

INTRODUCTION

- Electroencephalography (EEG) may be used in the perioperative setting to assess neurologic function, cortical ischemia, and anesthetic depth.
- Typically, 16-20 electrode needles are placed along the scalp (or 2-3 if processed EEG) and measure changes in voltage between the needle tips. These are highly sensitive and may be affected by a multitude of perioperative anesthetic, surgical, and environmental factors.
- EEG waveforms are stratified by frequency, amplitude, and wave-shape, with certain waveforms predominating in awake versus sleep cycles (Figure 1).
- Specifically, continuous EEG (cEEG) has shown promise in understanding neurologic prognostication in ischemic or anoxic brain injury.
- cEEG may be used in vascular procedures, specifically those that involve the carotid arteries supplying blood flow to the cerebrum, as a surrogate to a neurologic exam when patients are anesthetized to detect intraoperative cortical ischemia when there are pronounced changes from baseline EEG.

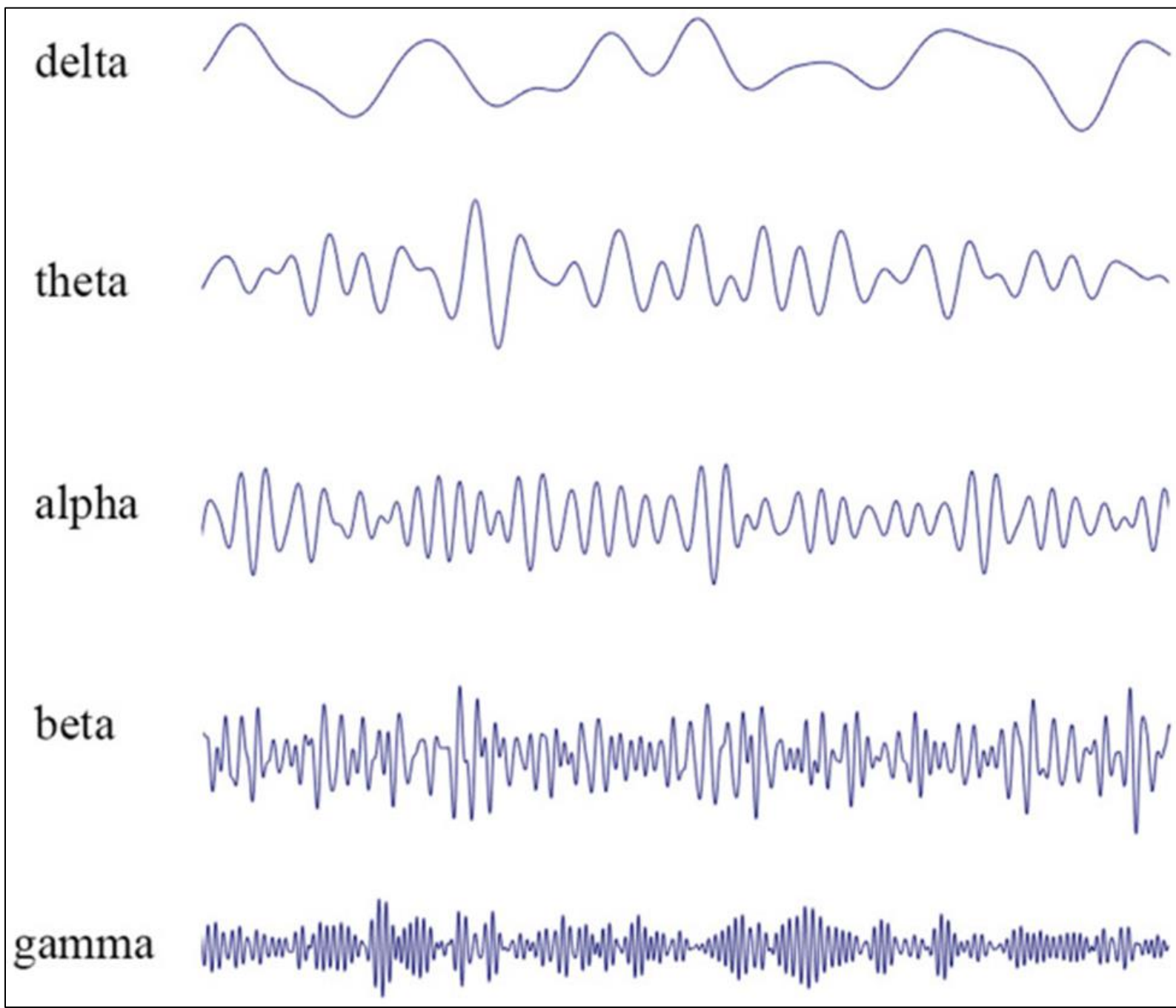


FIGURE 1

EEG waves listed by increasing frequencies: delta (0.5–3 Hz), theta (4–7 Hz), alpha (8–12 Hz), beta (13–30 Hz), and gamma (>30 Hz). Alpha waves predominate in awake with eyes closed state, beta waves in awake with eyes open and concentrating state, theta and delta waves in sleep states, and gamma waves in cognitive states.



FIGURE 2

Non-contrast computed tomography (CT) head demonstrating left-sided multi-territorial cerebral infarcts. Moderate supratentorial mass effect with 4mm left to right midline shift and slight uncus herniation. Moderate to advanced infratentorial mass effect with concern for impending obstructive hydrocephalus and/or herniation.

CASE DESCRIPTION

BACKGROUND

- 58-year-old male undergoing revision right carotid to left carotid to left subclavian bypass to allow for left vertebral artery flow and spinal cord perfusion with subsequent thoracoabdominal aortic aneurysm repair.
- Medical comorbidities included: PVD, HTN, nicotine dependence with active smoking, chronic pain, complex vascular anatomy due to ascending AAA s/p prior TAA endovascular repair and R carotid to L carotid bypass
- Jehovah's Witness: Did not wish to have transfusion of banked blood products. Accepted autotransfusion, factor concentrates, colloid.

INTRAOPERATIVE COURSE / ELECTROENCEPHALOGRAPHY FINDINGS

- Underwent general endotracheal anesthesia with continuous EEG monitoring.
- Surgical case complicated by massive blood loss (EBL 8L) due to left subclavian artery injury during dissection, with insufficient hemostasis with endovascular balloon and requiring median sternotomy with left subclavian artery ligation.
- During this time of resuscitation, approximately 3L albumin, 4L cell-saver, concentrated fibrinogen, PCC, and 12L crystalloid were given. CaCl, epi pushes, phenyl/NE/epi/vaso gtt were also started and titrated as indicated.
- Baseline awake EEG with asymmetric decreased activity on L side with known L carotid stenosis. With L subclavian artery bleed and hypotension, L hemisphere slowing then R hemisphere slowing with transient improvement in the R. When R carotid was occluded, there was B/L (L>R) hemispheric slowing and attenuation, with shunting leading to EEG improvement, especially on the R but without return to baseline. L carotid occlusion led to slowing and attenuation on L hemisphere then when shunt was removed after anastomosis confirmed, there was still persistent B/L (L>R) hemispheric slowing/suppression and attenuation.

POSTOPERATIVE / INTENSIVE CARE UNIT COURSE

- Postoperatively, despite withholding sedation, he did not show signs of emergence from anesthesia with decerebrate posturing. CT Head showed watershed ischemia along L cerebral hemisphere, B/L cerebellar infarcts, and 4mm midline shift (Figure 2).
- Thrombocytopenia (PLT 16K) without ability to transfuse blood products precluded surgical decompression, and his elevated intracranial pressure was medically managed with hypertonic saline. With progressive neurologic deterioration, goals of care discussions were had. Decision was made by family to transition to comfort care measures.

DISCUSSION

- Vascular surgical cases pose a variety of anesthetic implications. Commonly, when serial awake neurologic exams are not feasible, EEG monitoring can be utilized to assess adequacy of cerebral perfusion when operative procedures involve major cerebral vasculature.
- Notably, EEG wave changes may guide (1) intraoperative anatomic manipulation, (2) decisions to shunt, and (3) identification of surgical complications, such as decreased cerebral perfusion and/or embolic phenomena.
- Findings in decreased cerebral perfusion can include acute EEG asymmetry, decreased total amplitude or power of EEG waves, and electrocortical slowing or silence. Burst suppression and isoelectricity may also be noted in cerebral ischemia.
- In our patient, intraoperative EEG was utilized to guide anesthetic resuscitation and surgical revascularization approach including the decision to shunt and simultaneously correlated to postoperative neurologic findings.

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