurrence factor. But, DM was a significant risk factor of recurrence of CSDHs in several articles. Yamamoto et al., reported that recurrence rate of patients without DM had a higher recurrence rate than those with DM. They asserted that DM decreases rebleeding in CSDH patients, because the blood of patients with DM has a hyperviscosity, high osmotic pressure and increased platelet aggregation. In contrast to this result, DM may play a role in recurrence of CSDHs in several articles. Exudate of macrocapillaries in the outer membrane had an influence on recurrence of CSDH. The significance of HTN and DM as an independent risk factor for recurrence are still controversial.[17] Drainage tube removal time can be taken into consideration as a predicting factor of recurrence of CSDHs. Drainage tube removal within 24 hours is an independent risk factor of recurrence of CSDHs in this study. In the results of Ohet al., patients who underwent removal of drainage within 24 hours had a higher recurrence rate than the other patients, but there is no statistically significant difference. Early drainage tube removal is necessary for to reduce an incidence of infection. But, too early removal of drainage tube can cause reaccumulation of subdural hematoma. The drainage tube removal time should be decided with due regard to amount of drainage and color of drainage fluid. An ideal time of drainage removal is controversial.[10]

Demographics and clinical presentation

Generally, an occurrence of CSDH in older people comes from an age-related decrease in brain volume, increase of the tension on the cerebral bridging vein and an increased venous fragility associated with aging. This tendency might be different in the male and the female group. The male gender was definitely related to the recurrence of CSDH with a significant difference between both groups. Generally, male are predisposed to develop CSDH. Our study also showed that trauma history of the male was much higher than those of the female consistently. In fact, the male group had a much higher chance to suffer from a trauma to the head than the female group. There is a theoretic possibility that higher levels of estrogen in the female group may have some protective effect on capillaries. In addition, estrogen is

related to the repair of damaged vessels, because estrogen is known to induce vascular repair and angiogenesis.[18]

Many studies revealed an apparent head trauma history up to 74.4% of CSDH. However, our data showed a definite trauma history in 104 patients (76.0%). If a minor trauma is so trivial, people tend to forget their trauma history. Furthermore, indirect trauma is also reported as important factor. Although 50% of the patients had a history of fall, patients did not hit their head on the ground. Even if it is not absolutely proportional to the occurrence of CSDH, the head trauma history is very important in CSDH.

CT and CSDH recurrence rate

A CT is well known as a useful tool for the diagnosis of CSDH. Therefore, we mainly used CT to evaluate CSDH. Our data showed that single layer hematoma was significant in the recurrence of CSDH. Single layer hematoma was present in 80.6% (22 out of 28) of recurrent cases.

The recurrence rate of CSDH showing isodensity was 64.5% (18 out of 28). These findings correspond well to one result reported in the literature. Therefore, the isodensity of CSDH might also be important as a radiological factor of CSDH recurrence. However, Mori and Maeda and Tsai et al. could not detect a positive correlation between radiological images based on CT density and recurrence. Saito et al. also did not detect a positive association between radiological images and CSDH recurrence. He concluded that chemical factors of the hematoma membrane may show a better relationship with the CSDH recurrence than radiological characteristics. His study referred only to chemical factors such as vascular endothelial growth factor and transforming growth factor-β influence on the vascularization of the hematoma membrane. Further studies are consistently required as the relationship between radiological factors and CSDH recurrence remains still unclear.[19]

Surgical procedures and the recurrence of CSDH

We mostly performed burr hole trephination through parietal eminence. The number of burr holes in each operation showed no specific differences in our study. Other studies showed no significant differences in the recurrence rate between 1 hole and 2 holes trephination also. However, Taussky et al. found a significantly higher rate of recurrence for 1 hole trephination. Their data showed a longer length of hospital stay and an increased rate of wound infection in the group with 1 hole trephination.[20]

CONCLUSION

There are some differences among the previous articles and our study. These differences are due to several different limitations in these studies. So, a cooperative study of various hospitals and a large well-defined prospective study should be conducted in the future. In accordance with our results, the heterogeneous type hematoma and the bilaterality are the significant recurrent factors in preoperative CT findings. If predicting factors related to recurrence will be displayed on preoperative brain CT, the more deliberate surgical consideration will have to be needed. And, the postoperative care such as drainage tube removal is also important to reduce the recurrence rate of CSDHs.

We suggest that diabetes mellitus, anticoagulation, headache are independent preoperative predictors of recurrence of chronic subdural hematoma.

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