Epilepsy & Behavior Reports 16 (2021) 100438

Contents lists available at ScienceDirect

Epilepsy & Behavior Reports

journal homepage: www.elsevier.com/locate/ebcr

Case Report

Management of post-operative delirium following stereoelectroencephalography electrode placement for drug resistant epilepsy: Lessons learned from two case reports

Katherine Belanger [a,*], Fabio Grassia [a,b], Michael W. Kortz [b], John A. Thompson [a,b,c], Sam DeStefano [a,c], Steven Ojemann [a,b,c]

[a] School of Medicine, University of Colorado Anschutz Medical Campus, Aurora, CO 80217, USA
[b] Department of Neurosurgery, University of Colorado Anschutz Medical Campus, Aurora, CO 80217, USA
[c] Department of Neurology, University of Colorado Anschutz Medical Campus, Aurora, CO 80217, USA

ARTICLE INFO

Article history:
Received 16 January 2021
Revised 3 March 2021
Accepted 9 March 2021
Available online 22 March 2021

Keywords:
Epilepsy
Stereoencephalography
Delirium
Neurosurgery
Case report

ABSTRACT

Post-operative delirium (POD) represents a unique challenge in the care of any surgical patient but is especially challenging in neurosurgical inpatient management due to a host of potentially significant predisposing factors. Patients undergoing stereoencephalography (SEEG) for diagnosis of drug resistant epilepsy are at unique risk due to safety concerns, yet POD has been underdiscussed in this population. Patients should be counseled pre-operatively about their risk and subsequent steps be taken post-operatively. We present two cases of POD status-post SEEG and propose a mechanism by which future post-operative care be coordinated by the physician, patient, and patient's family.

1. Introduction

Post-operative delirium (POD) is an acute, fluctuating disruption in attention and cognition that is associated with altered perception, inappropriate behavior, changes in awareness, and disorganized thinking [1–3]. Often expression of POD cannot be explained by a pre-existing disorder and can impair ability to comply with medical care [4,5]. Diagnosis and treatment are complicated by a multitude of interactions between pre-operative vulnerabilities with intra-operative and post-operative precipitating factors [6,7].

Patients undergoing neurosurgical interventions are at unique risk for POD [4]. They require frequent neurologic checks, have baseline deficits with neurologic and metabolic derangements, and neurosurgical related brain injury [2,5,8]. In this population factors such as age, functional and neurologic impairment, and structural comorbidities of the brain (epilepsy, ischemia, etc.) have all been shown to be predisposing factors to delirium [3,9].

Contributing to POD is potentially a direct psychotropic effect of surgical implantation of electrodes suggested by research investigating POD in Parkinson's patients with deep brain stimulation [10]. Yet, there has been little research in patients undergoing stereoelectroencephalography (SEEG) surgery, where depth electrodes are implanted directly into the brain for localization of epileptic foci. While the outcome of a complex interplay of a multitude of factors, hyperactive delirium is of particular interest in this population because of the potential for self-harm.

Although there is the potential for self-harm when the patient is delirious, aborting the SEEG procedure before epileptic foci localization can prevent patients from receiving subsequent epileptic surgery aimed at seizure control. This is often their last therapeutic option for seizure control after several failed medical management trials. Thus, pre-operative risk mitigation and discussing the potential for POD can allow therapeutic alignment between patient, family and treatment team about delirium management and preserve this therapeutic option. This paper reviews two cases of POD in patients undergoing SEEG neuromonitoring out of 62 SEEG neuromonitoring cases between 2018 and 2019 at the University of Colorado Hospital and proposes how to mitigate complications post-operatively if a patient becomes acutely delirious.

* Corresponding author at: 2136 Spruce St, Denver, CO 80238, USA.
E-mail address: katherine.belanger@cuanschutz.edu (K. Belanger).

https://doi.org/10.1016/j.ebr.2021.100438
2589-9864/

2. Case reports

2.1. Case 1

A 20-year-old female patient presented to the University of Colorado Neurology Department in 2015 with a 4-year history of drug resistant focal epilepsy. Due to two non-diagnostic phase 1 video-EEG (VEEG) sessions, she ultimately underwent three phase 1 VEEG sessions in the epilepsy monitoring unit (EMU) over a seven-month span. During the first session, the patient had an altercation with her parents and asked for security to escort them from her room. She then was adamant about leaving herself. She had completed the VEEG session but her final magnetic resonance imaging (MRI) had to be completed as an outpatient. Two subsequent phase 1 evaluations were without further altercations. VEEG helped localize seizure onset to the right posterior temporal lobe along with MRI findings of heterotopic gray matter along the right hippocampus and medial right temporal lobe.

In 2019 the patient presented to the University of Colorado Neurology Department for surgical consideration. A multidisciplinary team recommended phase 2 invasive neuromonitoring using SEEG to further localize seizure onset given the lack of clear posterior margin and the uncertainties regarding involvement of hippocampus and overlying neocortical tissue in the epileptogenic zone. In part due to known previous substance abuse issues with methamphetamines and current cannabis use, psychiatric evaluation was performed prior to surgery and the patient was deemed an appropriate surgical candidate. Electrodes were implanted in the temporal occipital pole, anterior temporal pole, amygdala, anterior, middle and posterior hippocampus, posterior periventricular nodular heterotopia, temporal occipital junction and insula.

On post-operative day 1, the patient demonstrated severe agitation. She attempted to remove her electrodes and slam her head against the bed aiming at the surgical site. The patient was physically restrained by multiple individuals and given 5 mg Haldol and 4 mg Ativan to sedate her and address her POD. She was subsequently started on risperidone 0.5 mg twice daily after for POD management.

An emergent consultation with psychiatry deemed the patient lacked decision making capacity and was a potential active harm to herself and staff. The treatment teams deemed it prudent to remove electrodes over safety concerns. The family and patient showed unwillingness to consent for explantation surgery. Ultimately consent was obtained, though family expressed a strong preference the electrodes remain. Legal counsel advised the neurosurgical team to not remove the electrodes unless necessary. Thus, the patient and family were advised that the next incident of any agitation/antagonism would result in immediate removal.

The patient was left in the intensive care unit (ICU) for better control of environment. She was given a sitter for monitoring of her POD and safety. She had successful capture of seizures and was explanted uneventfully on hospital day 23 without further incident.

2.2. Case 2

A 34-year-old male presented to the University of Colorado Neurology Department in 2018 with a 12-year history of drug resistant focal epilepsy. He was scheduled for a phase 1 EMU study which was rescheduled on the day of admission as the patient believed he was only having a half day test opposed to a multi-day study. His reasoning for rescheduling was that he was "not in the right mental space to tolerate the test". He was later admitted for his phase 1 evaluation in the EMU using VEEG and completed the study with no disturbances. The pre-surgical hypothesis was left temporal lobe, non-lesional epilepsy with no obvious anatomical abnormalities on MRI.

In 2019 a multi-disciplinary team recommended SEEG to further localize seizures for potential surgical intervention. Prior to surgery the patient was evaluated by psychiatry due to concern over prior substance use and competence and was deemed an appropriate surgical candidate.

Starting on post-operative day 1, while under observation in the EMU after electrode implantation, the patient had multiple episodes of agitation suspected to be secondary to nicotine and marijuana withdrawal and expressed interest in leaving against medical advice (AMA). During these POD episodes he threatened to pull out his electrodes. He was counseled on the adverse and potentially life-threatening outcome of electrode tampering and subsequent ineligibility for future epilepsy surgery. Psychiatry noted that during periods of agitation the patient lacked capacity to understand the consequences of leaving the hospital with electrodes in place. He was given 2 mg Ativan once and put on Quetiapine 25 mg on post-operative day 1 in response to POD that was increased to 50 mg on post-operative day 2. The patient went on to have multiple target seizures and was successfully explanted on hospital day four.

Following explantation, the patient was still severely agitated and expressed interest in leaving the hospital. He was counseled on the post-operative risks and informed that leaving AMA would prevent future surgical interventions due to concern over treatment compliance. The patient was able to calm down, though had repeated cycles of agitation where he threatened to leave until discharged 24 hours later.

3. Discussion

Well known risk factors for POD include increased age, cognitive impairment, substance abuse, and many others. [11,9]. These vulnerabilities interact with intra-, peri-, and post-operative factors to result in an acutely delirious state [12,13,5]. SEEG has been demonstrated to have a low complication rate with few reports of a variety of psychiatric changes as a complication of this neuromonitoring modality [14]. The post-electrode implantation psychiatric consequences of SEEG monitoring is multifactorial with factors such as substance withdrawal, potential epileptic psychosis, baseline mood disturbances, and a variety of other factors all contributing. Of consequence, intracranial electrodes provide an external conduit in patients following SEEG placement thus providing a mechanism by which hyperactive delirium can result in devastating intracranial damage via electrode tampering. Thus, patients following SEEG placement are a particularly vulnerable population, but no guidance exists on POD in this population.

Pre-operative substance use is a modifiable risk factor for POD. In our two case reports, both patients had significant substance use with abstinence contributing to agitation while hospitalized. Additionally, both of these patients had documented issues tolerating previous phase 1 studies and difficulty abstaining from substances for recommended periods of time (e.g. prior to WADA testing). More thorough documentation of these occurrences may enlighten the care team to the possibility of such situations during phase 2 studies. We propose detailed documentation regarding prior studies, duration of substance abstinence prior to hospitalization and patient tolerance of the prior monitoring to be part of the discussion at epilepsy surgery patient care conferences. This documentation and neuropsychiatric evaluation can be used synergistically to generate a level of suspicion of potential POD in patients pre-operatively. This increased level of suspicion can help guide post-operative management to avoid use of known delirium contributing drugs. For instance, our first patient received diphenhydramine

and oxycodone and our second patient received hydrocodone-acetaminophen and acetaminophen-codeine for pain management, which are known to contribute to POD. Avoidance of delirium contributing medications in patients with a high baseline suspicion for POD would benefit the patient.

As well, patients and families need to be informed of the potential of POD and the risk it poses to a patient before electrode placement. Identification of surrogate decision makers and assent for electrode removal if needed for safety concerns can be obtained pre-operatively. Thus, patients and families are able to make better informed decisions and allows for alignment of the patient, family and treatment team on the surgical treatment plan.

Post-operatively, if a patient develops POD re-orientation and modification of risk factors is necessary. As well, decision making capacity should be evaluated using standard hospital protocol. If the patient lacks decision making capacity then the pre-determined medical durable power of attorney (MDPOA) should be reached for treatment discussion. If the MDPOA is not available or no one is designated, legal should be involved, particularly if there is a disagreement about explanation over safety concerns between the treatment team and patient/family. Escalation to this point is hoped to be avoided by the pre-emptive conversations and decrease in substance use before surgery.

As demonstrated in these case reports, patients that have hyperactive delirium after SEEG can pose unique risk of harm to themselves. By having an external conduit via the electrodes, pulling at the electrodes and aggressive movement of the head can result in neurologic damage that can have devastating consequences. Thus, we propose several steps that can mitigate the risk of POD and lessen the decision making burden post-operatively in the event the patient becomes delirious.

4. Conclusion

Patients undergoing SEEG neuromonitoring for drug resistant epilepsy are at risk of POD and have unique safety concerns. Yet, there is a paucity of literature about POD in patients undergoing SEEG monitoring. Thus, we propose several steps pre-operatively that can help reduce the risk of POD and ways post-operatively that POD can be mitigated and addressed by the treatment team.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

For this type of study formal consent is not required.

Contributions

All authors contributed to the article's conception and design. Material preparation, data collection, and analysis were performed by K. Belanger, F. Grassia and S. DeStefano. The first draft of the manuscript was written by K. Belanger and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

References

[1] Bilotta F, Lauretta MP, Borozdina A, Mizikov VM, Rosa G. Postoperative delirium: risk factors, diagnosis and perioperative care. Minerva Anestesiol 2013;79(9):1066–76.
[2] Rudolph JL, Marcantonio ER. Postoperative delirium: acute change with long-term implications. Anesth Analg 2011;112(5):1202–11.
[3] Stienen MN. Delirium in neurosurgery. Acta Neurochir 2019;161(7):1305–6.
[4] Morshed RA, Young JS, Safaee M, Sankaran S, Berger MS, Mcdermott MW, et al. Delirium risk factors and associated outcomes in a neurosurgical cohort: a case-control study. World Neurosurg 2019;126:930–6.
[5] Rengel KF, Pandharipande PP, Hughes CG. Postoperative delirium. La Presse Médicale 2018;47(4):53–64.
[6] Brown EG, Josephson SA, Anderson N, Reid M, Lee M, Douglas VC. Evaluation of a multicomponent pathway to address inpatient delirium on a neurosciences ward. BMC Health Services Res 2018;18(1):106.
[7] Inouye SK, Bogardus ST, Charpentier PA, Leo-Summers L, Acampora D, Holford TR, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. New Engl J Med 1999;340(9):669–76.
[8] Wang J, Ji Y, Wang N, Chen W, Bao Y, Qin Q, et al. Establishment and validation of a delirium prediction model for neurosurgery patients in intensive care. Int J Nurs Pr 2020;26(4).
[9] Zipser CM, Deuel J, Ernst J, Schubert M, Känel RV, Böttger S. The predisposing and precipitating risk factors for delirium in neurosurgery: a prospective cohort study of 949 patients. Acta Neurochir 2019;161(7):1307–15.
[10] Carlson JD, Neumiller JJ, Swain LD, Mark J, Mcleod P, Hirschauer J. Postoperative delirium in Parkinson's disease patients following deep brain stimulation surgery. J Clin Neurosci 2014;21(7):1192–5.
[11] Greene NH, Attix DK, Weldon BC, Smith PJ, Mcdonagh DL, Monk TG. Measures of executive function and depression identify patients at risk for postoperative delirium. J Am Soc Anesthesiol 2009;110(4):788–95.
[12] Maldonado JR. Acute brain failure: pathophysiology, diagnosis, management, and sequelae of delirium. Crit Care Clin 2017;33(3):461–519.
[13] Matano F, Mizunari T, Yamada K, Kobayashi S, Murai Y, Morita A. Environmental and clinical risk factors for delirium in a neurosurgical center: a prospective study. World Neurosurg 2017;103:424–30.
[14] Mullin JP, Shriver M, Alomar S, Najm I, Bulacio J, Chauvel P, et al. Is SEEG safe? a systematic review and meta-analysis of stereo-electroencephalography-related complications. Epilepsia 2016;57(3):386–401.