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RESEARCH

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Efficacy of single burr hole with irrigation and sub-dural drain in the evacuation of chronic subdural hematoma

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Abstract

Background Chronic subdural hematoma (CSDH) remains one of the most common types of traumatic and spontaneous intracranial hematomas. The optimal method of treatment has not been definitely established. Surgical treatment options includes craniotomy, trephination, burrhole drainage and twist drill perforation. This study aimed at the evaluation of the clinical and radiological outcome after the efficacy of single burr hole with irrigation and subdural drain in the aim of successful evacuation of CSDH.

Results A total of 53 patients were included in this study, the mean age of patients was 61.53 + 13.81 years. Results of the paired *t* test showed that the Glasgow coma scale has significantly improved by 0.89 points ($p < 0.001$) and that the average motor power has significantly improved for all individuals by 0.4 points ($p = 0.043$). We found that older aged patients have significantly less improvements in the postoperative motor power ($r = -0.317$, $p = 0.02$) and require longer hospital stay ($r = 0.32$, $p = 0.0197$).

Conclusions A single burr hole with irrigation and leaving a subdural drain is safe procedure in managing subdural hematoma. We did not experience major adverse events related to drain insertion and efficient evacuation of collection and no obvious increase in mortality or morbidity rates.

Background

Chronic subdural hematoma (CSDH) remains one of the most common types of traumatic and spontaneous intracranial hematomas, taking place often in the elderly. In the pre-computed tomography (CT) era, the diagnosis was largely clinical and many patients died undiagnosed or suffered from persistent disability because of a delay in diagnosis [1–4].

Neurosurgeons often treat patients with chronic subdural hematoma (CSDH). Although CSDH is commonly thought to be a benign disease, and the functional outcome at discharge is poor and not satisfying the patient at 28.4% [5, 6].

Symptoms of chronic subdural hematoma include hemiparesis, headache, loss of consciousness, and seizures. The treatment of chronic subdural hematoma is variable from pharmacologic therapy to operative therapy. However, most patients are operated except if the patient is not in operable condition or a small amount of hematoma with no symptoms [7, 8].

Surgical treatment has been widely approved as the most effective way to manage symptomatic CSDH, yet the optimal method has not been definitely established. Chronic subdural hematoma drainage is one of the most common procedures performed in neurosurgical practice. Surgical treatment includes craniotomy, trephination, burr hole drainage and twist drill perforation [9–12].

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It has been reported that CSDH has a good prognosis, with a mortality rate of approximately 2%. However, the postoperative recurrence rate is reportedly 5–33%. Since the disease is common among the elderly, the reduction in recurrence rate is essential, to prevent deterioration in the activities of daily living caused by prolonged hospitalization [13, 14].

This study aimed at the evaluation of the clinical and radiological outcome after the efficacy of single burr hole with irrigation and sub-dural drain in the aim of successful evacuation of CSDH.

Methods

This is a retrospective study on 53 patients with symptomatic unilateral or bilateral chronic subdural hematoma indicated for surgical evacuation conducted at neurosurgery department, Fayoum university hospital in the period between November 2020 and March 2023. Patients included in this study were followed up for at least 3 months after surgery.

Patients' inclusion criteria included all patients with symptomatic unilateral or bilateral chronic subdural hematoma indicated for surgical evacuation, with recent brain images confirming the diagnosis, including CT scan or MRI of the brain. On the other hand, the exclusion criteria involved patients with acute subdural hemorrhage, patients who were candidates for conservative management trial with a hematoma thickness less than one centimeter in its maximum width on brain images, patients with recurrent subdural collections, and those who were unfit for surgery were also excluded from our series.

Patients were managed according to their history and clinical presentation. the presence of comorbidities such as hypertension, diabetes mellitus, renal problems, liver disease, hemorrhagic diatheses, previous cerebrovascular insults and cardiac disease with regular intake of anticoagulants.

Patients' preoperative evaluation included the assessment of their demographics (age, sex), relevant past history of any significant head trauma and details of trauma timing, imaging and management, full history was obtained and recorded especially events of neurological importance, such as altered level of sensorium, fits and motor deterioration. Full neurological examination was performed, GCS for every patient was assessed with full assessment of motor and sensory function and laboratory investigations were carried out with attention to coagulation profile and liver condition.

CT or MRI of the brain was the main diagnostic tool for all patients with CSDH; urgent CT scanning was performed for patients who presented with deterioration of conscious level. MRI of the brain with contrast was indicated for patients with suspicion of subdural empyema. Radiographic parameters, such as hematoma location, density, thickness of hematoma, and midline shift in mm, were recorded.

Patients in a stable condition, who were treated with anticoagulants, were managed as not urgent patients, anticoagulants were stopped 5 days preoperatively, while if the patient presented with altered sensorium or massive mid-line shift were considered as an emergent case with administering the patients with fresh frozen plasma, vitamin K levels (10–20 mg intravenously at ≤ 1 mg/min), and 12 unit of platelets, guided by the platelet count and bleeding time to reverse the action of antiplatelet drugs.

An informed consent was obtained from all patients or by their first-degree relatives prior to surgery. Patients and their relatives were also informed about the underlying neurological problems, rule of surgery, surgical technique, post-operative care and expected (mortality, morbidity and their percentages). This study was approved by the Fayoum University Supreme Ethical Committee.

Technical note: Majority of our patients were operated under general anesthesia with deep sedation, only 2 patients were operated using local anesthesia with light sedation. The patient was positioned in supine position with the head rotated to the other side, a pillow was placed under the ipsilateral shoulder, provided that the burrhole site was at the highest point (Fig. 1a)

A single burr hole on the corresponding site of the hematoma was planned at the site of maximal thickness of the hematoma or at parietal eminence. A scalp incision between 3 and 4 cm down to the periosteum was done, followed by periosteal cutting using the diathermy knife allowing skull bone exposure. A single burr hole around 1.2 cm diameter using the Hudson Drill and the Kerrison rongeur or Midas-Rex high speed drill was then performed followed by dural cauterization using the bipolar cautery. Cross-shaped durotomy using no. 11 or 15 Blade scalpel was carried out followed by cauterizing the dural flap leaflets against the burr hole bony edges by bipolar creating a circular dural defect, the outer vascular fibrous membrane of the hematoma was penetrated to be able to evacuate the hematoma fluid, then, a generous gentle non traumatizing irrigation of the subdural space by saline was performed allowing slow and steady drainage of the hematoma till the fluid comes out quite clear.

A subdural Nelton drain then were introduced in the subdural cavity through a separate skin incision just behind our incision, then we closed the skin in full thickness using 2/zero silk suture, while the surgeon was stitching the wound, the assistant was continuing saline irrigation gently through the drain allowing the

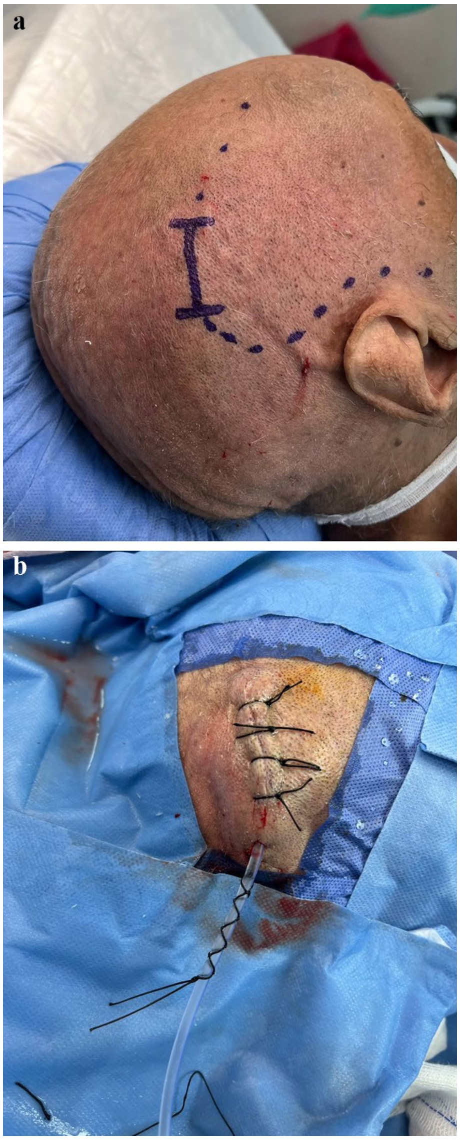

Fig. 1 **a** Image showing the positioning of the head after anasetheia and the site of incision at the highest point on the maximal thinness of the hematoma. **b** At the end of surgery after wound closure over subdural drain

saline and air to be washed through the wound till last suture and then the drain was connected to a sterile bag (Fig. 1b)

Patients were then transferred to ICU, where they were requested to maintain flat position for 12–24 h, while the drainage bag was kept below the level of the head with no negative pressure applied. Gradual head elevation prior to patient ambulation by the end of the second day and the drainage system was removed after 36–48 h according to the post-operative CT brain ensuring adequate evacuation of the hematoma.

The postoperative evaluation included the assessment of the patients' GCS for all patients immediately postoperatively and in comparison, to preoperative scores, the evaluation of their motor power and fits control, and the incidence of any postoperative neurological deterioration through the detection of an alteration in mental status or the worsening of the pre-existing manifestations. CT brain was done within first 48 h post-op before drain removal and 4 weeks post-op in regular follow-up (Fig. 2a, b)

Statistical analysis**:** The data were treated using the statistical package for Social Sciences (SPSS-v27). The data were described using the number (%) for dichotomous variables or the mean ± standard deviation (SD) for continuous variables. *T* test was used for the comparison of the continuous variables. At the same time, Chi-square tests were used for the categorical variables. Pearson correlation and multivariate linear regression tests were used to assess the correlation between different variables. All statistical tests were two-tailed, and statistical significance was set at $p < 0.05$.

Results

Demographics of patients: A total of 53 patients were included in this study, and Table 1 shows the patients demographic characteristics. The mean + SD age of patients was 61.53 + 13.81 years. Thirty-two patients (60%) were males and 21 (40%) were females. The presence of headache was observed in 35 (66%) patients, and 19 (35.85%) were on anticoagulation. Detailed data about the comorbidities of patients are summarized in Table 1. Seven cases (13%) experienced preoperative fits.

Regarding the side of hematoma, we report six cases (11.3%) of bilateral subdural hematoma, 22 (41.5%) in the right side, and 25 (47.2%) in the left side. 51 (96.2%) patients were operated on under general anesthesia, while two (3.8%) underwent local anesthesia.

Postoperative endpoints: We found that the average duration of procedure was 35.75 ± 8.66 min, and the average hospital stay days were 5.93 ± 3.452 days. Results of the paired *t* test showed that the Glasgow coma scale has significantly improved by 0.89 points ($p < 0.001$) and that the average motor power has significantly improved for all individuals by 0.4 points ($p = 0.043$), Table 2.

Regarding the incidence of complications, six patients experienced subdural recollection, five patients had minimal cortical contusions who were managed conservatively. One patient needed re-evacuation and three patients (5.67%) died after the operation. The remaining patients (71.7%) passed without experiencing any notable complications.

Correlation analysis: We conducted a correlation analysis (Table 3) to evaluate the effect of age on

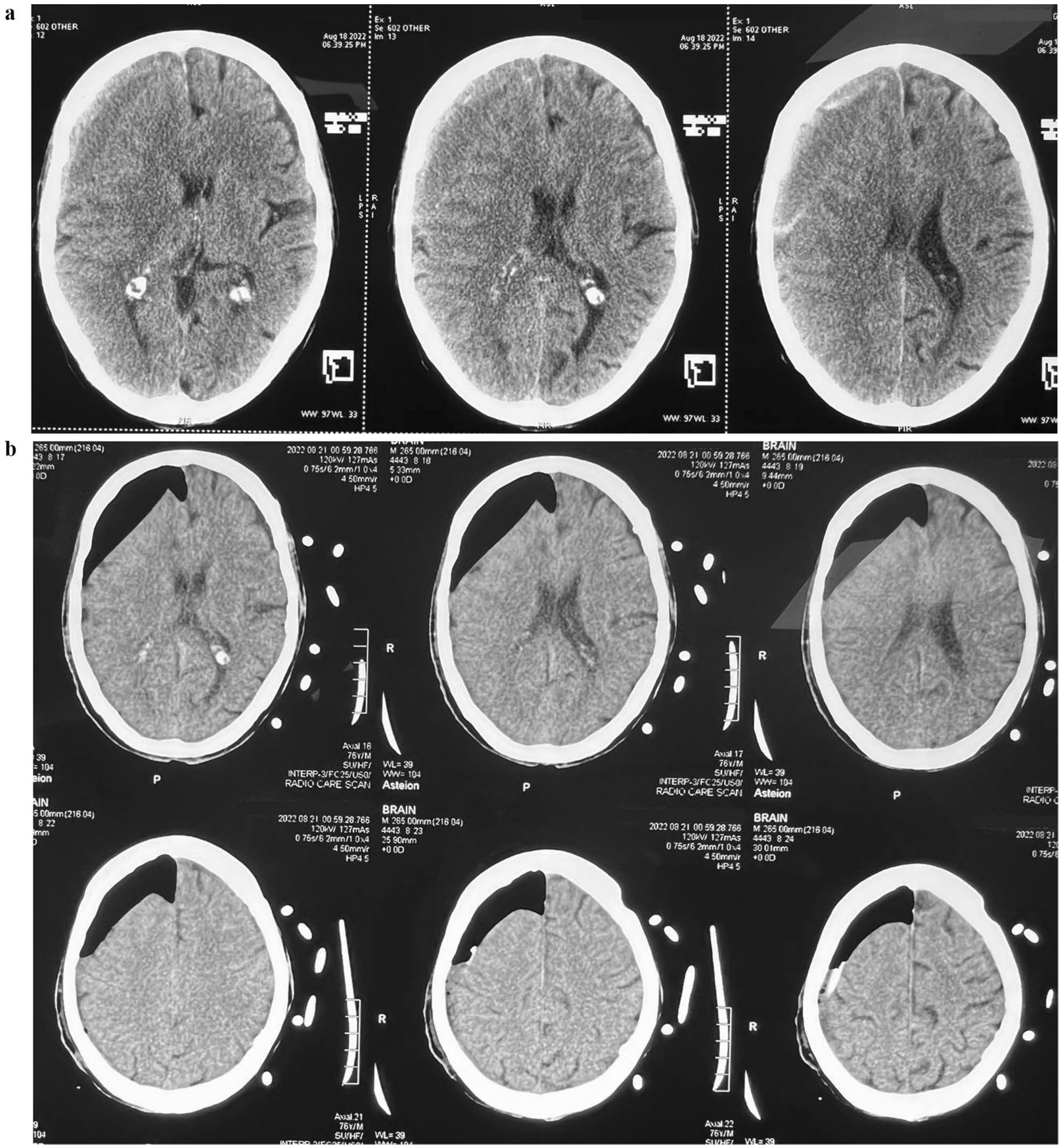

Fig. 2 **a** CT showing chronic subdural hematoma on the right side with midline shift. **b** CT showing good evacuation of the hematoma with the drain tip in the subdural space with improvement of midline shift

postoperative motor power and hospital stay. We found that older aged patients have significantly less improvements in the postoperative motor power (r = − 0.317, $p = 0.02$, Fig. 3) and require longer hospital stay (r = 0.32, $p = 0.0197$, Fig. 4). Both correlations were of average strength.

Discussion

In our clinical trial, we reported an average duration of procedure of 35.75 min, and an average hospital stay of 5.93 days. Most patients experienced significant improvement in their Glasgow coma scale by an average of 0.89 points. In addition, the average motor power has

Table 1 Baseline and demographic characteristics of included participants

	(*N* = 53)
Age, years	61.53 ± 13.81
History of trauma	26.37 ± 10.71
Gender	
Female	21 (39.62%)
Male	32 (60.38%)
Headache	35 (66.04%)
Anticoagulation intake	19 (35.85%)
Comorbidities	
Hypertension	20 (37.74%)
Diabetes	13 (24.53%)
Cardiac disease	8 (15.09%)
Hepatic	2 (3.77%)
Renal failure	5 (9.43%)
Post-COVID	1 (1.89%)
Fits	7 (13.21%)
Side of hematoma	
Rt side	22 (41.51%)
Lt side	25 (47.17%)
Bilateral	6 (11.32%)
Type of anesthesia	
General	51 (96.23%)
Local	2 (3.77%)

GCS: Glasgow Coma Scale, MP: Motor power. N: Number, SD: Standard Deviation, Rt: Right, and Lt: Left, Data are presented as mean ± SD or *n* (%)

significantly improved for most individuals by an average of 0.4 points. Furthermore, we carried out a correlation analysis to evaluate the effect of age on postoperative motor power and hospital stay. We found that older aged patients have significantly less improvements in the postoperative motor power and require longer hospital stay. Longer hospital stay for geriatric age group may be explained by the other morbidities they had required special medical concerns, such as blood pressure control or preoperative reverse of anticoagulants effect and postoperative need for ICU admission for many days in some patients.

The findings of our study are consistent with previously published studies in the literature. In a 2003 comprehensive study, Weigel et al. [15] discovered that the use of a subdural drain had no impact on morbidity, death, or cure rates. However, they only included one RCT [16] in their study. Lega et al. [17] also found that while utilising a Monte Carlo simulation model to assess the advantages and drawbacks of subdural drains following burr-hole draining, they were unable to come to any definitive findings. These differences might be attributed to the fact that both trials were conducted before the release of the best RCTs now available evaluating the clinical efficacy of subdural drains. RCT is the gold standard research in epidemiology, and it should be the first option of evidence-based recommendations in challenging and possibly biased evaluations, such as drain usage in patients with CSDH. As a result, the current study's accuracy and power may be increased thanks to the exclusive selection of RCTs [18–20].

Our patients experienced some complications consistent with the normal range of global incidence. The most common complication occurred was subdural recollection of fluid in 6 patients. However, the collection was asymptomatic in 5 of them with a width of less than 10 mm in the post-operative CT or MRI. These cases were managed conservatively by just serial follow-up imaging for 3 months. One patient experienced resistant headache and increased motor weakness, an MRI revealed a subdural recollection 23 mm in width and the patient was scheduled for re-evacuation surgery after 3 weeks. The patient was operated on through the same burr hole of the first surgery and we left a subdural drain.

The other complications were mainly minimal cortical contusions which may be due to reperfusion injury resulting from re-expansion of compressed brain tissue after hemorrhage evacuation. Alternatively, saline stream during irrigation might be a cause. All cases were

Table 3 Correlations between operative endpoints

	Postoperative motor power and age	**Hospital stay in days and age**
Pearson correlation	− 0.317	0.320
Sig. (two-tailed)	0.021	0.0197

Table 2 Postoperative outcomes

	Preoperative	**Postoperative**	**Mean difference**	**Std. deviation**	**Std. error mean**	**Lower 95% CI**	**Upper 95% CI**	**t**	***p* value***
GCS	13.36 ± 1.6	14.2 ± 0.77	0.886792	1.836179	0.252219	0.380679	1.392906	3.515968	**< 0.001**
Motor Power	4 ± 0.9	4.4 ± 0.6	0.433962	1.525544	0.20955	0.01347	0.854454	2.070928	**0.043**

Std. deviation: standard deviation, Std. error mean: standard error of the mean, 95% CI: 95% confidence interval, t: *t* value, *p* value: probability value, and GCS: Glasgow Coma Scale, **p* value was calculated using the paired *t* test

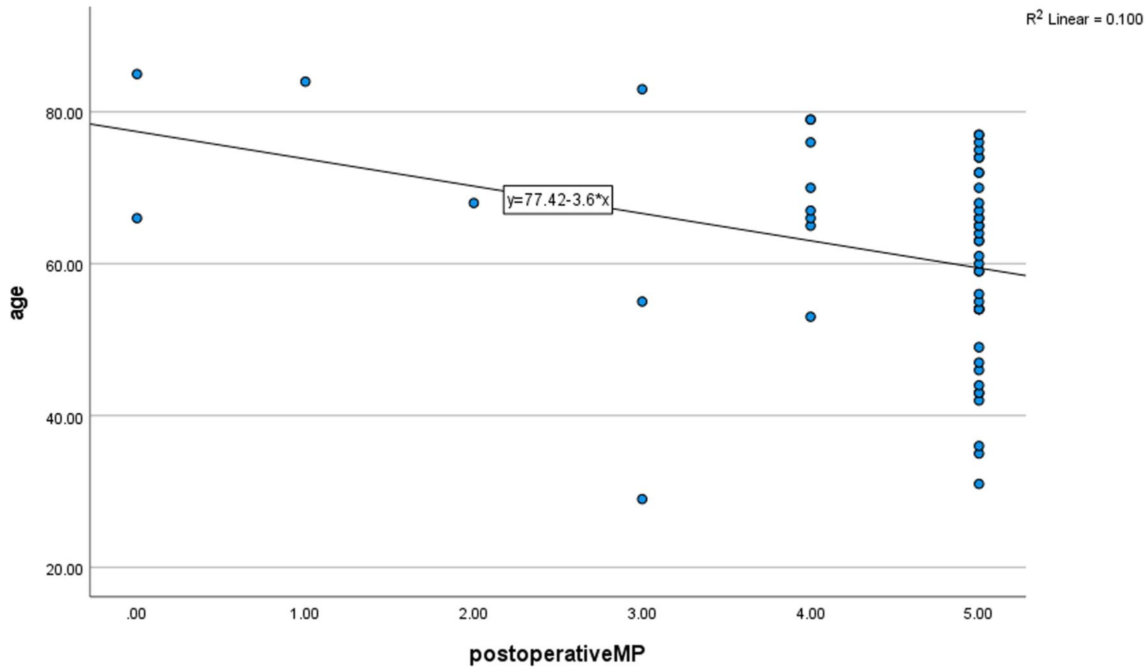

Fig. 3 Negative correlation between age and postoperative motor power

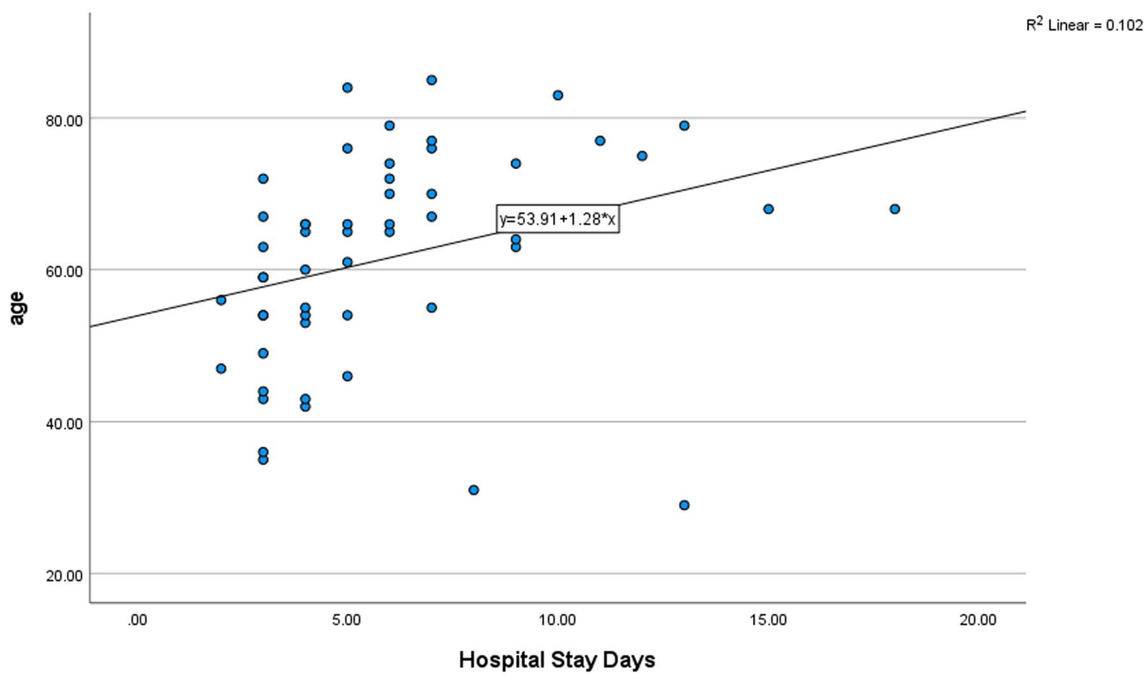

Fig. 4 Positive correlation between age and hospital stay days

managed conservatively by follow-up and anti-epileptic prophylaxis. Death occurred in three patients from the total population. However, this may be due to their bad outcome from the start as they presented with poor neurological status. They were in deep coma with GCS 7 or less and one of them experienced a collection of a huge acute subdural hematoma. The patient was scheduled for emergency re-exploration through craniotomy and although all measures were taken, the patient's condition did not improve and died.

Subdural drain placement was one of several therapy options that Almenawer et al. [21] evaluated in a prior meta-analysis in terms of mortality, morbidity, cure, and recurrence rates for patients with CSDH. However, it had a number of significant flaws. First of all, since a number of RCT were left out of the pooled analysis [16, 18] it does not accurately represent the current body of research. Second, the effectiveness measurements were not standardized. The scientists used the better neurological results that were mentioned in the publications that were included. Therefore, neurological outcomes are evaluated using a variety of measures; the Markwalder classification system is the most often used [22]. The Markwalder score was first created as a gauge for the clinical severity of CSDH and has now been identified as a separate predictor for poor functional outcome [22–24]. However, due to uncertainties over its reliability, it is not routinely utilised as a measure of functional outcome [25]. Finally, there were many ways to identify recurrence, including by symptoms and imaging-defined scans. All of these flaws have the potential to significantly change the sample size, data extraction, and outcomes and may be the cause of any discrepancies in our findings.

One of the most prevalent problems after burr-hole drainage of CSDH is symptomatic recurrence, which is thought to be avoidable by inserting a subdural drain [26, 27]. Our pooled analysis of the included RCTs shows that the use of a subdural drain considerably lowers the probability of overall symptomatic recurrence as well as the need for repeat surgery.

The results of the subgroup analysis in the current research revealed that although early recurrences remained unaltered, the benefits of subdural drains are stronger in avoiding long-term recurrence (6 months). According to the criteria of the outcome, only repeated CSDHs that were discovered by monitoring of symptoms and signs were included in the study; clinically silent fluid accumulations were excluded. It may take many weeks for a recurrence to be clinically significant due to the fact that the clinical signs of CSDH are mostly driven by mass effect and are relieved quickly after drainage [28].

The literature states that there are relatively few publications on patient recurrence-related mortality and functional outcomes [16, 27, 29]. Even in patients who needed several treatments, there was a low risk of death following draining of a recurrent CSDH, according to certain studies that are currently available [16, 27]. As a result, it is reasonable to anticipate that our pooled analysis may not have enough power to identify variations in the risk of death in this situation.

It is always important to note that subdural drain complications are not uncommon to occur. Acute subdural haemorrhage, cortical damage, parenchymal haemorrhage, tension pneumocephalus, meningitis, and subdural empyema, have reportedly been linked to subdural drains [19, 30–34]. Careful surgical technique and adequate planning with early removal of the drain within 48 h can reduce the incidence of complications [35–38]. Adjusting the patient's condition and thorough examination postoperatively helps in reducing the incidence of long term complications such as deep vein thrombosis, aspiration pneumonia, pressure ulcers, and atelectasis which all further worsen the patient's overall condition and handicaps motor and cognitive improvement [39, 40].

Conclusion

We concluded that the management of chronic subdural hematoma with a single burr hole with irrigation and leaving a subdural drain is safe procedure in managing subdural hematoma evacuation. Careful surgical technique and thorough patient postoperative care can reduce the incidence of complications. We did not experience major adverse events related to drain insertion and efficient emptying of collection and no obvious increase in mortality or morbidity rates above global indices in the literature.

Abbreviations

CSDH	Chronic subdural hematoma
CT	Computed tomography
MRI	Magnetic resonance imaging
GCS	Glascow coma scale
SD	Standard deviation
MP	Motor power
Rt	Right
Lt	Left
ICU	Intensive care unit
RCT	Randomized controlled trials

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Author contributions

MG: Conducting literature reviews, gathering data, and contributing to the analysis. AA: Leading the research project, designing experiments, and providing overall direction. AO: Overseeing the project timeline and coordinating tasks.

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Availability of data and materials

All data available with the corresponding author.

Declarations

Ethics approval and consent to participate

This study was approved by the Fayoum University Supreme Ethical Committee. An informed consent was obtained from all patients or by their first-degree relatives prior to surgery. Patients and their relatives were also informed about the underlying neurological problems, rule of surgery, surgical technique, post-operative care and expected (mortality, morbidity and their percentages). Code number of the proposal (EC 2238). Receiving date: February 1, 2023–Approval date: April 9, 2023.

Consent for publication
Not applicable.

Competing interests
There is no conflict of interest.

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