Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/44jdp102

ROLE OF STEROIDS IN PREVENTION OF RECURRENCE OF CHRONIC SUBDURAL HEMATOMA OPERATED CASES: A PROSPECTIVE STUDY

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ABSTRACT

Background

Chronic subdural hematoma (CSDH) represents a significant neurosurgical challenge, particularly in the elderly population. Despite surgical intervention being the primary treatment modality, recurrence rates remain concerning, ranging from 5-30%. This study investigated the efficacy of postoperative steroid administration in preventing CSDH recurrence and improving neurological outcomes.

Methods

A prospective randomized controlled study was conducted between November 2023 and October 2024, involving 84 patients who underwent burr-hole surgery for CSDH. Patients were equally randomized into either the steroid group (n=42) receiving postoperative dexamethasone or the control group (n=42). The study evaluated recurrence rates, neurological outcomes using the modified Rankin Scale (mRS), radiological resolution and complications over a 6-month follow-up period.

Results

The steroid group demonstrated significantly lower recurrence rates (7.1% vs 19.0%, p=0.04) and better neurological improvement (mean mRS improvement 1.8 ± 0.6 vs 1.4 ± 0.7, p=0.03) compared to the control group. Radiological resolution was superior in the steroid group (92.9% vs 76.2%, p=0.02) with shorter hospital stays (4.2 ± 1.8 vs 5.1 ± 2.1 days, p=0.04). While the steroid group showed a trend toward more minor complications, none reached statistical significance in severity or frequency.

Conclusion

Postoperative steroid administration effectively reduces CSDH recurrence rates and enhances neurological recovery following burr-hole surgery. The therapeutic benefits appear to outweigh potential risks when appropriate patient selection and monitoring protocols are followed.

Keywords: Chronic subdural hematoma; dexamethasone; steroid therapy; burr-hole surgery; recurrence prevention; neurological outcome; anti-inflammatory therapy; neurosurgical intervention; hematoma resolution; clinical outcomes.

INTRODUCTION

Chronic subdural hematoma (CSDH) represents one of the most common neurosurgical conditions with increasing prevalence in aging populations worldwide. The global incidence ranges from 1.7 to 18 cases per 100,000 people annually with rates rising dramatically to 58-80 per 100,000 in individuals over 65 years.[1] This age-related increase correlates with greater brain atrophy, increased vascular fragility and higher likelihood of anticoagulation therapy use in elderly populations.[2] The standard treatment involves surgical evacuation, typically through burr-hole drainage. However, postoperative recurrence rates remain significant, ranging from 5% to 30%, posing challenges in patient management.[3] The pathophysiology of CSDH suggests that inflammation and angiogenesis play crucial roles in its development and recurrence. This understanding has led to the exploration of adjuvant therapies aimed at modulating these processes. Corticosteroids, particularly dexamethasone, have been investigated for their anti-inflammatory and anti-angiogenic properties, which may mitigate factors contributing to hematoma recurrence.[4]

Recent studies have produced mixed results regarding the efficacy of corticosteroids in preventing CSDH recurrence. A systematic review and meta-analysis indicated that adjuvant corticosteroid therapy with surgery significantly reduces the risk of recurrence compared to surgery alone. However, this benefit did not extend to improvements in all-cause mortality or functional outcomes.[5] Given these conflicting findings, further prospective studies are warranted to elucidate the role of corticosteroids in preventing recurrence of CSDH post-surgery. This study aims to assess the efficacy and safety of steroid therapy in reducing recurrence rates among patients undergoing surgical treatment for CSDH.

AIM AND OBJECTIVES

Aim

To evaluate the efficacy of postoperative steroid administration in preventing CSDH recurrence after burr-hole surgery

Objectives

- To assess the impact of steroid therapy on neurological recovery patterns, duration of hospital stay, time to radiological resolution and quality of life measures
- To analyze the safety profile and complications associated with postoperative steroid use in preventing recurrence and patient satisfaction and compliance with treatment protocol

MATERIALS & METHODS

This prospective, randomized, controlled trial was conducted at our institution from November 2023 and October 2024, following approval from the institutional ethics committee and registration with the clinical trials registry. Patient selection followed strict criteria to ensure homogeneity and reliability of results. All patients aged 18 years or above presenting with radiologically confirmed CSDH and requiring surgical intervention were considered for enrollment. Exclusion criteria encompassed active systemic infection, uncontrolled diabetes mellitus, contraindications to steroid therapy, pregnancy and previous enrollment in the study. Additionally, patients with severe coagulopathy or active malignancy.

A total of 84 eligible patients were enrolled and randomly assigned to either the steroid group (n=42) or the control group (n=42) using computer-generated randomization sequences. While complete blinding was not possible due to the nature of the intervention, outcome assessors were blinded to group allocation. The steroid group received a standardized dexamethasone protocol consisting of 8mg/day for three days postoperatively, followed by a systematic tapering over two weeks (6mg/day for 3 days, 4mg/day for 3 days, 2mg/day for 3 days and 1mg/day for 2 days). The control group received standard postoperative care without steroids. Both groups underwent identical surgical procedures using double burr-hole technique under local anesthesia with conscious sedation.

Clinical assessment included detailed neurological examination using the modified Rankin Scale (mRS), Glasgow Coma Scale (GCS) and Markwalder's Grading Scale (MGS) at admission, discharge

and follow-up visits. Radiological evaluation comprised CT scans at discharge, 3 months and 6 months post-surgery. Additional scans were performed if clinically indicated. Quality of life assessment utilized the EQ-5D-5L questionnaire at baseline and follow-up visits. Comprehensive monitoring for adverse events followed standardized protocols with particular attention to potential steroid-related complications. Regular blood glucose monitoring, wound inspection and systematic review of systems were conducted.

Statistical analysis employed SPSS version 23.0. Continuous variables were analyzed using Student's t-test or Mann-Whitney U test as appropriate, while categorical variables underwent chi-square or Fisher's exact test analysis. Multivariate analysis assessed potential predictive factors for recurrence. Statistical significance was set at $p<0.05$ with confidence intervals calculated at 95%.

RESULTS

The present study aimed to evaluate the efficacy and safety of postoperative steroid therapy in preventing the recurrence of chronic subdural hematoma (CSDH) following burr-hole surgery. A total of 84 patients were enrolled in the study and randomly assigned to either the steroid group (n=42) or the control group (n=42). The following results were observed over the 6-month follow-up period. Table 1 outlines the baseline demographic and clinical characteristics of the patients in both the steroid and control groups. The mean age in the steroid group was 68.31 ± 12.42 years, while in the control group, it was 67.85 ± 11.90 years with a p-value of 0.851 indicating no significant difference in age between the two groups. The sex distribution also shows no significant difference with 25 males and 17 females in the steroid group compared to 32 males and 10 females in the control group (p-value 0.264). Both groups had similar body mass indices (BMI): 24.08 ± 3.21 in the steroid group and 25.13 ± 3.42 in the control group (p-value 0.784), showing that both groups had comparable body sizes.

Characteristic	**Steroid Group (n=42)**	**Control Group (n=42)**	**p-value**
Age (years, mean ± SD)	68.31 ± 12.42	67.85 ± 11.90	0.851
Male/Female	25/17	32/10	0.264
Body Mass Index	24.08 ± 3.21	25.13 ± 3.42	0.784
Initial hematoma volume (mL)	98.2 ± 32.60	96.82 ± 31.94	0.838
Bilateral CSDH	11 (26.19%)	7 (16.74%)	0.436
Pre-op mRS score	2.81 ± 0.92	2.75 ± 0.82	0.897
Pre-op GCS score	14.25 ± 1.16	14.31 ± 1.01	0.914
Markwalder's Grade			0.949
- Grade 1	15 (35.79%)	16 (38.10%)	0.981
- Grade 2	20 (47.61%)	19 (45.29%)	
- Grade 3	7 (16.77%)	7 (16.77%)	

Table 1: Patient Demographics and Clinical Characteristics

The initial hematoma volume in both groups was almost identical: 98.2 ± 32.60 mL in the steroid group and 96.82 ± 31.94 mL in the control group (p-value 0.838). Regarding the type of CSDH, the steroid group had 11 cases of bilateral CSDH (26.19%) compared to 7 cases (16.74%) in the control group, though this difference was not statistically significant (p-value 0.436). Preoperative mRS and GCS scores were also similar across both groups: the steroid group had an mRS score of 2.81 ± 0.92 and a GCS score of 14.25 ± 1.16, while the control group had an mRS score of 2.75 ± 0.82 and a GCS score of 14.31 ± 1.01 with p-values of 0.897 and 0.914, respectively. The distribution of Markwalder's Grade was comparable between the two groups with similar proportions of patients in Grade 1 (35.79% vs. 38.10%), Grade 2 (47.61% vs. 45.29%) and Grade 3 (16.77% in both groups) with a p-value of 0.949, indicating no significant differences.

Characteristic	Steroid Group (n=42)	Control Group (n=42)	p-value
Hypertension	25 (59.52%)	27 (64.29%)	0.82
Diabetes Mellitus	12 (28.57%)	17 (40.48%)	0.81
Previous Trauma	28 (66.67%)	22 (52.38%)	0.82
Anticoagulation Use	15 (35.71%)	21 (50.00%)	0.82
Atrial Fibrillation	8 (19.05%)	4 (9.52%)	0.77
Chronic Kidney Disease	5 (11.90%)	9 (21.43%)	0.75
Previous Stroke	7 (16.67%)	8 (19.05%)	0.77
Table 2: Risk Factors and Comorbidities			

Table 2 presents the prevalence of common risk factors and comorbidities in both groups. In the steroid group, 59.52% (25 patients) had hypertension, compared to 64.29% (27 patients) in the control group with a p-value of 0.82 indicating no significant difference between the groups. The prevalence of diabetes mellitus was 28.57% (12 patients) in the steroid group and 40.48% (17 patients) in the control group with a p-value of 0.81, showing no statistical significance. Previous trauma, which is a significant risk factor for CSDH, was reported in 66.67% (28 patients) of the steroid group and 52.38% (22 patients) of the control group with a p-value of 0.82, also showing no significant difference. Anticoagulation use was observed in 35.71% (15 patients) of the steroid group and 50.00% (21 patients) of the control group with a p-value of 0.82, indicating no significant difference. Other comorbidities such as atrial fibrillation (19.05% vs. 9.52%), chronic kidney disease (11.90% vs. 21.43%) and previous stroke (16.67% vs. 19.05%) were also similarly distributed across both groups with p-values of 0.77, 0.75 and 0.77, respectively. These data suggest that the risk profiles of both groups were comparable, minimizing the potential influence of underlying conditions on the study outcomes.

Clinical Outcomes

Outcome	Steroid Group (n=42)	Control Group (n=42)	p-value
Recurrence rate	3 (7.12%)	8 (19.09%)	0.041
Mean mRS improvement	1.80 ± 0.64	1.46 ± 0.77	0.036
Complete resolution on CT	39 (92.95%)	32 (76.21%)	0.020
Length of hospital stay (days)	4.26 ± 1.82	5.14 ± 2.13	0.003
Return to normal activities (weeks)	3.24 ± 1.19	4.58 ± 1.45	0.001
Patient satisfaction score (1-10)	8.43 ± 1.27	7.60 ± 1.44	0.002
Table 3: Primary and Secondary Outcomes at 6 Months			

Table 3 highlights the primary and secondary outcomes at 6 months post-surgery. The recurrence rate in the steroid group was 7.12% (3 patients), significantly lower than the 19.09% (8 patients) in the control group with a p-value of 0.041 indicating a statistically significant reduction in recurrence in the steroid group. The mean improvement in mRS score, which reflects neurological recovery, was 1.80 ± 0.64 in the steroid group compared to 1.46 ± 0.77 in the control group with a p-value of 0.036 demonstrating a significant improvement in neurological outcomes in the steroid group. Radiological resolution was significantly better in the steroid group with 92.95% (39 patients) showing complete resolution on CT scans compared to 76.21% (32 patients) in the control group with a p-value of 0.020. The steroid group also had a significantly shorter hospital stay (4.26 ± 1.82 days) compared to the control group (5.14 ± 2.13 days) with a p-value of 0.003 reflecting the faster recovery and resolution of the hematoma. Additionally, the steroid group returned to normal activities significantly earlier (3.24 ± 1.19 weeks) than the control group (4.58 ± 1.45 weeks) with a p-value of 0.001. The patient satisfaction score was also significantly higher in the steroid group (8.43 ± 1.27) compared to the control group (7.60 ± 1.44) with a p-value of 0.002, indicating that patients in the steroid group were more satisfied with their overall recovery.

Time Point	Parameter	Steroid Group (n=42)	Control Group (n=42)	p-value
Discharge	mRS improvement	0.92 ± 0.38	0.73 ± 0.44	0.011
	GCS improvement	0.81 ± 0.36	0.69 ± 0.31	0.001
3 months	mRS improvement	1.45 ± 0.52	1.17 ± 0.65	0.025
	GCS improvement	1.22 ± 0.48	0.96 ± 0.57	0.008
6 months	mRS improvement	1.86 ± 0.64	1.42 ± 0.79	0.006
	GCS improvement	1.53 ± 0.59	1.28 ± 0.63	0.014

Table 4: Neurological Recovery Patterns

Table 4 shows the neurological recovery patterns at different time points. At discharge, the steroid group had a significantly greater improvement in both mRS score (0.92 ± 0.38 vs. 0.73 ± 0.44, p-value 0.011) and GCS score (0.81 ± 0.36 vs. 0.69 ± 0.31, p-value 0.001) compared to the control group. At 3 months, the steroid group also showed greater improvements in both mRS (1.45 ± 0.52 vs. 1.17 ± 0.65, p-value 0.025) and GCS (1.22 ± 0.48 vs. 0.96 ± 0.57, p-value 0.008) compared to the control group. By 6 months, the steroid group had a significantly higher mean improvement in mRS (1.86 ± 0.64 vs. 1.42 ± 0.79, p-value 0.006) and GCS (1.53 ± 0.59 vs. 1.28 ± 0.63, p-value 0.014) than the control group reflecting sustained neurological recovery over time.

Parameter	Steroid Group (n=42)	Control Group (n=42)	p-value
Complete resolution at 3 months	31 (73.82%)	24 (57.1%)	0.001
Complete resolution at 6 months	39 (92.97%)	32 (76.2%)	0.001
Mean reduction in hematoma volume			
- At discharge	45.22 ± 12.48%	38.66 ± 11.88%	0.001
- At 3 months	78.46 ± 15.66%	65.39 ± 14.96%	0.013
- At 6 months	94.89 ± 5.29%	82.75 ± 8.46%	0.004
Time to complete resolution (weeks)	14.20 ± 4.14	16.49 ± 2.40	0.019

Table 5: Radiological Outcomes

Table 5 presents the radiological outcomes over a 6-month period. At 3 months, 73.82% (31 patients) in the steroid group had complete resolution of the hematoma, compared to 57.1% (24 patients) in the control group with a p-value of 0.001 indicating significantly better resolution in the steroid group. By 6 months, the steroid group had 92.97% (39 patients) achieving complete resolution, while the control group had 76.2% (32 patients) with a p-value of 0.001. The reduction in hematoma volume was also significantly greater in the steroid group at all time points: 45.22% ± 12.48% at discharge (vs. 38.66% ± 11.88% in the control group, p-value 0.001), 78.46% ± 15.66% at 3 months (vs. 65.39% ± 14.96%, p-value 0.013) and 94.89% ± 5.29% at 6 months (vs. 82.75% ± 8.46%, p-value 0.004). The time to complete resolution was also shorter in the steroid group (14.20 ± 4.14 weeks) compared to the control group (16.49 ± 2.40 weeks) with a p-value of 0.019.

Complications and Adverse Events

Complication	Steroid Group (n=42)	Control Group (n=42)	p-value
Surgical Site Infection	2 (4.76%)	1 (2.38%)	0.570
Hyperglycemia requiring intervention	5 (11.90%)	1 (2.38%)	0.091
GI symptoms	4 (9.52%)	1 (2.38%)	0.166
Wound healing issues	1 (2.38%)	2 (4.76%)	0.547
Pneumonia	1 (2.38%)	2 (4.76%)	0.509
Deep vein thrombosis	1 (2.38%)	1 (2.38%)	1.000
Psychiatric symptoms	2 (4.76%)	1 (2.38%)	0.570
Total complications	**16 (38.10%)**	**9 (21.43%)**	**0.067**

Table 6: Adverse Events and Complications

Table 6 presents data on the adverse events and complications observed in both groups. The total complication rate was higher in the steroid group (38.10%, 16 patients) compared to the control group (21.43%, 9 patients), although the difference was not statistically significant (p-value 0.067). Surgical site infections occurred in 4.76% (2 patients) in the steroid group and 2.38% (1 patient) in the control group (p-value 0.570). Hyperglycemia requiring intervention was observed in 11.90% (5 patients) of the steroid group and 2.38% (1 patient) of the control group (p-value 0.091). Other complications, such as gastrointestinal symptoms (9.52% vs. 2.38%, p-value 0.166), wound healing issues (2.38% vs. 4.76%, p-value 0.547), pneumonia (2.38% vs. 4.76%, p-value 0.509), deep vein thrombosis (2.38% in both groups, p-value 1.000) and psychiatric symptoms (4.76% vs. 2.38%, p-value 0.570) were also recorded, but none reached statistical significance. These findings suggest that while there were some minor complications, the overall safety profile of control therapy was manageable.

Parameter	**Steroid Group (n=42)**	**Control Group (n=42)**	**p-value**
EQ-5D-5L Score Improvement			
- At 3 months	0.32 ± 0.11	0.24 ± 0.10	0.003
- At 6 months	0.45 ± 0.13	0.35 ± 0.12	0.001
Days of work lost	24.33 ± 8.22	32.6 ± 9.46	0.001
Follow-up visits required	3.25 ± 0.87	4.15 ± 1.18	0.002
Additional imaging studies needed	1.49 ± 0.69	2.29 ± 0.89	0.010
Table 7: Quality of Life			

Table 7 presents data on quality of life outcomes. The steroid group showed significantly greater improvements in EQ-5D-5L scores at both 3 months (0.32 ± 0.11 vs. 0.24 ± 0.10, p-value 0.003) and 6 months (0.45 ± 0.13 vs. 0.35 ± 0.12, p-value 0.001). The steroid group also reported fewer days of work lost (24.33 ± 8.22 days vs. 32.6 ± 9.46 days in the control group, p-value 0.001) and fewer follow-up visits (3.25 ± 0.87 vs. 4.15 ± 1.18, p-value 0.002). Additionally, the steroid group required fewer additional imaging studies (1.49 ± 0.69 vs. 2.29 ± 0.89, p-value 0.010) suggesting that steroid therapy contributed to more efficient post-surgical care and quicker recovery.

DISCUSSION

Chronic subdural hematoma (CSDH) is a prevalent neurosurgical condition, particularly among the elderly, characterized by the accumulation of blood between the dura mater and the arachnoid membrane. Despite surgical interventions, recurrence rates remain significant, prompting the exploration of adjunctive therapies such as corticosteroids to mitigate recurrence. A systematic review and meta-analysis by Shrestha et al (2021)[7] evaluated the impact of steroid treatment on CSDH recurrence. The study found that steroid therapy was associated with a 61% reduction in the odds of recurrence compared to non-steroid treatments. However, no significant differences were observed in mortality rates or functional outcomes between the two groups. Additionally, the study noted a modest increase in adverse events among patients receiving steroids.

Similarly, Hutchinson et al. (2020) investigated the use of dexamethasone in patients with symptomatic CSDH.[6] The study found that dexamethasone reduced the need for surgical reintervention but did not significantly improve functional outcomes at 6 months. In contrast, a Bayesian network meta-analysis by Yu et al (2022)[8] evaluated various drug therapies for CSDH recurrence prevention. The study concluded that atorvastatin combined with dexamethasone (ATO+DXM) was the most effective intervention, followed by dexamethasone alone. This suggests that while steroids alone may be beneficial, their efficacy could be enhanced when used in combination with other agents. The present study's findings align with these observations demonstrating a significant reduction in recurrence rates with steroid therapy. The observed recurrence rate of 7.1% in our steroid group is comparable to the 8.3% reported by Mebberson et al (2020)[9] and significantly better than the 19.0% in our control group. This improvement aligns with the molecular mechanisms described by Edlmann et al (2017),[10] who demonstrated reduced inflammatory marker levels in CSDH fluid following steroid administration.

The accelerated neurological recovery in the steroid group supports findings by Kolias et al (2018),[11] who reported similar improvements in functional outcomes. Our study extends these observations by documenting the recovery trajectory through multiple time points, demonstrating early and sustained benefits of steroid therapy. Radiological outcomes in our study showed faster hematoma resolution in the steroid group, consistent with findings by Mikkelsen et al (2023)[12] and Chen et al (2021),[13] who used volumetric analysis to demonstrate enhanced absorption rates with steroid therapy. This faster resolution may explain the shorter hospital stays and earlier return to normal activities observed in our steroid group.

The safety profile of corticosteroid therapy in CSDH management has been a subject of concern. Shrestha et al (2022)[7] reported a 2.7-fold increase in the odds of adverse effects in the steroid group compared to the control group. These adverse effects included gastrointestinal disturbances, hyperglycemia, and increased risk of infections. Similarly, Hutchinson et al (2020)[6] noted a higher incidence of adverse events in the dexamethasone group, including wound infections and delayed healing. These findings underscore the importance of weighing the benefits of recurrence prevention against the potential risks associated with steroid therapy. The safety profile also observed in our study parallels that reported by Hong et al (2023)[14] showing manageable complications without significant increases in severe adverse events. The slightly higher rate of hyperglycemia in our steroid group was effectively managed through routine monitoring and medication adjustments, supporting the feasibility of steroid protocols in clinical practice. In the present study, while a slightly higher rate of minor complications was observed in the steroid group, these were manageable and did not result in significant morbidity. This suggests that with appropriate patient selection and monitoring, the safety profile of corticosteroid therapy can be acceptable.

A prospective phase IIB pilot randomized controlled trial by Chan et al (2015)[15] assessed the efficacy of dexamethasone with surgical drainage in reducing recurrence requiring reoperation. The study found that dexamethasone therapy was associated with a lower risk of recurrence and a shorter hospital stay compared to primary surgery. Zhang et al (2021)[16] recommended low-dose atorvastatin as a treatment to promote CSDH absorption and prevent recurrence. This aligns with the findings of the present study, which observed a significant reduction in recurrence rates with steroid therapy. A systematic review and meta-analysis by Holl et al (2019)[17] compared corticosteroid treatment with surgery in CSDH patients. The study concluded that corticosteroid treatment was associated with a lower recurrence rate but did not significantly improve functional outcomes.

CONCLUSION

The results of this prospective study demonstrate that postoperative steroid therapy significantly reduces the recurrence rate of chronic subdural hematoma (CSDH) following burr-hole surgery. The steroid group exhibited a lower recurrence rate (7.12%) compared to the control group (19.09%), indicating the potential benefit of corticosteroids in preventing hematoma reaccumulation. Additionally, patients in the steroid group showed better neurological recovery, as evidenced by greater improvements in the modified Rankin Scale (mRS) and Glasgow Coma Scale (GCS) scores. Radiologically, the steroid group had a higher rate of complete resolution of the hematoma, along with a faster resolution and shorter hospital stay. Although the steroid group had a slightly higher rate of minor complications, the safety profile was manageable, with no significant increase in severe adverse events. The improved quality of life, reduced workdays lost, and fewer follow-up visits further support the use of postoperative steroids in enhancing recovery and minimizing healthcare resource utilization. These findings suggest that corticosteroid therapy, when administered carefully and with appropriate patient selection, can be an effective adjunct to surgical management of CSDH, offering substantial clinical benefits without significant risks. Further studies are warranted to refine steroid dosing protocols and identify high-risk subgroups that would benefit most from this treatment.

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