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Research Article

Exploring the Connection Between Family History of Seizures and Post-traumatic Brain Injury Seizure Types: A Retrospective Study

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Abstract

Background: Traumatic brain injury (TBI) is one of the most common presentations to emergency departments and is associated with seizures carrying different significance at different stages following injury. The occurrence of seizures after head injury is a recognized complication of TBI and has been demonstrated to worsen functional outcomes significantly. Despite previous studies identifying various PTS risk factors, our understanding remains limited, particularly regarding familial seizure history.

Materials and Methods: A retrospective study was conducted at King Abdullah University Hospital (KAUH), Jordan, examining 1934 TBI cases from 2017 to 2023, identifying 118 patients with confirmed post-traumatic seizures.

Results: This study involved 118 TBI patients, aged between 2 and 86 years (median 21.5 years), with 74.6% male and 25.4% female. A family history of seizures was reported by 23.7% of patients. Intracerebral hemorrhage (ICH) (52.5%) and subarachnoid hemorrhage (SAH) (38.1%) were the predominant trauma types. Generalized tonic-clonic (GTCs) seizures (69.5%) and focal seizures (30.5%) were observed post-TBI. Among 28 patients with a family history of seizures**,** no evidence of association was observed between the family history and post-traumatic seizure types (GTCs or focal seizures), this was confirmed by performing Chi-square tests ($p = 0.9841$) and logistic regression analysis ($p = 0.79$).

Conclusion: Our findings suggest that there is no evidence of the association between family history and post-traumatic seizure types, implying that a specialized approach for patients with positive family histories may not be warranted. Larger studies are recommended for further validation.

Keywords: TBI, PTS, seizure, epilepsy, family history

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1. Introduction

Traumatic brain injury (TBI) is a common occurrence in emergency departments and is often associated with seizures, which can vary in severity at different stages after the injury [1]. Seizures following head injury are a recognized complication of TBI and can significantly worsen functional outcomes [2]. TBI can lead to various outcomes, ranging from naive spasms to debilitating post-traumatic epilepsy (PTE) [3]. Post-traumatic seizures (PTS) have been classified based on the time of onset after injury, the ones occurring within 24 hr are called “immediate.” “Early seizures” appear between 24 hr and 1 week. Those after 1 week are “late seizures” [4]. Efforts have been made to prevent or minimize the development of post-traumatic epilepsy, with a clear understanding of risk factors and the natural course of the disease being crucial in controlling this costly TBI complication [5]. In a population study, injuries were classified as severe (brain contusion, intracerebral or intracranial hematoma, or 24 hr of either unconsciousness or amnesia). The study found that the risk of post-traumatic seizures after severe injury was 7.1% within 1 year and 11.5% within 5 years [6]. In another study involving 421 veterans with penetrating brain wounds in Vietnam 15 years ago, 53% had post-traumatic epilepsy, with half still experiencing seizures 15 years after the injury. The study also suggested that the location of the lesion may have been more important than its size in determining the likelihood of seizures [7]. This paper aims to provide an overview of the familial risk factors for seizure and their influence on the likelihood of seizure types after TBI, exploring specific relationships with different types of seizures. The long-term goal is to develop a clear understanding of the risk of specific seizure types after TBI in this population, anticipating a significant impact on patient health and outcomes. Furthermore, a comprehensive understanding of this subject could support arguments for implementing a specialized approach in the emergency room, including the use of prophylactic anti-epileptic medication and hospital admission.

2. Materials and Methods

The study was conducted as a cross-sectional retrospective study over a period of 7 months, from June 2023 to January 2024. The data were collected from the medical records of patients admitted to King Abdullah University Hospital (KAUH) between 2017 and 2023. King Abdullah University Hospital (KAUH) is the largest medical structure in the north of Jordan. The hospital Ethics Committee approved the protocol (2023/854).

A total of 1734 cases of traumatic brain injury were identified, from which a representative sample of 118 patients suffering from post-traumatic seizures was analyzed. Demographic data, including age, gender, and family history, were systematically extracted from medical records. While trauma categories and seizure types were classified based on documented clinical manifestations.

Participants exhibited a variety of trauma categories, including intracranial hemorrhage (ICH), sub-arachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH), subdural hemorrhage (SDH), epidural hemorrhage (EDH), brain contusion, and skull fracture. Post-TBI seizure types included generalized tonic-clonic seizures (GTCs) and focal seizures.

To enhance the accuracy of the data, a meticulous approach was adopted, including personalized phone interviews with participants to confirm the reported family history of seizures. Two separate researchers performed standardized phone interviews to guarantee the accuracy of the data.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS). Continuous variables are presented as the mean and standard deviation. Frequency and percentage values were used to present categorical variables. The Chi-square test was used to study the hypothesis. Differences are considered statistically significant if the p-value < 0.05 and highly significant if the p-value < 0.01.

3. Results

Our study included a total of 118 patients with a median age of 21.5 years (ranging from 2 to 86 years). The gender distribution was 74.6% male and 25.4% female. A family history of seizures was reported by 23.7% of patients, while 76.3% had no family history of seizures.

Regarding trauma categories, patients were categorized into various types, with intracerebral hemorrhage (ICH) being the most common at 52.5%, followed by SAH at 38.1. Other trauma categories included subdural hematoma (SDH), (IVH), EDH, and skull fracture. Regarding seizure types, 69.5% of participants experienced GTCs, while 30.5% had focal seizures, the demographics of the included patients are shown in Table **1**.

Table 1: Demographics of the included patients.

Variable		N	%
General characteristics (N = 118)			
Age, Median (Range)		21.5 (2 – 86)	
Gender	Female	30	25.4
	Male	88	74.6
Family history of seizures	Yes	28	23.7
	No	90	76.3
Trauma category	ICH	62	52.5
	SAH	45	38.1
	IVH	20	17
	SDH	34	28.8
	EDH	15	12.7
	Skull Fracture	45	38.1
Seizure type	GTCs	82	69.5
	Focal	36	30.5
Patient outcome	Alive	100	84.7
	Dead	18	15

*ICH: Intracerebral hemorrhage, SAH: Subarachnoid hemorrhage, IVH: Intraventricular hemorrhage, SDH: Subdural hematoma, EDH: Epidural hematoma, GTCs: Generalized tonic-clonic seizures, Focal: Focal Seizures.

In this study, we investigated the association between a family history of seizures and post-traumatic brain injury seizure types. The study consisted of 28 patients with a positive family history of seizures.

Their median age was 20.5 years. Gender distribution analysis showed that among patients with a family history, 33.3% were females and 66.7% were males. Analysis of seizure types, including GTC seizures and focal seizures, did not show any significant correlations with family history. Both positive and negative cases of GTCs and focal seizures demonstrated similar proportions between patients with and without a family history.

The analysis aimed to evaluate the correlation between family history of seizures and different seizure types following TBI, using Chi-square tests for statistical analysis.

Regarding family history of seizures and different seizure types following TBI, there is no evidence of the association between the family history and post-traumatic seizure types (χ^2 = 0.0004, p = 0.9841), Table **2**.

Table 2: Summary of the association between family history of seizures and types of seizures occurred post-TBI. Chi-square tests were used to determine the statistical significance of the associations.

GTCs		Family history of seizure (N = 118)					
		Negative		Positive		Total	
		N	%	N	%	N	%
Negative		28	77.8	8	22.2	36	31
Positive		62	75.6	20	24.4	82	70
Total		90	76	28	24	118	100
Chi-square	X^2	0.0004					
	P-value	0.9841					

In the binary logistic regression analysis investigating the predictive relationship between family history of seizures and seizure type post-TBI, the odds ratio for the family history of seizure variable was estimated to be 1.13, with a 95% confidence interval. However, the associated p-value of 0.79 indicates that this coefficient lacks statistical significance. Thus, there appears to be no evidence of the association between family history of seizures and the incidence of seizure type post-TB.

4. Discussion

TBI frequently occurs in clinical practice and can vary from mild to severe, often resulting in significant and long-term effects on those affected. Seizures are one of the most common complications of TBI. Studies have shown that both genetic and acquired factors play important roles in the development of seizures, underscoring the importance of examining the influence of family history on the development of seizures [8, 9]. This study will specifically focus on the impact of a family history of seizures on the type of seizure experienced following brain trauma.

Among the 118 individuals selected for the study due to confirmed TBI and subsequent post-TBI seizures, only 28 cases reported a family history of seizures. Of these 28 cases, approximately 71% experienced GTC seizures. This initially suggests a potential association. However, when examining post-TBI patients without a family history of seizures, a similar GTC seizure rate of about 69% is observed.

To better understand these findings, it is essential to analyze the demographics of the participants and consider the study's potential limitations.

It is important to note that no specific pattern in the type of seizure following brain trauma was observed in several previous studies [10]. However, it was also found that up to two-thirds of seizures post-trauma were generalized or focal with secondary generalization [10]. In our study, it is worth mentioning that GTC seizures were observed in 69.5% of cases, which is consistent with some previous research [11]. However, according to Da Silva et al., the majority of cases in his research were partial seizures, with only 37.6% being GTC seizures [12]. This discrepancy could be explained by the presence of several possible etiologies, including the blood-brain barrier disruption and iron deposition caused by trauma, oxidative stress, and glutamate excitotoxicity, resulting in epigenetic alterations leading to seizures [13].

In our study, we found that 74.6% of patients were male, with a median age of 21.5 years. This demographic distribution can be explained by the tendency of men, particularly young men, to engage in more risky activities compared to women, leading to higher levels of physical activity and consequently increased susceptibility to trauma. This finding is consistent with a study by Zhao et al. conducted in China, which also reported a male predominance in post-brain trauma seizures, with the highest incidence observed among individuals aged between 20 and 29 [14].

In the context of trauma, it is important to note that SAH is no longer considered a rare cause of post-brain trauma seizures, as up to 25% of cases may present with GTC seizures at the onset of bleeding, according to several sources [15-18]. Additionally, seizures occurring at the onset of SAH have been associated with worse outcomes [15]. Other studies have indicated that seizures are more common in patients with cortical injuries, particularly those with hemorrhages, subdural hematomas, or epidural hematomas [19, 20]. Our study also observed this trend, with nearly half of the post-brain trauma seizure patients presenting with ICH and approximately 38.1% experiencing SAH.

Our research represents a pioneering effort to examine the impact of a family history of seizures on the types of seizures following brain trauma. Although no evidence of the association between family history of seizures and seizure types in TBI patients was found, several limitations were identified. This study was a retrospective study conducted at a single medical center, and the data were limited to discharge outcomes. Furthermore, other variables may also play a significant role in determining seizure types post-TBI as shown in our study. Therefore, further investigation into the influence of family history of seizures on post-TBI seizure types is warranted, employing a more effective, multi-institutional approach to provide deeper insights into this topic.

5. Conclusion

This study examined the impact of family history on the types of seizures experienced after TBI in 118 patients. Among them, 28 had a family history of seizures, with 71% experiencing GTC seizures, a rate similar to those without a family history, suggesting no evidence of the association. The findings align with existing research showing high GTC seizure prevalence post-TBI, despite some studies reporting a predominance of partial seizures due to different underlying mechanisms. A predominance of young male patients was observed, consistent with higher risk-taking behaviors in this group. The study also highlighted significant occurrences of seizures in patients with SAH and ICH, linking cortical injuries to post-TBI seizures. While pioneering, the study's retrospective, single-center design and focus on discharge outcomes are limitations. Further multi-institutional research is needed to explore genetic and acquired factors influencing seizure outcomes in TBI patients, potentially improving clinical interventions.

Author Contributions

Suleiman Daoud: Conceptualization, writing- original draft preparation; Rasha S. Mustafa: Conceptualization, writing- original draft preparation; Almutazballlah Qablan: Methodology, writing- original draft preparation; Yasmeen Jamal Alabdallat: Methodology, software, Adam M. Abdallah: Data curation, and writing, Mohammad Alsharman: Data curation, and writing, Amer Jaradat: Writing- reviewing and editing, Sultan Jarrar: Writing- reviewing and editing, Mohammad A Jamous: Writing- reviewing and editing, Mohemmed M. Al Barbarawi: Supervision, Atef F. Hulliel: Writing- reviewing and editing, Omar Ahmad: Writing- reviewing and editing.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Artificial Intelligence (AI) Disclosure Statement

AI-unassisted work.

Data Availability

Data sets are not available publicly due to privacy and security. However, the current study's datasets are available upon reasonable request from the corresponding author.

Ethics Statement

All subjects participated voluntarily. The study was approved by the institutional review board of Jordan University of Science and Technology (Ref: 90/164/2023, Date: 12.11.2023). The Declaration of Helsinki was adequately addressed. Consent forms were not required as per the decision of the institutional review board, under the condition of maintaining data confidentiality and using it only for scientific purposes.

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References

[1] Fordington S, Manford M. A review of seizures and epilepsy following traumatic brain injury. J Neurol. 2020 Oct;267(10):3105–3111.

[2] Asikainen I, Kaste M, Sarna S. Early and late posttraumatic seizures in traumatic brain injury rehabilitation patients: Brain injury factors causing late seizures and influence of seizures on long-term outcome. Epilepsia. 1999 May;40(5):584–589.

[3] Anwer F, Oliveri F, Kakargias F, Panday P, Arcia Franchini AP, Iskander B, et al. Post-traumatic seizures: A deep-dive into pathogenesis. Cureus. 2021 Apr;13(4):e14395.

[4] DeGrauw X, Thurman D, Xu L, Kancherla V, DeGrauw T. Epidemiology of traumatic brain injury-associated epilepsy and early use of anti-epilepsy drugs: An analysis of insurance claims data, 2004-2014. Epilepsy Res. 2018 Oct;146:41–49.

[5] Frey LC. Epidemiology of posttraumatic epilepsy: A critical review. Epilepsia. 2003;44 s10:11–17.

[6] Annegers JF, Grabow JD, Groover RV, Laws ER Jr, Elveback LR, Kurland LT. Seizures after head trauma: A population study. Neurology. 1980 Jul;30(7 Pt 1):683–689.

[7] Salazar AM, Jabbari B, Vance SC, Grafman J, Amin D, Dillon JD. Epilepsy after penetrating head injury. I. Clinical correlates: A report of the Vietnam Head Injury Study. Neurology. 1985 Oct;35(10):1406–1414.

[8] Steinlein OK. Genetics and epilepsy. Dialogues Clin Neurosci. 2008;10(1):29–38.

[9] Guerrini R, Casari G, Marini C. The genetic and molecular basis of epilepsy. Trends Mol Med. 2003 Jul;9(7):300–306.

[10] Lamar CD, Hurley RA, Rowland JA, Taber KH. Post-traumatic epilepsy: Review of risks, pathophysiology, and potential biomarkers. J Neuropsychiatry Clin Neurosci. 2014 Apr;26(2):iv-113.

[11] Kodankandath TV, Theodore D, Samanta D. Generalized tonic-clonic seizure, in StatPearls. 2024: Treasure Island (FL) ineligible companies. Disclosure: Danny Theodore declares no relevant financial relationships with ineligible companies. Disclosure: Debopam Samanta declares no relevant financial relationships with ineligible companies.

[12] da Silva AM, Nunes B, Vaz AR, Mendonça D. Posttraumatic epilepsy in civilians: Clinical and electroencephalographic studies. Acta Neurochir Suppl (Wien). 1992;55:56–63.

[13] Tunthanathip T. Chapter 8: Seizures in traumatic brain injury: A focus on cellular aspects. In: Rajendram R, Preedy VR, Martin CR, editors. Cellular, molecular, physiological, and behavioral aspects of traumatic brain injury. Academic Press; 2022. pp. 95–105.

[14] Zhao Y, Wu H, Wang X, Li J, Zhang S. Clinical epidemiology of posttraumatic epilepsy in a group of Chinese patients. Seizure. 2012 Jun;21(5):322–326.

[15] Bögli SY, Wang S, Romaguera N, Schütz V, Rafi O, Gilone M, et al. Impact of seizures and status epilepticus on outcome in patients with aneurysmal subarachnoid hemorrhage. Neurocrit Care. 2022 Jun;36(3):751–759.

[16] Labak CM, Shammassian BH, Zhou X, Alkhachroum A. Multimodality monitoring for delayed cerebral ischemia in subarachnoid hemorrhage: A mini review. Front Neurol. 2022 Apr;13:869107.

[17] Rhoney DH, Tipps LB, Murry KR, Basham MC, Michael DB, Coplin WM. Anticonvulsant prophylaxis and timing of seizures after aneurysmal subarachnoid hemorrhage. Neurology. 2000 Jul;55(2):258–265.

[18] Sundaram MB, Chow F. Seizures associated with spontaneous subarachnoid hemorrhage. Can J Neurol Sci. 1986 Aug;13(3):229–231.

[19] Gottesman RF, Komotar R, Hillis AE. Neurologic aspects of traumatic brain injury. Int Rev Psychiatry. 2003 Nov;15(4):302–309.

[20] Greene KA, Jacobowitz R, Marciano FF, Johnson BA, Spetzler RF, Harrington TR. Impact of traumatic subarachnoid hemorrhage on outcome in nonpenetrating head injury. Part II: Relationship to clinical course and outcome variables during acute hospitalization. J Trauma. 1996 Dec;41(6):964–971.