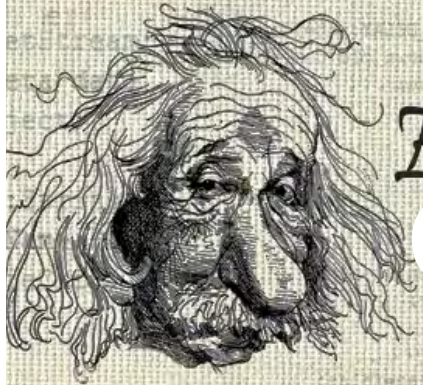


DNA



$$E=mc^2$$

Craneotomía en el paciente despierto, análisis

Left moribimortalidad según la técnica Right brain

I am the left brain.
I am a scientist. A mathematician.
the familiar. I categorize. I am accurate. Linear.
Analytical. Strategic. I am practical.
rs in control. A master of words and language.
I calculate equations and play with numbers.
I am order. I am logic.
I know exactly who I am.

Lydia Salvador Adjunto Anestesia

Oscar Torres MIR 3 Anestesia

SARD del HGUV

I am the right brain.
I am creativity. A free spirit. I am pass
Yearning. Sensuality. I am the sound of roaring
I am taste. The feeling of sand beneath ba
I am movement. Vivid colors.
I am the urge to paint on an empty can
I am boundless imagination. Art. Poetry. I ser
I am everything I wanted to be.

Servicio de Anestesia Reanimación y Tratamiento del Dolor
Consorcio Hospital General Universitario de Valencia

=3.12



$$F_y = \frac{\rho}{2} v^2 \infty C_y A$$

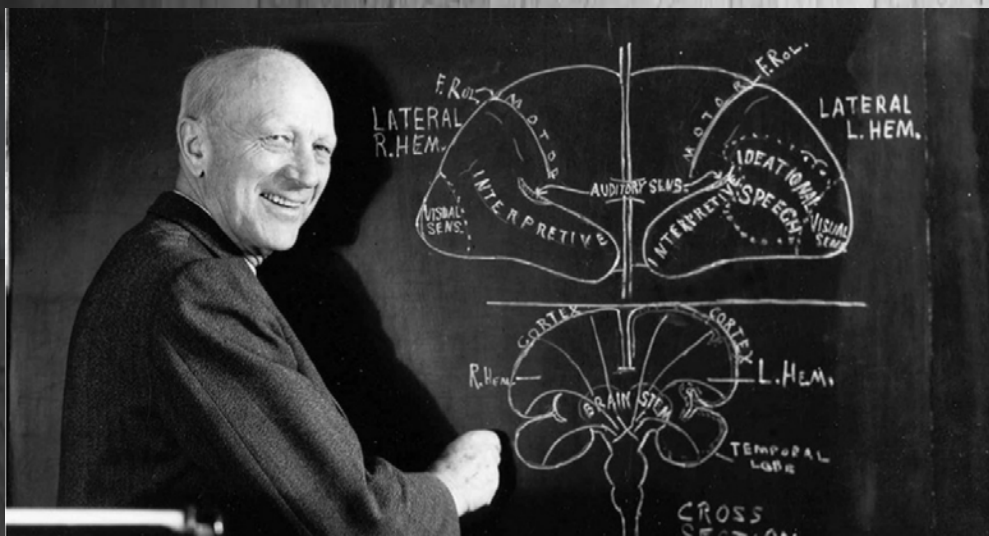


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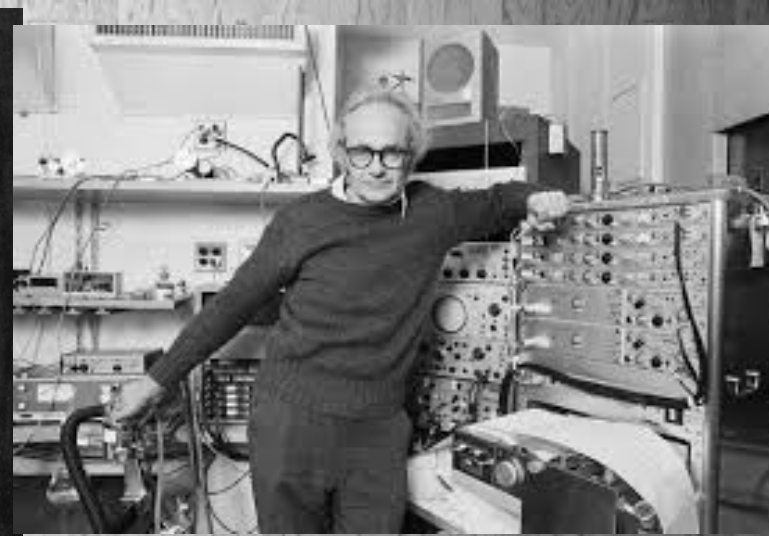
"Awake craniotomy"



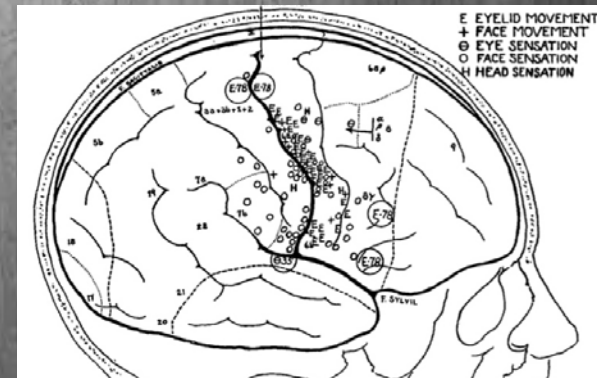
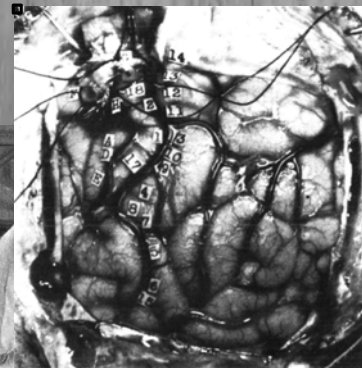
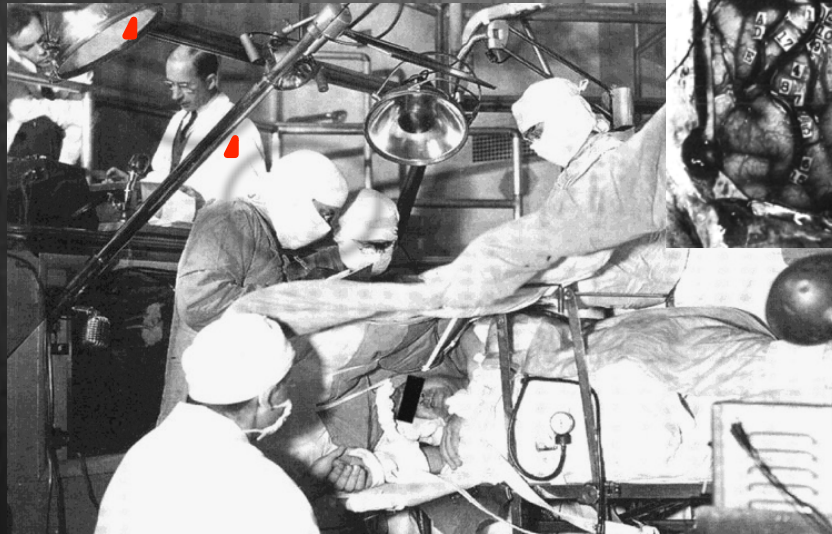
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Willer Penfield



Herbert Jasper





"Awake craniotomy"

Problemas



Procedimientos largos

+ Incomodidad / claustrofobia

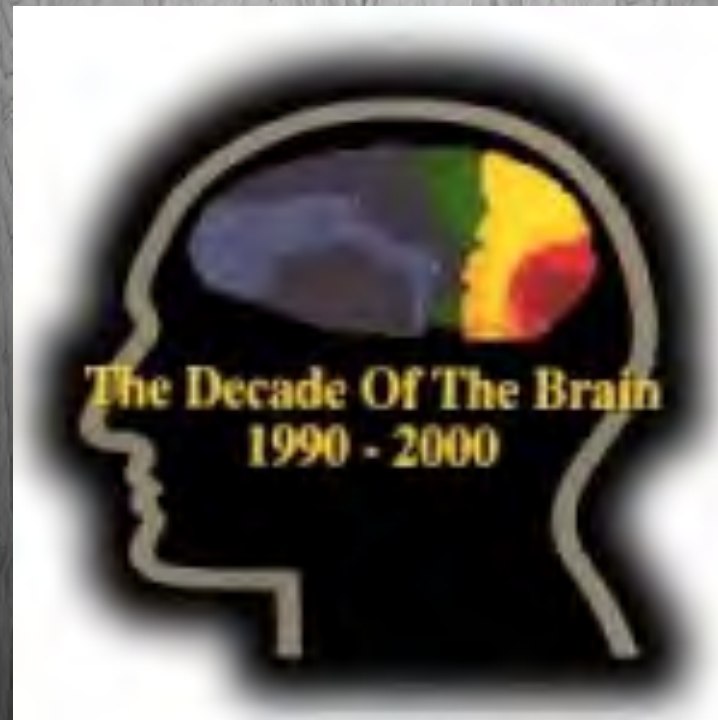
Accesibilidad limitada al paciente

+ Riesgo de complicaciones



Muerte es la incapacidad de un organismo para generar impulsos eléctricos.

Dr. Leaz 1999





¿Que escogerías?

Craneotomía
despierto

Craneotomía
anestesia general



CRANEOTOMÍA DESPIERTO

Primariamente realizada para cirugía de epilepsia.

Durante las últimas décadas se ha utilizado mayoritariamente para monitorizar funciones motoras y del lenguaje.

Más recientemente otras funciones cognitivas.



CRANEOTOMÍA DESPIERTO

El propósito de la craneotomía despierto es monitorizar la actividad de **areas elocuentes** del cerebro mientras se realiza la resección de lesiones.



Método más fiable de preservar las funciones de áreas elocuentes.



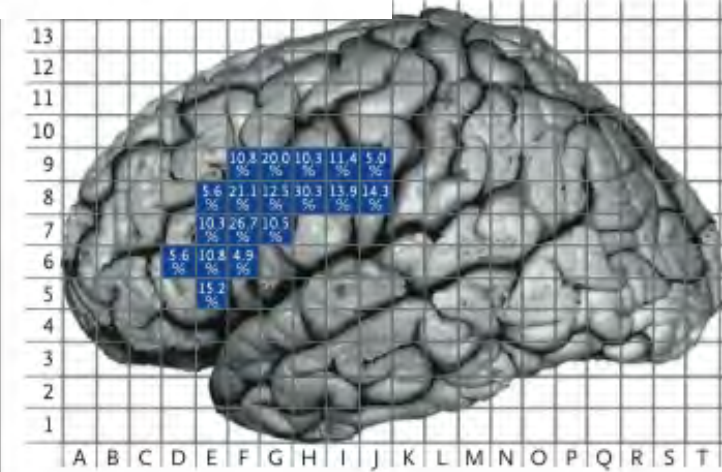
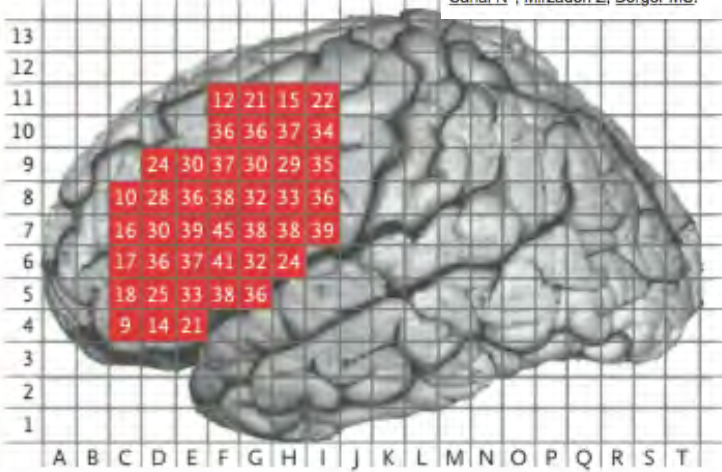
¿RM funcional preoperatoria?



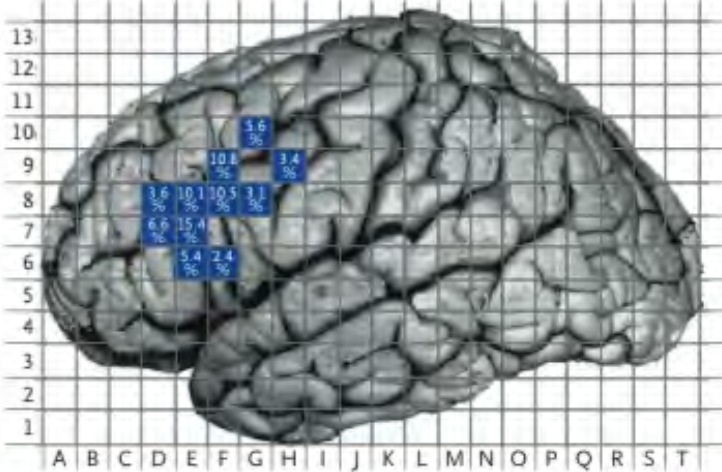
Functional outcome after language mapping for glioma resection.

Sanai N¹, Mirzadeh Z, Berger MS.

A All Sites



C Anomia



D Alexia

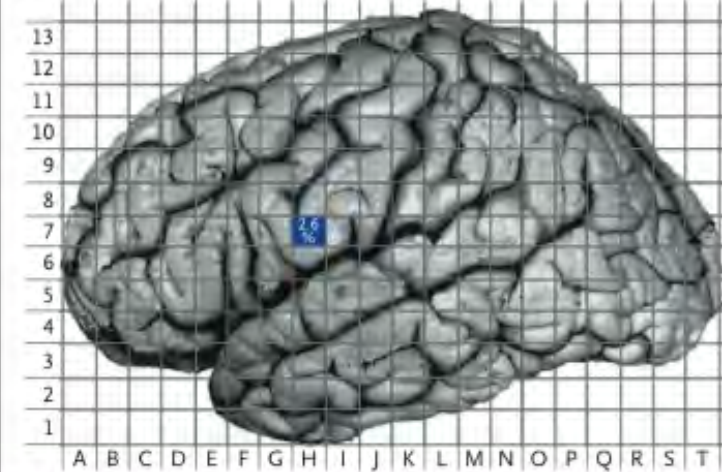


Figure 1. Frontal-Lobe Language Sites.

A total of 1237 cortical sites were stimulated in 151 patients. The red squares indicate the total number of sites that were stimulated, and the blue squares indicate the percentage of total stimulations at that site that induced speech dysfunction. A lateral view of the dominant-hemisphere cortex indicating the total number of stimulations per square centimeter of the frontal cortex is shown in Panel A. The percentage of total stimulations that induced speech arrest (Panel B), anomia (Panel C), and alexia (Panel D) is shown in each square centimeter of the frontal cortex. An interactive graphic showing both the total number of sites that were stimulated and the percentage of total stimulations at that site that induced speech dysfunction is available with the full text of this article at www.nejm.org.



INDICACIONES

Cirugía de epilepsia.

Resección LOE de próximas a áreas corticales elocuentes (**Gliomas**)

Neurocirugía funcional (enf. del sistema extrapiramidal, dolor crónico, trastornos del control de los impulsos, etc.)

Procedimientos intracraneales menores (biopsias estereotáxicas, ventriculostomía endoscópica 3er ventrículo, drenajes)

Aneurismas, malformaciones arteriovenosas, procedimientos endovasculares.




INDICACIONES

Cualquier masa/lesión supratentorial localizada cerca o en la **corteza elocuente** se beneficiaría de la craniotomía despierto.

[J Neurosurg.](#) 2007 Jul;107(1):1-6.

Prospective study of awake craniotomy used routinely and nonselectively for supratentorial tumors.

[Serletis D¹](#), [Bernstein M.](#)

 **Author information**

¹Division of Neurosurgery, Toronto Western Hospital, Toronto, Ontario, Canada.

Abstract

OBJECT: The authors prospectively assessed the value of awake craniotomy used nonselectively in patients undergoing resection of supratentorial tumors.



OBJETIVOS ANESTÉSICOS

Garantizar cooperación del paciente y no interferir con el mapeo electrofisiológico ni con los test cognitivos.

Realizar profilaxis de náuseas y vómitos.

Prevenir y/o tratar las convulsiones.

Mantener la homeostasia tanto sistémica como neurológica, garantizando una correcta ventilación y estabilidad hemodinámica.



CRANEOTOMÍA **DESPIERTO**

Técnicas

Sedación
consciente

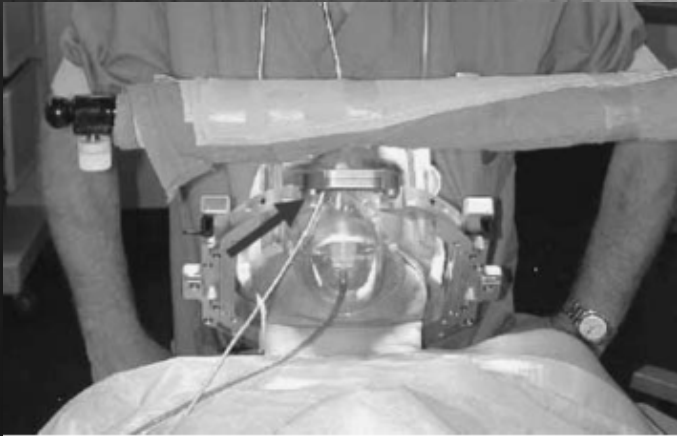
Anestesia general con fase
de despertar intraoperatorio.
(A-A-A)

**No existe consenso de cual es el regimen anestésico
optimo.**



CRANEOTOMÍA DESPIERTO

Sedación consciente



- La ventilación espontánea es mantenida durante todo el procedimiento.
- No hay control de la vía aérea.
- Dificultad en intervenciones largas y posiciones incómodas.
- Vigilancia de la función respiratoria.

CRANEOTOMÍA **DESPIERTO**

Técnicas

Sedación consciente.

Anestesia general con fase
de despertar intraoperatorio.
(A-A-A)



CRANEOTOMÍA DESPIERTO

Anestesia general con fase de despertar intraoperatorio.
(A-A-A)



1ª fase anestesia general (ML, EET)

2ª Despierto y ventilation espontánea durante los test funcionales.

3ª fase Anestesia general Nuevamente.



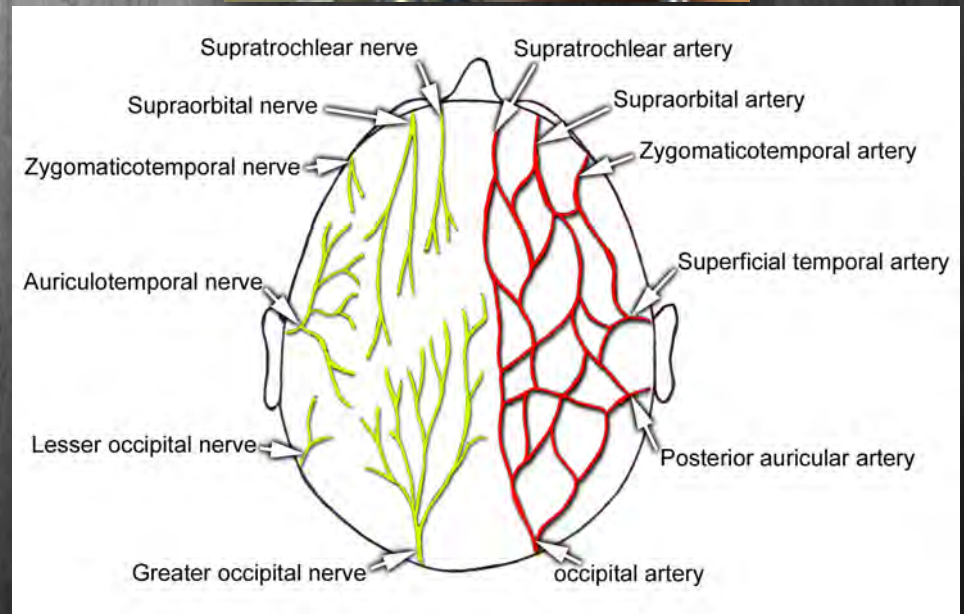
CRANEOTOMÍA DESPIERTO

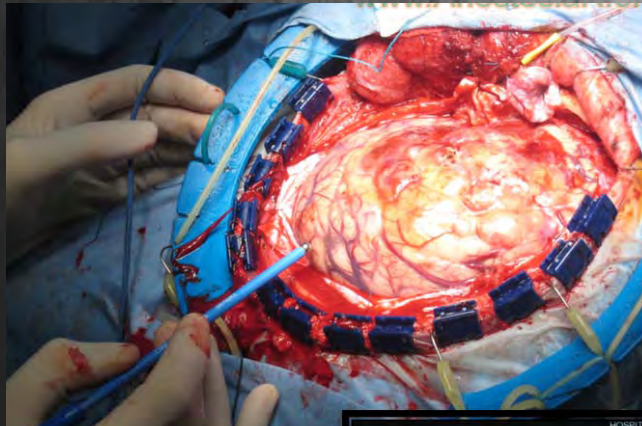
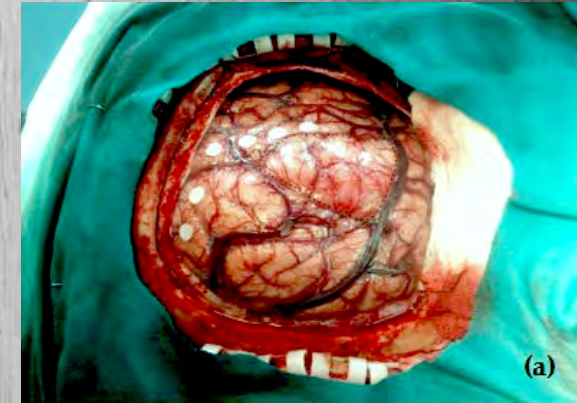
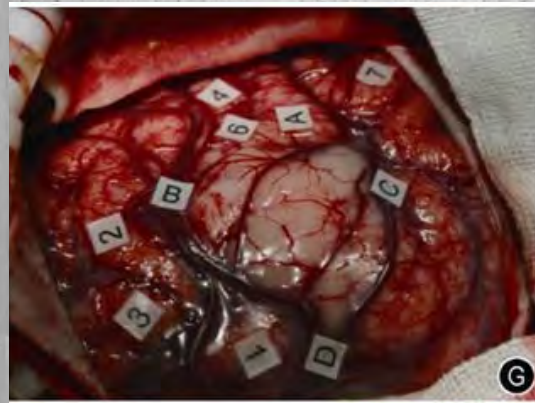
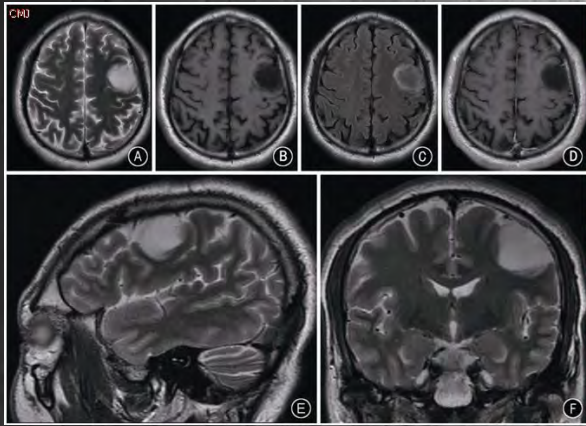
Anestesia locoregional

Independientemente de la técnica anestésica se debe utilizar una técnica locoregional.

Ramas del trigemino inervan (piel, periostio)

Minimiza la dosis de hipnóticos y opiodes.





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Valencia 16 de Diciembre de 2014

Reto anestésico

Manejo de la
via aerea

Manejo
Hemodinámico
o.

Sedación y
Analgesia

El principal reto anestésico esta en la habilidad de ajustar rápidamente el nivel de consciencia y analgesia de acuerdo a la secuencia de eventos quirúrgicos, asegurando una estabilidad hemodinámica y adecuada ventilación, con minima interferencia en los registros electrofisiológicos.



Retoanestésico

Manejo de la
via aerea

Hipercapnia
Hipoxemia
Bronco
aspiración

Canulas Nasales
Mascarilla
laringea
Intubación



Riesgo de hipoventilación y obstrucción
Acceso limitado a la vi aerea.

Reto anestésico

Manejo de la
via aerea

Manejo
Hemodinámico.
o.

Sedación y
Analgesia



Retoanestésico

Manejo
Hemodinámico.
o.

Hipotensión
relativa o
normotensión
(Reduce sangrado
y edema cerebral)

Optimizar las condiciones operatorias manipulando la hemodinámica cerebral y sistémica.



Reto anestésico

Manejo de la
via aerea

Manejo
Hemodinámico.

Sedación y
Analgesia



Reto anestésico

Sedación y
Analgesia

Exceso de
sedación (poca
cooperación del
paciente, depresión
respi)

Falta de sedación
(Agitación,

La sedación debe ser ajustada al estímulo quirúrgico.
Particularmente importante en ausencia de control definitivo
la vía aérea.



Complicaciones

Obstrucción vía aérea

Convulsiones (realizar estipulaciones simples en lugar de repetidas)

Nausea y vomito. 8 % de los pacientes.

Hemodinámicas: Hiper TA vs Hipo TA

Dolor.

Pobre cooperación .

Embolismo aéreo.



Complicaciones

Table 3 Complications of awake craniotomies

Complication	Consequences	Prevention
Obstructive apnoea Hypoventilation	<ul style="list-style-type: none"> - Hypoxaemia - Hypercarbia - Increased ICP 	<ul style="list-style-type: none"> - Preoperative evaluation - Tight titration of sedation - Expired CO₂ monitoring - Head positioning – access - Noninvasive positive pressure ventilation devices - Asleep-awake-asleep technique
Nausea – vomiting	<ul style="list-style-type: none"> - Movements - Inhalation - Increased ICP 	<ul style="list-style-type: none"> - Preoperative evaluation - Psychological preparation - Corticoids - Setrons - Metoclopramide - Limited opioid use - Propofol
Seizures	<ul style="list-style-type: none"> Movements Increased ICP Compromised ventilation 	<ul style="list-style-type: none"> - Preoperative evaluation - Preoperative prevention - Single electrical stimulations
Loss of patient cooperation	<ul style="list-style-type: none"> Movements Agitation Functional testing compromised 	<ul style="list-style-type: none"> - Psychological preparation - Tight titration of sedation - Good analgesia - Good installation - Procedure as short as possible
Hypertension Tachycardia Trigemino-cardiac reflex	<ul style="list-style-type: none"> - Bleeding - Increased ICP - Bradycardia 	<ul style="list-style-type: none"> - Optimal analgesia - Vasodilators – β-blockers - Topical anaesthesia of the dura - Atropine
Air embolism	<ul style="list-style-type: none"> - Hypoxaemia - Haemodynamic instability 	<ul style="list-style-type: none"> - Head positioning - Optimal volaemia
Bleeding	<ul style="list-style-type: none"> - Increased ICP - Surgical embarrassment 	<ul style="list-style-type: none"> - Screening for bleeding disorders - Avoid other complications

Fármacos Anestésicos

Numerosos regimenes anestésicos están descritos, siendo la mayoría combinaciones de ansiolíticos, analgésicos e hipnóticos.

Los mas utilizados Propofol, remifentanilo, dexmedetomidina y midazolam.

Table 2 Known advantages and disadvantages of anaesthetic agents in the context of awake craniotomy

Agents	Advantages	Disadvantages
Propofol	<ul style="list-style-type: none">- Rapid onset and offset- No prolonged effect on electrophysiological recordings- Antiemetic properties	<ul style="list-style-type: none">- Respiratory depression (with opioids)- Motor restlessness and abnormal movements (subanaesthetic concentrations)
Remifentanil	<ul style="list-style-type: none">- Short-acting: rapid onset and offset- Good analgesia	<ul style="list-style-type: none">- Respiratory depression
Neuroleptic agents	<ul style="list-style-type: none">- No respiratory depression	<ul style="list-style-type: none">- Seizures- Respiratory depression (with opioids)- Prolonged QT interval
<u>Dexmedetomidine</u>	<ul style="list-style-type: none">- Good analgesia- Anxiolysis- Sedation but easily arousable- Few interferences with electrophysiological recordings- Pharmacokinetic profile	<ul style="list-style-type: none">- Hypotension- Bradycardia
Clonidine	<ul style="list-style-type: none">- Same as dexmedetomidine	<ul style="list-style-type: none">- Prolonged elimination
Ketamine	<ul style="list-style-type: none">- Analgesia- No respiratory depression	<ul style="list-style-type: none">- Psychotropic effects- ICP
Inhaled compounds		<ul style="list-style-type: none">- Not easy to use in spontaneously breathing patients



Dexmedetomidina

Receptor selectivo de los receptores α_2

Proporciona sedación y analgesia sin depresión respiratoria.

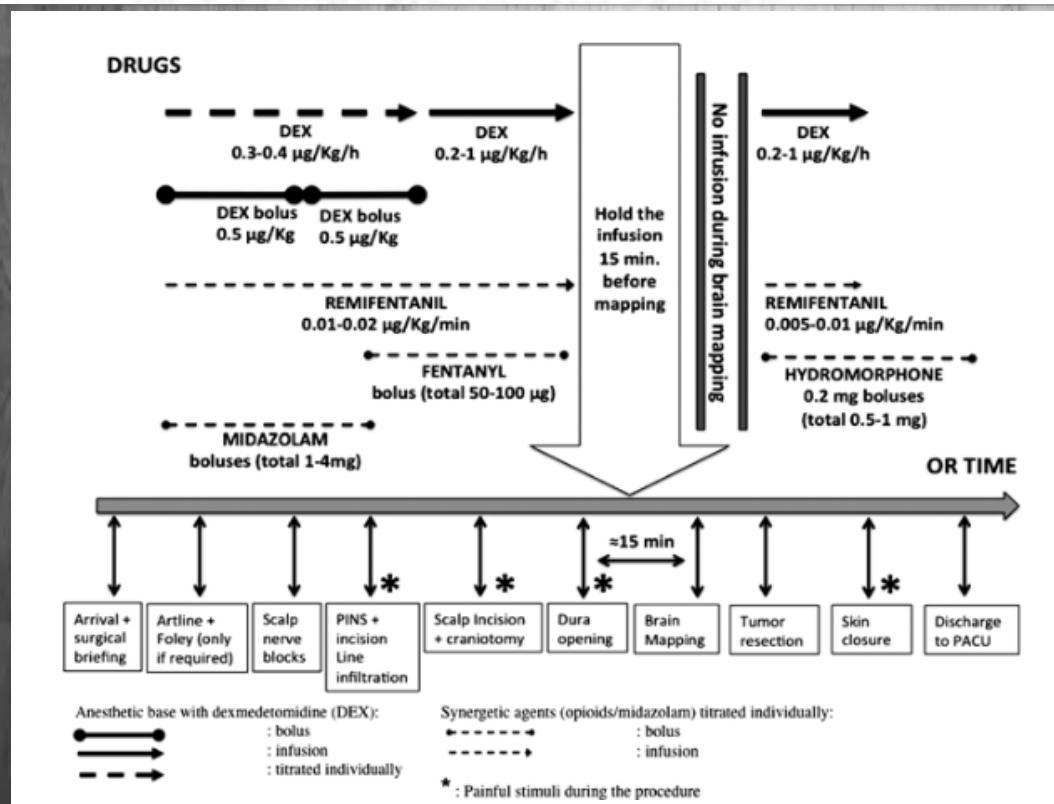
Pacientes sedados pero despiertan fácil a estímulos verbales.

Hipotensión y bradicardia efectos adversos mas frecuentes.



Anesthetic approach to high-risk patients and prolonged awake craniotomy using dexmedetomidine and scalp block.

Garavaglia MM¹, Das S, Cusimano MD, Crescini C, Mazer CD, Hare GM, Rigamonti A.



Results: All patients underwent successful awake craniotomy, intraoperative mapping, and tumor resection with adequate sedation for up to 9 hours (median 3.5 h, range 3 to 9 h) without any loss of neurological function, airway competency, or the need to provide any active rescue airway management. We report 4 of these cases that highlight our experience: 1 case required prolonged surgery because of the complexity of tumor resection and 3 patients had important medical comorbidities and/or relative contraindication for an awake procedure.

RIESGO BENEFICIO

Cuidadosa y adecuada elección de los pacientes.

Lo mas importante antes que la edad es la cooperación y motivación del paciente.

Table 1 Elements influencing the risk – benefit balance of an awake craniotomy

Benefit	Risk
Surgery Functional preservation Immediate follow-up <ul style="list-style-type: none">- earlier recovery- earlier discharge- earlier neurological follow-up	Recurrence of lesion
Electrophysiological recordings <ul style="list-style-type: none">- no effect of anaesthesia	
Patient Active participation <ul style="list-style-type: none">- functional testing	Obstructive apnoea Seizures Nausea – vomiting Bleeding Elevated ICP Collaboration <ul style="list-style-type: none">- anxiety- pain- discomfort- willingness to collaborate Neurological abnormalities <ul style="list-style-type: none">- abnormal movements- dysphasia



Valoración Preoperatoria

Ganarse la confianza del paciente.

Saber por que se realiza despierto y que este de acuerdo con el procedimiento.

Posibles incomodidades y riesgos asociados.

Preparación psicológica del paciente.

Estar entrenado sobre los test que se realizaran durante la cirugía.

- (1) Upper airway
 - (a) Difficult intubation signs (mouth opening, Mallampaty score, large tongue, cervical stiffness, teeth, neck diameter, prognatia, retrognatia)
 - (b) Obstructive apnoea (obesity, sleep apnoea)
- (2) Seizures
 - (a) Current treatment
 - (b) Plasma levels
 - (c) Type, number, and frequency of episodes
- (3) Nausea and vomiting
 - (a) Past history following anaesthesia
 - (b) History of motion sickness
- (4) ICP
 - (a) Type and size of lesion
 - (b) Indirect neuroimaging signs and clinical signs of elevated ICP
- (5) Bleeding
 - (a) Type and localization of lesion
 - (b) Current medications (antiplatelets, nonsteroidal anti-inflammatory medications)
 - (c) Personal and family past history
- (6) Patient collaboration
 - (a) Anxiety
 - (b) Neurological problems (dysphasia, abnormal movements).



Contraindicaciones

Incapacidad para comunicarse o cooperar

Niños pequeños

Alteración mental

Problemas de conducta

Condiciones premórbidas que se puedan complicar (Vía aérea difícil, Obesidad, SAOS)

Inexperiencia del equipo neuroquirúrgico, anestesia o equipo de enfermería.

Tumores occipitales bajos (decubito supino)

Compromiso dural significativo (doloroso)

TABLE 1. Preoperative Assessment of Comorbidities and Surgical Considerations Indicated Patients at a High Risk of Failure and Complications for Awake Craniotomy

Comorbidities

Congestive heart failure

Severe chronic obstructive pulmonary disease/asthma

Obstructive sleep apnea

Anticipated difficult airway

Obesity

Anxiety disorder, panic attack (on medications)

Signs of intracranial mass effect with midline shift (brain imaging)

Surgical considerations

Estimated length of surgery > 5 h

Multiple intraoperative neurological testing

Positioning (eg, lateral, bench park)



CRANEOTOMÍA DESPIERTO

Menos secuelas neurológicas postoperatorias.

Ayuda a maximizar la resección de lesiones.

Preservar la función neurológica y la calidad de vida.

Reduce la monitorización postoperatoria en la UCI

Reduce la estancia hospitalaria

Disminuye costos.

Alta satisfacción de los pacientes.



Awake craniotomy vs surgery under general anesthesia for resection of supratentorial lesions.

Sacko O¹, Lauwers-Cances V, Brauge D, Sesay M, Brenner A, Roux FE.

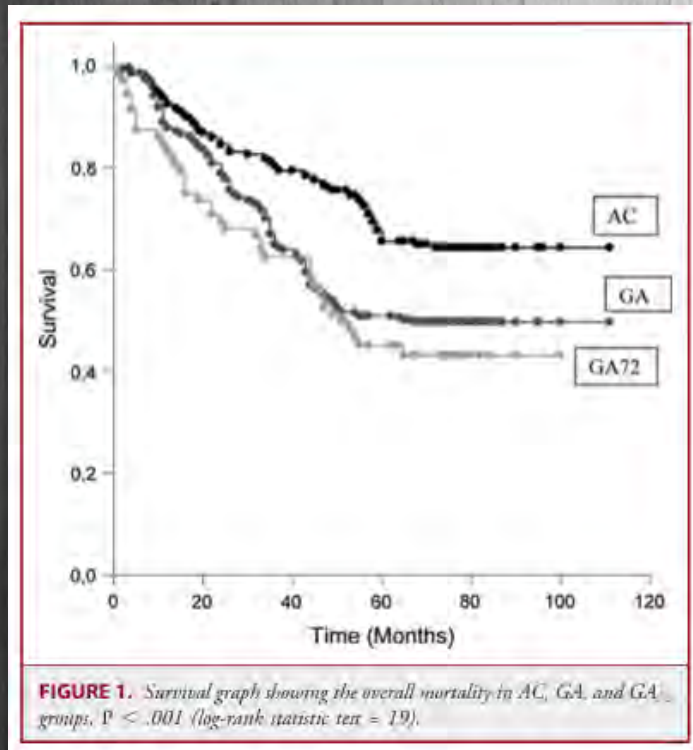


TABLE 5. Neurological Outcome in Study Population at 3 Months After Surgery^a

Groups ^b	Preoperative Status	n	New Deficit, n (%)	Transient Deficit, n (%)	Permanent Deficit, n (%)
AC	All patients	214	7 (3.3)	52 (24)	10 (4.6)
	No deficit	118	4 (3.3)	2 (1.7)	2 (1.7)
	With deficit	96	3 (3.1)	50 (52)	8 (8.3)
GA ₇₂ ^c	All patients	70	40 (57)	59 (84)	11 (16)
	No deficit	38	38 (100)	35 (92)	3 (7.8)
	With deficit	32	2 (6.2)	24 (75)	8 (25)
GA	All patients	359	47 (13)	81 (22.5)	13 (3.6)
	No deficit	306	43 (14)	37 (12)	4 (1.3)
	With deficit	53	4 (7.5)	44 (83)	9 (17)

^aNo significant difference was found between the AC and GA group. The neurological outcome was better in the AC group than in the GA₇₂ group.

^bAC, awake craniotomy; GA, general anesthesia; GA₇₂, subset of 72 patients with lesions in eloquent areas.

^cThere were 2 deaths in the GA₇₂ group at 3 months.

RESEARCH—HUMAN—CLINICAL STUDIES

Awake Craniotomy vs Surgery Under General Anesthesia for Resection of Supratentorial Lesions

Oumar Sacko, MD*
 Valérie Lauwers-Cances, MD§
 David Brauge, MD‡
 Musa Sesay, MD¶
 Adam Brenner, MD
 Franck-Emmanuel Roux, MD,
 PhD*

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Received, March 27, 2010.
 Accepted, August 23, 2010.

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 Congress of Neurological Surgeons

BACKGROUND: The use of an awake craniotomy in the treatment of supratentorial lesions is a challenge for both patients and staff in the operation theater.

OBJECT: To assess the safety and effectiveness of an awake craniotomy with brain mapping in comparison with a craniotomy performed under general anesthesia.

METHODS: We prospectively compared 2 groups of patients who underwent surgery for supratentorial lesions: those in whom an awake craniotomy with intraoperative brain mapping was used (AC group, n = 214) and those in whom surgery was performed under general anesthesia (GA group, n = 361, including 72 patients with lesions in eloquent areas). The AC group included lesions in close proximity to the eloquent cortex that were surgically treated on an elective basis.

RESULTS: Globally, the 2 groups were comparable in terms of sex, age, American Society of Anesthesiologists score, pathology, size of lesions, quality of resection, duration of surgery, and neurological outcome, and different in tumor location and preoperative neurological deficits (higher in the AC group). However, specific data analysis of patients with lesions in eloquent areas revealed a significantly better neurological outcome and quality of resection ($P < .001$) in the AC group than the subgroup of GA patients with lesions in eloquent areas. Surgery was uneventful in AC patients and they were discharged home sooner.

CONCLUSION: AC with brain mapping is safe and allows maximal removal of lesions close to functional areas with low neurological complication rates. It provides an excellent alternative to craniotomy under GA.

KEY WORDS: Anesthesia, Awake, Craniotomy, Neurological deficit, Tumor

Neurosurgery 68:1192-1199, 2011

DOI: 10.1227/NEU.0b013e31820c02a3

www.neurosurgery-online.com



Awake craniotomy for brain tumor resection: the rule rather than the exception?

Brown T¹, Shah AH, Bregy A, Shah NH, Thambuswamy M, Barbarite E, Fuhrman T, Komotar RJ.

TABLE 1. Patient Characteristics

References	Surgery Type	% Female	Age (y)	Pathology
Sacko et al ¹³	AC	46.7	46.5*	Mixed
	GA	50.7	46.0*	Mixed
Gupta et al ¹⁴	GA _{eloquent}	52.7	46.3*	Mixed
	AC	23.1	42.7	Mainly gliomas

TABLE 2. Studies Directly Comparing Patients Undergoing Surgery by AC and GA

References	Study Design	# AC Patients (Eloquent?)	# GA Patients (Eloquent?)	Surgery Time (min) (AC/GA)	Hospital Stay (d) (AC/GA)	Gross Total Resection (%) (AC/GA)	New Neurological Deficit (%) (AC/GA)
Sacko et al ¹³	Pro	214 (Y)	289 (N)	135/132	5.4/8.5†‡	32/52	3.3/13†
Gupta et al ¹⁴	ProRan	26 (Y)	72 (Y)	135/149†	5.4/12.7†‡	32/14**	3.3/58***
			27 (Y)	196/182*†	6/4†	47/63	19/11.1
De Benedictis et al ¹⁵	Ret	9 (Y)	9 (Y)	NR	7/NR†	44/0**	22/66†
Manninen and Tan ¹⁶	Pro	50 (Y)	57 (Y)	197/270	4/12**	NR	4/12
Peruzzi et al ¹⁷	Ret	20 (Y)	19 (N)	283/312	3.5/4.6**	NR	18/27
Ali et al ¹⁸	Pro	20 (Y)	20 (Y)	173/167	3.8/8.15*	40/50	10/60***
Hol et al ¹⁹	Pro	20 (Y)	20 (N)	275/327†	4.53/6.17**	NR	NR
Pinsker et al ²⁰	Ret	52 (Y)	27 (Y)	NR	NR	77/33†	12/33†
Mean	—	—	—	165/168	4/9	41/44	7/23
Total	—	411	540	—	—	—	—

AC values appear on the left and GA values appear on the right.

* $P < 0.05$.

** $P = 0.05$.

*** $P < 0.001$.

†Median value.

‡Significance not reported.

AC indicates awake craniotomy; GA, general anesthesia; ProRan, prospective randomized; Pro, prospective; Ret, retrospective.

	Craniotomy	Anesthesia
Frontal	179	201
Temporal	65	122
Parietal	67	51
Occipital	4	9
Parieto-occipital/temporo-occipital	10	202
Unspecified location	91	35
Total	416	620



Conclusiones

A pesar de las complicaciones potenciales, una buena elección de los pacientes al igual que una adecuada información conllevan a un exitosa realizaron de la craneotomía despierto.

La craneotomía despierto presenta ventajas en cuanto a secuelas postoperatorias y también desde el punto de vista costoefectivo.

Faltan estudios prospectivo, multicéntricos que comparen las complicaciones perioperatorias entre AG y AC.



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REVISIÓN

Craneotomía en el paciente consciente. Consideraciones en situaciones especiales[☆]

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! GRACIAS !



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