

Reply to P. Gelisse, P. Genton, A. Crespela 'Failure to recognize muscular artifacts on the EEG may cause a wrong diagnosis of myoclonic status epilepticus'. *Epilepsy Behav Rep.* 5 April 2020, 100362. <https://doi.org/10.1016/j.ebr.2020.100362>

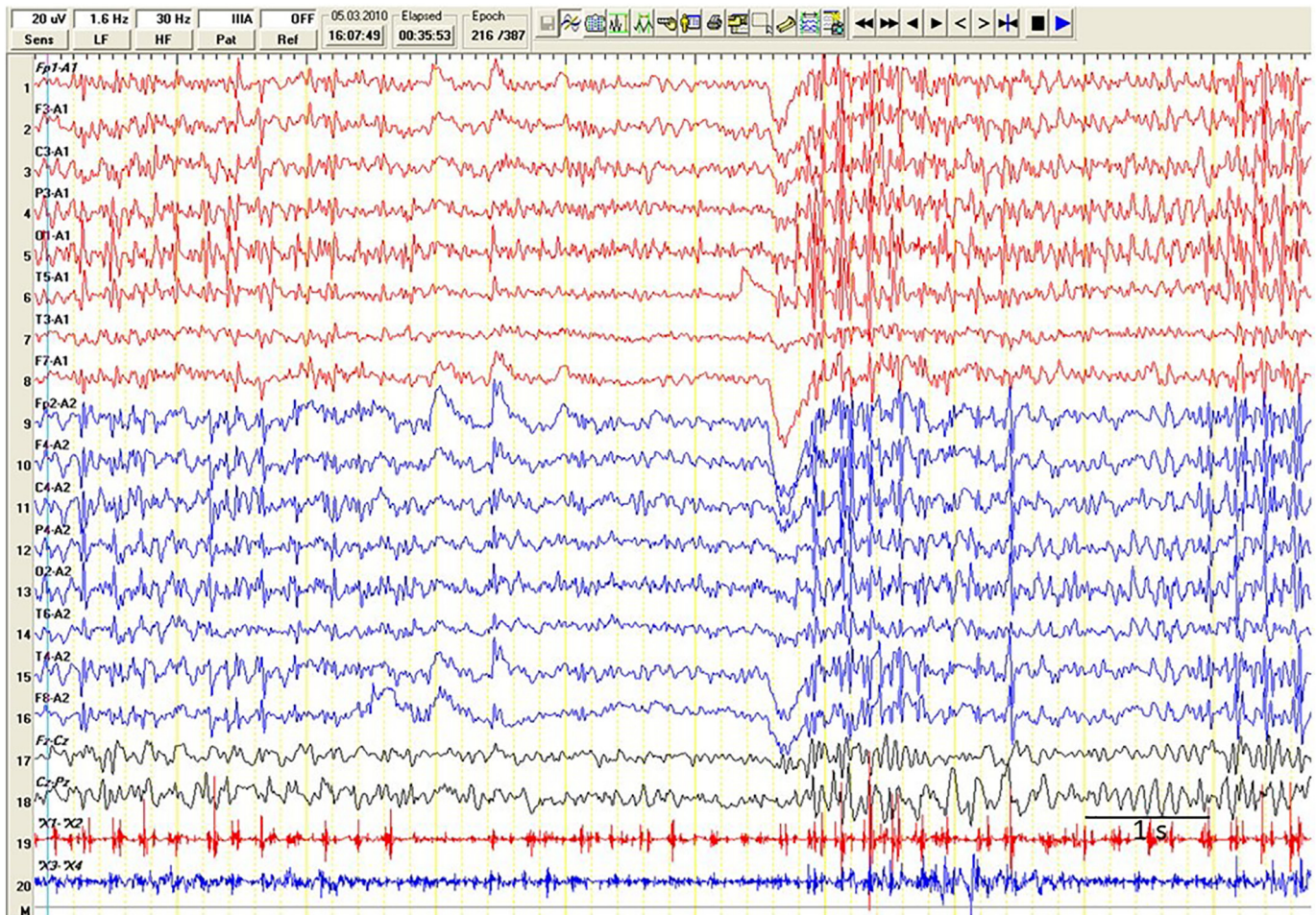


findings in our article published in *Epilepsy & Behavior Reports* [1,2]. We read the letter with great interest and we would like to thank to authors for their time to discuss this challenging topic.

In our case series we described the clinical and video-EEG features of 6 adult patients with myoclonic status epilepticus (MSE) who did not have a prior diagnosis of epilepsy [2]. In four of the patients (patients 3–6) MSE was precipitated by pregabalin and beta-lactam group antibiotics. Two of them (patients 3 and 6) had underlying chronic renal disease. In two of the patients (patients 1–2) seizure provoking factors were not clear, however in patient 1 with dementia we supposed underlying neurodegenerative disease or quetiapine might have generated seizures as previously reported [2–4]. In all except one patient,

Dear Editor,

Thank you for the opportunity to respond the letter from Dr. Gelisse et al. to discuss the topic about EEG artifacts and to explain the EEG



**Fig. 1.** a–c: A sample page of EEG during the patient's myoclonic seizures with a display speed of 30 mm/s (patient 1). On an ipsilateral ears referential montage, the EEG shows generalized high-amplitude bursts of polyspikes superimposed with myogenic artifact. Surface electromyography (EMG) of the extensor muscles (X1–X2 and X3–X4) of forearms shows that myoclonic jerks are <sup>1</sup> usually synchronous with the EEG abnormalities.

<sup>1</sup> Eliminate figure b and c and use only figure 1a but relabel as figure.

MSE responded to treatment with intravenous antiseizure medications and withdrawal of seizure provoking medications. We presented two EEG figures and two video-files to illustrate the clinical and electrophysiologic findings of our patients [2].

It's correct that muscle and movement artifacts may mimic cerebral activity in EEG. Misinterpretation of the artifacts as spikes or seizures may lead to misdiagnosis and improper treatment [5]. Muscle artifacts are recorded most frequently by electrodes that overlie the muscles of scalp (frontopolar and midtemporal electrodes) and do not well represented in the midline (Cz and Pz) derivations, since there is almost no muscle over the vertex of the skull [5–7]. Furthermore, myogenic spikes are not followed by slow waves, they are much faster than cerebral spikes, usually shorter than 20 ms, they are prominent in the waking state and they disappear with relaxation or at sleep [7]. We acknowledge that Fig. 1 previously including EEG findings of patient 1 was not a representative sample of the patient's entire EEG. Further, it does not adequately demonstrate polyspikes in the vertex region very well, and may mislead the reader as muscle artifacts. During the video-EEG recording our patient had continuous irregular, asynchronous, multifocal series of jerks of the bilateral upper extremities and the trunk that appears at rest and increases when the limbs are outstretched with very brief loss of tonus. EEG displayed concomitant bursts of high voltage generalized polyspikes, predominant on posterior temporal derivatives of the EEG which are superimposed by muscle and movement artifacts (Fig. 1a–c). During the electromyography (EMG) recordings, abrupt short-term increases in muscle discharges followed by brief lapses of muscle contraction associated with generalized polyspikes in the EEG were seen (Fig. 1a–c). Patients were able to respond during these discharges which disappeared after intravenous diazepam. A second EEG was subsequently recorded after the treatment when the patient was awake and was normal [2]. The patient did not report any myoclonic movements in the follow-up, after treatment with levetiracetam. The video-EEG recordings of the other patients showed generalized polyspikes and polyspike-waves involving the vertex region as well. The distinction between epileptic and nonepileptic myoclonus is often done through presence or absence of EEG epileptiform discharges time-locked to jerks. It's sometimes challenging to differentiate myogenic artifact due to myoclonus from generalized polyspike-waves. We believe that simultaneous EEG–EMG polygraphic recordings with jerk-locked back-averaging techniques, evoked potential studies combined with long-latency responses, long-loop reflexes, movement monitors, and fast display speeds on EEG may be used to clarify the electrophysiological findings produced by myoclonus [8]. Ictal EEG features of myoclonic seizures are characterized by high-amplitude, frontocentral dominant generalized polyspike activity of 10–16 Hz. These typical discharges may be preceded by 2–5 Hz generalized spike-wave activity [9,10].

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## Author contributions

Leyla Baysal-Kirac: Conceptualization, writing, review, editing.  
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## Declaration of competing interest

No potential conflict of interest was reported by the authors.

## References

- [1] Gelisse P, Genton P, Crespela A. Failure to recognize muscular artifacts on the EEG may cause a wrong diagnosis of myoclonic status epilepticus. *Epilepsy Behav Rep* April 2020;5:100362. <https://doi.org/10.1016/j.ebr.2020.100362>.
- [2] Baysal Kirac L, Aydogdu I, Acarer A, Alpaydin S, Bayam FE, Onbasi H, et al. Myoclonic status epilepticus in six patients without epilepsy. *Epilepsy Behav Case Rep* 2012;1:10–3. <https://doi.org/10.1016/j.ebr.2012.10.003>.
- [3] Shao SC, Wu WH, Yang YK, Lai EC. Quetiapine-induced absence seizures in a dementia patient. *Geriatr Gerontol Int* 2016;16:1168–71. <https://doi.org/10.1111/ggi.12683>.
- [4] Kim HK. Myoclonic status epilepticus of unknown etiology in an elderly patient. *J Clin Neurol* 2018;14:100–1. <https://doi.org/10.3988/jcn.2018.14.1.100>.
- [5] Hirsch LJ, Brenner RP. Artifacts that can mimic seizures or other physiologic patterns. *Atlas of EEG in critical care*. John Wiley & Sons, Inc.; 2010. p. 187–216.
- [6] Libenson M. *Electroencephalographic artefacts. Practical approach to electroencephalography*. Saunders: Elsevier; 2010. p. 124–45.
- [7] Abou-Khalil B, Misulis KE. Normal routine EEG. *Atlas of EEG& seizure semiology*. Elsevier; 2006. p. 89–91.
- [8] Avanzini G, Shibasaki H, Rubboli G, Canafoglia L, Panzica F, Franceschetti S, et al. Neurophysiology of myoclonus and progressive myoclonus epilepsies. *Epileptic Disord* 2016;18(S2):11–27.
- [9] Seneviratne U, Cook MJ, D'Souza WJ. Electroencephalography in the diagnosis of genetic generalized epilepsy syndromes. *Front Neurol* 2017;8:499. <https://doi.org/10.3389/fneur.2017.00499>.
- [10] Larch J, Unterberger I, Bauer G, Reichsoellner J, Kuchukhidze G, Trinka E. Myoclonic status epilepticus in juvenile myoclonic epilepsy. *Epileptic Disord* 2009;11:309–14. <https://doi.org/10.1684/epd.2009.0284>.

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