Prolonged Seizure with Respiratory Arrest in a Resource-Limited Setting during a Global Health Service Trip

Keywords

seizure emergency; ictal central apnea; epilepsy; global health; resource-limited setting

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Abstract

Seizure emergencies in low-resource settings present unique challenges because of limited access to diagnostics, antiseizure medications, and emergency services. Global health literature emphasizes the importance of rapid, coordinated interventions when standard treatments are unavailable. During an annual service-learning trip in the Dominican Republic, an adolescent patient with a history of transient loss of consciousness presented to a temporary outreach clinic. While awaiting referral planning, the patient became emotionally distressed and developed a generalized tonic–clonic seizure, followed by recurrent seizures and apnea. A care team including medical students, residents, nurses, pharmacists, and attending physicians provided continuous monitoring and supportive management with airway protection, bag-valve-mask ventilation, intravenous access, and dextrose-containing fluids. No antiepileptic diagnostic equipment or medications were available. The patient experienced prolonged seizure activity with recurrent respiratory arrest, suspected to represent ictal central apnea (ICA). Oxygen saturation fell to the low 70s but stabilized above 92% with sustained ventilation. We hypothesize that recurrent episodes of respiratory arrest represented ICA, contributing substantially to the severity of presentation. Emergency care continued for approximately 30 to 60 minutes until transfer by emergency medical services. The patient was later hospitalized and discharged without neurologic deficits. This case highlights the clinical and logistical challenges of managing seizure emergencies in resource-limited environments and underscores the lifesaving potential of rapid, coordinated interdisciplinary action. Even without access to pharmacologic therapy or advanced diagnostics, effective teamwork and decisive supportive care proved critical.

Introduction

Seizures remain a significant global health concern, affecting millions worldwide and contributing substantially to morbidity, mortality, and reduced quality of life. The point prevalence of active epilepsy is estimated at 6.4 per 1000 people, with a lifetime prevalence of approximately 7.6 per 1000 and an annual incidence of 61 per 100,000 person-years.[1,2] The burden is disproportionately higher in low- and middle-income countries, particularly in rural and remote regions, where limited access to health care infrastructure, diagnostic tools, and pharmacologic therapies substantially impedes effective management.[3,4]

In these settings, preventable or acquired neurologic insults, including central nervous system infections, perinatal brain injuries, traumatic brain injuries, and metabolic disturbances, contribute to a higher prevalence of epilepsy.[5,6] Despite this elevated disease burden, up to 75% of individuals with epilepsy in low- and middle-income countries remain untreated. This situation represents a substantial disparity driven by systemic challenges such as antiseizure drug shortages, lack of trained providers, scarce diagnostic resources, and sociocultural stigma.[7,8] Together, these barriers accentuate an urgent need for adaptable, evidence-based seizure management strategies that can be feasibly integrated into rural health systems.[9,10]

Seizure emergencies in resource-limited contexts underscore the importance of interdisciplinary preparedness and adaptive clinical reasoning. In such environments, where electroencephalography (EEG), neuroimaging, and abortive therapies may be unavailable, management often relies on rapid recognition of semiology, airway protection, and supportive care, particularly when confronting rare but life-threatening seizures complicated by ictal central apnea (ICA).[11]

Emerging clinical research has emphasized the significance of ICA as a semiologic marker with both diagnostic and prognostic implications. ICA, defined as a transient cessation of breathing during seizures, occurs most frequently in focal epilepsies of temporal lobe origin and is strongly associated with mesial temporal structures, particularly the amygdala and hippocampus.[12,13] Mesial temporal lobe epilepsy, one of the most prevalent and treatment-resistant focal epilepsies in children, is often associated with mesial temporal sclerosis, a common cause linked to early brain injury or febrile seizures.[14] Furthermore, experimental and clinical studies demonstrate that amygdala involvement in seizure propagation can directly disrupt respiratory regulation, resulting in apnea even in the absence of overt motor features.[15,16] Clinically, ICA may present as abrupt behavioral arrest, fear, or unresponsiveness, which may represent subtle signs that are easily overlooked, particularly in children.

Importantly, ICA often precedes scalp EEG seizure onset by several seconds, conferring diagnostic value in the early recognition of focal seizures.[17,18] In a large prospective cohort study, ICA was observed in 47% of patients with focal epilepsy, with temporal lobe epilepsy demonstrating a significantly higher association with ICA than extratemporal epilepsies.[15–17,19,20] Similarly, a multicenter study of 126 patients showed that ICA occurred exclusively in focal epilepsy, involving 36.5% of seizures, frequently preceding EEG onset and, in some cases, representing the sole clinical manifestation of seizure activity; temporal lobe epilepsy again showed a strong association with ICA.[15] Further supporting its localization value, a prospective intracranial EEG study demonstrated that the presence of ICA predicted mesial temporal seizure onset with approximately fourfold greater odds and high specificity, implicating mesial temporal structures such as the amygdala and hippocampus in seizure propagation.[21] Recognition of ICA may therefore aid in anatomo-electroclinical correlation and inform electrode placement, a critical step in presurgical evaluation to guide treatment. In addition, small case series have documented ICA as the initial or primary seizure manifestation in patients with temporal lobe epilepsy, underscoring its potential to occur subclinically and to serve as a subtle but localizing semiologic feature.[13,22]

Although the sensitivity of ICA remains limited, its relative specificity for mesial temporal seizure onset supports its role as a noninvasive semiologic biomarker. Collectively, these findings highlight the growing clinical relevance of ICA in seizure localization and diagnostic evaluation while underscoring the need for further studies to determine its effect on clinical outcomes and management strategies.

During an annual service-learning trip in the Dominican Republic, medical trainees and clinicians encountered a pediatric patient with prolonged seizures complicated by recurrent respiratory arrest. This paper presents the case, which illustrates the challenges and opportunities for improving seizure care in underserved global health settings and highlights the diagnostic utility of ICA in the absence of advanced resources. By situating the case within the broader literature on seizure semiology and global health, we aim to emphasize scalable strategies for seizure recognition and management in resource-limited environments.

Case Report

An adolescent patient presented to a temporary outreach clinic during an annual service-learning trip in a rural setting in the Dominican Republic for evaluation of recurrent episodes of transient loss of consciousness. History was obtained from the patient and caregiver with interpreter assistance.

The patient reported recurrent episodes over several months characterized by brief loss of consciousness with rapid return to baseline. Episodes were sometimes associated with reduced oral intake and heat exposure. The patient described emotional distress preceding some episodes. No prodromal palpitations, chest pain, dyspnea, vertigo, or visual disturbances were reported. There was no known personal or family history of seizures, neurologic disease, or congenital heart disease.

On the basis of the clinical history, the initial working impression was syncope related to hypovolemia or hypoglycemia, and referral for neurologic evaluation was recommended. Near the conclusion of the visit, the patient became visibly distressed and experienced abrupt loss of consciousness.

The patient was placed supine with leg elevation. Airway, breathing, and circulation were initially intact, though the patient was unresponsive. After approximately 30 seconds, focal tremors of the right hand progressed to a generalized tonic–clonic seizure. The patient was turned laterally and protected from injury. No abortive antiseizure medications were available.

Following brief postictal recovery, the patient experienced recurrent tonic–clonic seizures accompanied by intermittent apnea. Initial ventilation was performed with mouth-to-mask techniques because of equipment malfunction until bag-valve-mask ventilation was established. Oxygen saturation transiently dropped to the low 70s and improved to the mid-90s with effective ventilation. Capillary glucose was normal.

Over the ensuing 30 to 60 minutes, the patient experienced recurrent seizures with intermittent respiratory arrest, with some apneic episodes lasting several minutes and requiring continuous bag-valve-mask ventilation. Intravenous access was obtained, and dextrose-containing fluids were initiated. Oxygen saturation was maintained above

92%, and other vital signs remained stable. Upon arrival of emergency medical services, the patient was postictal but breathing spontaneously and was transferred to a local hospital.

According to subsequent communication with local contacts, the patient was hospitalized and treated for seizures, underwent further neurologic evaluation, and was discharged home within several days without residual neurologic deficits. Details of his inpatient diagnostic workup remain unknown.

Discussion

The differential diagnosis for this adolescent patient presenting with recurrent transient loss of consciousness evolving into focal-to-generalized seizures includes temporal lobe epilepsy, psychogenic nonepileptic seizures (PNES), syncope, and metabolic or systemic causes. An official diagnosis could not be confirmed because of the absence of EEG, neuroimaging, and laboratory studies, which are essential for identifying structural abnormalities, localizing seizure onset, and excluding metabolic or infectious causes. Nonetheless, clinical semiology strongly favored temporal lobe epilepsy. The presence of ICA, a psychic aura with fear and sadness, focal motor onset, and lack of an immediate return to baseline between seizures suggested an origin in the mesial temporal structures. Importantly, the patient's earlier brief episodes may have been attributable to vasovagal syncope or PNES, whereas the event we witnessed was more consistent with an epileptic seizure. Overall, this case highlights how clinical judgment and semiologic analysis remain essential when diagnostic resources are scarce, allowing clinicians to delineate a proper treatment course for a neurologic condition.

As a limitation, although evidence increasingly supports ICA as a semiologic feature associated with temporal lobe seizures, there are currently no published cohort studies or controlled trials that directly compare clinical outcomes on the basis of whether ICA was explicitly incorporated into diagnostic algorithms or treatment decision making. The existing literature primarily characterizes the incidence, localization value, and semiologic features of ICA in focal epilepsies, most often within specialized monitoring environments such as video EEG or intracranial EEG studies. Consequently, the effect of ICA recognition on treatment outcomes, particularly in resource-constrained settings, remains insufficiently studied. Nevertheless, this case underscores the clinical importance of recognizing seizure-associated apnea, because unrecognized peri-ictal respiratory compromise may carry substantial risk and be fatal, warranting prompt clinical attention.

Equally significant is how this case illustrates effective seizure management by a structured and interdisciplinary medical team operating in a low-resource environment. Each team member, whether student, nurse, pharmacist, resident, or attending physician, assumed a clear role, which minimized delays and prevented confusion. The team effectively applied basic life support principles in parallel, ensuring airway protection, monitoring cardiorespiratory status, and maintaining patient safety throughout the event. The absence of role confusion or conflict enabled the team to operate efficiently despite limited resources. This experience reinforces the importance of having necessary equipment and confident providers trained in Advanced Life Support for Cardiac Arrest and Pediatric Advanced Life Support frameworks during any emergency or code situation. In addition, clearly assigning responsibilities and promoting mutual respect among providers from diverse backgrounds is crucial for achieving optimal outcomes.

Furthermore, access to contact information for local health care professionals and the emergency response system enabled rapid activation of emergency medical services and transfer to a nearby hospital for definitive management. This underscores the importance of establishing referral pathways and emergency communication strategies before deployment, which should be standard practice for medical service trips. Mobile care teams have also demonstrated the ability to manage status epilepticus effectively in the field, with one report showing that a mobile medical team achieved seizure control as quickly as or faster than an emergency department team in rural Japan.[23]

This case emphasizes a critical deficiency in seizure management: the restricted availability of abortive antiseizure medications in resource-limited settings. During medical service missions, the transport of controlled substances, including intravenous benzodiazepines, is frequently constrained by the regulatory frameworks of host countries. These restrictions can impede the ability to deliver timely pharmacologic interventions for seizures. Under ideal circumstances, prolonged seizures lasting beyond 2 minutes are treated as medical emergencies necessitating immediate drug therapy. Consequently, the inclusion of accessible nonintravenous formulations, such as intranasal midazolam or rectal diazepam, in emergency kits should be considered.

It is also imperative to acknowledge that the administration of abortive antiseizure medications, particularly benzodiazepines, requires preparedness for potential respiratory adverse effects. In this case, the patient was already exhibiting ICA, and benzodiazepine administration could have further suppressed respiratory drive or prolonged apnea. In such circumstances, the medical team must be equipped to provide immediate respiratory support, including supplemental oxygen and, if necessary, airway protection and endotracheal intubation. Although flumazenil can reverse benzodiazepine-induced sedation and respiratory depression, its use is generally contraindicated in patients with epilepsy or status epilepticus, because it may precipitate seizures by antagonizing γ-aminobutyric acid–mediated inhibition.[24,25] Therefore, flumazenil should not be considered a safe alternative to appropriate airway management in patients with seizure-related respiratory compromise. In our situation, we lacked the necessary airway equipment; therefore, even if benzodiazepines had been available, we could not have proceeded safely with that treatment. Although the availability of antiseizure medications could substantially mitigate seizure-related morbidity, medical teams must remain cognizant of the potential adverse effects associated with these medications. Thus, it is essential to ensure that appropriate equipment, training, and fail-safes are in place to facilitate effective responses in emergencies.

In addition to medical logistics, broader barriers such as cultural stigma and misconceptions surrounding seizures often further delay treatment seeking in low-resource communities. Accordingly, local partnerships and community education campaigns can help counteract these challenges by promoting awareness that epilepsy is a treatable, noncontagious neurologic condition rather than a supernatural or social curse.[26] Technology also offers innovative pathways to bridge disparities: wearable monitoring devices, mobile health applications, and handheld diagnostic tools, such as portable ultrasonography, can augment care in the absence of advanced hospital infrastructure. Although not substitutes for continuous EEG or imaging, these tools can assist in the timely recognition, stabilization, and referral of patients with epilepsy in rural areas and have been effectively used for procedures including peripheral intravenous placement, endotracheal tube insertion, and thoracentesis.[27]

Conclusion

This case, encountered during an annual service trip to the Dominican Republic, illustrates the complexities of diagnosing and managing epilepsy in low-resource settings while demonstrating the effectiveness of rapid, team-based responses grounded in basic life support principles and strong local partnerships. For medical service trips, the lessons learned emphasize the necessity of predeployment basic life support and seizure-response training, the establishment of emergency referral systems, and consideration of carrying safe, effective nonintravenous anticonvulsants. Beyond logistics, addressing stigma and fostering community education remain essential to reducing the treatment gap for epilepsy globally. By integrating clinical vigilance, strategic preparedness, structured teamwork with clearly designated roles, and local collaboration, medical service trips can improve outcomes for vulnerable patients and serve as a model for global health practice in underserved communities.

References

1. Fiest KM, Sauro KM, Wiebe S, et al. Prevalence and incidence of epilepsy: a systematic review and meta-analysis of international studies. Neurology 2017;88:296-303. doi:10.1212/WNL.0000000000003509
2. Ngugi AK, Kariuki SM, Bottomley C, Kleinschmidt I, Sander JW, Newton CR. Incidence of epilepsy: a systematic review and meta-analysis. Neurology 2011;77:1005-1012. doi:10.1212/WNL.0b013e31822cfc90
3. Singh G, Sander JW. The global burden of epilepsy report: implications for low- and middle-income countries. Epilepsy Behav 2020;105:106949. doi:10.1016/j.yebeh.2020.106949
4. Meyer AC, Dua T, Ma J, Saxena S, Birbeck G. Global disparities in the epilepsy treatment gap: a systematic review. Bull World Health Organ 2010;88:260-266. doi:10.2471/BLT.09.064147
5. Ngugi AK, Bottomley C, Kleinschmidt I, et al. Prevalence of active convulsive epilepsy in sub-Saharan Africa and associated risk factors: cross-sectional and case-control studies. Lancet Neurol 2013;12:253-263. doi:10.1016/S1474-4422(13)70003-6
6. de Boer HM, Mula M, Sander JW. The global burden and stigma of epilepsy. Epilepsy Behav 2008;12:540-546. doi:10.1016/j.yebeh.2007.12.019
7. Newton CR, Garcia HH. Epilepsy in poor regions of the world. Lancet 2012;380:1193-1201. doi:10.1016/S0140-6736(12)61381-6
8. Birbeck G. Epilepsy care in developing countries: Part I of II. Epilepsy Curr 2010;10:75-79. doi:10.1111/j.1535-7511.2010.01362.x
9. Jacoby A, Austin JK. Social stigma for adults and children with epilepsy. Epilepsia 2007;48:6-9. doi:10.1111/j.1528-1167.2007.01391.x
10. World Health Organization. Epilepsy. 2024. Accessed October 2, 2025. https://www.who.int/news-room/fact-sheets/detail/epilepsy
11. Mbuba CK, Ngugi AK, Newton CR, Carter JA. The epilepsy treatment gap in developing countries: a systematic review of the magnitude, causes, and intervention strategies. Epilepsia 2008;49:1491-1503. doi:10.1111/j.1528-1167.2008.01693.x
12. Rhone AE, Kovach CK, Harmata GI, et al. A human amygdala site that inhibits respiration and elicits apnea in pediatric epilepsy. JCI Insight 2020;5. doi:10.1172/jci.insight.134852
13. Vilella L, Lacuey N, Hampson JP, et al. Incidence, recurrence, and risk factors for peri-ictal central apnea and sudden unexpected death in epilepsy. Front Neurol 2019;10:166. doi:10.3389/fneur.2019.00166
14. Villamizar-Torres D, Cepeda Trillos AC, Vargas-Moreno A. Mesial temporal sclerosis and epilepsy: a narrative review. Acta Epileptol 2024;6:28. doi:10.1186/s42494-024-00172-5
15. Lacuey N, Zonjy B, Hampson JP, et al. The incidence and significance of periictal apnea in

epileptic seizures. Epilepsia 2018;59:573-582. doi:10.1111/epi.14006
16. Nobis WP, González Otárula KA, Templer JW, et al. The effect of seizure spread to the amygdala on respiration and onset of ictal central apnea. J Neurosurg 2020;132:1313-1323. doi:10.3171/2019.1.JNS183157
17. Lacuey N, Hampson JP, Harper RM, Miller JP, Lhatoo S. Limbic and paralimbic structures driving ictal central apnea. Neurology 2019;92. doi:10.1212/WNL.0000000000006920
18. Tio E, Culler GW, Bachman EM, Schuele S. Ictal central apneas in temporal lobe epilepsies. Epilepsy Behav 2020;112:107434. doi:10.1016/j.yebeh.2020.107434
19. Lacuey N, Hupp NJ, Hampson JP, Lhatoo S. Ictal central apnea (ICA) may be a useful semiological sign in invasive epilepsy surgery evaluations. Epilepsy Res 2019;156:106164. doi:10.1016/j.eplepsyres.2019.106164
20. Micalizzi E, Vaudano AE, Ballerini A, et al. Ictal apnea: a prospective monocentric study in patients with epilepsy. Eur J Neurol 2022;29:3701-3710. doi:10.1111/ene.15547
21. Lacuey N, Talavera B, Magana-Tellez O, et al. Ictal central apnea is predictive of mesial temporal seizure onset: an intracranial investigation. Ann Neurol 2024;95:998-1008. doi:10.1002/ana.26888
22. Micalizzi E, Vaudano AE, Giovannini G, et al. Case report: ictal central apnea as first and overlooked symptom in temporal lobe seizures. Front Neurol 2021;12:753860. doi:10.3389/fneur.2021.753860
23. Shiraki A, Yasui M, Kidokoro H, et al. Initial treatment of seizures in children in an emergency department in rural Japan. Brain Dev 2021;43:288-293. doi:10.1016/j.braindev.2020.08.004
24. An H, Godwin J. Flumazenil in benzodiazepine overdose. CMAJ 2016;188:17-18. doi:10.1503/cmaj.160357
25. Spivey WH. Flumazenil and seizures: analysis of 43 cases. Clin Ther 1992;14:292-305. PMID:1611650
26. Wilmshurst JM, Badoe E, Wammanda RD, et al. Child neurology services in Africa. J Child Neurol 2011;26:1555-1563. doi:10.1177/0883073811420601
27. Shrestha GS, Nepal G, Brasil S. Low-cost strategies for the development of neurocritical care in resource-limited settings. Neurocrit Care 2025;42:1087-1098. doi:10.1007/s12028-025-02215-2.