The Diagnostic Value of 24-Hour Video-Eeg Monitoring in Pediatric Epilepsy

Markus Rauchenzauner[1,2,*], Lena Romberg[1], Gabriele Unterholzner[1], Katerina Weber[1], Jutta Einsle[1], Evelin Beck[1], Ina Kaufmann[1], Birgitt Häberle[1] and Katharina Schiller[1,3,*]

[1]Hospital Group Ostallgaeu-Kaufbeuren, Department of Pediatric Neurology, Kaufbeuren, Germany

[2]Medical University Innsbruck, Department of Pediatrics, Innsbruck, Austria

[3]University Hospital Augsburg, Department of Pediatric Neurology, Augsburg, Germany

Abstract: Epilepsy is one of the most frequent chronic neurological diseases in childhood. Numerous differential diagnoses lead to a high risk of misinterpretation due to similar seizure semiology. Longer EEG recordings such as 24-hour video-EEG monitorings can enhance sensitivity and specificity to diagnose epilepsy. The goal of this study was to determine the diagnostic value of 24-hour video-EEG monitoring. Therefore, 105 children (8.5 $\pm$ 4.7 years, 37 female) who underwent 24-hour video-EEG in the monitoring unit were included in this study. Epilepsy was newly diagnosed in 28 children (26.7%) and ruled out in 17 children (16.2%). The monitoring led to a change in epilepsy classification in 8 children (7.6%). Antiseizure medication was modified in 50 patients (47.6%). Children with pathological EEGs with IEDs were more likely to be diagnosed with epilepsy than those without IEDs (p=0.047). Further, epilepsy was more often ruled out in children without IEDs than in those with IEDs (p=0.037). No complications were registered during the monitoring. In conclusion, the use of 24h-video-EEG-monitoring can improve diagnostic accuracy in clinical practice and enhance long-term management in pediatric epilepsy while being non-invasive with absent complications when implemented in pediatric patients.

Keywords: Epilepsy, Children, Video-EEG, seizure, 24h EEG monitoring.

INTRODUCTION

Epilepsy is one of the most common neurological diseases and about 50% of affected individuals experience onset during childhood [1]. Epilepsy can present with a wide variety of symptoms and has a highly variable course [2]. Cerebral seizures occur in 4–5% of all children at least once during childhood [3]. They can be classified into epileptic seizures and non-epileptic seizures (*e.g.*, psychogenic seizures, convulsive syncope, reflex syncope, affective seizures) [4]; misinterpretations are common because the seizures often present similarly in appearance.

The electroencephalogram (EEG) often provides reliable findings only after repeated recordings, sleep deprivation, or sleep recordings [5]. Seizures may not always be captured, but epileptic seizures are likely if interictal epileptiform discharges (IEDs) are present. Only about 3% of healthy children show IEDs in EEGs [6]. In many childhood epilepsy syndromes, abnormalities only appear during sleep, and the sensitivity to detect IEDs is increased during sleep [7]. Additionally, muscle and motion artifacts are reduced, focal abnormalities may be activated, and occipital IEDs may become more visible due to reduced background activity [6]. In focal epilepsy, hypersynchronous activity may also become apparent during sleep [8]. In about 15% of children with epilepsy, no EEG changes are visible initially due to infrequent discharges or a deep seizure focus [9]. A timely diagnosis is of high importance as diagnostic delays were found to be associated with substantial decrements in development and IQ later in childhood [10].

If routine and sleep EEGs are unsuccessful, longer recordings are recommended [5]. Invasive and non-invasive video-EEG monitoring is also used in children before epilepsy surgery to localize the seizure focus [11]. The 24-hour video-EEG monitoring, with synchronized video and EEG including sleep periods, meets many criteria relevant for diagnosing epilepsy in children and adolescents. As systematic studies about the value of 24-hour video-EEG monitoring without medication withdrawal are rare, this study investigated its clinical significance under stable antiseizure medication.

METHODS

Study population

The 24-hour video-EEG monitoring was conducted in children who: i) already had a diagnosed epilepsy (for disease course evaluation), ii) showed indications of epilepsy without a confirmed diagnosis [12], or iii) had a high suspicion of epilepsy (to confirm or exclude

*Address correspondence to this author at the Hospital Group Ostallgaeu-Kaufbeuren, Department of Pediatric Neurology, Dr.-Gutermann-Str. 2, 87600 Kaufbeuren, Bavaria, Germany; Tel: +49 8341 42 2206 | Fax: +49 8341 42 2231; E-mail: katharina.schiller@kliniken-oal-kf.de; markus.rauchenzauner@kliniken-oal-kf.de

Received on 25-09-2025 Accepted on 05-11-2025 Published on 10-11-2025

E-ISSN: 2311-8687/25

the diagnosis). Physician reports, EEG results, and monitoring findings of all consecutive children aged 0–17 years who underwent 24-hour video-EEG monitoring at Kaufbeuren Children's Hospital between August 1, 2015, and May 1, 2018, were reviewed. If a patient had more than one monitoring session, only the first was included. Finally, 105 patients (8.5 ± 4.7 years, 37 female) fulfilled the inclusion criteria. A 1-year follow-up was available for 85 children. The patients were divided into four groups:

1. Children with an epilepsy diagnosis before monitoring
2. Children with pathological EEG and IEDs but no epilepsy diagnosis
3. Children with pathological EEG without IEDs
4. Children with normal EEG before monitoring

This study was approved by the local Ethics board. As this research was retrospective, informed consent was waived.

EEG monitoring

Patients underwent a 24-hour video-EEG in the monitoring unit with 20 EEG electrodes placed according to the 10–20 system. For safety reasons, the ASM were not discontinued during the 24-hour video-EEG monitoring. In many centers, antiepileptic medications are reduced or stopped to provoke seizures [13]. Rapid withdrawal can lead to quicker seizure occurrence and shorten the monitoring time [14]. This can facilitate the analysis of IEDs potentially helping in localizing seizure foci [15]. Simultaneously recorded video supports identification of affected brain areas based on semiology [15].

Statistics

Statistical analyses were performed using SPSS Statistics Version 25 (IBM Corp., Armonk, New York) using descriptive statistics with a confidence interval of 0.95. A p-value <0.05 was considered to indicate statistical significance. For the correlation analyses, Phi-/Cramer V Test was applied. To compare the groups, an ANOVA was calculated with the additional Post-Hoc-Test Scheffè tests.

RESULTS

Before the monitoring

Patients were assigned to four groups (Table **1**). In 65.9% of patients with a diagnosis of epilepsy, epilepsy could be clearly cassified. Of the children on antiseizure medication before monitoring, 32 (88.9%) had a diagnosed epilepsy and 4 (11.1%) had pathological EEGs with IEDs but no confirmed epilepsy diagnosis. Parental observations of suspected seizures included tonic-clonic episodes, falls, loss of consciousness, muscle stiffening, myoclonus, automatisms, abnormal head movements, absences, syncope, teeth grinding, headaches, behavioral problems, and apnea. Some parents presented their children due to suspected consequences of epilepsy, such as developmental delays, poor concentration, declining school performance, daytime sleepiness, or enuresis.

Table 1: Patients were Grouped into Four Groups before Undergoing EEG Monitoring

	Number n (%)
Epilepsy diagnosed	41 (39)
Pathological EEG with IEDs	43 (41)
Pathological EEG without IEDs	6 (5.7)
Normal EEG	15 (14.3)

After the monitoring

From the 105 monitorings, 20 children (19.0%) had clinical seizures during monitoring. Seizure types ranged from focal seizures, absences, eyelid or limb myoclonus, myoclonic-astatic seizures to tonic and clonic seizures. 75 children (71.4%) showed IEDs in the EEG. In 28 children (27.2%), a new epilepsy diagnosis could be established (Figure **1**, Table **2**). In 17 children (16.6%) epilepsy was ruled out due to the following differential diagnoses: psychogenic seizures, circulatory dysfunction, endocrine issues, convulsive syncope, behavioral disorders. complex febrile seizure, oral twitching during stuttering and seizure-like activity

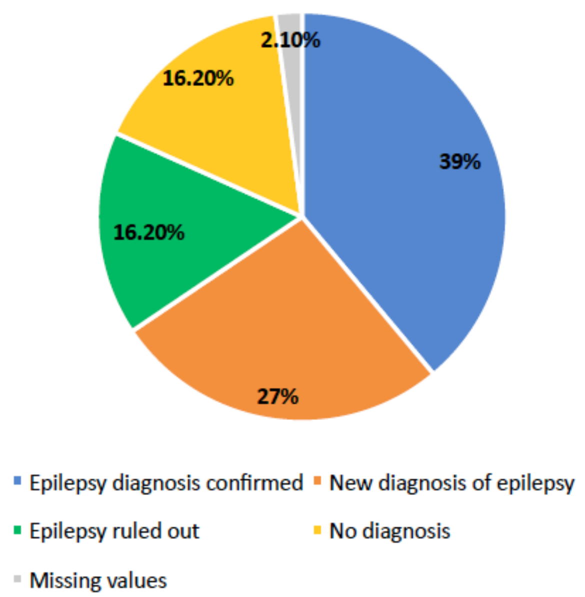

Figure 1: The different outcomes after the monitoring.

in a breastfed infant (possibly due to maternal lamotrigine). Among these, 2 children (1.9%) had previously unknown status-like discharges and 3 children (2.9%) were newly diagnosed with Electrical Status Epilepticus in Sleep syndrome. In 8 children (7.6%) classification of epilepsy was changed. In 50 patients (47.6%), monitoring led to changes in antiseizure medication.

Table 2: The Number of each Outcome after Undergoing 24h-EEG Monitoring

	Number n (%)
Epilepsy diagnosis confirmed	41 (39.0)
New diagnosis of epilepsy	28 (26.7)
Epilepsy ruled out	17 (16.2)
No diagnosis	17 (16.2)
Missing values	2 (1.9)

One-Year-Follow-up

In the one-year follow-up, 43 children (51.2%) continued to experience clinical seizures. 56 children (66.7%) still had IEDs in the EEG. Thirty-five children (41.7%) underwent further changes in antiseizure medication. There was a statistically significant correlation between seizure freedom and new epilepsy diagnosis (phi=0.35, p=0.007). Within patients who had received a new diagnosis through the monitoring, 13 children (52%) were seizure free at follow-up.

Group differences

The four groups differed significantly regarding new diagnoses (p<0.001) and exclusions (p<0.001) (Table 3). Children with pathological EEGs with IEDs were more likely to be diagnosed with epilepsy than those without IEDs (p=0.047, mean difference z = 0.37, confidence interval 95% [0.02, 0.72]). Epilepsy was more often ruled out in children without IEDs than in those with IEDs (p=0.037, mean difference z = 0.47, confidence interval 95% [0.00, 0.95]).

Parental Assessment

Most children who showed abnormalities in the monitoring or received a new diagnosis of epilepsy had parents who reported seizure-like symptoms. However, such reports were also common among children in whom epilepsy was ultimately ruled out, especially those with psychogenic seizures indicating frequent confusion with non-epileptic events.

Complications

No complications occurred during the 24-hour monitorings.

DISCUSSION

This study demonstrates that 24-hour video-EEG monitoring has substantial diagnostic value in the evaluation of pediatric patients with suspected epilepsy. In our cohort, a new diagnosis of epilepsy was established in more than one quarter of children, while epilepsy was ruled out in approximately one sixth of cases. These findings highlight the utility of prolonged EEG recordings, which extend beyond the capabilities of routine or sleep EEGs, in differentiating epileptic from non-epileptic events.

Our results are in line with recent studies showing that extended video-EEG monitoring significantly improves diagnostic yield [16]. Importantly, nearly half of our patients underwent ASM modifications based on the findings in the monitoring. This is consistent with findings that long-term video-EEG monitoring in pediatric patients frequently influenced diagnosis, classification, and treatment [17]. At one-year follow-up, children with newly diagnosed epilepsy were more likely to achieve seizure freedom, highlighting the long-term therapeutic relevance of early diagnostic clarification through video-EEG.

The strong association between IEDs and confirmed epilepsy in our cohort is in line with results showing that IEDs could serve as a predictor of seizure recurrence after a first unprovoked seizure [18].

Table 3: The Differences between Patient Groups Regarding IEDs during Monitoring, Seizures during Monitoring, new Diagnosis Of epilepsy and Epilepsy Ruled out

	Patients n (%)			
	Epilepsy Diagnosis	Pathological EEG with IEDs	Pathological EEG without IEDs	Normal EEG
IEDs during monitoring	37 (49.3)	32 (42.7)	3 (4.0)	3 (4.0)
Seizures during monitoring	15 (75.0)	5 (25.0)	0	0
New diagnosis of epilepsy	0	25 (89.3)	1 (3.6)	2 (7.1)
Epilepsy ruled out	0	5 (41.7)	2 (16.6)	5 (41.7)

Moreover, recent work has linked frequent IEDs with impaired cognitive and academic performance in children, underlining the importance of accurate detection not only for seizure management but also for broader neurodevelopmental outcomes [19].

Additionally, international guidelines, as well as routine practice in many centers, often recommend video-EEG monitoring over multiple days ranging from 48 to 72 hours or longer particularly in presurgical diagnostics or complex epilepsy cases [5, 14]. Longer recordings may increase the probability of capturing spontaneous seizures and allow for more comprehensive seizure classification [16, 17]. Nevertheless, our findings indicate that already a 24-hour video-EEG monitoring can provide substantial diagnostic and therapeutic benefit in pediatric patients, without the risks of medication tapering and with greater feasibility in routine settings. This suggests that shorter monitoring periods should be more widely considered as an option in diagnostically uncertain cases.

Beyond the diagnostic accuracy, the broader implications for pediatric healthcare are important. Early and accurate diagnosis of epilepsy allows timely intervention, which can prevent delays in treatment and improve long-term developmental outcomes [10, 20]. Furthermore, minimizing the period of the diagnostic process can reduce parental anxiety and stress which is often increased in families with children with epilepsy [21, 22].

A notable strength of this study is the use of 24-hour monitoring under stable antiseizure medication, which avoids the risks associated with medication withdrawal and reflects real-world clinical practice. The absence of complications further demonstrates the safety and feasibility of this approach. Nonetheless, some limitations should be mentioned. This was a single-center study with a moderate sample size, which may limit generalizability and may underlie a selection bias. In addition, although we obtained a one-year follow-up in most patients, a longer follow-up would be helpful to assess sustained seizure control and cognitive outcomes. Despite these limitations, our findings support the integration of 24-hour video-EEG monitoring into the diagnostic pathway for children with suspected epilepsy, especially in cases with inconclusive routine EEGs.

CONCLUSION

Epilepsy presents variably in children and has many differential diagnoses. International guidelines recommend routine awake and sleep EEGs, but longer recordings should be considered when results are inconclusive. This study supports the use of 24-hour video-EEG monitoring due to its non-invasiveness, diagnostic clarity, strong correlation with clinical outcomes as well as safety and practicality. It is particularly useful for children with abnormal EEGs and IEDs who lack a confirmed epilepsy diagnosis. Monitoring in these cases frequently leads to new diagnoses, more precise classifications, greater seizure control, and improved EEG findings over time. Pediatric neurologists should consider incorporating 24-hour EEG-monitoring earlier in the diagnostic workflow particularly when routine EEGs yield inconclusive results. This approach not only enhances diagnostic efficiency but also facilitates earlier treatment optimization and family reassurance. In conclusion, 24-hour video-EEG monitoring should be considered early in the diagnostic process when epilepsy is suspected — especially in complex or unclear cases — and used not only for diagnosis but also for therapeutic optimization and broader psychosocial benefit.

DISCLOSURE STATEMENT

Financial disclosure

None

Non-financial disclosure

None

Ethical Statement

This study was approved by the local Ethics board. As this research was retrospective, informed consent was waived.

Acknowledgement

We wish to show our appreciation to the patients and the clinical and research team at the Department of Neurology at the Hospital Kaufbeuren.

REFERENCES

[1] Stafstrom CE, Carmant L. Seizures and epilepsy: an overview for neuroscientists. Cold Spring Harb Perspect Med. 2015; 5(6). https://doi.org/10.1101/cshperspect.a022426

[2] Milligan TA. Epilepsy: A Clinical Overview. Am J Med. 2021; 134(7): 840-7. https://doi.org/10.1016/j.amjmed.2021.01.038

[3] Friedman MJ, Sharieff GQ. Seizures in children. Pediatr Clin North Am. 2006; 53(2): 257-77. https://doi.org/10.1016/j.pcl.2005.09.010

[4] Leibetseder A, Eisermann M, LaFrance WC, Jr., Nobili L, von Oertzen TJ. How to distinguish seizures from non-epileptic manifestations. Epileptic Disord. 2020; 22(6): 716-38. https://doi.org/10.1684/epd.2020.1234

[5] Peltola ME, Leitinger M, Halford JJ, Vinayan KP, Kobayashi K, Pressler RM, *et al*. Routine and sleep EEG: Minimum

recording standards of the International Federation of Clinical Neurophysiology and the International League Against Epilepsy. Epilepsia. 2023; 64(3): 602-18. https://doi.org/10.1111/epi.17448

[6] György I. [Epilepsy in childhood: diagnosis and therapy]. Orv Hetil. 2005; 146(20): 1003-8.

[7] Sunwoo JS. Influence of sleep on seizures and interictal epileptiform discharges in epilepsy. Encephalitis. 2025; 5(1): 1-5. https://doi.org/10.47936/encephalitis.2024.00087

[8] Ernst K, Erhard B, Fearns N, Birk D, Rémi J. Circadian rhythm and sleep in focal epilepsy. Epilepsy Behav. 2025; 167: 110395. https://doi.org/10.1016/j.yebeh.2025.110395

[9] Kliegman R, Stanton B, Geme S, Schor N, Behrman R. Nelson textbook of pediatrics, Philadelphia, Publisher. Elsevier Saunders; 2016.

[10] Berg AT, Loddenkemper T, Baca CB. Diagnostic delays in children with early onset epilepsy: impact, reasons, and opportunities to improve care. Epilepsia. 2014; 55(1): 123-32. https://doi.org/10.1111/epi.12479

[11] Fung FW, Libenson MH, Bolton J, Pearl PL, Kapur K, Marti C, *et al*. Seizure clustering during presurgical electroencephalographic monitoring in children. Epilepsy Behav. 2018; 80: 291-5. https://doi.org/10.1016/j.yebeh.2018.01.013

[12] Scheffer IE, Berkovic S, Capovilla G, Connolly MB, French J, Guilhoto L, *et al*. ILAE classification of the epilepsies: Position paper of the ILAE Commission for Classification and Terminology. Epilepsia. 2017; 58(4): 512-21. https://doi.org/10.1111/epi.13709

[13] Kumar S, Ramanujam B, Chandra PS, Dash D, Mehta S, Anubha S, *et al*. Randomized controlled study comparing the efficacy of rapid and slow withdrawal of antiepileptic drugs during long-term video-EEG monitoring. Epilepsia. 2018; 59(2): 460-7. https://doi.org/10.1111/epi.13966

[14] Pressler RM, Seri S, Kane N, Martland T, Goyal S, Iyer A, *et al*. Consensus-based guidelines for Video EEG monitoring in the pre-surgical evaluation of children with epilepsy in the UK. Seizure. 2017; 50: 6-11. https://doi.org/10.1016/j.seizure.2017.05.008

[15] Schulze-Bonhage A, Zentner J. Prächirurgische Epilepsiediagnostik und operative Epilepsietherapie. Dtsch Arztebl International. 2014; 111(18): 313-9.

[16] Zhang Q, Zheng W, Jean S, Lai F, Liu W, Song S. The Utility of 24-h Video-EEG Monitoring in the Diagnosis of Epilepsy in Children. Clin EEG Neurosci. 2025; 56(2): 197-203. https://doi.org/10.1177/15500594241286684

[17] Mann C, Willems LM, Leyer AC, Freiman TM, Konczalla J, Kieslich M, *et al*. Benefits, safety and outcomes of long-term video EEG monitoring in pediatric patients. Eur J Paediatr Neurol. 2021; 32: 29-35. https://doi.org/10.1016/j.ejpn.2021.03.006

[18] Baykan B, Dunne J, Wiebe S, Maillard L, Beniczky S, Koutroumanidis M, *et al*. Presence of interictal epileptiform EEG discharges implies increased risk of recurrence after the first unprovoked seizure: Report of the International League Against Epilepsy and International Federation of Clinical Neurophysiology. Epilepsia. 2025. https://doi.org/10.1111/epi.18591

[19] Cheng D, Yan X, Xu K, Zhou X, Chen Q. The effect of interictal epileptiform discharges on cognitive and academic performance in children with idiopathic epilepsy. BMC Neurol. 2020; 20(1): 233. https://doi.org/10.1186/s12883-020-01807-z

[20] Khan A, Lim H, Almubarak S. Importance of prompt diagnosis in pediatric epilepsy outcomes. Seizure. 2020; 80: 24-30. https://doi.org/10.1016/j.seizure.2020.03.011

[21] Jones C, Reilly C. Parental anxiety in childhood epilepsy: A systematic review. Epilepsia. 2016; 57(4): 529-37. https://doi.org/10.1111/epi.13326

[22] Schiller K, Dassi C, Berrahmoune S, Frauscher B, Myers KA. Sociocultural Factors Influence on Burden and Stress of Caregivers of Children with Epilepsy. Can J Neurol Sci. 2024: 1-14. https://doi.org/10.1017/cjn.2024.271

https://doi.org/10.12974/2311-8687.2025.13.06