

Friedberg's triad and opioid free anesthesia in the morbidly obese patient

La tríada de Friedberg y la anestesia sin opiáceos en el paciente con obesidad mórbida

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ABSTRACT

Friedberg's Triad for opioid free anesthesia is a simple, minimally invasive paradigm which is 1) Measures the brain; 2) Preempt the pain; 3) Emetic drugs abstain. After an incremental propofol induction, ketamine 50 mg IV produces 10-20 minutes' immobility for the surgeon's tumescent analgesia injections. Immobility with the 50 mg dose was consistently observed in patients weighing between 80 to 146 kg. Processed EEG monitoring Immobility from the pain of tumescent anesthesia injections was eliminated with a unit ketamine does of 50 mg independent of weight or age.

Key words: Opioid free anesthesia, obese patients.

RESUMEN

La tríada de Friedberg para la anestesia sin opiáceos es un paradigma sencillo, y mínimamente invasivo, que consiste en 1) Medir el cerebro; 2) Prevenir el dolor; 3) Abstenerse de fármacos eméticos. Tras una inducción incremental de propofol, la ketamina 50 mg IV se utilizó para producir inmovilidad de 10-20 minutos para las inyecciones de analgesia tumescente del cirujano. La inmovilidad con la dosis de 50 mg se observó consistentemente, en pacientes entre 80 a 146 kg. El EEG procesado monitorizó la inmovilidad del dolor de las inyecciones de anestesia tumescente que fue eliminado con ketamina de 50 mg, independientemente del peso o la edad.

Palabras clave: Anestesia libre de opioides, obesos.

Friedberg's Triad in combination with regional anesthesia is a simplified propofol then ketamine paradigm for opioid free anesthesia (OFA) and better outcomes[1] (Figure 1). Other OFA paradigms involve more drugs[2],[3]. Friedberg's Triad is 1) Measure the brain; 2) Preempt the pain; 3) Emetic drugs abstain. The BIS trend is delayed 15-30 seconds from real time. Titrating propofol with BIS trend only is akin to trying to drive a car with only the rear-view mirror information. Real time EMG trending greatly improves BIS utility.

Anesthesia may be defined as hypnosis plus analgesia. Hypnosis can include amnesia. Analgesia can include sufficient muscle relaxation to imbricate the rectus muscle sheath for abdominoplasty or dissect the pectoralis muscle off the chest

wall for a submuscular breast augmentation. The surgical era of lengthy skin incisions for large thoracic or abdominal retractors belongs to the 20th century. The benefits of 21st century, minimally invasive surgery can be enhanced with minimally invasive anesthesia[4].

Prior to the 1998 addition of brain monitoring to this cosmetic surgery anesthesia practice, hypnosis was defined by incrementally titrating propofol to a loss of lid reflex and loss of verbal response. Hypnotic doses of propofol block ketamine hallucinations[5]. Additional advantages of an incremental propofol induction are avoiding creating the difficult airway[6] and rapid identification of the dramatic variation in propofol rates to achieve identical numerical sedation levels[7].

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If you cannot measure it, you cannot improve it. -Lord Kelvin

Hypnosis can be reproducibly measured with bispectral (BIS) index monitoring. Moderate to deep sedation is $60 < \text{BIS} < 75$. General anesthesia is $40 < \text{BIS} < 60$ [8]. Most patients can achieve $60 < \text{BIS} < 75$ with propofol infusion rates between $25\text{--}50 \text{ mcg} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. Very sensitive patients achieve $60 < \text{BIS} < 75$ with a rate as low as $2 \text{ mcg} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ and very resistant patients may require a rate as high as $200 \text{ mcg} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ [7].

Directly measuring patient cortical response exposes this 100-fold variation in rates required to achieve identical sedation levels.

An incremental, not bolus, induction maintains baseline tone in the genioglossus, masseter, temporalis, and orbicularis oris muscles, maintaining a patent airway, spontaneous ventilation, and often, without requirement for supplemental oxygen. In this video clip (<https://lnkd.in/gAnPtSD>) the infusion pump was set to a $25 \text{ mcg} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ baseline infusion rate while the patient received $50 \text{ mcg} \cdot \text{kg}^{-1}$ for each repeated bolus until the EMG showed its initial descent towards the baseline. Both the rate and bolus are adjusted according to the BIS and EMG response.

In the preceding YouTube video, neither a chin lift nor an artificial airway was required to maintain the airway. Despite no supplemental oxygen, the pulse oximeter tone is unchanged while the hypnosis level decreases to the desired $\text{BIS} < 75$ range with baseline, real time EMG. Incremental propofol induction provides a stable CNS level warding off ketamine hallucinations, hypertension, and tachycardia[1]. Elimination of opioids avoids compounding propofol respiratory depression as well as

abetting spontaneous ventilation and preventing the difficult airway.

After an incremental propofol induction, ketamine 50 mg IV produces 10-20 minutes' immobility for the surgeon's tumescent analgesia injections. Immobility with the 50 mg dose was consistently observed in patients weighing between 30 to 146 kg and in ages 7 up to 94. The effective NMDA receptor saturating ketamine dose does not appear to vary with either weight or age[7]. Ketamine 50 mg is administered 2-3 minutes prior to tumescent analgesia injections.

Glycopyrrolate 0.2 mg is always administered prior to propofol induction to decrease secretions that may produce ketamine associated laryngospasm[9]. This type of laryngospasm involves the complete vocal cord closure without the characteristic 'crowing' sounds. Only a cough or sneeze may precede ketamine associated laryngospasm. Prompt recognition and treatment with $1 \text{ mg} \cdot \text{pound}^{-1}$ or $2 \text{ mg} \cdot \text{kg}^{-1}$ IV lidocaine will resolve the issue[9].

While scientifically validated surveyed anesthesiologists chose pain as the #1 outcome to avoid[10], patients chose emesis as #1, gagging on the ET #2, nausea #3, and pain as a surprising #4 outcome to avoid. (11) PONV is patients' number one anesthesia outcome to avoid. PONV is a disconcerting outcome especially in cosmetic surgery as retching may disrupt rectus sheath sutures or produce a facial hematoma in rhytidectomy patients. A 0.6% PONV rate was published in an Apfel-defined high risk, opioid free, propofol then ketamine outpatient population without antiemetics[12] validating opioids as the principal cause of PONV[13]. Apfel wrote, 'As long as emetogenic agents are part of the anesthetic regimen, the use of antiemetics is of limited utility[14].

Analgesia in cosmetic surgery is commonly administered

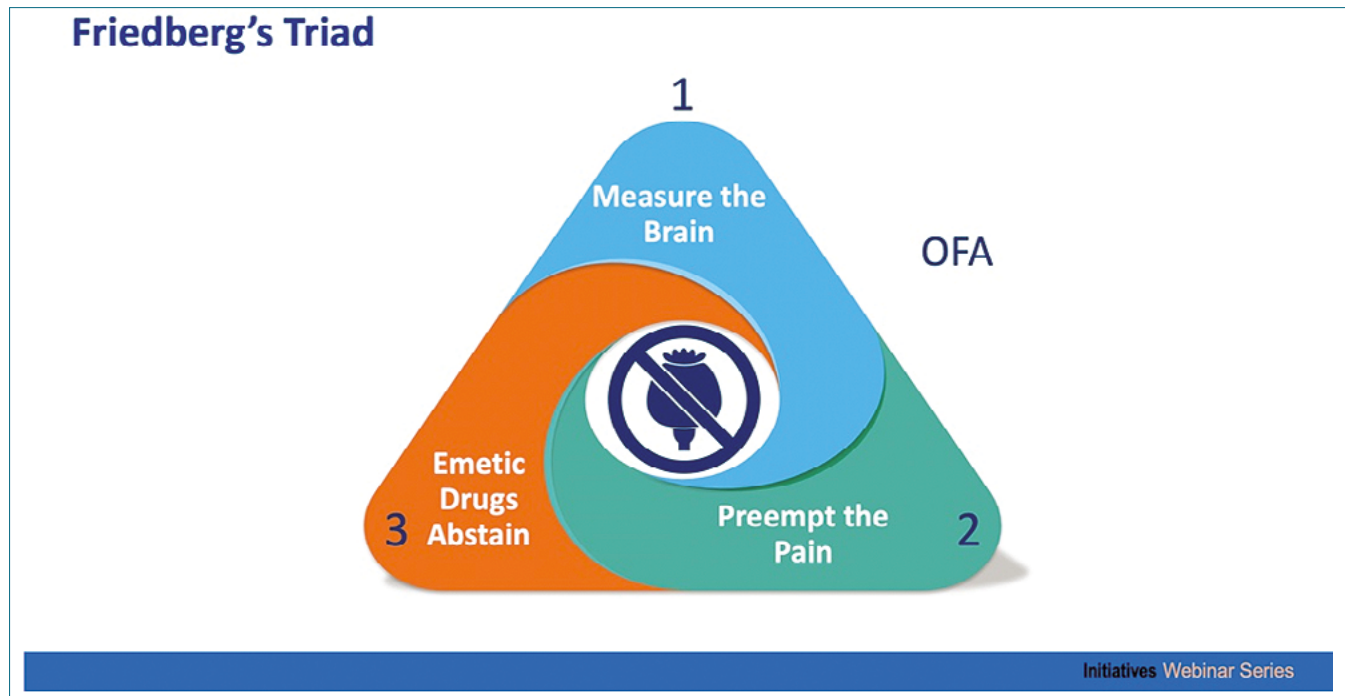


Figure 1. Friedberg's Triad. The character in the middle of the Triad is an opium poppy.

Why is BIS not used more often?

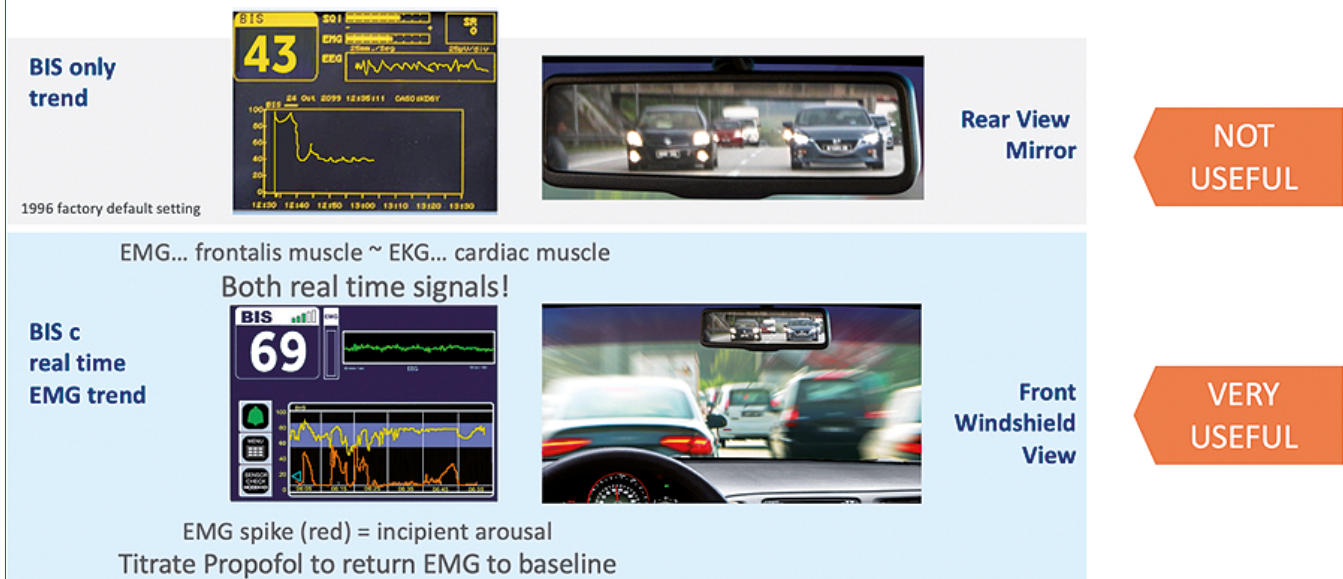


Figure 2. Why BIS is not used more often.

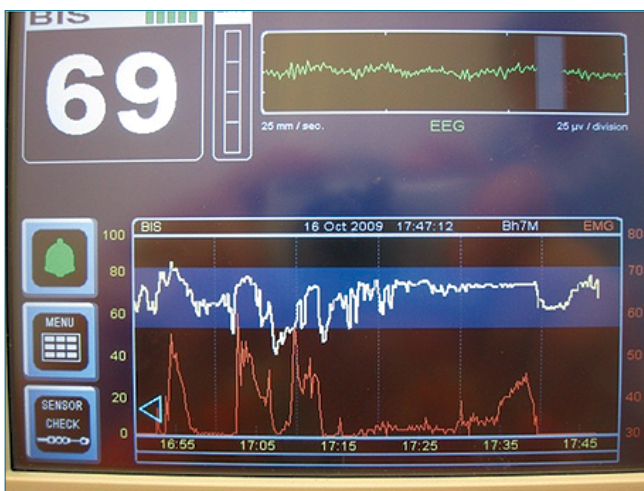


Figure 3. Free-standing BIS unit with lower (red) real time EMG trend. BIS trend is delayed from real time by 15-30 seconds.



Figure 4. Arousal precedes nociception... 'Ouch' precedes withdrawal.

with multiple, stimulating, percutaneous injections into the subcutaneous tissues by the surgeon with ultra-dilute or tumescent solution. Tumescent lidocaine analgesia has its practical limits. Klein published $35 \text{ mg} \cdot \text{kg}^{-1}$ (15) with liposuction and $28 \text{ mg} \cdot \text{kg}^{-1}$ without liposuction[16]. Ostad published up to $55 \text{ mg} \cdot \text{kg}^{-1}$ [17]. Tumescent volumes greater than 5,000 ccs of tumescent analgesia are associated with higher complication rates. As such, 5,000 ccs is considered an upper safe limit in California. In Florida, 4,000 ccs is considered to be the safe upper limit.

The BIS trend is delayed from real time by 15-30 seconds. Figure 2 Unlike the plug-in modules, only free-standing BIS units

allow the display of the real time EMG trend. This trend appears as the lower (red) line. Figure 3 EMG spikes signal incipient arousal[18]. Arousal precedes nociception. Ouch precedes withdrawal. Figure 4 Responding to EMG spikes with sufficient propofol to drive the spike back to baseline prevents incipient arousal. Preventing arousal prevents nociception[19].

After tumescent anesthesia injections, an opioid free, numb patient tends to remain immobile with liposuction. A not-infrequent occurrence may be patient movement during propofol sedation. How can movement generated from the cortex, suggesting inadequate hypnosis (with possible awareness) be differentiated from movement generated from sub-cortical or



Figure 5. Morbidly obese 146 kg patient.

spinal cord regions suggesting inadequate analgesia (no awareness)? The surgeon assumes epinephrine-induced vasoconstriction equals adequate analgesia and demands deeper sedation to terminate the movement. Vasoconstriction only guarantees adequate epinephrine effect. The anesthesiologist responds to the surgeon's demand by asking for more local analgesia. Resolving this dilemma may be very much to the patient's benefit by avoiding unnecessarily excessive, unneeded medications.

Patient movement without EMG spike defines sub-cortical generated movement origin without awareness risk. Patient movement without EMG spike also defines inadequate analgesia. Re-injection of the immediate area of stimulation resolves 98-99% of the sub-cortical generated patient movement[7]. Re-injection of the entire surgical field is unnecessary. Patient movement with EMG spike defines cortical origin movement and requires additional hypnosis with sufficient propofol to bring the EMG spike back to baseline[7].

Morbidly obese patients sometimes seek liposuction. Fig. 5 The airway and distribution volume for propofol are unique considerations in the morbidly obese. The obese patient tends to have a thicker tongue and neck compared to non-obese patients. The morbidly obese tend to have a greater incidence of obstructive sleep apnea (OSA). In addition to no PONV and no antiemetics, opioid avoidance minimizes propofol respiratory depression. Morbidly obese patients also have a greater blood volume of distribution than the typical 70 kg patient making achieving a stable CNS propofol level more challenging. At 70 ml . kg⁻¹ the 146 kg patient has a blood volume slightly more than 10 liters. A propofol bolus induction is the invitation to the difficult airway as well as a greater challenge creating a stable CNS propofol level with redistribution occurs.

This patient had 1,500 ccs liposuction in each of her upper arms. Approximately 2,000 ccs tumescent fluid was injected in each upper arm. Brain size does not vary proportionately with body weight. A 146 kg patient does not have a correspondingly twice the brain size of a 73 kg one. Ketamine 50 mg IV after propofol induction provided immobility for the tumescent injections.

Airway management for this patient's induction was incremental and progressive. Initially her chin was extended, and her head was initially rotated to the right side, the so-called rhytidectomy or facelift position. When that was insufficient to maintain her airway, a 1,000 cc unheated IV bag was inserted under her shoulders to increase the force of extension on the genioglossus muscle. After those two initial non-invasive maneuvers did not maintain her airway, a nasal airway was inserted. This was sufficient to maintain this patient's airway and the fourth (final) maneuver of LMA was not needed. Over 26 years, in none of more than 6,000 opioid free propofol, then ketamine patients was endotracheal intubation required. Oxygen 1 L . min⁻¹ was also administered in this case. She emerged minutes after the discontinuation of the propofol infusion without either pain or PONV.

Conclusion

Friedberg's Triad for opioid free anesthesia is a simple, minimally invasive paradigm useful even for morbidly obese patients. Processed EEG monitoring was especially useful with patients having greater than 5 liters blood volume to assure propofol levels remained in the hypnotic (60 < BIS < 75 with baseline EMG) zone throughout the surgery. Ketamine associated hallucinations were avoided. Immobility from the pain of tumescent anesthesia injections was eliminated with a unit ketamine dose of 50 mg independent of weight or age.

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