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REM: A PUBLICATION FOR RESIDENTS AND FELLOWS

IMAGES: A Case of EEG Artifact By Proxy

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In this manuscript we describe a case of electroencephalography artifact during polysomnography that occurred in the context of mother co-sleeping with her child. The potential interference from a co-sleeping parent's electrocardiography, as illustrated in this case, may be an under-recognized source of electroencephalography artifact in pediatric patients.

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INTRODUCTION

Electroencephalography (EEG) artifact is defined as any recorded activity that does not originate from the brain and is a commonly encountered issue in the interpretation of polysomnography. The two major categories of EEG artifacts include physiologic and extraphysiologic artifacts. It is crucial for the practicing clinician to be able to identify EEG artifact to allow for accurate staging of sleep and prevent inaccurate conclusion of epileptiform activity.

Broadly speaking, physiologic EEG artifacts arise from any patient source other than the brain. These sources may include electric fields generated from muscle, heart, ocular, or sweat sources. Movement artifact most commonly presents as large deflections in the EEG record caused by to movement of the contact leads. In contrast, muscle artifact appears as high-amplitude fast activity and can obscure the background activity, leading to more difficult staging of sleep. Ocular artifact helps the sleep interpreter with staging, as slow-rolling eye movements and rapid eye movements are essential to accurate staging of sleep. Less well-known ocular artifacts that may mimic epileptiform activity include "lateral rectus spikes" and "photomyogenic response."[1] Sweat artifact appears as low-amplitude and low-frequency oscillations and should alert the sleep technician to cool the ambient room temperature and wipe off the patient's sweat. Cardiac artifact, also known as electrocardiography (EKG) artifact, is commonly encountered and easily identified because it appears in the scalp EEG in sync with the EKG channel and with a similar sharp morphology as the EKG tracing. EKG artifacts can be misinterpreted as epileptiform activity by novice readers, and it is important to recognize this artifact to prevent misdiagnosis.

The other major category of EEG artifacts is extraphysiologic artifacts, which can arise from the environment or surrounding equipment. Well-known causes of extraphysiologic artifacts include 60 Hz electrical noise, electrode popping artifact, and telephone artifact. Electrical popping artifact can mimic epileptiform activity and should alert the sleep technician to check impedance. In contrast, 60 Hz and telephone artifact are rarely confused with epileptiform discharges and have a distinct morphology. Less commonly described extraphysiologic artifacts may include low frequency (5–9 Hz) sharply contoured waveforms with intermittent high- frequency sinusoidal waves on EEG related to mobile phone signals.[2]

Here we describe another case of EEG artifact that represents overlap between these two broad classes of artifact, which is physiological in nature, but generated by an external source in the patient under evaluation.

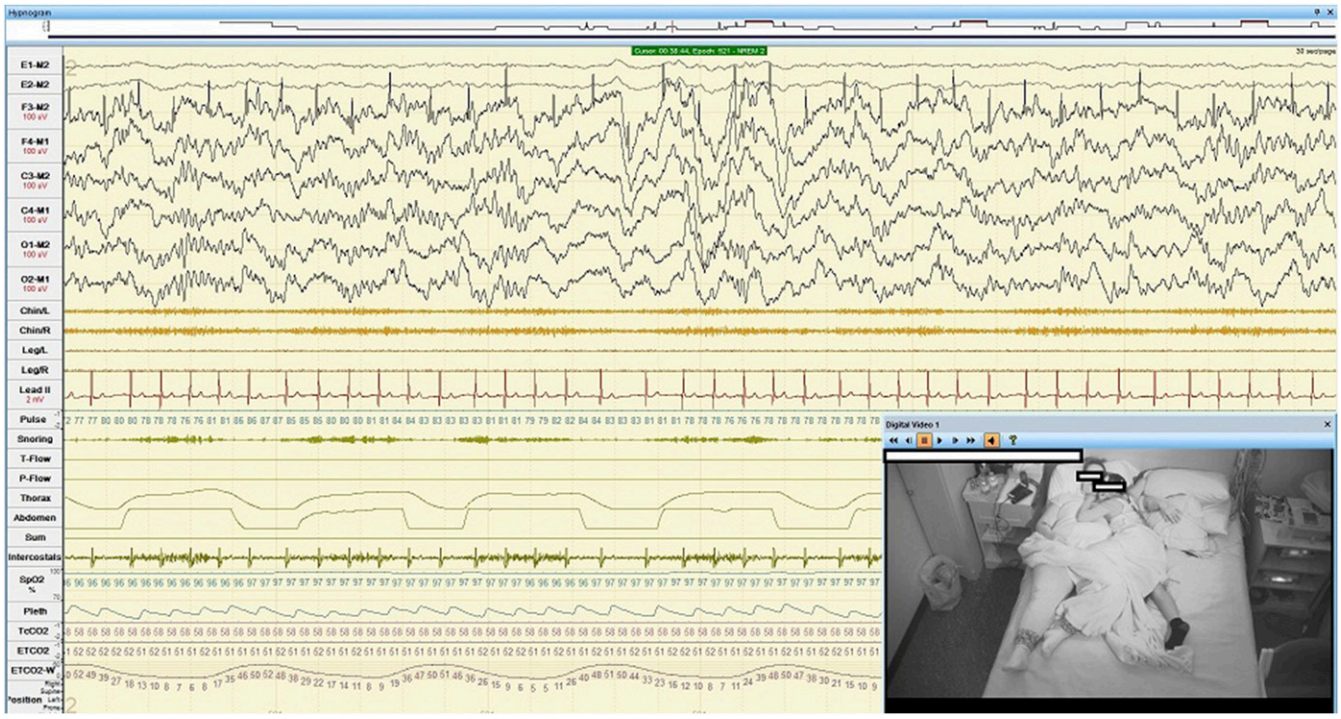
REPORT OF CASE

A 10-year-old boy with a history of trisomy 21 was referred by his primary care provider to the sleep laboratory for evaluation of snoring and possible sleep apnea. To optimize tolerance to the laboratory environment, the patient's mother was allowed to sleep in bed with him.

ASSOCIATED IMAGES

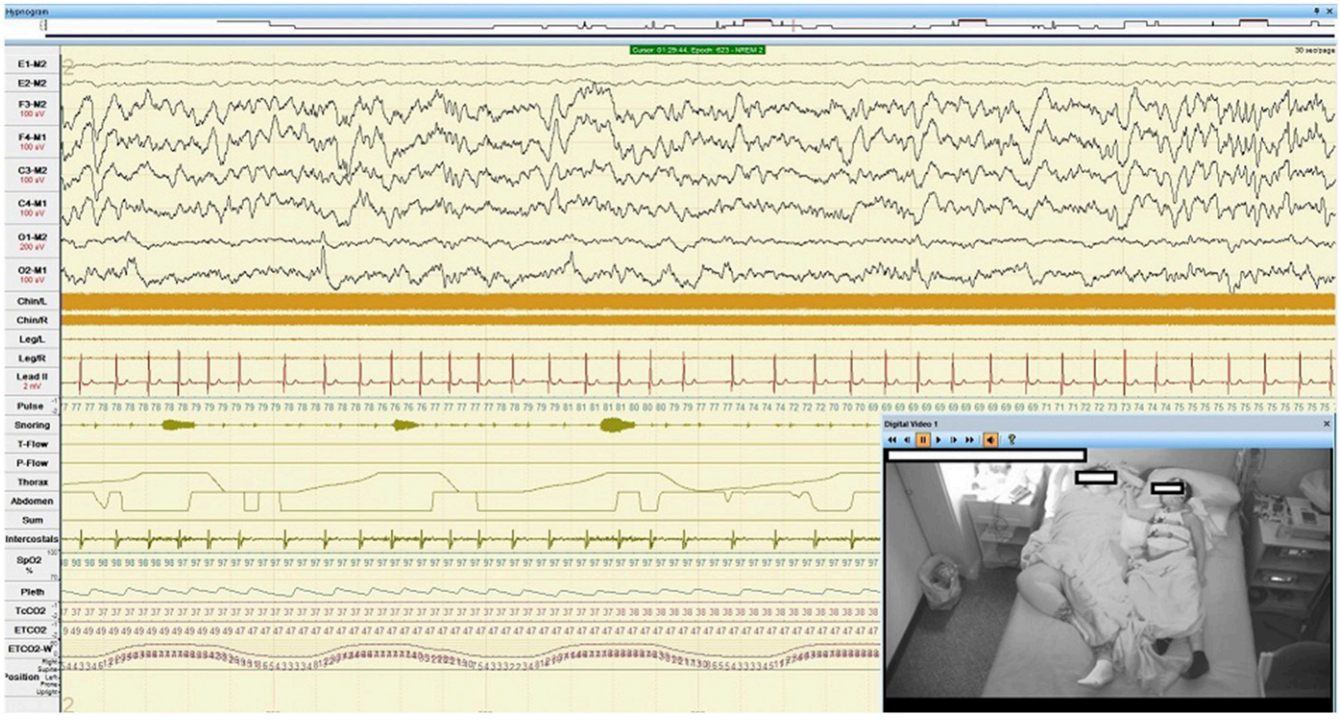
During the recording, sharp activity occurring regularly at approximately 1 Hz was observed during stage N2 sleep, most prominently at the left frontal electrode (**Figure 1**). Notably, this activity did not correspond in time to the patient's own EKG tracing (**Figure 1**). Review of concurrent video monitoring demonstrated the patient's head was positioned against his mother's neck and chest, and thus artifact generated by the mother's pulse waveform was suspected. This was confirmed by resolution of the artifact when the patient eventually changed positions and his head was no longer in contact with his mother's neck and chest (**Figure 2**). When the patient later rolled to lie again against the mother's neck and chest, similar artifact recurred, and again resolved when the patient separated from the mother.

Figure 1—Frontal EEG artifact observed during stage N2 sleep.



Pattern is suspicious for EKG artifact emanating from co-sleeping parent (lower right panel). EEG = electroencephalography, EKG = electrocardiography.

Figure 2—Resolution of EEG artifact.



Resolution of EEG artifact during stage N2 sleep with repositioning of patient confirms the artifact source as emanating from co-sleeping parent (lower right panel). EEG = electroencephalography.

DISCUSSION

This case highlights the fact that artifact from a physiological source emanating from an external source can be detected during routine polysomnographic evaluation. In cases of classic EKG artifact that arise from the patient's own cardiac rhythm, the detected artifact is synchronous with the patient's own EKG tracing, and thus can be readily identified and often removed by automated EKG subtraction algorithms. The potential interference from a co-sleeping parent's EKG, as illustrated in this case, may be an underrecognized source of EEG artifact in pediatric patients. A similar case has previously been described, in which maternal heartbeat artifact mimicked an ictal EEG pattern during long-term epilepsy monitoring in a 2-year-old girl with epilepsy.[3] Although electrode popping is also in the differential diagnosis of the observed artifact here, this is less likely than artifact from an external EKG source. Typically, electrode popping artifact results from poor contact with the skin, which can lead to a similar appearance, though the rate of occurrence is more commonly in sync with the patient's respiratory rate. Given that this artifact occurs at a rate of 60 to 70 times per minute, we posit that external EKG artifact is more likely to be causative. If electrode popping is suspected at the time of recording, this could be confirmed by elevated impedance when checked by the operating technician. Because many pediatric patients undergoing polysomnography may be at increased risk for having abnormal EEG findings compared to the general population, as was the case for this patient with trisomy 21,[4] the possibility of such "EEG artifact by proxy" should be considered in the differential of suspicious EEG findings. This artifact had a uniform appearance without any evolution in the EEG background, which reassures against a cerebral source of EEG activity. In such instances, the use of concurrent video monitoring is crucial to verify that the artifact is indeed benign, as the position of the patient's frontal leads are in contact with the mother's neck and chest, which is the exact location of the artifact on the polysomnogram. Finally, when our patient repositions away from the mother, there is complete resolution of the artifact.

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