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Chronic subdural hematoma-induced parkinsonism: A systematic review

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ABSTRACT

Background: Chronic subdural hematoma (CSDH) is one of the most common neurosurgical cases, especially in elderly individuals. Secondary parkinsonism due to CSDH is a rare entity. The mechanism of parkinsonism symptoms in chronic subdural hematoma has been suggested to include direct mechanical compression of the basal ganglia due to hematoma or indirectly through brain structure changes due to space lesions and vascular disorders. Surgery on the subdural hematoma provides a favorable outcome for parkinsonism symptoms.
Objectives: To systematically review the literature on CSDH-induced parkinsonism.
Search methods: This is a systematic review on case reports. Literature search was performed using the predefined keywords on PubMed, ProQuest, and Google Scholar. We also provided our own case report and compared it with published studies.
Result: Sixteen cases from 13 case reports/series were identified, predominantly consisting of male patients with the mean age of 66.5 ± 9.73 years. The most common symptoms were rigidity, gait disturbance, and bradykinesia, observed in 12 (75%) cases each. The second and third most common symptoms were tremor (11; 68.75%) and facial masking (8; 50%), respectively. Other reported symptoms were dysphasia (3; 18.75%), dysarthria (3; 18.75%), and urinary incontinence (2; 12. 5%). Time gap between the symptom onset and CSDH diagnosis and unilateral location seemed to influence the outcome.
Conclusion: Only 16 CSDH-induced parkinsonism were identified since the 1960s. This condition is thought to occur due to basal ganglia compression. Surgery on the subdural hematoma provides a favorable outcome for parkinsonism symptoms. Timely CSDH diagnosis might yield better outcome. However, further research on CSDH-induced parkinsonism is needed, especially in the mechanisms and treatment outcomes.

1. Introduction

Chronic subdural hematoma (CSDH) is a common neurosurgical diagnosis among elderly individuals [1]. This condition could occur following a trivial head trauma, and thus, patients usually cannot recall such event ever happening [2]. Various CSDH symptoms range from asymptomatic to the presence of neurological deficits, such as speech and motor [3].

CSDH could rarely cause parkinsonism [4]. The underlying mechanism of CSDH-induced parkinsonism has not been well understood. Mass effect on the basal ganglia [5] or the midbrain [6] might decrease the number of dopaminergic receptors and nigro-striatal dopaminergic pathway, respectively.

To date, this type of secondary parkinsonism has been described in the limited number of publications, predominantly in the form of case reports. Therefore, this study aimed to review the general characteristics, symptoms, onset, and outcomes of CSDH-induced parkinsonism based on the available published case reports.

2. Material and methods

2.1. General information and literature search strategy

Studies were selected using the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocol method guideline. Data were collected from *PubMed, Sciencedirect, Springer*, and *Cochrane*.

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Table 1
Search strategy.

No	Keywords
1	Chronic Subdural Hematoma
2	Subdural Hematoma
3	"Hematoma, Subdural, Chronic" [Mesh]
4	"Hematoma, Subdural, Intracranial" [Mesh]
5	Parkinsonism
6	Parkinson Disease
7	"Parkinson Disease, Secondary" [Mesh]
8	"Parkinson Disease" [Mesh]
9	"Parkinsonian Disorders" [Mesh]
10	(#1 OR #2 OR #3 OR #4) AND (#5 OR #6 OR #7 OR #8 OR #9)

2.2. Eligibility criteria

Articles included in this review were case reports of patients without age or origin restriction who had CSDH with parkinsonism symptoms. Only articles written in English were accepted for this review. For inclusion, published articles must report CSDH, parkinsonism symptoms, surgery, outcomes, and follow-up patients.

All articles as well as reviews, editorials, commentaries, or publications not reporting patients outcome were excluded. Studies performing analysis without description of individual patients were excluded. All case reports and case series on patients with history of Parkinson's disease (PD) were further excluded.

2.3. Information source and search strategy

We conducted a systematic search on the literature to identify relevant articles using PubMed, ProQuest, and Google Scholar using the following keywords in Table 1.

2.4. Study selection

All potentially included articles were screened in two eligibility stages. In the first assessment stage, titles and abstracts of potentially pertinent articles were independently screened by two authors (HK and SA). For abstracts that met the inclusion criteria, the full text was retrieved and independently reviewed by the same authors in the second assessment stage. Contretemps and technical uncertainties were discussed and resolved among review authors (HK, SA, AF, HS, BU and AT).

2.5. Data collection

The data collection protocol was designated and agreed before starting the project. Bibliographic data, patient's management, outcome feature, and follow-up outcome were extracted. Two authors (HK and SA) independently extracted the data from selected studies. Data were jointly reconciled, and disputes and technical uncertainties were discussed and resolved among review authors (HK, SA, AF, HS, BU and AT).

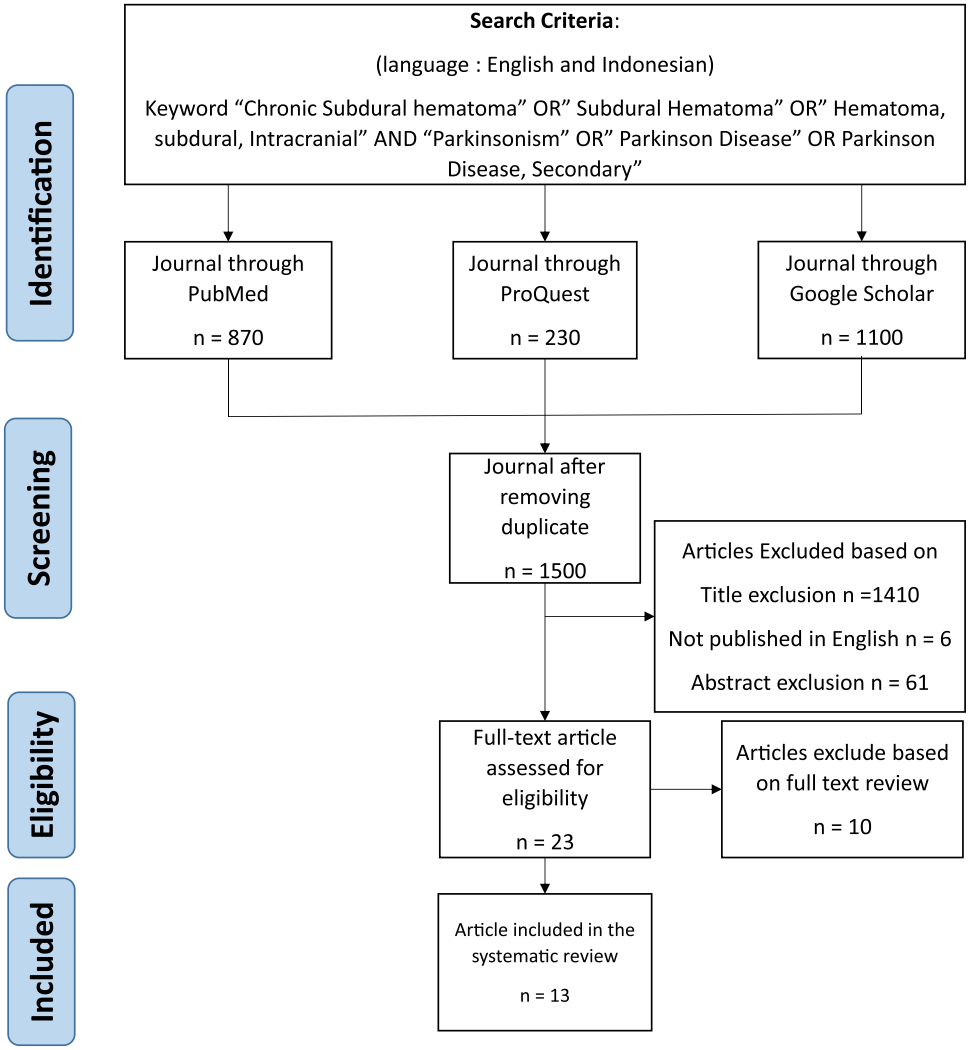

Fig. 1. PRISMA flow diagram of article search, screening, eligibility, and inclusion.

Table 2
Participant characteristic of all included studies.

Mean age (years)	66.5 ± 9.73
Site of lesion n (%)	
Bilateral	7 (43.75)
Right-sided	5 (31.25)
Left-sided	4 (25)
Traumatic event n (%)	
Known	10 (62.5)
Denied	6 (37.5)
Symptoms	
Tremor	11 (68.75)
Rigidity	12 (75)
Gait disturbance	12 (75)
Dysphasia	3 (18.75)
Facial masking	8 (50)
Bradykinesia	12 (75)
Urinary incontinence	2 (12.5)
Dysarthria	3 (18.75)
Time to symptoms n (%)	
≤1 month	6 (37.5)
>1 month	4 (25)
Unreported	6 (37.5)
Symptoms to diagnosis n (%)	
≤1 month	10 (62.5)
>1 month	5 (31.25)
Unreported	1 (6.25)
Treatment n (%)	
Burr hole drainage	8 (50)
Craniotomy	3 (18.75)
Burr hole drainage + medication	2 (12.5)
Craniotomy + medication	1 (6.25)
Observation	1 (6.25)
Not reported	1 (6.25)
Outcome	
Minimally symptomatic/partial recovery	6 (37.5)
No symptoms	10 (62.5)
Duration of follow-up (median, range)	3 months (1 week–4 years)

3. Results

3.1. Search result

Our search strategy yields 12 case reports and one case series published from 1963 to 2017. The detailed exclusion process of search results can be observed in Fig. 1.

3.2. Summary of studies

The included studies comprised 16 cases of CSDH-induced parkinsonism, and 12 (75%) of which occurred in male. The youngest patient aged 38 years [7], whereas the oldest aged 83 years [8]. The mean age was 66.5 ± 9.73 years (Table 2). Hematoma in seven of these cases were bilateral, five were on the left side, and the rest were on the right side. In ten (62.5%) of 16 cases, the traumatic event leading to CSDH could be identified, whereas the other six (37.5%) could not recall such event.

The time gap between known traumatic event to the symptom onset ranged from 1 week to 6 months. Conversely, the CSDH diagnosis was known as early as 1 week to as late as 5 months since the symptom onset. Burr hole drainage and craniotomy were performed in eight (50%) and three (18.75%) studies, respectively. The presentation of CSDH can occur in patients with confirmed PD, that we did not include it in the CSDH-induced parkinsonism group [9,10]. One case had combined levodopa and craniotomy [11]. One case unfortunately did not specifically mention the performed surgical procedure [12], whereas the other one decided to only observe the patient without any intervention [13].

The most common symptoms were rigidity, gait disturbance, and bradykinesia, as reported in 12 (75%) of the cases each. The second and third most common symptoms were tremor (11; 68.75%) and facial masking (8; 50%), respectively. Other reported symptoms were dysphasia (3; 18.75%), dysarthria (3; 18.75%), and urinary incontinence (2; 12.5%) (Table 3).

We tried to calculate the risk ratio of SDH location and its outcome. Bilateral CSDH resulted in minimally symptomatic outcome in two cases and free of symptoms in five cases. Unilateral CSDH resulted in minimally symptomatic outcome in four cases and free of symptoms in five cases. Risk ratio (RR) calculation showed that unilateral CSDH is 1.5, more likely to result in partial recovery.

We also tried to dichotomize the time gap of symptom onset to CSDH diagnosis into ≤1 month and >1 month. Three symptomatic patients were classified in the ≤1-month group and 7 patients who were asymptomatic upon follow-ups. In the >1-month group, three and two patients were symptomatic and asymptomatic, respectively. One patient did not mention the time gap between symptom onset and CSDH diagnosis. The RR calculation showed that longer time gap between symptoms and diagnosis doubled the risk of partial recovery.

4. Discussion

Parkinsonism due to CSDH quite rarely occurs. We had experienced treating such patient. A 76-year-old man presents with rigidity and tremors in both arms and legs for 1 month before admission. He also complained of sluggish movement of both arms and legs. Complaints are continuously getting worse. The Unified Parkinson Disease Rating Scale (UPDRS) shows a score of 100. In the last 1 month, the patient fell and hit his head; however, he did not remember the exact time of and frequency of occurrences. Other complaints such as headache, nausea, vomiting, seizures, and decreased consciousness were not observed. No history of parkinsonism was observed. Patient also had no history of Parkinson medication.

The patient then underwent a magnetic resonance imaging (MRI) of the head, revealing a bilateral chronic subdural hematoma (CSDH) (Fig. 2). We decided to perform bilateral burr-hole drainage craniotomy. Postoperative computed tomography (CT) scan evaluation shows decreased hematoma size (Fig. 3). Parkinson-like symptoms disappeared immediately after the surgery, and the UPDRS shows a score of 24. After a 2-week hospitalization, the patient was discharged without any anti-Parkinson drugs administered. Postoperative follow-up shows complete resolution of all Parkinson-like symptoms. The UPDRS score remains at 24, until the 5-year postoperative follow-up. The 2-year postoperative MRI examination shows no residual hematoma left (Fig. 4).

Parkinsonism consists of several extrapyramidal signs, characterized by muscle rigidity, tremor, bradykinesia, and loss of postural reflexes. The most common cause of parkinsonism is idiopathic Parkinson's disease, whereas the secondary ones include drug exposure, infection, and trauma, constituting approximately 14–16% of all cases, especially in patients aged ≥40 years [10,14–18].

Acute onset of parkinsonism or worsening of pre-existing parkinsonism is a rare CSDH manifestation, but is significantly correlated because both parkinsonism and CSDH are related with elderly individuals [9,16]. Trauma is an important factor in the CSDH occurrence in elderly individuals. Old age is associated with cerebral atrophy and increased venous fragility, the major predisposing factors for CSDH, even after the minor head injury. Nevertheless, a direct head injury is not reported in 30–50% of studies [19,20]. CSDH itself may have various movement disorder manifestations, such as chorea [21], dystonia [22], and parkinsonism [13,17]. Movement disorders are occasionally associated with chronic subdural hematomas [9].

The interval between initial symptoms and CSDH diagnosis ranged from 1 week to 1 year (mean interval, 8 weeks) in a study [10]. The pathomechanism leading to parkinsonism in CSH remains unclear, and several mechanisms can be postulated. Direct mechanical pressure on the basal ganglia, either directly by the overlaying hematoma or through torsion and brain structure displacement, has been postulated [7,15]. Compression may result in decreased number of dopaminergic receptors in the striatum, and a disturbance of nigrostriatal pathways and striatum

Table 3
Summary of findings of included studies.

No	Author	Participants		Symptoms	Diagnosis	History of trauma	Trauma to onset of symptoms	Treatment	Onset of Symptoms to Diagnosis of CSDH	Outcome	
		Sex	Age (year)							Symptom	Duration of follow-up
1	Samiy, 1963	M	52	Tremor, rigidity, gait disturbance, dysphasia.	CSDH (L)	Denied	n/a	Craniotomy	4 months	Minimal	3 months
2	Sandyk, 1983	F	38	Tremor, rigidity, gait disturbance, facial masking, dysphasia, bradykinesia	CSDH (R)	Denied	n/a	Craniotomy	3 weeks	None	3 months
3	Accardi, 1985	M	48	Tremor, rigidity, gait disturbance, bradykinesia	Bilateral CSDH	Denied	n/a	Surgery, not specifically mentioned	5 months	Minimal	3 months
4	Krul, 1987	M	83	Tremor, rigidity, gait disturbance, facial masking, dysphasia, bradykinesia, urinary incontinence.	Bilateral Frontal CSDH	Yes	1 week	Burr hole	3 weeks	Partial recovery	n/a
5	Pau, 1989	F	60	Rigidity, bradykinesia	CSDH (R)	Yes	1 month	Craniotomy	1 month	Minimal	3 months
6	Hageman, 1994	M	66	Tremor, facial masking, dysarthria, bradykinesia	CSDH (L)	Denied	n/a	Observation	a few months	Minimal	3 months
7	Sunada, 1996	M	75	Tremor, rigidity, gait disturbance, facial masking	CSDH (L)	Yes	1 month	Levodopa 3 months + Craniotomy	1 month	None	3 months
8	Wiest, 1999	M	63	Tremor, rigidity, gait disturbance, facial masking, dysarthria, bradykinesia	CSDH (R)	Yes	1 week	Pre-op Levodopa 3 × 250 mg + Burr hole	n/a	None	4 weeks
9	Suman, 2006	M	81	Rigidity, gait disturbance	Bilateral Frontoparietal CSDH	Yes	2 months	Burr hole	2 weeks	None	1 weeks
10	Park, 2009	M	78	Tremor, rigidity, gait disturbance, facial masking, dysarthria, bradykinesia	CSDH (L)	Yes	3 months	Burr hole	2 weeks	Minimal	3 weeks
11	Bostantjopoulou, 2009	F	65	Rigidity, gait disturbance, facial masking, bradykinesia	Bilateral CSDH	Yes	45 days	Burr hole	1 weeks	None	1 months
12	Gelabert-Gonzalez, 2012	M	71	Tremor, rigidity, bradykinesia	Bilateral Frontoparietal CSDH	Yes	1 week	Pre-op Levodopa (20 days) + Burr hole	35 days	None	2 months
		M	68	Tremor, gait disturbance, bradykinesia	CSDH (L)	Denied	n/a	Burr hole	1 month	None	3 months
		M	77	Rigidity, gait disturbance	Bilateral CSDH	Yes	1 month	Burr hole	2 weeks	None	6 months
		F	59	Tremor, facial masking, bradykinesia	CSDH (R)	Denied	n/a	Burr hole	7 weeks	None	4 weeks
13	Guppy, 2017	M	80	Gait disturbance, urinary incontinence, bradykinesia	Bilateral CSDH	Yes	6 weeks	Burr hole	2 weeks	None	4 years

and lead to onset of a parkinsonian syndrome. Reduction of dopaminergic receptors has been reported in a patient with parkinsonism secondary to an intracranial tumor who did not benefit from levodopa therapy [9]. Midbrain compression from the transtentorial uncal herniation following the brain shift has also been postulated [3]. Positron emission tomography (PET) and diffusion tensor imaging (DTI) MRI might be helpful to uncover the mechanism in the future. Transient circulatory disturbances of basal ganglion structures could be caused by anterior choroidal artery displacement and compression. Exploration about glymphatics and brain lymphatics also needed. For the compressive theory, all patients rapidly recovered after the subdural hematoma evacuation and displacement disappearance of the hemisphere [7]. However, the rarity of parkinsonism due to CSH has led to the hypothesis that these particular patients may have preclinical nigrostriatal dysfunction, and therefore, they cannot compensate with further insults to the basal ganglia [13,23].

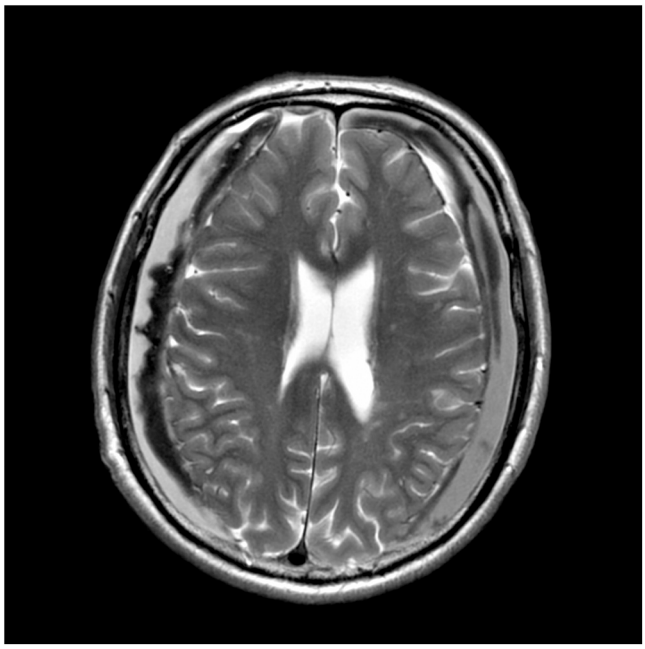

Fig. 2. Preoperative brain MRI examination shows a bilateral crescent-shaped hyperdense lesion under the dura mater that compresses both hemispheres of the cortex, suggesting a bilateral chronic subdural hematoma (CSDH).

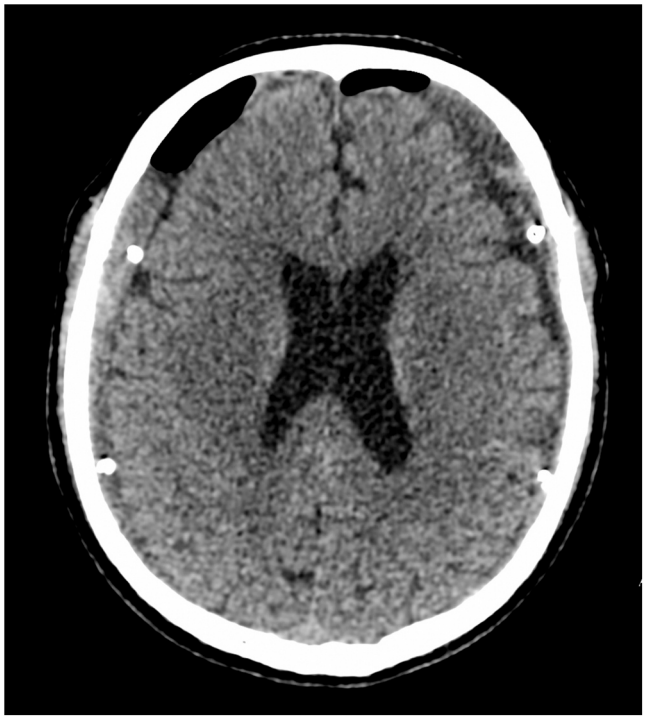

Fig. 3. Postoperative head CT scan shows the drainage tube placed in the bilateral subdural space, decreasing the hematoma size. A, Axial CT scan; B, Three-dimensional reconstruction.

Our patient presented with an extremely new onset, and rapidly progressive symmetrical parkinsonism that affects the whole body. This patient was suspected with CSDH due to history of head impacts for the last 1 month. CSDH in this patient is suspected to be the main cause of the occurrence of signs and symptoms of parkinsonism. This is evident after the hematoma drainage; the patient has experienced dramatic and rapid clinical improvement. Even in the hospitalization, the patient did not take any anti-parkinsonism medications postoperatively until 5-years follow-up. Surgical evacuation of the hematoma has become the gold standard for patients with CSDH, with or without parkinsonism symptoms, and these patients have demonstrated rapid symptom improvement in patients postoperatively [7].

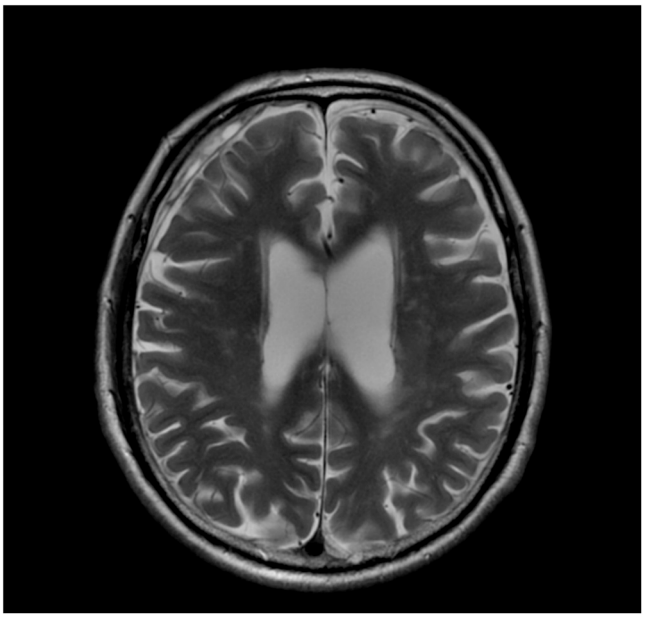

Fig. 4. Two-year postoperative brain MRI examination shows a small residual of hematoma.

Long-term evaluation is required in these patients, due to the theory of preclinical nigrostriatal dysfunction in patients with parkinsonism in CSDH. Our patients were subjected to periodic follow-up and brain MRI 2-years postoperatively (Fig. 4). To evaluate the signs and symptoms of Parkinson's disease in these patients, a thorough assessment, including regular UPDRS scoring as performed in our patient, is necessary [13,23].

4.1. Limitation

Limitation of this review relates to exclusion of case reports and case series not in English or Bahasa. Moreover, we might have missed few case reports because relevant search terms may not be found in titles or abstracts. In this study, the conclusions are also found to be limited due to the small number of identified articles.

Another limitation of this review is that the outcome assessment was unclear, as only one case report used the UPDRS to assess the outcome.

5. Conclusion

Only 16 CSDH-induced parkinsonisms were identified since the 1960s. This condition is thought to occur due to basal ganglia compression. Surgery on the chronic subdural hematoma provides a favorable outcomes on alleviating parkinsonism symptoms. Timely diagnosis of CSDH might result in better outcomes. To screen any CSDH-induced parkinsonism, we propose to perform CT Scan or MRI in every patient with parkinsonism. Further research is needed on CSDH-induced parkinsonism is needed, especially in the mechanisms and treatment outcomes.

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Conflict of interest

The authors declare no conflict of interest regarding this study.

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