Craniotomie éveillée : Considérations et options anesthésiques

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Objectifs

- Identifier le rôle de l’anesthésiologiste en craniotomie éveillée
- Comparer les options anesthésiques pour la craniotomie éveillée
- Résumer les facteurs de risque d'échec du monitoring neurologique per-opératoire

Craniotomie éveillée : objectifs du CR

16.3 Surgical procedures
16.3.1 Demonstrate knowledge of the implications of, and provide anesthetic care for neurosurgical patients presenting with the following conditions:
16.3.1.1 Intracranial Masses
16.3.1.1.1 Supratentorial tumour resection
16.3.1.1.2 Posterior fossa tumour resection
16.3.1.1.3 Pituitary tumour resection
16.3.1.1.4 *Awake craniotomy for tumour resection*

The procedures listed below as italicized items are not expected to be performed independently but the Anesthesiologist shall demonstrate knowledge of the principles of the procedure.

Craniotomie éveillée – le rôle de l'anesthésiologiste

- ABC
- Optimiser les conditions chirurgicales
- Permettre un monitoring neurologique per-op fiable

Craniotomie éveillée pour tumeur – bénéfices

- Meilleure étendue de résection
- Meilleure survie
- Moins de déficits neurologiques
- Réduction de la durée de séjour

Meng et al., Can J Anesth, 2017

Sélection des patients

- Seule contre-indication absolue : refus du patient / non-collaboration
- Troubles psychiatriques
  - Anxiété sévère
  - Claustrophobie
  - Troubles psychotiques non contrôlés
  - Troubles cognitifs sévères
- Enjeux respiratoires
  - Voies aériennes difficiles
  - Apnée du sommeil / obésité
- Conditions neurologiques
  - Épilepsie non contrôlée
  - Hypertension intracrânienne significative

Meng et al., Can J Anesth 2017
Min KT, Anesth Pain Med 2025

Consultation anesthésique préopératoire

- Essentielle !
- Identification des facteurs de risque + stratégies de mitigation des risques
- État neurologique de base (orthophonistes, physiothérapeutes, neuropsy)
- Explication de la procédure
  - Bien tolérée dans la grande majorité des cas
  - Gestion des attentes face à la douleur intraopératoire (positionnement, muscle temporal, dure-mère a/n base du crâne, faux, scissure sylvienne)
  - Bruit durant chirurgie (ad 120 dB)
- Gagner la confiance du patient

Potters et Klimek, Curr Op Anestheiology 2015
Fontaine et Almairac, Neurochirurgie 2017
Bala et al., J Neuro-psychol 2024

Options d'anesthésie locale

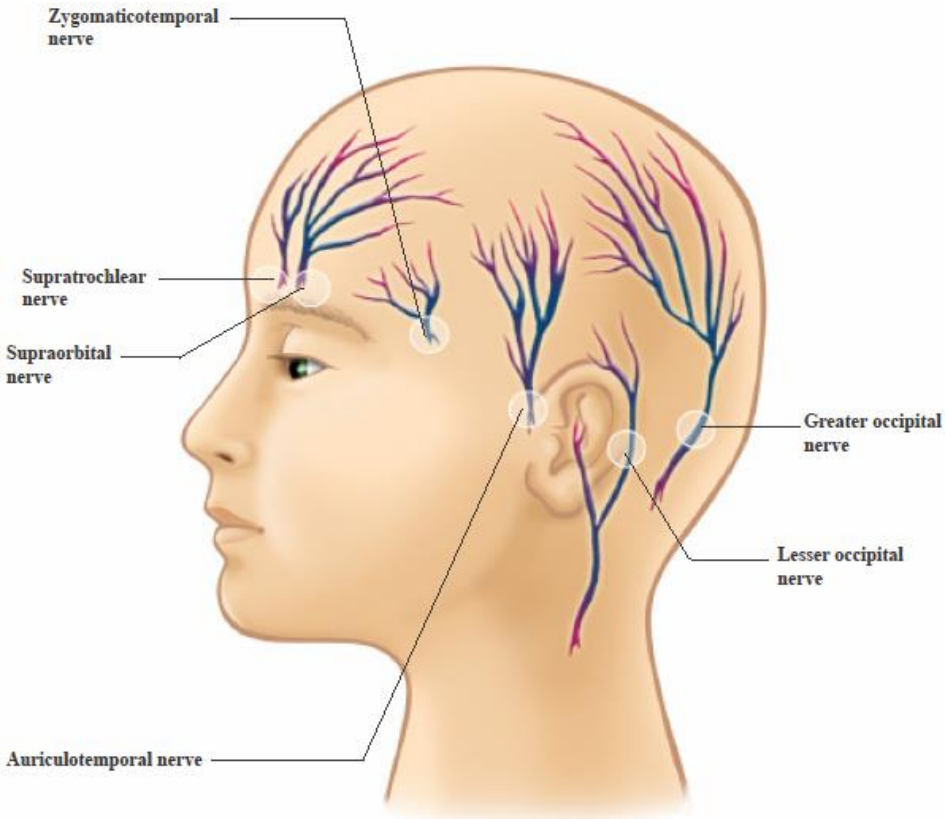
- Plusieurs infiltrations possibles
  - Bloc du scalp vs field block
  - Locale au site du Mayfield
  - Locale sur la dure-mère

- Choix d'agent AL
  - Ropivacaine vs bupi + épinéphrine
  - Lidocaine
  - Adjuvants péri-neuraux
    - Durée 14h avec dexmededetomidine 1 mcg/kg, vs 12h avec dexamethasone 8 mg

Sharma et al., Clin Neurol Neurosurg 2025

- Attention aux doses toxiques !
  - Pic sérique à 15 min
  - 3 mg/kg ropi (ad 5 mg/kg ?)

Sato et al., Front Med 2022



https://www.researchgate.net/figure/Schematic-of-scalp-block-nerves-in-a-pediatric-patient_fig1_269941698

Serum Concentration of Ropivacaine After Repeated Administration to Several Parts of the Head During Awake Craniotomy: A Prospective Cohort Study

Takehito Sato[1], Takahiro Ando[1], Ichiko Asano[1], Atsushi Mori[2], Kazuya Motomura[3] and Kimitoshi Nishiwaki[1]*

frontiers | Frontiers in Medicine

BRIEF RESEARCH REPORT
published: 04 May 2022
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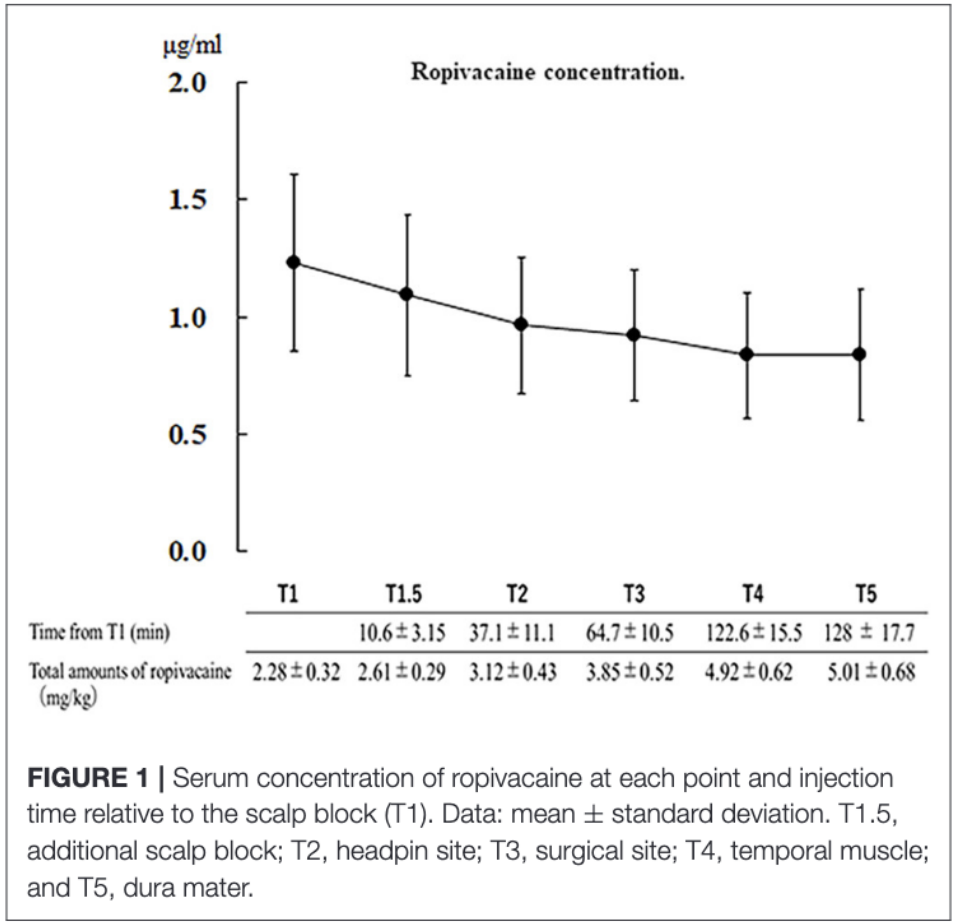


	T1	T1.5	T2	T3	T4	T5
Time from T1 (min)		10.6 ± 3.15	37.1 ± 11.1	64.7 ± 10.5	122.6 ± 15.5	128 ± 17.7
Total amounts of ropivacaine (mg/kg)	2.28 ± 0.32	2.61 ± 0.29	3.12 ± 0.43	3.85 ± 0.52	4.92 ± 0.62	5.01 ± 0.68

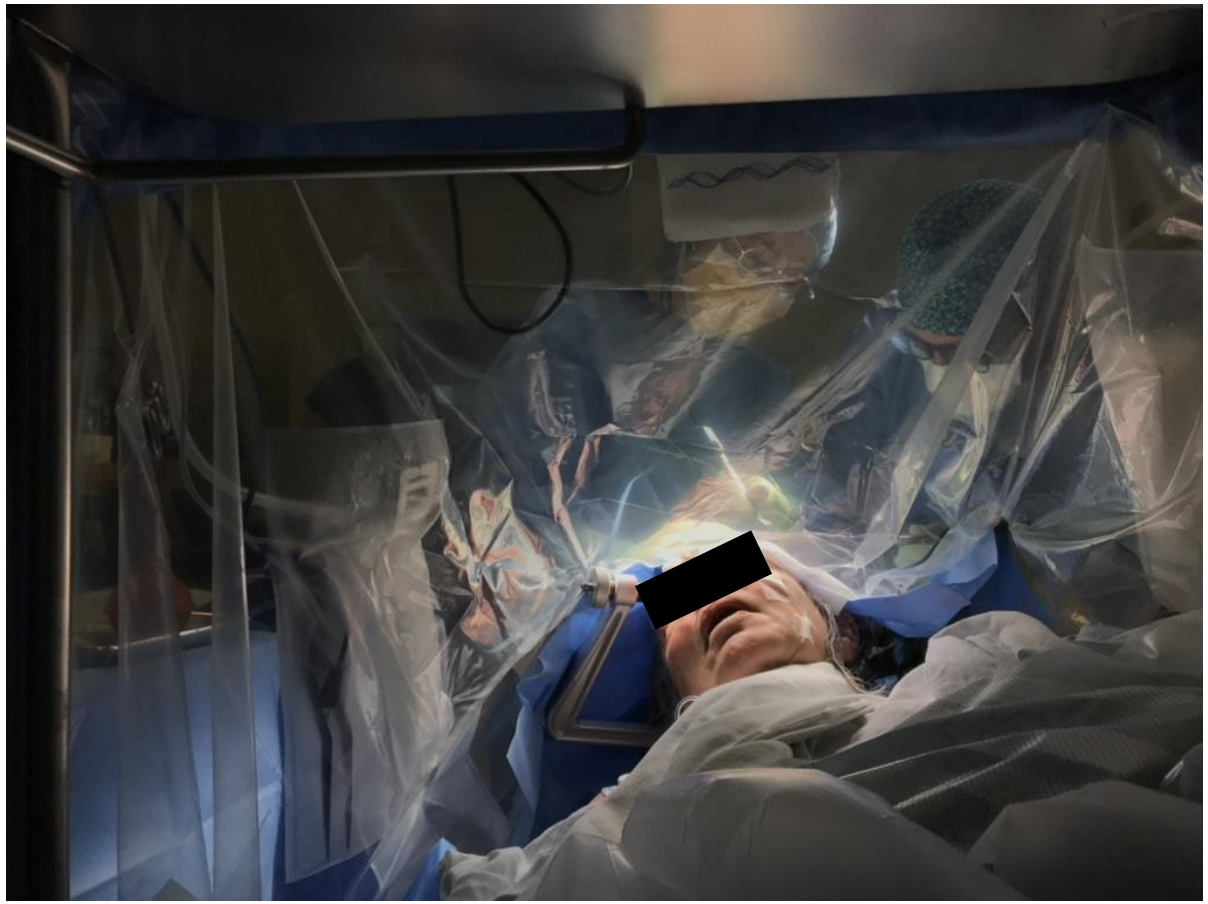
FIGURE 1 | Serum concentration of ropivacaine at each point and injection time relative to the scalp block (T1). Data: mean ± standard deviation. T1.5, additional scalp block; T2, headpin site; T3, surgical site; T4, temporal muscle; and T5, dura mater.

- Dose moyenne de ropi = 5 mg/kg (max 6,3 mg/kg)
- Seuil toxique pour la concentration plasmatique de ropi = 4,3 mcg/ml (atteinte chez aucun des pt)
- Délai moyen entre T1 et T5 = 128 min

Positionnement

- Sédation minimale durant positionnement
- Tête en position neutre (doit être capable d’avaler)
- Protection points de pression (région axillaire, hanche)
- Espace pour tests intraop et accès aux voies aériennes (table Mayo)
- Support sous le cou
- Champ transparent

Positionnement



Options anesthésiques

- Anesthésie locale seule (awake-awake-awake, AAA)
- Sédation consciente (MAC)
- Asleep-awake-asleep (SAS)

Options anesthésiques - comparaisons

	Anesthésie locale seule (awake-awake-awake, AAA)	Sédation consciente (MAC)	Asleep-awake-asleep (SAS)
Avantages	• Pas d'interférence avec le monitoring • Limite les cx respiratoires • Possible avec ressources limitées	• Confort du patient • ↓ **échec (1% MAC vs 4% SAS),** mais résultat drivé par une seule étude monocentrique • **Procédure plus rapide (vs AAA et SAS)** • ↓ **durée de séjour**	• Contrôle de la ventilation durant craniotomie • **Moins de convulsions**
Inconvénients	• Nécessite patient motivé	• Sédation (ad AG) avec voies aériennes non protégées • Risque d'hypoventilation • Possibilité de douleur per-op	• Manipulation des voies aériennes • **Plus d'HTA durant partie éveillée**

Dilmen et al., J Clinical Neuroscience, 2016
Eseonu et al., World Neurosurg 2017
Molina et al., J Neurosurg 2018
Natalini et al., J Neurosurg Anesthesiol, 2022

Comparison of the Asleep-Awake-Asleep Technique and Monitored Anesthesia Care During Awake Craniotomy: A Systematic Review and Meta-analysis

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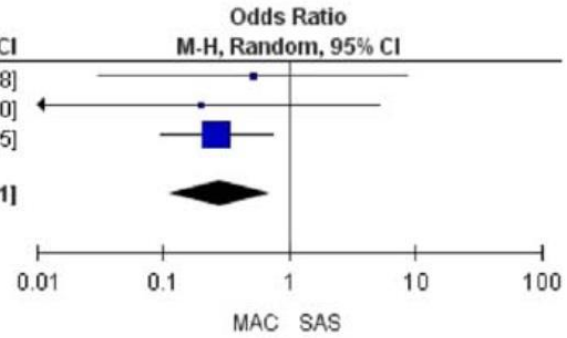
AC failure

Study or Subgroup	MAC Events	MAC Total	SAS Events	SAS Total	Weight	Odds Ratio M-H, Random, 95% CI
Dilmen 2016	1	43	1	23	10.7%	0.52 [0.03, 8.78]
Eseonu et al 2017	0	50	1	31	8.1%	0.20 [0.01, 5.10]
Suero Molina et al 2018	5	75	22	105	81.2%	0.27 [0.10, 0.75]
Total (95% CI)		**168**		**159**	**100.0%**	**0.28 [0.11, 0.71]**
Total events	6		24			

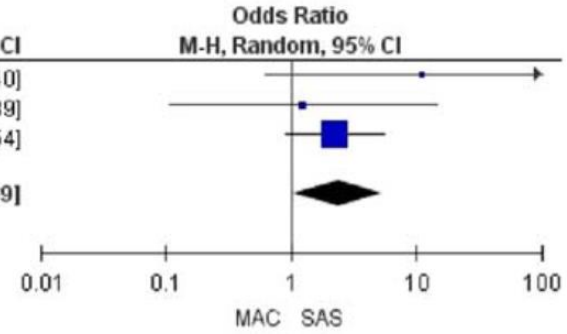
Heterogeneity: Tau² = 0.00; Chi² = 0.24, df = 2 (P = 0.89); I² = 0%
Test for overall effect: Z = 2.69 (P = 0.007)



Intraoperative Seizures

Study or Subgroup	MAC Events	MAC Total	SAS Events	SAS Total	Weight	Odds Ratio M-H, Random, 95% CI
Dilmen 2016	8	43	0	23	7.9%	11.25 [0.62, 204.40]
Eseonu et al 2017	2	50	1	31	11.2%	1.25 [0.11, 14.39]
Suero Molina et al 2018	13	75	9	105	80.9%	2.24 [0.90, 5.54]
Total (95% CI)		**168**		**159**	**100.0%**	**2.38 [1.05, 5.39]**
Total events	23		10			

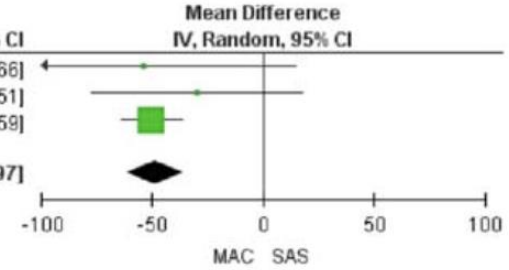
Heterogeneity: Tau² = 0.00; Chi² = 1.47, df = 2 (P = 0.48); I² = 0%
Test for overall effect: Z = 2.08 (P = 0.04)



Duration of Surgery

Study or Subgroup	MAC Mean	MAC SD	MAC Total	SAS Mean	SAS SD	SAS Total	Weight	Mean Difference IV, Random, 95% CI
Dilmen 2016	350.73	117.68	42	404.09	138.73	22	3.5%	-53.36 [-121.38, 14.66]
Eseonu et al 2017	283.5	105.6	50	313.3	105.6	31	7.3%	-29.80 [-77.11, 17.51]
Suero Molina et al 2018	202.32	45.7	75	252.45	45.7	105	89.2%	-50.13 [-63.67, -36.59]
Total (95% CI)			**167**			**158**	**100.0%**	**-48.76 [-61.55, -35.97]**

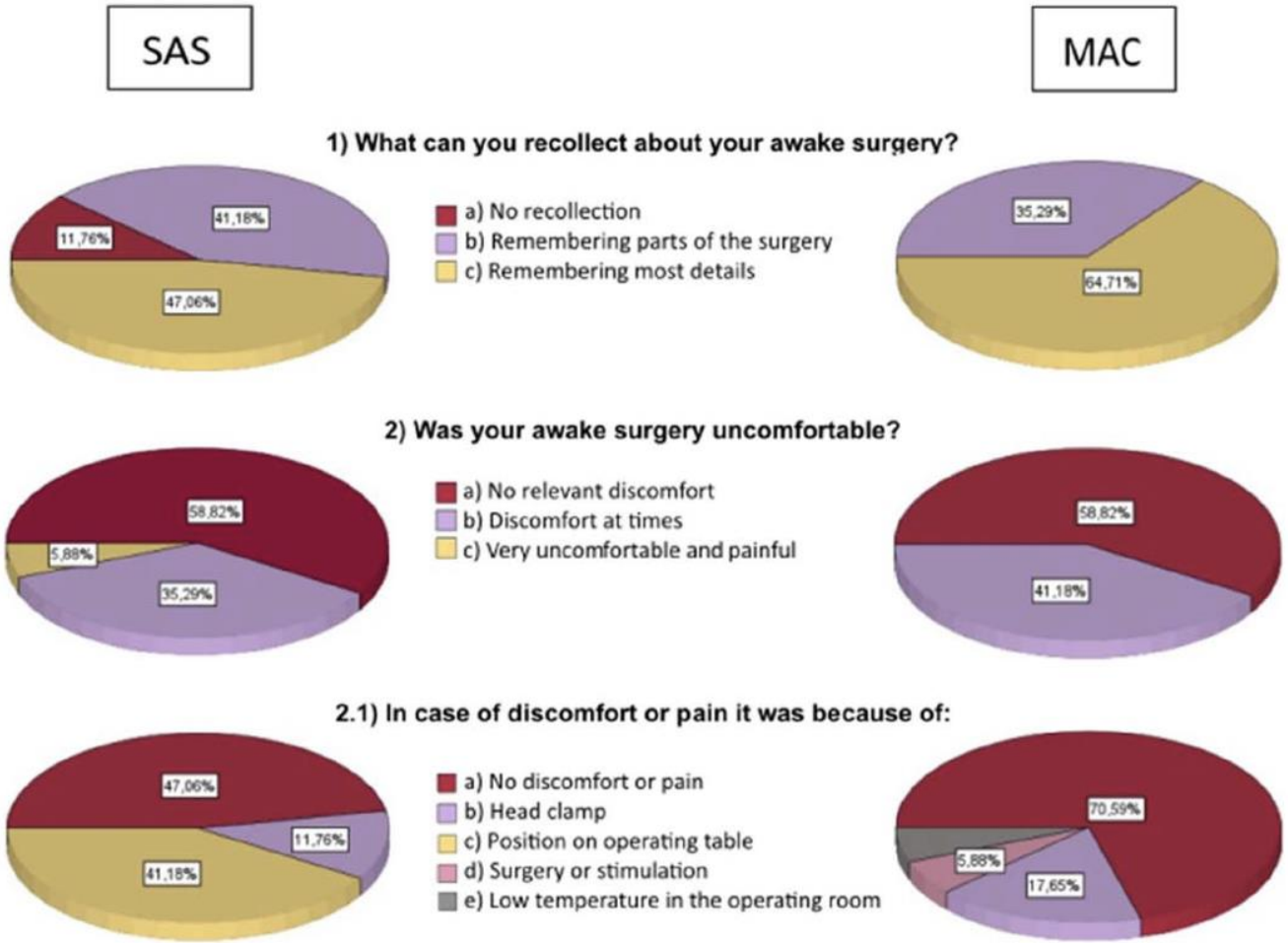
Heterogeneity: Tau² = 0.00; Chi² = 0.67, df = 2 (P = 0.71); I² = 0%
Test for overall effect: Z = 7.47 (P < 0.00001)



Comparison of Subjective Patient Experiences Between Asleep-Awake-Asleep and Monitored Anesthesia Care Techniques During Awake Craniotomy

Laura Krismer, MD, Ursula Tröndle, MD,† Christian Schwer, MD,† Javier Trincado, MD,‡ Serife M. Pinar, MD,* Zeynep Mercan, MD,* Kathrin Wagner, MD,§ Elizaveta Mirlina, MD,‖ Jürgen Beck, MD,* Amir El Rahal, MD,* and Roland Roelz, MD**

(*J Neurosurg Anesthesiol* 2025;00:000–000)



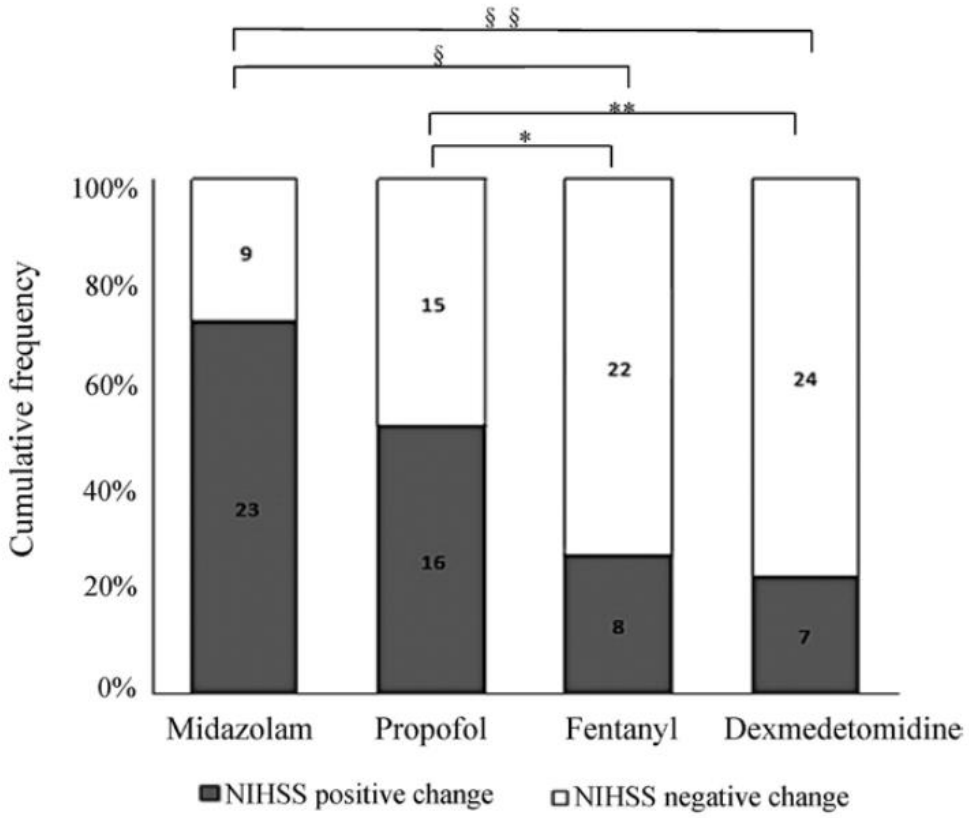
Craniotomie éveillée – options médicamenteuses

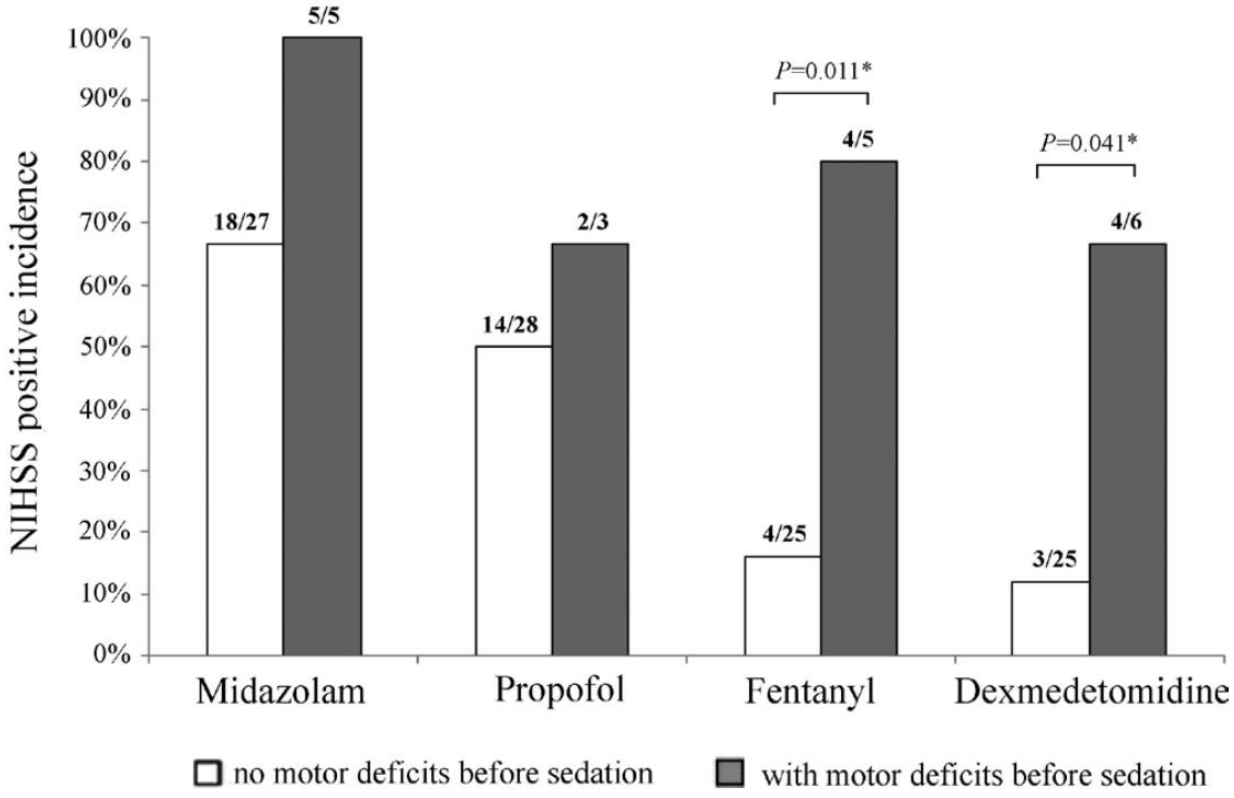
- Neuroleptanesthésie (historique)
- Benzodiazépines (midazolam, remimazolam)
- Opioïdes (fentanyl, remifentanil)
- Propofol
- Dexmédétomidine
- Kétamine ?

Mild Sedation Exacerbates or Unmasks Focal Neurologic Dysfunction in Neurosurgical Patients with Supratentorial Brain Mass Lesions in a Drug-specific Manner

Nan Lin, M.D., Ruquan Han, M.D., Ph.D., Jianxin Zhou, M.D., Adrian W. Gelb, M.B.Ch.B.

(ANESTHESIOLOGY 2016; 124:598-607)





Avantages théoriques de la dexmédétomidine

- Préserve la collaboration du patient
- Interférence minimale avec monitoring et ECoG
- Effet analgésique
- Moins d'obstruction des voies aériennes supérieures
- Moins de délirium ? (études avec cas sous AG)

Bekker et al., Anesth Analg 2001
Mack et al., J Neurosurg Anesthesiol 2004
Li et al., Br J Anaesth 2023

Dexmédétomidine en cranio éveillée (MAC) : études

- Dexmed +/- propofol vs propofol/remi
  - ↓ événements respiratoires
  - ↓ N/V
  - Meilleur score de sédation

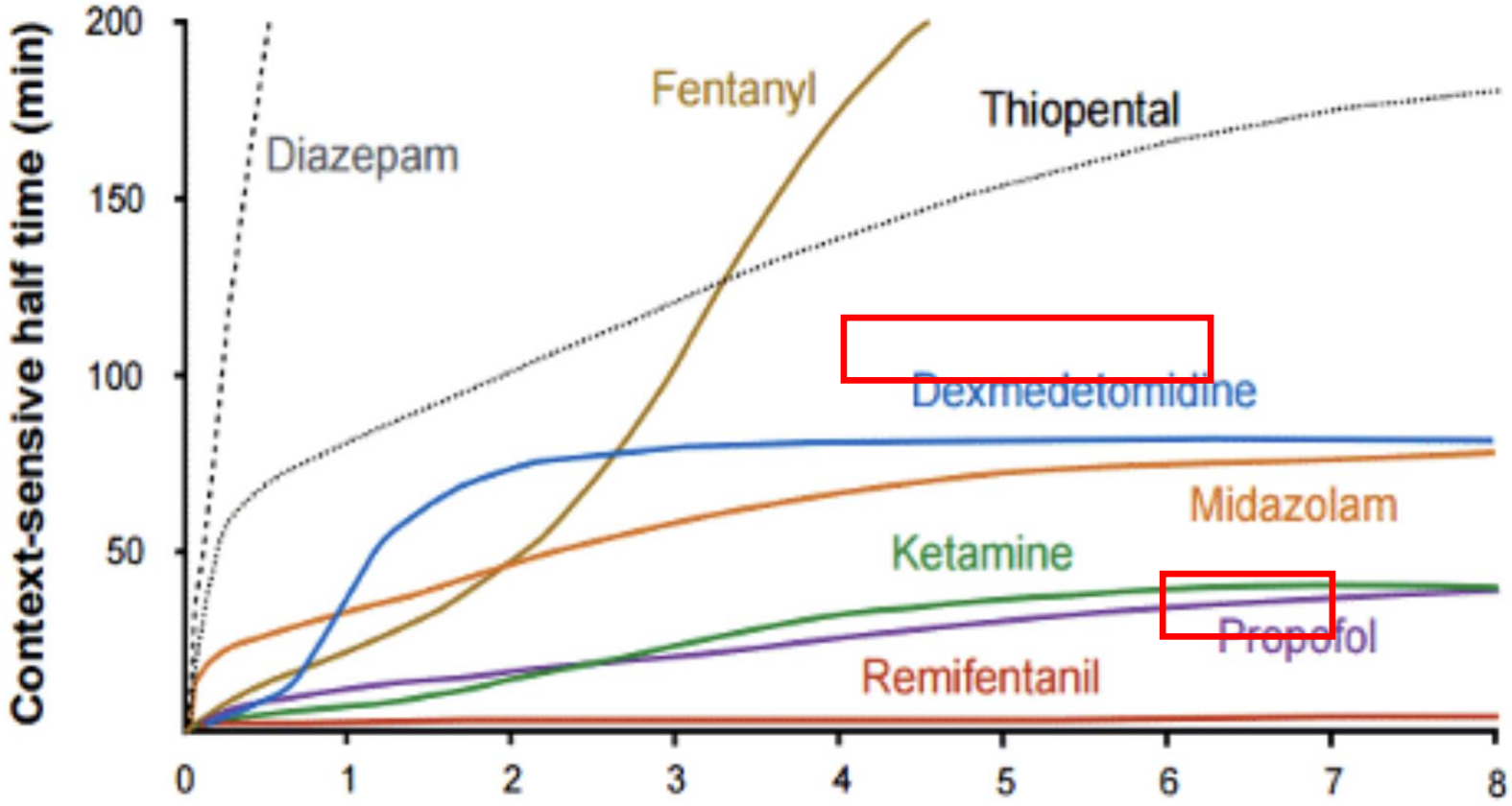
Goettel et al., British Journal of Anaesthesia, 2016
Elbakry et Ibrahim, Minerva Anestesiologica, 2017

- Dexmed vs propofol
  - Meilleure satisfaction du chirurgien (méta-analyse de RCTs)

Viderman et al., Clin Neurol Neurosurg 2023

- Pas de différence démontrée pour capacité à réaliser le mapping

Demi-vie contextuelle : propofol vs dexmed



https://advances.massgeneral.org/research-and-innovation/article.aspx?id=1355

The Differential Effects of Propofol and Dexmedetomidine on Intraoperative Neuropsychological Testing During Awake Craniotomies

Sara Pillay[1], Ben Maruska[2], Alissa M. Butts[1], Mohammad Saber[3], William L. Gross[1,3]

WORLD NEUROSURGERY 202: 124400, October 2025

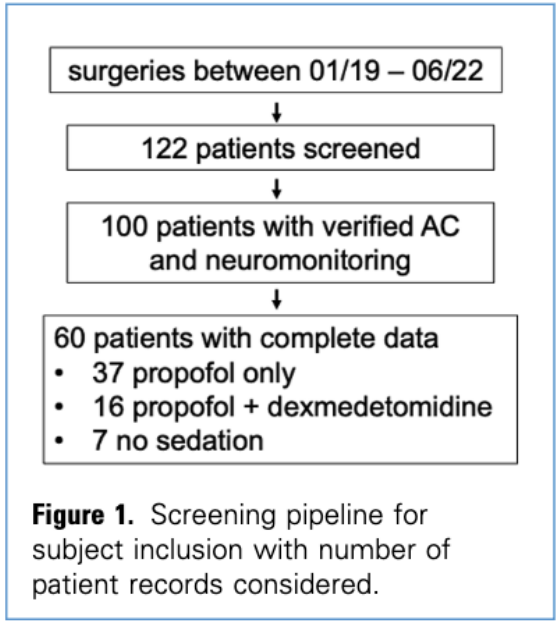


Figure 1. Screening pipeline for subject inclusion with number of patient records considered.

Table 1. Average Total Dosage of Sedative Drugs Used (Bolus + Total Infusion) During Surgery

Drug	Mean	SD	Minimum	Maximum
Propofol, no dexmed (mg/kg)	3.31	1.95	0.50	8.91
Propofol, with dexmed (mg/kg)	2.37	1.47	0.41	6.43
Dexmedetomidine (mcg/kg)	0.173	0.142	0.020	0.583

Values exclude data points where that drug was not used.
SD, standard deviation.

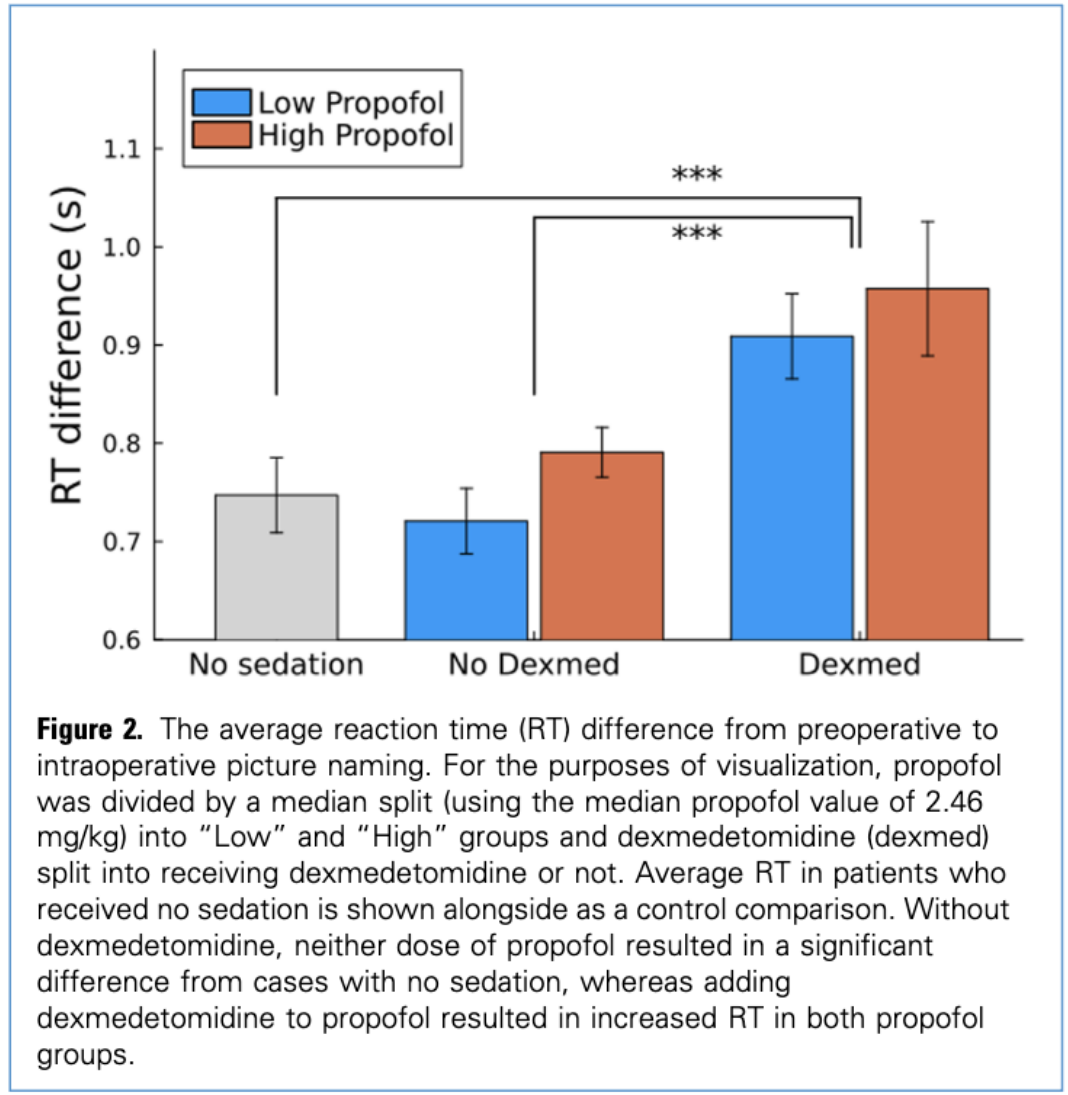


Figure 2. The average reaction time (RT) difference from preoperative to intraoperative picture naming. For the purposes of visualization, propofol was divided by a median split (using the median propofol value of 2.46 mg/kg) into "Low" and "High" groups and dexmedetomidine (dexmed) split into receiving dexmedetomidine or not. Average RT in patients who received no sedation is shown alongside as a control comparison. Without dexmedetomidine, neither dose of propofol resulted in a significant difference from cases with no sedation, whereas adding dexmedetomidine to propofol resulted in increased RT in both propofol groups.

Options anesthésiques en craniotomie éveillée – points clés

- Pratiques locales variables
- Plusieurs options adéquates
- Dexmédétomidine semble être un agent de choix, mais attention à l’accumulation
- À moduler selon caractéristiques du pt, de la procédure et des tests planifiés

Échec de la craniotomie éveillée

- Définitions
  - Conversion en AG non planifiée (2%)
  - Impossibilité de compléter la cartographie prévue
  - Faux positifs
- Rare (0,5 à 4%)
- Associé à résection incomplète et morbidité post-opératoire

Nossek et al., J Neurosurg 2013
Hervey-Jumper et al., J Neurosurg 2015
Stevenson et al., PLOS One 2016
Takami et al., J Neurosurg 2020
Natalini et al., J Neurosurg Anesthesiol 2022
Elia et al., Neurosurg 2023

Échec – complication respiratoire

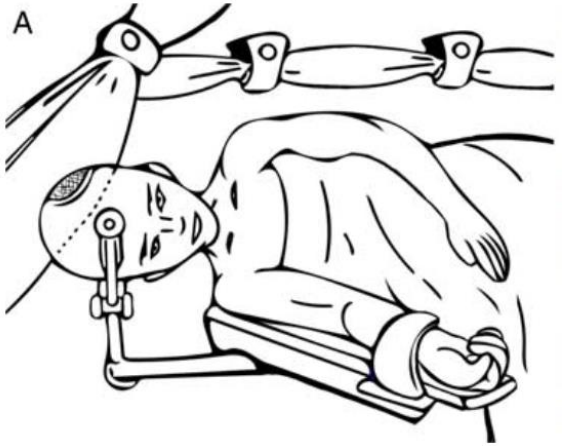
- Rarement cause d'échec (moins de 1%)
- Facteurs de risque : asthme, remifentanil
- Prise en charge des voies aériennes
  - Ventilation au masque +/- canule OP ou NP
  - LMA (plus rapide)
  - Intubation avec FOB via LMA
  - Vidéolaryngoscopie

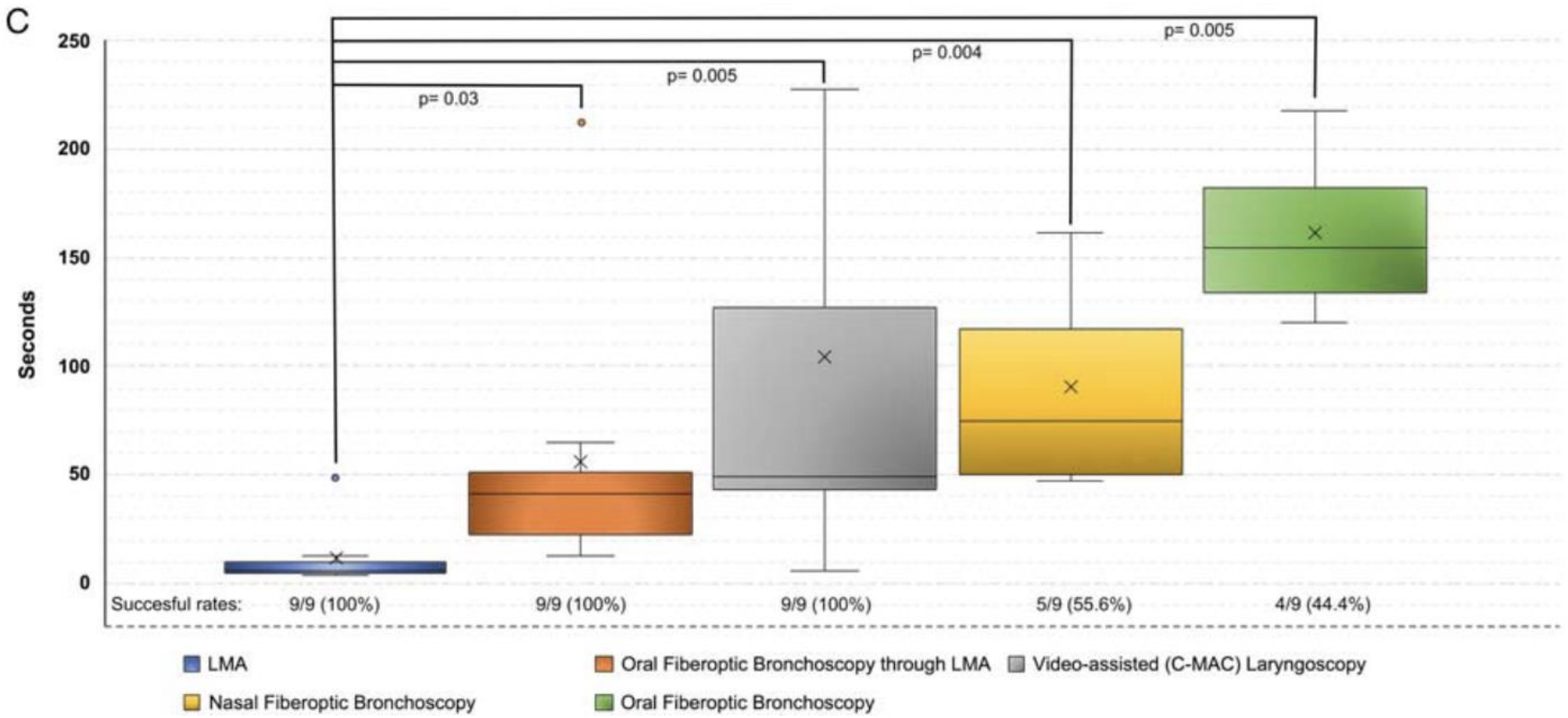
Abaziou et al., J Clin Anesth 2020
Gruenbaum et al., J Neurosurg Anesthesiol 2022

Emergency Airway Management During Awake Craniotomy: Comparison of 5 Techniques in a Cadaveric Model

Shaun E. Gruenbaum, MD, PhD, Federico Bilotta, MD, PhD,† Tais G.O. Bertasi, MD,* Raphael A.O. Bertasi, MD,* William E. Clifton, MD,‡ Benjamin F. Gruenbaum, MD,§ Gaetano De Biase, MD,‡ Diogo M. Garcia, MD,‡ Elird Bojaxhi, MD,* Klaus D. Torp, MD,* and Alfredo Quinones-Hinojosa, MD‡*

(*J Neurosurg Anesthesiol* 2022;34:74–78)





Échec – convulsions intra-opératoires

- Incidence 0-30%, plus rarement cause d'échec (0.5%)
- Ne semble pas avoir d'impact négatif sur le devenir neurologique à long terme
- Facteurs de risque
  - Tumeur frontale
  - Épilepsie pré-opératoire
  - Rx anti-crises multiples
  - Volume de la tumeur
  - Radiothérapie préopératoire
  - Utilisation de dexmédétomidine ?

Nossek et al., J Neurosurg 2013
Nossek et al., Neurosurgery 2013
Meng et al., Can J Anesth 2017
Sewell et Smith, Curr Op Anesthesiol 2019
Abacassiou et al., J Neurosurg 2021
Deana et al., World Neurosurg 2023
Paquin-Lanthier et al. J Neurosurg Anesthesiol 2023
Shakir et al., Surg Neurol Int 2023
Alimohamadi et al., J Neurosurg Sci 2024

TABLE 3. Seizure Characteristics, Treatment and Complications (n = 29)

	N (%)
Type of seizure	
Focal	27 (93.1)
Generalized	2 (6.9)
Timing of seizure	
During head pinning	2 (6.9)
During surgical approach	2 (6.9)
Stimulation-induced seizure	20 (69.0)
During resection or biopsy	4 (13.8)
Unclear timing in record	1 (3.4)
Treatment of seizure	
Spontaneous resolution	7 (24.1)
Cold saline alone	4 (13.8)
Propofol bolus alone	7 (24.1)
Cold saline+propofol	8 (27.6)
Cold saline+benzodiazepine	1 (3.4)
Propofol+benzodiazepine	2 (6.9%)
Intraoperative use of antiepileptic drugs (AEDs)	
Therapeutic phenytoin	4 (13.8)
No intraoperative AED	25 (86.2)
Intraoperative complications related to seizure	
Planned mapping not performed	3 (10.3)
Conversion to general anesthesia	0

Risk Factors and Characteristics of Intraoperative Seizures During Awake Craniotomy: A Retrospective Cohort Study of 562 Consecutive Patients With a Space-occupying Brain Lesion

Gabriel Paquin-Lanthier, MD, FRCPC, Sudhakar Subramaniam, MBBS, DA,* Kok Weng Leong, MD, M.Anaes,* Abigail Daniels, MBChB, DA,* Kawalpreet Singh, MD,* Hirokazu Takami, MD, PhD,† Tumul Chowdhury, MD, DM, FRCPC,* Mark Bernstein, MD, MHSc, FRCS(C),† and Lashmi Venkatraghavan, MD, FRCA, FRCPC**

(*J Neurosurg Anesthesiol* 2023;35:194–200)

TABLE 4. Results From Multivariate Analysis of Risk Factors for Intraoperative Seizure

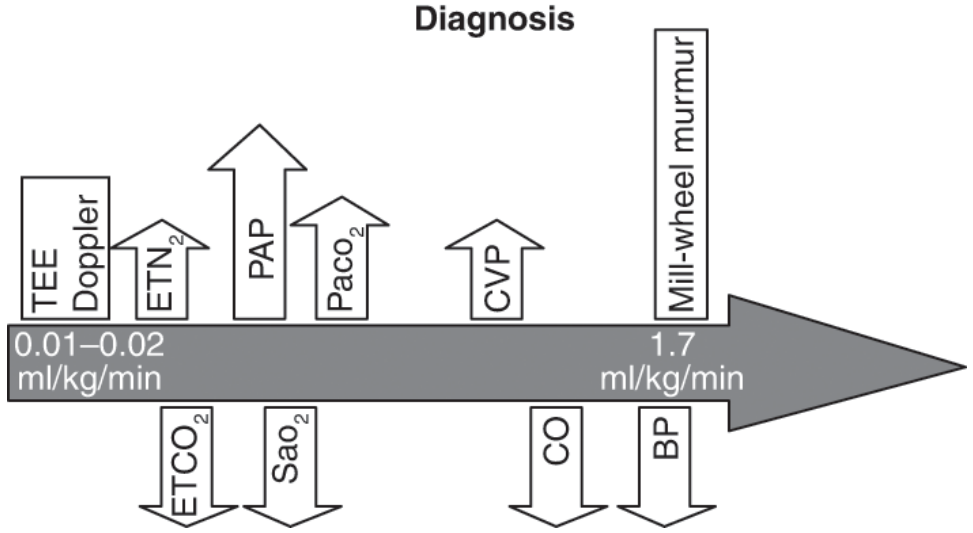
	aOR	95% CI	*P*
Frontal location of tumor	**5.681**	**(2.11-15.30)**	**0.001**
Preoperative radiotherapy	1.974	(0.87-4.49)	0.11
Preoperative history of seizures	1.539	(0.68-3.46)	0.30
Intraoperative use of dexmedetomidine	2.724	(1.24-6.00)	**0.01**
Intraoperative stimulation mapping	2.886	(0.96-8.70)	0.06

Values in bold indicate statistically significant differences ($P < 0.05$).

AEDs indicates antiepileptic drugs; aOR, adjusted odds ratio; CI, confidence interval.

Échec – embolie aérienne veineuse

- Cause #1 de conversion en AG (TWH)
- Favorisé par la ventilation spontanée
- Signe précoce = toux
- Reconnaissance / traitement rapides essentiels



Faust Anesthesiology Review 2015

Échec – autres causes

- Sédation excessive
  - FR: dysphasie préopératoire, phénytoïne prophylactique
- Intolérance émotionnelle
  - FR: KPS < 70
- Non collaboration
  - FR: > 70 ans, épilepsie non contrôlée, traitement oncologique antérieur, hyperperfusion à l'IRM, effet de masse
- Agitation
- Douleur
- Saignement

Nossek et al., J Neurosurg 2013
Khandelwal et al., J Neurosurg Anesthesiol 2019
Takami et al., J Neurosurg 2020
Elia et al., Neurosurg 2023

Conclusions

- La craniotomie éveillée est sécuritaire pour la grande majorité des patients avec tumeurs cérébrales à proximité des zones éloquentes.
- Plusieurs options anesthésiques peuvent être considérées selon les caractéristiques du cas et du patient.
- L’échec est rare avec une préparation adéquate.
- Une bonne collaboration entre anesthésiologistes et chirurgiens est essentielle au succès de la procédure.

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Merci ! Des questions ?