Egyptian Journal of Neurosurgery

REVIEW Open Access

Chronic epidural hematoma: a systematic review and meta-analysis

Nicaise Kpègnon Agada[1*], Nourou Dine Adeniran Bankole[1,2], Mèhomè Wilfried Dossou[1], Omar Boladji Adébayo Badirou[1], Emeka Alfred Clement[1], Fresnel Lutèce Ontsi Obame[1], Laté Dzidoula Lawson[1], Romeo Bujiriri Murhega[1], Arsène Daniel Nyalundja[1], Nukunté David Lionel Togbenon[1], Thierry Alihonou[1] and Yao Christian Hugues Dokponou[1]

Abstract

Background Epidural hematoma constitutes a common condition in neuro-traumatology. If its acute form is well known, the chronic one remains less described.

Objective This study aimed to evaluate the epidemiology, clinical presentations, management, and outcomes of chronic epidural hematoma.

Methodology Systematic searches of PubMed, Google Scholar, and ScienceDirect were performed from a database searching for all studies reporting chronic epidural hematoma. Pooled statistics were calculated using measures of central tendency and spread. The rank correlation test and the regression test, using the standard error of the observed outcomes as predictor, are used to check for funnel plot asymmetry.

Results A total of 3009 studies were identified, of which 95 were included with 359 patients. Chronic epidural hematoma (CEDH) was more common at the intracranial level than spinal level (91.9% vs 8.1%). The average age of onset was 37.2 ± 4.83 years. The common cause found was trauma ($n = 279$; 77.72%) with 271 (97.1%) cases for the head and 8 (2.9%) cases for the spine. The mean delay between the trauma and the first symptoms was 13.32 ± 1.73 days in intracranial level and 16.38 ± 2.49 days in spinal level. CT scan constituted the main diagnosis tool. The lesion was predominantly located in the temporal region at the intracranial level and lumbar region at the spinal level. Craniotomy and laminectomy constituted the most reported treatment option, respectively, at the intracranial and spinal level. The outcome was commonly uneventful. Correlation and regression tests for publication bias assessment show no significant funnel plot asymmetry with high p value ($p = 0.8458$ and $p = 0.9596$, respectively).

Conclusion CEDH was commonly related to trauma. Its treatment was mostly surgical at both sites.

Keywords Epidural, Spinal, Hematoma, Chronic, Cranial

Introduction

Epidural hematomas are common intracranial pathologies secondary to traumatic brain injuries and are associated with overlying skull fractures up to 85% of the time. Spinal chronic epidural hematomas are extremely rare and become clinically relevant when they affect the spinal cord and/or nerve roots, causing neurological symptoms [1]. The incidence of chronic epidural hematomas after traumatic injuries has been reported to account for 9–32% of all epidural hematomas [2, 3].

*Correspondence:
Nicaise Kpègnon Agada
nicaiseagada4@gmail.com
[1] Research Department of Sub-Saharan Africa Futures Neurosurgeons Association (SAFNA), Cotonou, Republic of Benin
[2] Department of Interventional Neuroradiology, Clinical Investigation Center (CIC) 1415, INSERM, Teaching Hospital of Tours, Tours, France

Regarding the age group of chronic epidural hematoma occurrence, it has been reported that epidural hematoma is unusual in the pediatric age group because the dura mater is relatively firmly attached to the inner table and the suture line rather than bleeding from the middle meningeal artery, which is common in adults. Nevertheless, it can be frequent in children because hematoma due to venous blood hemorrhage takes a long time to accumulate before it causes a significant mass effect [4, 5].

Furthermore, the epidural hematoma will start the ossification process 2 weeks after the injury. Without any treatment, this collection will become a mass that appears hyperdense on a CT scan [6]. Also, the incidence of low-intensity T2*-weighted images and bone erosions on computed tomography may help differentiate rare spinal chronic epidural hematoma (CSEH) from other lumbar degenerative diseases and epidural masses on MRI [7].

However, there is no available guideline for its management, and the outcomes were not previously well reported. This systematic review aimed to describe the epidemiology, availability of diagnostic modalities, managements of CEDH, and clinical outcomes globally.

Methods

We conducted a systematic review and meta-analysis of the epidemiology, presentation, management, and outcomes of chronic epidural hematoma as per the registered protocol [8]. This study was guided by the Arksey and O'Malley (2005) scoping review framework [9]. The Preferred Reporting Items for Systematic Review and Meta-analysis extension for Scoping Review (PRISMA-ScR) guidelines [10] were used to report the findings.

Search strategy

A search strategy was developed using a systematic approach that is consistent with a systematic review methodology to identify studies related to chronic epidural hematoma. The development of the search strategy was in consultation between the authors. The search was conducted using several databases, including PubMed, Google Scholar, and Science Direct.

The search terms included: ''chronic epidural hematoma," ''chronic extradural hematoma," ''chronic spinal epidural hematoma," ''chronic spinal extradural hematoma," ''chronic cranial epidural hematoma," and ''chronic cranial extradural hematoma."

In each database, we used subject headings and title abstract keywords descriptive of concepts related to chronic epidural hematoma. We also manually searched reference lists of reviews and relevant publications. We restricted the search to languages such as English and French.

Study selection

All the articles resulting from the search (3009) were exported into Zotero [11] where duplicates were identified and deleted. The 862 articles that remained were then exported into Rayyan [12]. Zotero and Rayyan are professional research softwares that are widely used by collaborators for ease of study selection decisions. The study selection process consisted of multiple steps. Firstly, authors (K.N.A., N.D.A.B., O.B.A.B., A.D.N., M.W.D., L.D.L., R.B.M., N.D.L.T., Y.C.H.D.) independently screened the titles and abstracts of the identified articles based on the pre-defined inclusion and exclusion criteria. Any disagreement between the reviewers' decisions prompted further discussion. If a disagreement persisted, a third reviewer (N.D.A.B. or Y.C.H.D.) resolved the conflict. The full texts of the remaining articles were also retrieved and screened by reviewers (K.N.A., N.D.A.B., O.B.A.B., A.D.N., M.W.D., L.D.L., O.O.F.L., R.B.M., N.D.L.T.) independently.

Inclusion and exclusion criteria

We included studies that fulfilled the specific inclusion criteria discussed in our published protocol. Studies of interest included those that discussed chronic epidural hematoma, whether spine or head. We included various publications including journal articles, abstracts, reviews, case reports, and letters. There were no restrictions to the period of the publications considered. Publications in English and French languages were considered.

We excluded all articles that (i) did not discuss chronic epidural hematoma and (ii) were neither written in English nor in French.

Data extraction

Studies that met inclusion criteria with full manuscripts were reviewed, and the following data were extracted, summarized , and tabulated in an Excel proforma sheet: title, original language of publication, journal title, year of publication, name of the first author, country of origin of the first author, the start date of participant recruitment in the study, the end date of participant recruitment in the study, study period, study design, site(s) of recruitment of participants, population size, participants characteristics (including sex, mean, median and range of age), past history, medication, lifestyle, patient clinical information, neuroimaging modality used, etiologies, type of intervention, delay between accident and first symptoms, delay between symptoms and diagnosis, delay between diagnosis and treatment, and outcome of care.

Data analysis

The statistical analyses performed in this study were univariate, bi-variate and multivariate descriptive. They were carried out using the statistical analysis software jamovi (Version 2.2) [13] and R (Version 4.0) [14]. It should be noted that the data were previously entered on excel and then cleaned and checked by three participants (A.K.N., N.D.A.B., O.B.A.B., Y.C.H.D.).

The calculated means for quantitative variables were approximated by the precision error, which determines a precision interval for the calculated mean value (mean ± precision). The distribution tables used made it possible to assess the distribution of individuals according to the different modalities and/or categories of the variable.

The regression models used in the analyses were the result of nested models (stepwise regressions). The correlation between the variables studied was evaluated by Pearson's regression test r. For the different associations, the significance threshold was 5%.

The analysis was carried out using the log odds ratio as the outcome measure. A random-effects model was fitted to the data. The amount of heterogeneity (i.e., tau^2) was estimated using the restricted maximum-likelihood estimator (Viechtbauer 2005). In addition to the estimate of tau^2, the Q-test for heterogeneity (Cochran 1954) and the I^2 statistic are reported. In case any amount of heterogeneity is detected (i.e., $tau^2 > 0$, regardless of the results of the Q-test), a prediction interval for the true outcomes is also provided. Studentized residuals and Cook's distances are used to examine whether studies may be outliers and/or influential in the context of the model. Studies with a studentized residual larger than the $100 \times (1-0.05/(2 \times k))$th percentile of a standard normal distribution are considered potential outliers (i.e., using a Bonferroni correction with two-sided alpha = 0.05 for k studies included in the meta-analysis). Studies with a Cook's distance larger than the median plus six times the interquartile range of the Cook's distances are considered to be influential. The rank correlation test and the regression test, using the standard error of the observed outcomes as predictor, are used to check for funnel plot asymmetry.

Results

Screening

The database search returned 3009 articles. After deduplication, title, and abstract screening, 197 (6,55%) articles remained for full-text screening. Most articles were excluded because they were not focused on chronic epidural hematoma ($n = 648$) or were not published in English or French ($n = 17$). The rest were excluded because they lacked full text ($n = 46$). Ninety-five (3.15%) articles were included after the full-text screening (Fig. 1).

Included studies

Ninety-five matching publications were included with a total of 359 patients. Quantitative synthesis implied 15 studies. The overall studies were a case report and case series, cohort studies published between 1949 and 2022. Ninety-four articles were published in English through international reviews such as Acta neurochirurgica, world neurosurgery, the British journal of neurosurgery, surgical neurology, the spine journal, and the American journal of surgery. The country of origin of the first author was the USA for 17 studies, Japan 13, India 11, Italy 9, Turkey 8, Brazil 6, Spain 6, China 5, Korea 5, Australia 3, Israel 2, England 2, Germany 2, France 1, Poland 1, Canada 1, South Africa 1, Morocco 1, Sweden 1.

Epidemiology

Among the 359 patients from the 95 papers included, we found a male predominance ($n = 263$; 73.26%), with an average onset age of 37.2 ± 4.83 years (range of 1 to 88 years).

Intracranial CEDH accounted for 91.9% ($n = 330$) of cases and spinal CEDH, 8.1% ($n = 29$) (Table 1). Furthermore, concerning the intracranial CEDH, the mean delay between the head traumatism and the manifestation of the first symptoms was 13.32 ± 1.73 days with a range from 0 to 60 days; whereas for the spinal one, this delay was 16.38 ± 2.49 days. The overall mean delay between diagnosis and treatment was 1.18 ± 0.3 days with a range from 0 to 21 days.

Risk factors and etiologies

Chronic epidural hematoma was related to trauma in 279 (77.72%) patients, of which 271 (97.1%) for the head and 08 (2.9%) for the spine. Only 4 patients have been reported to be under anticoagulant medication for cardiovascular conditions at the time of the head trauma. Regarding the spine CEDH, one case presented spinal CEDH after a blood patch, 2 cases after lumbar puncture, 4 cases under anticoagulant due, respectively, to stroke ($n = 2$), hemophilia ($n = 1$), hips prosthesis replacement ($n = 1$).

Clinical presentation and diagnosis

Headache ($n = 191$; 53.20%) and loss of consciousness ($n = 101$; 28.13%) were the most common clinical presentation in a patient with intracranial chronic extradural hematoma. Considering the spinal localization, 17 (58.62%) had back pain and 04 (13.79%) presented with progressive spinal cord compression syndrome. Nevertheless, globally on admission, patients had a Glasgow Coma Scale of 13 or higher ($n = 176$, 49.03%) (Table 2). Imaging modalities were CT scan ($n = 261$; 72.70%), magnetic resonance imaging ($n = 33$; 9.19%),

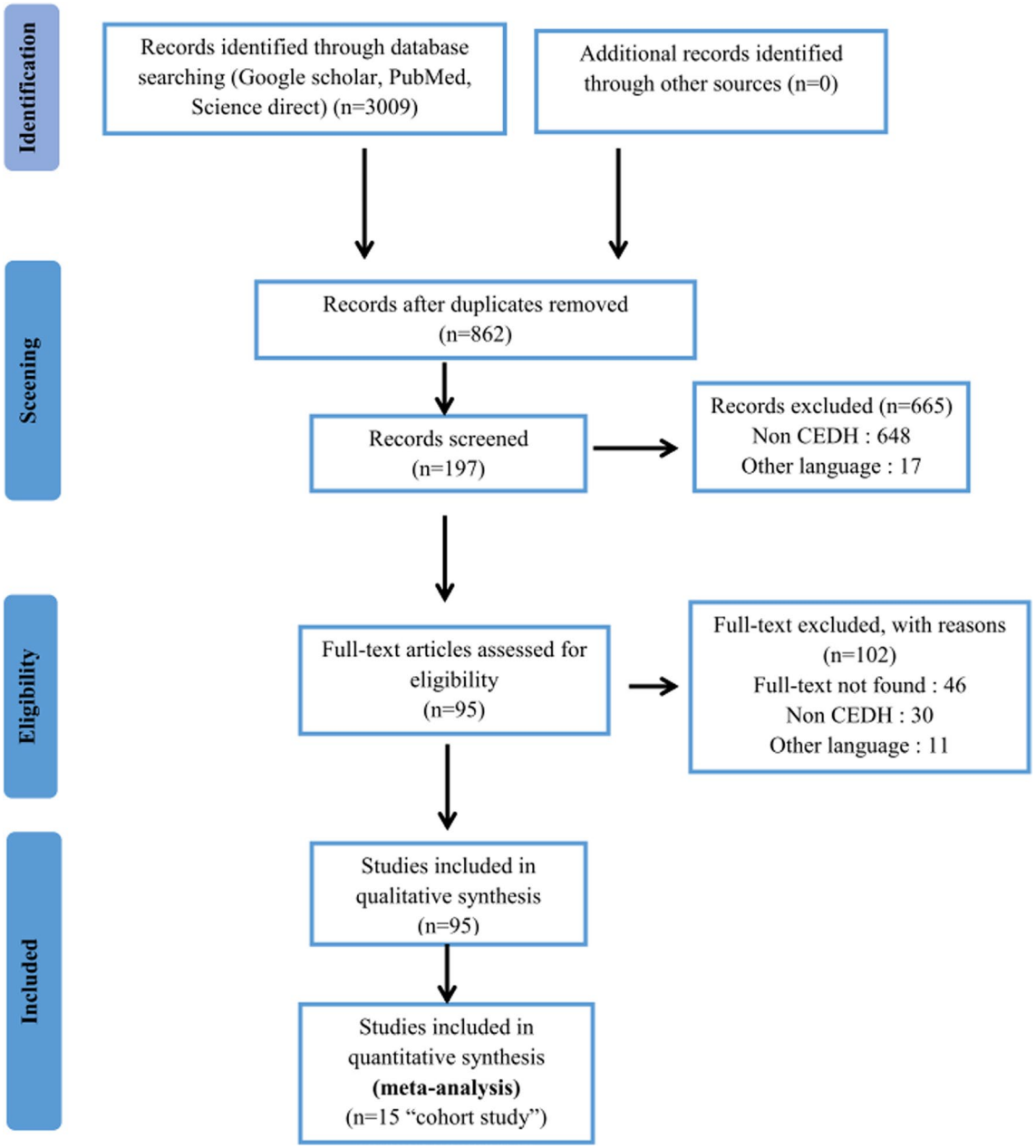

Fig. 1 Search strategy using PRISMA flowchart

Table 1 Epidemiological characteristics

Features	Frequency
Sex	
Male	263 (73.26%)
Female	95 (26.46%)
Intracranial CEDH	330 (91.9%)
Spinal CEDH	29 (8.1%)

or standard radiography ($n=43$; 11.98%) (Table 3). The common location at the intracranial site was the temporal region ($n=112$; 31.20%), followed by the frontal ($n=95$; 26.46%) and parietal regions (90; 25.07%); whereas at the spinal site, the lumbar region was the most common site ($n=22$; 75.86%) (Table 3, Fig. 2). According to this study, parietal and occipital regions seemed to more favor the CEDH constitution (p value = 0.001 and 0.004, respectively) (Table 4).

Table 2 Clinical presentation and Glasgow Coma Scale at admission

Features	Frequency
Head	
Seizure	34 (9.47%)
Headache	191(53.20%)
Visual troubles	92 (25.63%)
Vomiting	53 (14.76%)
Loss of consciousness	101 (28.13%)
Motor palsy	86 (23.96%)
GCS ≥ 13	176 (49.03%)
Spine	
Back pain	17/29 (58.62%)
Progressive spinal cord compression	04/29 (13.79%)

Table 3 Imaging modalities and topography of lesion

Features	Frequency
Imaging modalities	
CT scan	261 (72.70%)
MRI	33 (9.19%)
Rx	43 (11.98%)
Topography of lesion	
Head	
Temporal	112 (31.20%)
Occipital	36 (10.03%)
Frontal	95 (26.46%)
Parietal	90 (25.07%)
Posterior cranial fossa	14 (3.90%)
Spine	
Cervical	5 (17.24%)
Thoracic	4 (13.79%)
Lumbar	22 (75,86%)

Management and outcome

Craniotomy was the most reported treatment option ($n=234$; 65.18%) at the intracranial level and laminectomy ($n=25$; 6.96%) in the spinal level. Conservative treatment was recommended for 16 (4.46%) of which 12 (3.64%) for head localization and 4 (13.79%) for spine. Among them, 7 (1.95%) end up with spontaneous hematoma resorption of which 5 (1.52%) for the head localization and 2 (6.90%) for the spine. Globally, the evolution was improved for 316 (88.02%) patients, while 31 (8.64%) patients reported worsened. Thirteen patients (3.62%) died considering the two sites (head and spine) (Table 4).

Study bias assessment

A total of $k=15$ studies were included in the analysis. The observed log odds ratios ranged from −0.7958 to 3.0587, with the majority of post-traumatic chronic extradural hematoma (87%). The estimated average log odds ratio based on the random-effects model was=0.9308 (95% CI: 0.4012–1.4603). Therefore, the average outcome differed significantly from zero ($z=3.4451$, $p=0.0006$). According to the Q-test, the studies reporting post-traumatic chronic extradural hematoma appear to be heterogeneous ($Q(14)=48.6301$, $p<0.0001$, $\text{tau}^2=0.7647$, $I^2=72.9295\%$). A 95% prediction interval for the post-traumatic chronic extradural hematoma reported is given by −0.8631 to 2.7246. Hence, although the average outcome is estimated to be positive, in some studies the true outcome may in fact be negative. An examination of the studentized residuals revealed that none of the studies had a value larger than ±2.9352, and hence, there was no indication of outliers in the context of this model (Fig. 3). According to Cook's distances, none of the studies could be considered to be overly influential. Neither the rank correlation nor the regression test indicated any funnel plot asymmetry ($p=0.8458$ and $p=0.9596$, respectively) Fig. 4A, B.

Discussion

Key findings

We identified and extracted data from 95 studies on chronic epidural hematoma. To our knowledge, this is the first systematic review and meta-analysis on the chronic epidural hematoma. The four most striking findings from this study are as follow: (i) Chronic epidural hematoma was related to head and spine trauma in 77.72% ($n=279$) of cases; 97.1% ($n=271$) for the head, and 2.9% ($n=08$) for the spine. Four patients have been reported to be under anticoagulant medication. The risk factors in the group of spinal CEDH were blood patch ($n=1$), lumbar puncture ($n=2$), anticoagulant medication ($n=4$). (ii) Headache ($n=191$; 53.20%) and loss of consciousness ($n=101$; 28.13%) were the most common clinical presentation in intracranial group; whereas in the group of spinal CEDH, back pain ($n=17$; 58.62%) and spinal cord compression syndrome ($n=04$; 13.79%) were reported. (iii) The most common location of CEDH was at the intracranial level: temporal ($n=112$; 31.20%), frontal ($n=95$; 26.46%), and at the spinal level: lumbar ($n=22$; 75.86%). (iv) According to this study, parietal and occipital regions seemed to favor the hematoma chronicity (p value=0.001 and 0.004, respectively).

Implications

The results showed that CEDH occurs more frequently in young male adults. This confirms what many series reported through the literature [15, 16]. Both intracranial and spinal CEDH occurred more frequently after trauma conditions (n = 279; 77.72%) with the

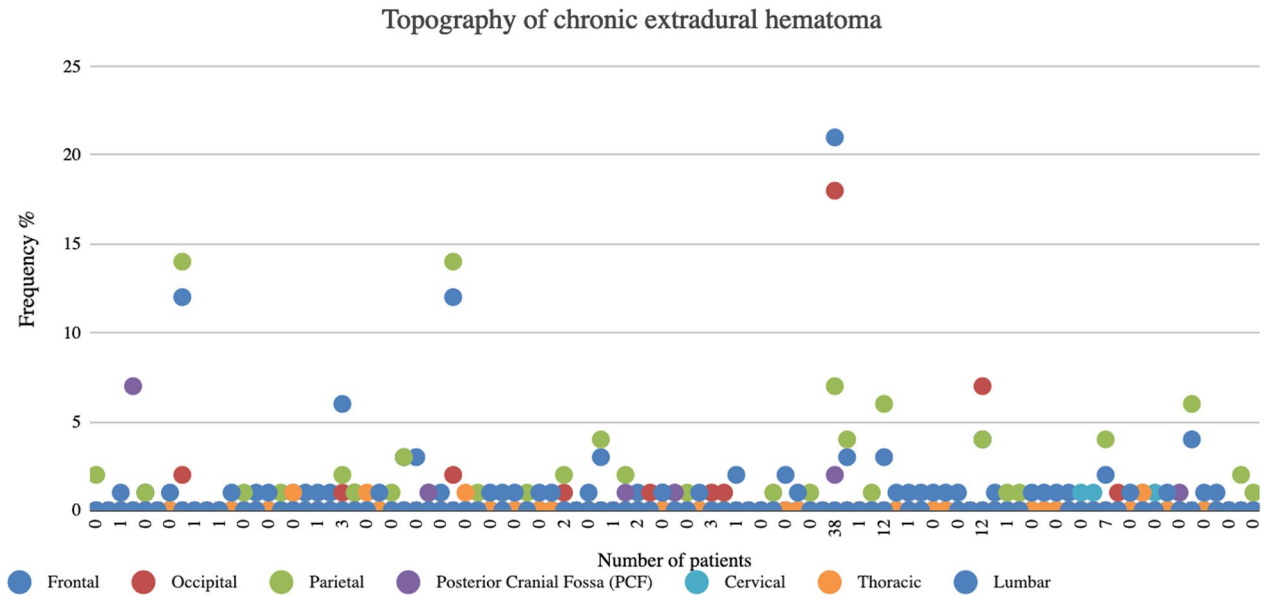

Fig. 2 Topography of chronic extradural hematoma

Table 4 Management modalities and clinical outcomes

Features	Frequency
Management	
Craniotomy	234 (65.18%)
Laminectomy	25 (6.96%)
Conservative treatment	16 (4.46%)
Clinical outcomes	
Improved	316 (88.02%)
Worsening	31 (8.64%)
Unchanged	8 (2.23%)
Spontaneous resolution	7 (1.95%)
Death	13 (3.62%)

predominance of the intracranial CEDH (n = 330; 91.9%). This implies that the skull is more involved in trauma conditions than the spine. In fact, the skull is more exposed than the spine and more influenced by the gravity power. The mean delay between the head trauma and the first symptoms was 13.32 days. This constitutes the mean delay of chronicity and allows us to confirm what is sparsely found in the literature [2, 15, 17]. Furthermore, our results allowed us to find that the mean delay between a spinal trauma and the first symptom accounts for 16.37 days. Aside from the trauma causes, other risk factors are reported through the literature (anticoagulation therapy, lumbar puncture,...). The risk factors in the group of spinal CEDH were blood patch (n = 1), lumbar puncture (n = 2), anticoagulant medication (n = 4). These findings have been reported by some authors with many cases of spontaneous chronic epidural hematoma in patients under anticoagulant medication or others that had undergone lumbar puncture [18]. The etiologies of spinal CEDH are dominated by coagulation disorder in our series.

From our results, persistent headache and a report of loss of consciousness at the time of the trauma constitute the frequent manifestation of intracranial CEDH whereas for the spinal localization, back pain and progressive spinal cord compression syndrome are more frequent. Fukatsu et al. as well as Han [19, 20] had confirmed these clinical manifestations in their individual reported studies. The neurologic examination revealed a drowsy mental status but no motor weakness in some, whereas others presented with lumbar pain and a history of paresthesia with pain in the right lower extremity.

However, these symptoms are neither specific for the intracranial nor spinal location, since any other space-occupying lesion can provide the same symptoms. Hence, the CT scan constitutes the main diagnostic tool for the CEDH. MRI and angiography are necessary at the spinal level. In the light of these findings, it is plausible to assume that the capsular membrane around the hematoma appears after the 8th day [21].

Our results highlight that the main location of the hematoma at the intracranial level is the temporal, followed by the frontal region. Other series in the literature reported different findings (frontal region more frequent) [15]. Tatagiba et al. [22] reported 8 cases of CEDH and

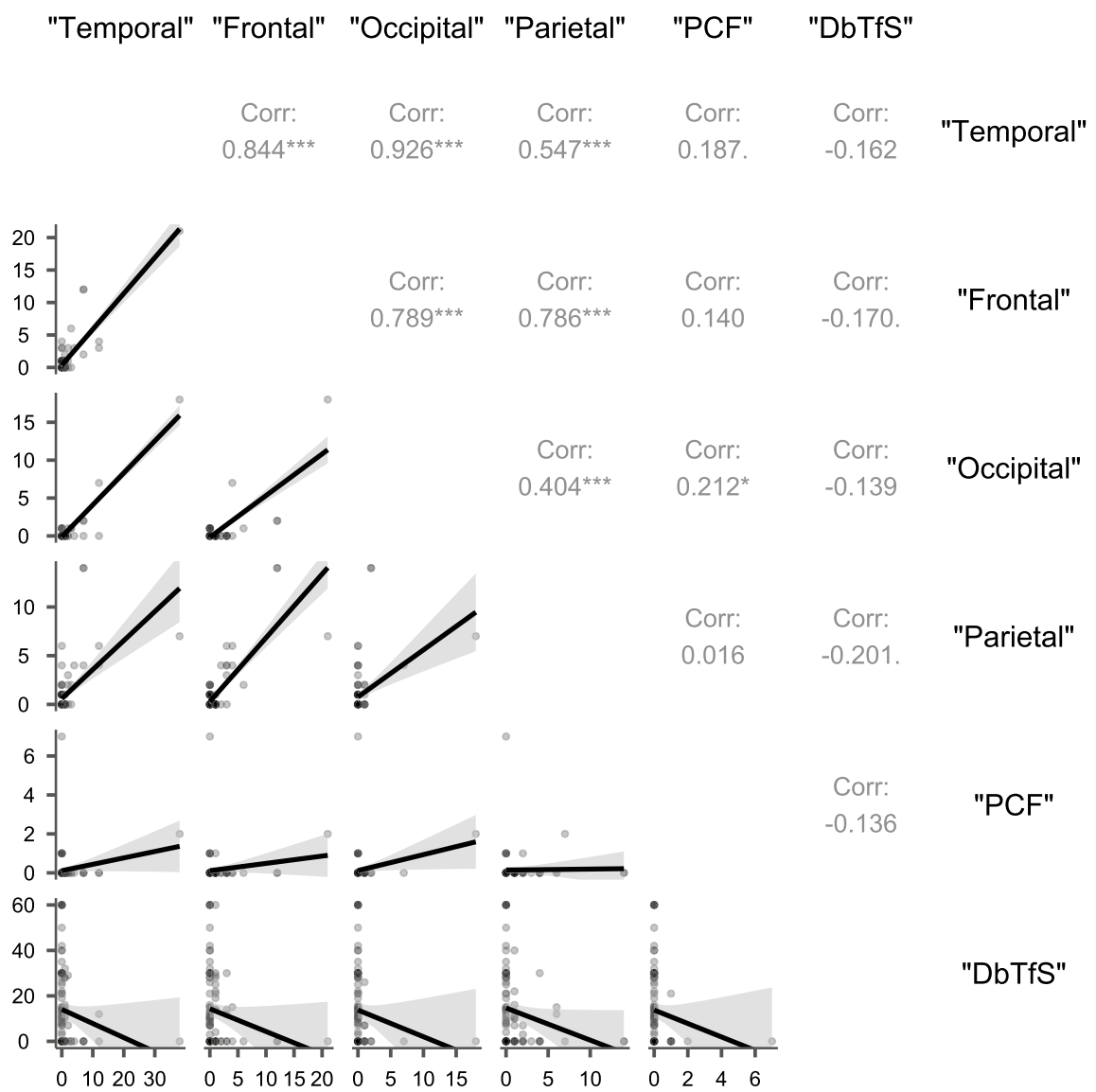

Fig. 3 Correlation Matrix Plot between CEDH location and the delay between the trauma and onset of the disease. Corr: Correlation; DbTfS: Delay between Trauma and first Symptoms; PCF: Posterior Cranial Fossa

concluded that the most frequent locations of clot were the parietal and the frontal regions. Meanwhile, in our data, we found that the parietal and occipital locations favored the chronicity of CEDH. But considering the spine, the lumbar region is reported to be more frequent.

We found a statistically significant correlation between the parietal CEDH (p value = 0.016) and the delay "trauma—onset" of the disease. That is to say, when located on the parietal side, the CEDH seems to reveal itself more slowly. Other authors have reported the same thing (this usually lasts more than 14 days compared to other locations of the CEDH) [2, 23]. The extra-temporal location of the hematoma is not associated with a transtentorial uncal herniation; so the usual rapidly progressive neurological deterioration may be absent hence an EDH may not be early suspected clinically [15]. At the spinal level, the long onset delay can be explained by the fact that, anatomically speaking, the lumbar region is more spacious and in addition, the bleeding is often from veinous source [20, 24]. Regarding the management, we found that the hematoma was commonly evacuated through craniotomy at the intracranial level such reported in the literature [5, 15, 25]. As a matter of fact, twist drill/burr holes might drain the liquid portion adequately, but will be inadequate for removing the solid clot portion

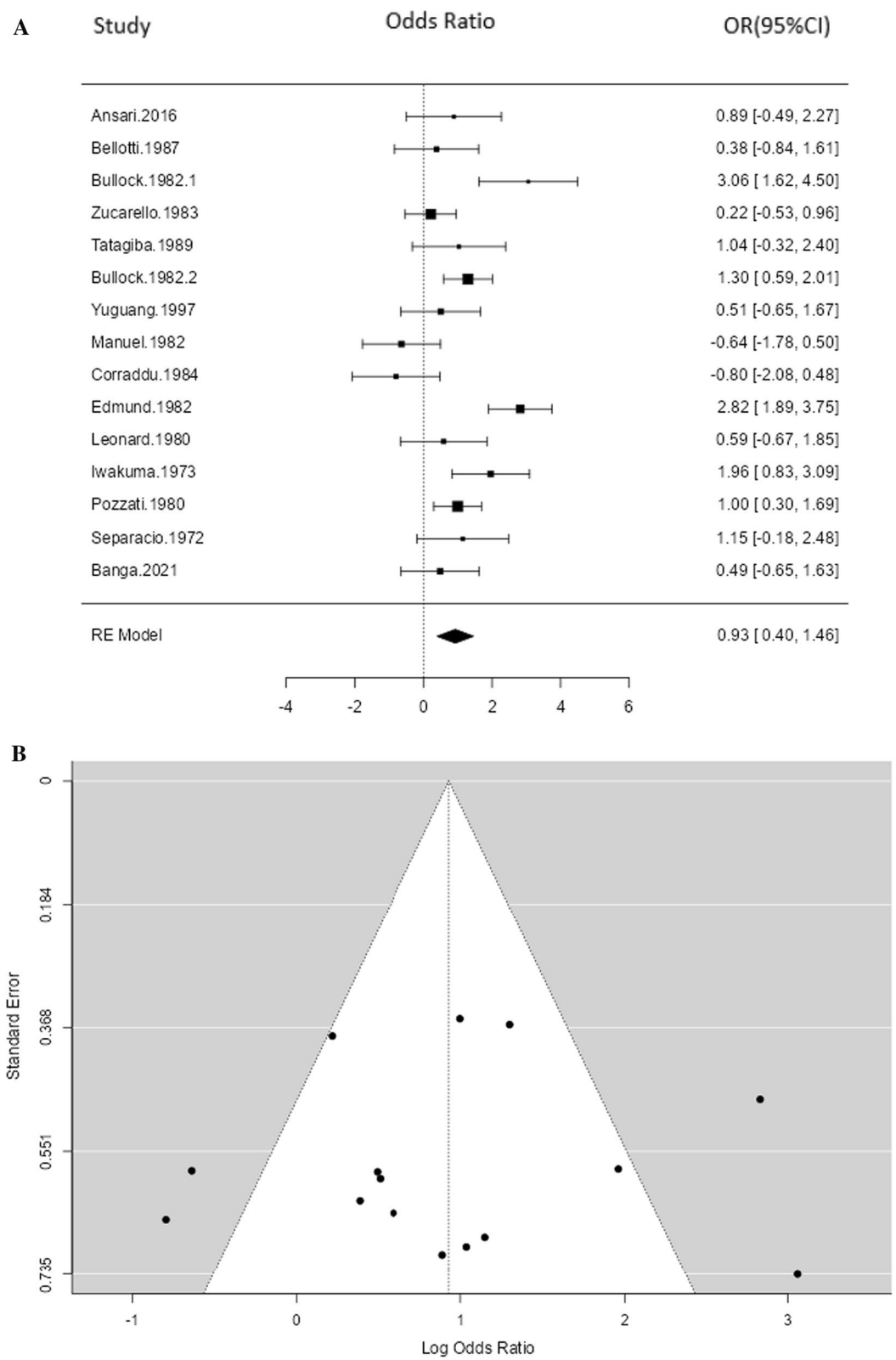

Fig. 4 **A** Forest plot of odds ratio (OR) for chronic extradural hematoma being post-traumatic versus spontaneous. CI = Confidence Interval. Cohort studies that reported chronic extradural hematoma secondary to traumatic brain injury as well as those without trauma. **B** Funnel plot as a graphical visualization of rank correlation and regression test for publication bias assessment. No significant funnel plot asymmetry with high *p* value ($p = 0.8458$ and $p = 0.9596$, respectively). The small size of included studies can explain the scattered distribution

of CEDH and hence are not recommended [24]. At the spinal level, laminectomy was the most frequent surgical procedure to evacuate the hematoma as reported in the literature [20, 26]. The post-operative follow-up was mainly uneventful. This confirms what is separately found through the literature [5, 15, 18, 20, 24]. However, some authors suggest conservative treatment with serial scans in patients with no or mild symptoms, normal neurological status, and a small-sized CEDH without any mass effect as a spontaneous resolution may be expected and consider surgery in absence of naturally resolution even if the patient's condition is good, because of the likelihood of calcification/ossification [15, 24].

Limitation

Despite the size of the included articles, we met the lack of data regarding some parameters. So we were not, for example, able to assess the occurring mechanism of CEDH.

The majority of the published articles in the literature were case and series reports; few articles were eligible for the meta-analysis, what limited the strength of the meta-analytic aspect of our study.

Conclusion

An extradural hematoma discovered about thirteen days laterly in intracranial and about sixteen days at spinal level can be defined as chronic. Parietal and frontal regions seemed to favor the hematoma chronicity. The trauma condition constitutes the most common risk factor for CEDH. So all patients coming to hospital and complaining of headache days after a head trauma must undergo a painstake work-up in order to rule out a chronic extradural hematoma. However, the mechanism leading to the hematoma chronicity remains poorly understood. Further studies are needed to elucidate this.

Abbreviations

CEDH	Chronic epidural/extradural hematoma
CSEH	Chronic spinal epidural/extradural hematoma
CT scan	Computed tomography scan
EDH	Epidural hematoma
Fig	Figure
GCS	Glasgow Coma Scale
MRI	Magnetic resonance imaging
PRISMA-ScR	Preferred Reporting Items for Systematic Review and Meta-analysis extension for Scoping Review
Rx	Standard radiography

Acknowledgements

Not applicable.

Author contributions

N.K.A. contributed to conceptualization, project administration, data curation, title and abstract screening, full-text screening, writing draft, reviewing and editing, visualization, validation, and methodology; N.D.A.B. contributed to title and abstract screening, full-text screening, writing draft, reviewing and editing, visualization, supervision, validation, and methodology; W.M.D. contributed to title and abstract screening, full-text screening, writing draft, and reviewing and editing; O.B.A.B. contributed to title and abstract screening, full-text screening, data curation, writing draft, and reviewing and editing; E.A.C. contributed to title and abstract screening, full-text screening, writing draft, and reviewing and editing; F.L.O.O. contributed to full-text screening, data extraction, writing draft, and reviewing and editing; D.L.L. contributed to title and abstract screening, full-text screening, and data extraction; R.B.M. contributed to title and abstract screening, full-text screening and data extraction; A.D.N. contributed to title and abstract screening, full-text screening, and data extraction; N.D.L.T. contributed to title and abstract screening, and full-text screening; T.A. contributed to reviewing and editing; Y.C.H.D. contributed to title and abstract screening, writing draft, reviewing and editing, supervision, validation, and methodology.

Funding

No external funding.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 5 April 2023 Accepted: 28 April 2023
Published online: 24 July 2023

References

1. Di Gaeta A, Capobianco E. Chronic extradural spinal hematoma after previous trauma. Eur J Radiol Open. 2015;2:55–7.
2. Iwakuma T, Brunngraber CV. Chronic extradural hematomas: a study of 21 cases. J Neurosurg. 1973;38(4):488–93.
3. McLaurin RL, Ford LE. Extradural hematoma: statistical survey of forty-seven cases. J Neurosurg. 1964;21(5):364–71.
4. King AB, Chambers JW. Delayed onset of symptoms due to extradural hematomas. Surgery. 1952;31(6):839–44.
5. Trivedi A, Hiran S. Calcified epidural hematoma in pediatric age group: a report of two cases. J Neurosci Rural Pract. 2010;1(2):89–91.
6. Lim J, Housley SB, Drumsta D, Spiro RM. Chronic epidural hematoma presenting with diplopia. Surg Neurol Int. 2021;12:420.
7. Kanematsu R, Hanakita J, Takahashi T, Park S, Minami M. Radiologic features and clinical course of chronic spinal epidural hematoma: report of 4 cases and literature review. World Neurosurg. 2018;120:82–9.
8. Agada KN, Adeniran BND, Nyalundja AD, Badirou OBA, Dossou MW, Dzidoula LL, et al. Chronic epidural hematoma : a systematic review and meta-analysis. 2022 [cited 2023 Apr 22]; Available from: https://osf.io/2u45r/.
9. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol. 2005;8:19–32.

10. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467–73.
11. Zotero | Your personal research assistant. [cited 2023 Apr 22]. Available from: https://www.zotero.org/start_standalone.
12. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan: a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):210.
13. jamovi - open statistical software for the desktop and cloud. [cited 2023 Apr 22]. Available from: https://www.jamovi.org/.
14. R: The R Project for Statistical Computing. [cited 2023 Apr 22]. Available from: https://www.r-project.org/.
15. Banga MS, Sandeep BV, Dixit S. Chronic epidural hematoma: still a rare entity? Indian J Neurotrauma. 2021;23–8.
16. Bellotti C, Medina M, Barrale S, Oliveri G, Ettorre F, Sturiale C, et al. Chronic extradural hematomas of the posterior cranial fossa. Surg Neurol. 1987;27(6):580–4.
17. Zuccarello M, Fiore DL, Pardatscher K, Trincia G, Andrioli GC. Chronic extradural haematomas. Acta Neurochir (Wien). 1983;67(1–2):57–66.
18. Sandvig A, Jonsson H. Spontaneous chronic epidural hematoma in the lumbar spine associated with Warfarin intake: a case report. Springerplus. 2016;5(1):1–5.
19. Han SR. Conservative management of a rapidly calcifying epidural hematoma in a young male patient. Interdiscip Neurosurg. 2015;2(4):183–5.
20. Fukatsu S, Ogihara S, Imada H, Ikemune S, Tamaru JI, Saita K. Chronic spontaneous epidural hematoma in the lumbar spine with cauda equina syndrome and severe vertebral scalloping mimicking a spinal tumor: a case report. BMC Musculoskelet Disord. 2022;23(1):1–6.
21. Kaufman HH, Herschberger J, Kopitnik T, McAllister P, Hogg J, Conner T. Chronic extradural haematomas: indications for surgery. Br J Neurosurg. 1992;6(4):359–64.
22. Tatagiba M, Sepehrnia A, El Azm M, Samii M. Chronic epidural hematoma: report on eight cases and review of the literature. Surg Neurol. 1989;32(6):453–8.
23. Merih İ, Aytac CAN, AKGÜL MH. Chronic supra-and infratentorial epidural hematoma. Case report. Turk Neurosurg. 2006;16(4).
24. Sen D, Satija L, Girdhar S. A rare case of chronic idiopathic spinal epidural haematoma. Med J Armed Forces India. 2015;71(Suppl 1):S32-35.
25. Sin EG. Chronic epidural hematoma evacuated through surgical treatment: a case report. J Trauma Inj. 2022;35(1):43–5.
26. Okazaki T, Nakagawa H, Hayase H, Irie S, Inagaki T, Saito O, et al. Idiopathic and chronic epidural hematoma in the lumbar spine: a case report and review of literatures. Neurol Med Chir (Tokyo). 2018;cr-2017.

Publisher's Note