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Chronic and Subacute Subdural Hematoma in the Adult Population. The Puerto Rico Experience.

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Objective. **The purpose of this investigation was to study the epidemiology of chronic and subacute subdural hematoma in an adult population and associated factors such as treatment, recurrence, seizures, complications, and outcome.**

Methods. **We retrospectively reviewed 267 consecutive cases operated for a suspected diagnosis of chronic or subacute subdural hematoma during a six-year period.**

Results. **An incorrect diagnosis was done in 12 of the cases (4.5%) giving a total of 255 cases of chronic or subacute subdural hematoma. The mean age of the patients was 68-year old. Two-thirds of the cases were chronic and one-third were subacute. A history of head trauma was identified in 79% of the patients occurring more frequently in the subacute group. The hematoma was bilateral in 16% of the patients. Recurrence occurred in 7.8% of the cases, but there was no significant difference between chronic and subacute cases nor the type of operation done. Postoperative seizures occurred in 6.2% of the cases. Preoperative seizures are not associated to the development of postoperative seizures. A postoperative intracerebral hematoma occurred in 2.7% of the patients and was associated in most of the cases with a poor outcome. The morbidity rate was 9% and the mortality rate was 0.9%. Outcome is good in 95% of the patients.**

Conclusions. **Chronic subdural hematoma occurs more frequently than subacute subdural hematoma. Surgical treatment modality and the use of a drain do not change the recurrence rate. Preoperative seizures are not associated to the development of postoperative seizures. The use of postoperative prophylactic antiepileptic drugs does not decrease the postoperative seizure rate even in the alcoholic patient, therefore, their prophylactic use is not indicated.** *Key Words: Subdural hematoma, Recurrence, Seizure, Neurosurgery*

Chronic subdural hematoma (SDH) and subacute SDH are two of the most common diseases treated by neurosurgeons. In 1975, the incidence of chronic SDH was 1 to 2 per 100,000 people per year (1). In 1996, the incidence of surgically treated chronic SDH was reported as 5.3 per 100,000 people per year (2). This increase is probably related to better identification and diagnosis of the condition. Since the report in 1960 by McKissock et al. (3), few series with over 200 cases of chronic and subacute SDH had been published (2,4-9). This report contains a very large number of cases and was designed to analyze the epidemiology of this disease and associated factors such as treatment, recurrence, seizures, complications, and outcome.

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Materials and Methods

We reviewed the hospital records of 230 consecutive patients operated for a suspected chronic or subacute SDH in a six-year period from July 1988 to June 1994. Subdural hematomas were classified as "chronic" when an etiological factor was identified three or more weeks prior to the patient's symptoms or as "subacute" when an etiological factor was identified between three days to three weeks prior to the patient's symptoms. In those cases in which no etiological factor was identified, a chronic SDH was considered if the hematoma was

completely liquefied and a subacute SDH was considered if it included solid clots. The population included patients from the University District Hospital and the Veterans Administration Hospital. The mean follow-up period was 12 months. These patients were analyzed to detect predisposing factors, etiology, treatment modalities, recurrence, seizure rate, complications and outcome. The patient's neurological condition was evaluated using Markwalder et al. (10) grading system. Surgical morbidity was defined as those patients presenting a complication related to the surgical procedure. Surgical mortality was defined as death within 30 days of the surgical procedure. Outcome was assessed at three months postoperative and was defined as excellent if the patient was without neurological deficit, good if the patient had improved but had some residual neurological deficit, and poor if the patient did not improve or worsen his neurological deficit.

Statistical analysis was performed using the χ^2 test and Fisher's exact test. All P values are two-tailed. Variables were considered significant at 95% confidence intervals, i.e., $P < 0.05$.

Results

There were 267 operated cases for a suspected diagnosis of chronic or subacute SDH among 230 patients. Twelve cases (4.4%) (10 patients) were considered misdiagnosis since the postoperative diagnosis was different to the preoperative diagnosis. Among the 12 cases of misdiagnosis, 11 were subdural hygromas and one was a subdural empyema. All the misdiagnosis cases were excluded from further data analysis. There were 255 cases (220 patients) of chronic or subacute SDH with a mean age of 68-year-old. Chronic SDH patients had a mean age of 69-year-old and subacute SDH patients had a mean age of 66-year-old. The cases were divided between 173 cases of chronic SDH and 82 cases of subacute SDH. Among the patients with chronic or subacute SDH, 35 (16%) of them had bilateral hematomas. Bilateral SDH was present in 15% of chronic SDH patients and in 19% of subacute SDH patients. Eighty-eight percent of the patients of subacute SDH and 75% of the patients of chronic SDH were associated to a history of head trauma. Those cases of chronic SDH with a history of head trauma had a mean interval from the trauma to the diagnosis of 38 days (range 12 days - 6 months), while those cases of subacute SDH had a mean interval of 25 days (range one day - five months).

During the six-year period, different neurosurgeons contributed to the surgical procedures depending on their preference. Most of the cases were treated with a single burr hole; the remainder of them had two burr holes, craniotomy, or three burr holes in decreasing percentage. Table 1 shows the surgical treatment modality for each type of SDH. The most common postoperative complications were seizures and intracerebral hematomas (Table 2). Surgical morbidity rate was 9% (22 patients) and mortality rate was 0.9% (two patients). None of the patients developed a postoperative infection. The outcome was good or excellent in 95% of the patients.

Table 1. Initial Surgical Treatment

Treatment	No. of Chronic Cases	No. of Subacute Cases
Burr hole X 1	85 (49.1%)	30 (36.6%)
Burr hole X 2	62 (35.8%)	32 (39.0%)
Burr hole X 3	16 (9.2%)	6 (7.3%)
Craniotomy	10 (5.8%)	14 (17.1%)

Table 2. Surgical Complications

Complication	No. of Patients
Postoperative seizures	14 (6.4%)
Intracerebral hematoma	6 (2.7%)
Tension pneumocephalus	2 (0.9%)
Acute subdural hematoma	1 (0.4%)

Symptomatic recurrence occurred more frequently (8.5%) in the subacute SDH patients than in the chronic SDH patients (7.5%) but not statistically significant ($P = 0.7936$). Recurrence rate among all the patients was 7.8% (Table 3). The mean interval for diagnosis of a recurrence was 53 days. The use of single burr hole, multiple burr holes, or craniotomy was not a significant factor for the recurrence rate in ($P = 0.1109$) (Table 4). Treatment for recurrent cases was done mainly by exploration of the burr hole (55%) (Table 5). Only three of the recurrent cases were treated at the first operation without a drain ($P = 0.7016$). The outcome of recurrent cases was good

Table 3. Recurrence for Chronic and Subacute Subdural Hematoma

Recurrence	No. of Cases
Total	20 (7.8%)
Chronic	13 (7.5%)
Subacute	7 (8.5%)

Table 4. Recurrent Cases for Each Initial Treatment Modality

Treatment Modality	No.	Recurrent Cases	Incidence
Single burr hole	115	13	11%
Multiple burr holes	116	7	6%
Craniotomy	24	0	0%

in 83% of the patients.

Preoperative seizures occurred in 13 patients (5.8%). The preoperative seizure rate for patients with chronic SDH was 4.6%, while for those with subacute SDH was 8.7%. All the patients who developed preoperative seizures were treated with antiepileptic drugs. Ninety-two percent of the patients with preoperative seizures and 86% of the patients with postoperative seizures had history of

Table 5. Surgical Treatment for Recurrent Cases

Treatment	No. of Cases
Burr hole re-exploration	11 (55%)
Burr hole-shunt ligation	3 (15%)
Subdural-peritoneal shunt	3 (15%)
Craniotomy	3 (15%)

head trauma. Postoperative seizures occurred in 14 patients (6.2%). Only one of these patients had preoperative seizures. The postoperative seizure rate for patients with chronic SDH was 6%, while for those with subacute SDH was 7.2%. During the first three years of this series, postoperative prophylactic antiepileptic drugs were routinely used but in the last three years no postoperative prophylaxis was given. This sequence gave an almost equal number of patients for each group. Six (5.77%) of the patients that did not receive postoperative prophylactic antiepileptic drugs developed postoperative seizures. Eight (6.96%) of the patients that received postoperative prophylactic antiepileptic drugs, developed postoperative seizures. There was no association between the development of postoperative seizures and the use of postoperative prophylactic antiepileptic drugs (P = 0.7365). Forty-three percent of the patients that developed postoperative seizures had history of alcoholism. This series had 41 patients with history of alcoholism from which 29 of them received postoperative prophylactic antiepileptic drugs and 12 did not receive prophylactic antiepileptic drugs. All six alcoholic patients that developed postoperative seizures were in the group that received postoperative prophylactic antiepileptic drugs (P = 0.1557). Only one case with postoperative seizures was associated to a postoperative intracerebral hematoma.

Discussion

The etiology of a chronic SDH is usually a direct or indirect head trauma that causes tearing of the bridging veins with subsequent development of a subdural blood collection between the dura and the arachnoid (11,12). With time, the hematoma develops membranes with neocapillaries that contribute to its enlargement by repeated bleeding (12-14). Seventy-nine percent of our patients had a history of head trauma. This association occurred more frequently in patients with subacute SDH than in patients with chronic SDH which could be related to the shorter interval of time between the trauma and the symptoms in cases of subacute SDH. In the literature, a history of head trauma is reported in over 60% of the cases (15-19). Patients with low intracranial pressure secondary to cerebral atrophy or a cerebrospinal fluid shunt, hematological problems such as hemophilia or anticoagulation therapy, and history of alcoholism are predisposed for the development of SDH even after minor head trauma.

Our population mean age was 68-year-old. In the literature, the mean age for chronic SDH varies between 62 and 70-year-old (2,11,15-17,20,21). Sixteen percent of our adult patients had bilateral hematomas without a significant difference between chronic and subacute cases. Bilateral chronic SDH had been reported to occur between 11% - 29% of the cases (2,3,15-18,21-25) and bilateral subacute SDH in 20% of the cases (3). Benzel et al. (26) found that chronic SDH represented 60% of all cases of non-acute SDH. Our study shows a similar proportion. Main symptoms in adults include headache, disturbances of consciousness, focal neurological deficits, and seizures (16-17).

The management of this common condition is the most controversial aspect of it. Treatment options include observation (27,28), twist drill craniostomy (13,14, 18,26,29-32), single burr hole without drain (3,16,18,33-36) or with drain (2,6,8,12,15-17,20,21,31,36-41) multiple burr holes (4,7,10,19,23,25,42,43) craniotomy without membranectomy (11,16,17,44) or with extensive membranectomy (15,19,44), craniectomy (44), and endoscopy (45,46). Injection of isotonic saline or Ringer's lactate solution by lumbar puncture or ventricular tap and incision of the inner membrane had also been done to expand the ventricular system and brain (11,17,23,42). Non surgical treatment of chronic SDH using mannitol had produced divergent results. Unresolved hematomas

may be present in 4.3% of the cases (28), but in up to 23% of the cases (27). Gjerris and Schmidt (47) compared surgical treatment to mannitol treatment and concluded that mannitol should not be used as a replacement for surgery in the treatment of chronic SDH.

A chronic SDH may be confused with a subdural hygroma. Hygromas usually occur in males and are bilateral in 50% of the cases (48). Park et al. (49) found that 9% of all hygromas convert into a chronic SDH by unknown mechanisms. There is no clinical or radiological characteristic that predicts the evolution of a subdural hygroma into a chronic SDH.

Operative treatment of chronic SDH is almost universally accepted (12,16). Simple twist drill aspiration, burr holes with saline irrigation, and craniotomy has proven to be effective in the management. Irrigation of the subdural space allows aggressive removal of subdural fluid that is low in fibrin and high in plasmin and fibrin split products that promotes hemorrhage from the neomembrane (15,33). Nowadays, the procedure most frequently performed for the treatment of chronic or subacute SDH is burr hole irrigation with drain. The irrigation is carried down until clear and the subdural drain is maintained in place for 24 - 48 hours. In our series, the most frequent procedure used was burr hole. Craniotomy composed less than 10% of the operative procedures. Tyson et al. (44) considered that treatment with one burr hole was as effective as two burr holes. Smely et al. (31) compared two non-randomized groups of patients with chronic SDH and found that those groups treated with twist drill trephination and subdural catheter drainage have better clinical results and lower morbidity and reoperation rates than those treated with single burr hole craniotomy and closed system drainage. We found that the use of a single burr hole, multiple burr holes, or a craniotomy did not alter the recurrence rate. Some authors have reported that management with a burr hole offers at least equivalent efficacy to craniotomy, but with much lower morbidity and mortality and a shorter postoperative hospital stay (12,41). The use of a craniotomy in our patients did not increase the morbidity and mortality rates. There is no consensus in the literature regarding the superiority of drains. Wakai et al. (36) found that the use of a drain significantly decreased the recurrence rate. Markwalder and Seiler (43) recommended its use to avoid early postoperative clinical deterioration but not to decrease the recurrence rate. They considered that it is not necessary in cases with considerable perioperative cortical expansion. Our practice includes the use of a postoperative drain in every case that the brain fails to expand completely leaving a space between the inner membrane and the bone. Prophylactic antibiotics are given until the drain is removed or for 24 hours postoperative if a drain was not used. Although most of our recurrent cases had a drain placed at the initial surgery, a conclusion regarding the prevention of a recurrence by the use of a drain can not be obtained since we did not have a control group.

Craniotomy is generally reserved for those cases in which the subdural fluid reaccumulates, there is a solid hematoma, or the brain fails to expand and obliterate the space (12,14,15,17,25,45). Hamilton et al. (16) considered that craniotomy was better to deal with the membranes, troublesome bleeding, and the placement of a subdural drain. Svien and Gelety (19) found that burr hole craniotomy was superior to craniotomy with removal of membranes in the treatment of chronic SDH. Excision of the membranes does not prevent recurrence of the condition (19,34). Craniotomy with membranectomy, which carries high morbidity and mortality rates, is usually reserved for recurrent cases (33). Tyson et al. (44) found that patients with multiple reaccumulations and with brain swelling benefit with a craniectomy because it obliterates the residual subdural space and provides external decompression in cases of brain swelling. Endoscopy through a small burr hole craniectomy had been recently used for the treatment of septated chronic SDH (45,46). Results are favorable with 0% long term recurrence rate (45). The surgical treatment for a subacute SDH is similar to a chronic SDH. It may include twist drill craniostomy (13,14,30), burr hole (33,34,37,40) and craniotomy (3). Operative superiority of a surgical treatment can only be decided with a randomized prospective trial.

The complete resolution of SDH fluid and expansion of the compressed brain are very slow and steady and require at least 10 to 20 days (10). Postoperative computed tomography (CT) scans demonstrate that the brain gradually expands during a 2 - 3 week period after surgery (17). The amount of perioperative cortical expansion has a linear relation to the thickness of the membrane (7). The radiographic finding of a persistent subdural fluid collection in patients whose neurological syndrome had resolved does not warrant additional surgical intervention (15,26). We do not perform a routine postoperative CT scan unless the patient does not improve his neurological condition or presents new neurological deficits. Persistence of neurological symptoms or signs should be used as a guide for additional surgery. A follow-up CT scan is done as an outpatient 4 - 6 weeks after the surgery.

Recurrence. A review of the literature showed that those patients treated with twist drill craniostomy had a recurrence rate which varies from 5% to 31% (13,14,18,26,29-32). Recurrence rate for burr hole without drain varies from 0% to 33% (16,18,35,36,38,50) and for burr hole with drain from 0% to 33% (2,6,8,15-

17,21,31,36,50). Recurrence rate for multiple burr holes varies from 0% to 20% (4,7,10,17,42). Recurrence rate for craniotomy varies from 2% to 37% (15,19). The recurrence rate in our series was 7.8%. There was no significant difference in the recurrence rate between chronic SDH and subacute SDH. Asano et al. (50) noticed that recurrent cases usually occurred in cases initially treated without a drain. Ernestus et al. (15) and Hamilton et al. (16) found no significant difference in the recurrence rate of chronic SDH among patients treated with burr holes or craniotomy irrespectively of the use of a drain. In our patients, recurrence occurred irrespectively of the use of a drain. No significant factors have been identified in the perioperative period that could predict which patients could develop a recurrence (2). Half of our recurrent cases were treated by burr hole exploration. Craniotomy was used in 15% of the cases. A ventriculo-peritoneal shunt was ligated in three cases but reopened later after resolution of the collection. Oku et al. (35) proposed a method for complete obliteration of the subdural space cavity of recurrent chronic SDH by conversion into an epidural space to prevent further hemorrhage or fluid collection.

Seizures. Another particular issue concerning this condition is its association with seizures and the role of postoperative prophylactic antiepileptic drug therapy. It has been suggested that the membrane of the hematoma and the reduction in cerebral blood flow play a role in the development of seizures (39). Svien and Gelety (19) did not relate the development of postoperative seizures to the presence of membranes. Postoperative seizures may be related to the accompanying cerebral injuries or to the surgical technique (40). Ninety-two percent of our patients with preoperative seizures, and 86% of the patients with postoperative seizures had a history of head trauma. This high percentage of history of head trauma in patients with seizures may indicate that they may have a greater probability of having accompanying cerebral injuries. In the literature, the preoperative seizure rate in patients with chronic SDH varies from 0.3% to 17% (3,5,16,22,24,39,40). The preoperative seizure rate in our patients with chronic SDH was 4.6%. Only one patient with preoperative seizures had seizures in the postoperative period. Preoperative seizure activity does not predispose to postoperative seizures. New postoperative seizure activity related to chronic SDH had been reported to vary from 1% to 14.4% (3,5,11,18,23,24,39,40,51). Postoperative seizures occurred in 6% of our patients with chronic SDH. Hirakawa et al. (5) found that postoperative seizures occur in 5.3% of the patients when treated with burr holes, but in 23.4% when treated with craniotomy with membranectomy. This difference may be related to cortical injury produced while removing the membranes. Sabo et al. (18) found a significant decrease in new seizure activity in patients with chronic SDH if treated with antiepileptic drugs and recommended its prophylactic use. Their study was retrospective and did not mention the criteria for the use of antiepileptic drugs. Samudrala and Copper (52) also recommended their prophylactic use but said that they can be discontinued one month postoperatively if seizures have not occurred. Ohno et al. (40) and Rubin and Rappaport (24) concluded that the prophylactic use of antiepileptic drugs in patients with chronic SDH is unnecessary. We agree with their conclusion since the use of postoperative prophylactic antiepileptic drugs did not decrease the postoperative seizure rate in our patients.

In the literature, preoperative seizures in subacute SDH occur in 3.3% of the cases, while postoperative seizures occur in 4.4% of the cases (3). In our series, 8.7% of the patients with subacute SDH developed preoperative seizures, while 7.2% developed them postoperatively. Some series that combine chronic SDH and subacute SDH cases found that preoperative seizures occur in 3.6% to 18.9% of the cases and postoperative seizures occur in 2.7% to 8.3% of the cases (34,42). Ohaegbulam (34) identified postoperative seizures only in cases of subacute SDH. In our series, postoperative seizures were equally divided between chronic and subacute cases.

Complications. Surgical complication rate varies in the literature from 6.5% (20) to 15.2% (16). Complications include recurrence of the hematoma, cerebral edema, hydrocephalus, infection, seizures, failure of the brain to expand, pneumocephalus, acute SDH, and intracerebral hematoma. Our complication rate was 9%. Postoperative intracerebral hematoma at or near the site of the surgery occurs in 2% - 5% of the cases (20,53). A postoperative intracerebral hematoma occurred in 2.7% of our patients. These patients presented with a rapid neurological deterioration in the immediate postoperative period and have a high mortality rate. Possible pathogenic mechanisms include hemorrhage into a previously undetected area of contusion, sudden increase in cerebral blood flow combined with damaged parenchymal blood vessels, and faulty autoregulation (53). Subdural empyema occurs at a rate of 2% (7,11,20). Multiple operations increase the risk for developing a subdural empyema (2).

Outcome. In most published series, 80% of patients with chronic or subacute SDH had a good outcome (6,11,16,17,21,24-26,34,42,51). In our series, 95% of the patients had a good outcome. Eighty-three percent of our patients with a recurrence had a good outcome. Ernestus

et al. (15) and Hamilton et al. (16) did not found a significant difference in outcome despite the treatment modality. Robinson (23) and van Havenbergh et al. (9) found that the neurological condition at the time of treatment was the only statistically significant factor important for the outcome of patients with chronic SDH. Krupp and Jans (6) found that the patient's age was also a statistically significant factor. Associated systemic diseases may also influence the outcome (32). Mortality rate for chronic SDH varies in the literature from 1.4% to 11.2% (2-4,6-8,11,16-18,20,21,23,24,42). Mortality rate for subacute SDH varies from 17% to 24% (3,37).

Conclusions

Chronic SDH is more common than subacute SDH. Recurrence of the hematoma occurs in less than 10% of the cases and is not associated to the treatment modality. At present, there is no management method of proven superiority. Preoperative seizures are not associated to postoperative seizures. The use of postoperative prophylactic antiepileptic drugs does not decrease the postoperative seizure rate even in the alcoholic patient, therefore, their use is not recommended. Outcome is good in 95% of the patients.

Resumen

Objetivo: El propósito de esta investigación fue estudiar la epidemiología del hematoma subdural crónico y subagudo en una población adulta y sus factores asociados como tratamiento, recurrencia, convulsiones, complicaciones y resultados.

Métodos: Se revisaron retrospectivamente 267 casos operados con un diagnóstico presuntivo de hematoma subdural crónico o subagudo durante un periodo de seis años.

Resultados: Se estableció un diagnóstico incorecto en 12 casos (4.5%) reduciendo el total a 255 casos confirmados de hematoma subdural crónico y subagudo. La edad promedio de los pacientes fue 68 años. Dos terceras partes de los casos fueron crónicos y una tercera parte fueron subagudos. Se identificó un historial de trauma a la cabeza en 79% de los pacientes. El hematoma fue bilateral en 16% de los pacientes. Recurrencia del hematoma ocurió en 7.8% de los casos, pero no hubo diferencia significativa entre los casos crónicos y los subagudos ni en el tipo de operación realizada. Convulsiones postoperatorias ocurieron en 6.2% de los casos. Las convulsiones preoperatorias no se asocian al desarrollo de convulsiones postoperatorias. Un hematoma intracerebral postoperatorio ocurrió en 2.7% de los pacientes, el cual estuvo asociado a un resultado pobre en la mayoría de ellos. La morbilidad fue 9% y la mortalidad fue 0.9%. El resultado fue bueno en 95% de los pacientes.

Conclusiones: El hematoma subdural crónico ocurre mas frecuente que el hematoma subdural subagudo. El tipo de tratamiento quirúrgico no altera la frecuencia de recurrencia. Las convulsiones preoperatorias no se asocian al desarrollo de convulsiones postoperatorias. El uso profiláctico postoperatorio de drogas antiepilépticas no disminuye la frecuencia de convulsiones postoperatorias, por lo tanto, su uso profiláctico no está indicado.

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