

M U N I
M E D

Klinika dětské
anesteziologie
a resuscitace



FAKULTNÍ
NEMOCNICE
BRNO

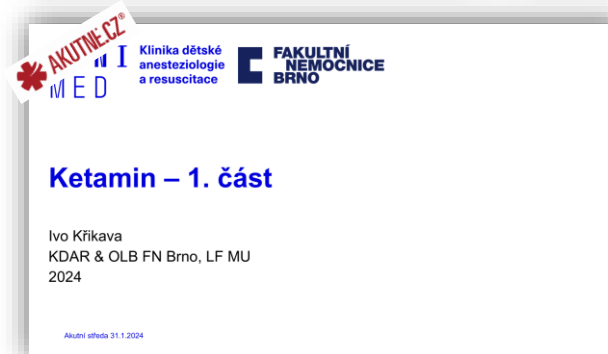
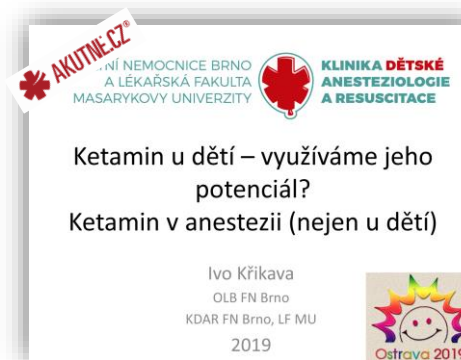
Ketamin úderně

(6.díl)

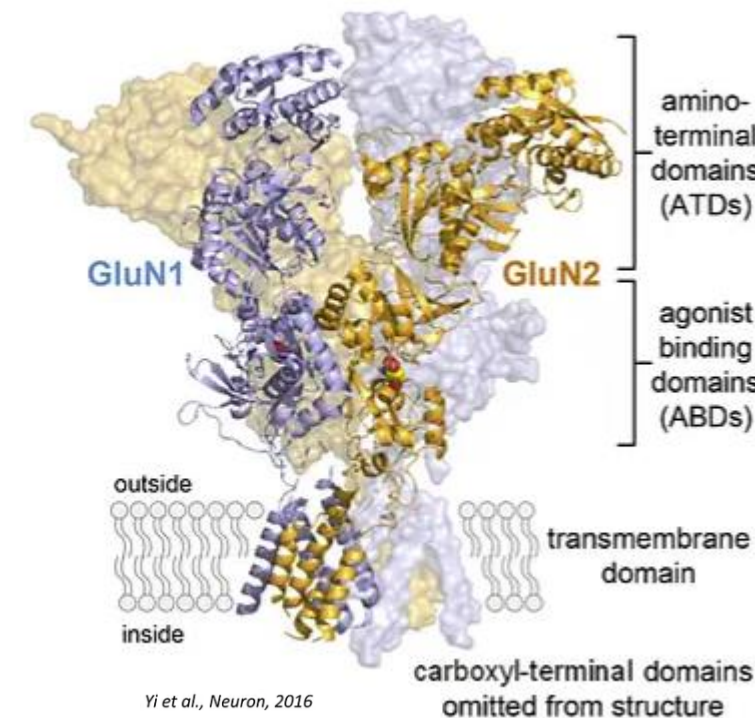
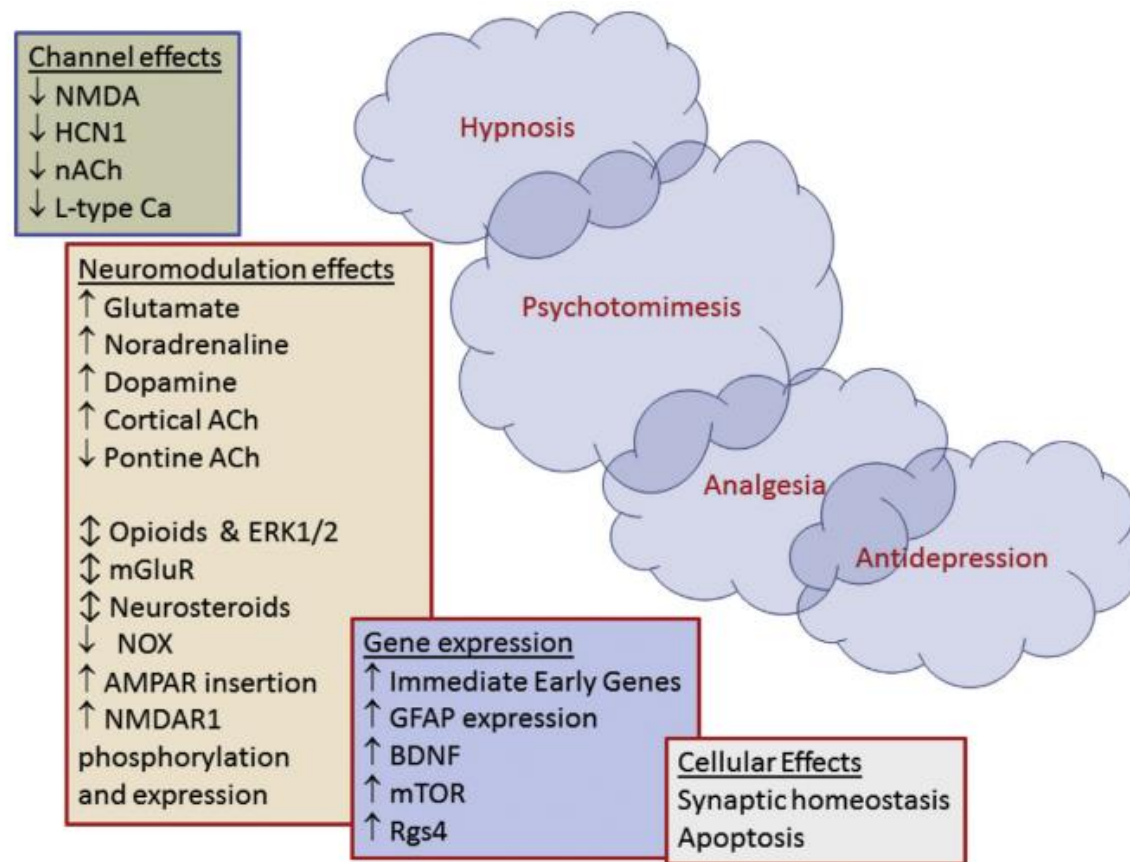
Ivo Křikava

KDAR & OLB FN Brno, LF MU

2025



Ketamin je NMDA antagonist



Receptors	Binding affinity (Ki)
NMDAR	Esketamine (0.8 μM) > Arketamine (5 μM)
Mu-type of opioid receptors	Esketamine (7 μM) > Arketamine (19 μM)
Kappa-type of opioid receptors	Esketamine (14 μM) > Arketamine (40 μM)
Sigma-1 receptor	Arketamine (27 μM) > Esketamine (131 μM)
Sigma-2 receptor	Arketamine (500 μM) > Esketamine (2800 μM)

Data are from Bonaventura et al.²³

Fig. 1. Summary diagram of the neuropharmacological actions of ketamine, and the resultant clinical effects. The rapid effects and actions are represented at the top left, and the more delayed and prolonged effects and actions represented towards the bottom right. [NMDA = N-methyl-D aspartate, HCN1 = hyperpolarisation-activated cyclic nucleotide channels, ACh = acetyl choline, nACh = nicotinic acetyl-choline receptors, AMPA = α-amino-3-hydroxy-5-methylisoxazole-4-propionic acid, mGluR = metabotropic glutamate receptors, ERK1/2 = extracellular signal-regulated kinases, NOX = NADPH oxidase, BDNF = brain-derived neurotrophic factor, mTOR = mammalian target of rapamycin, Rgs4 = regulator of G protein signalling 4, L-type Ca²⁺ = L-type calcium channels, GFAP = glial fibrillary acidic protein].

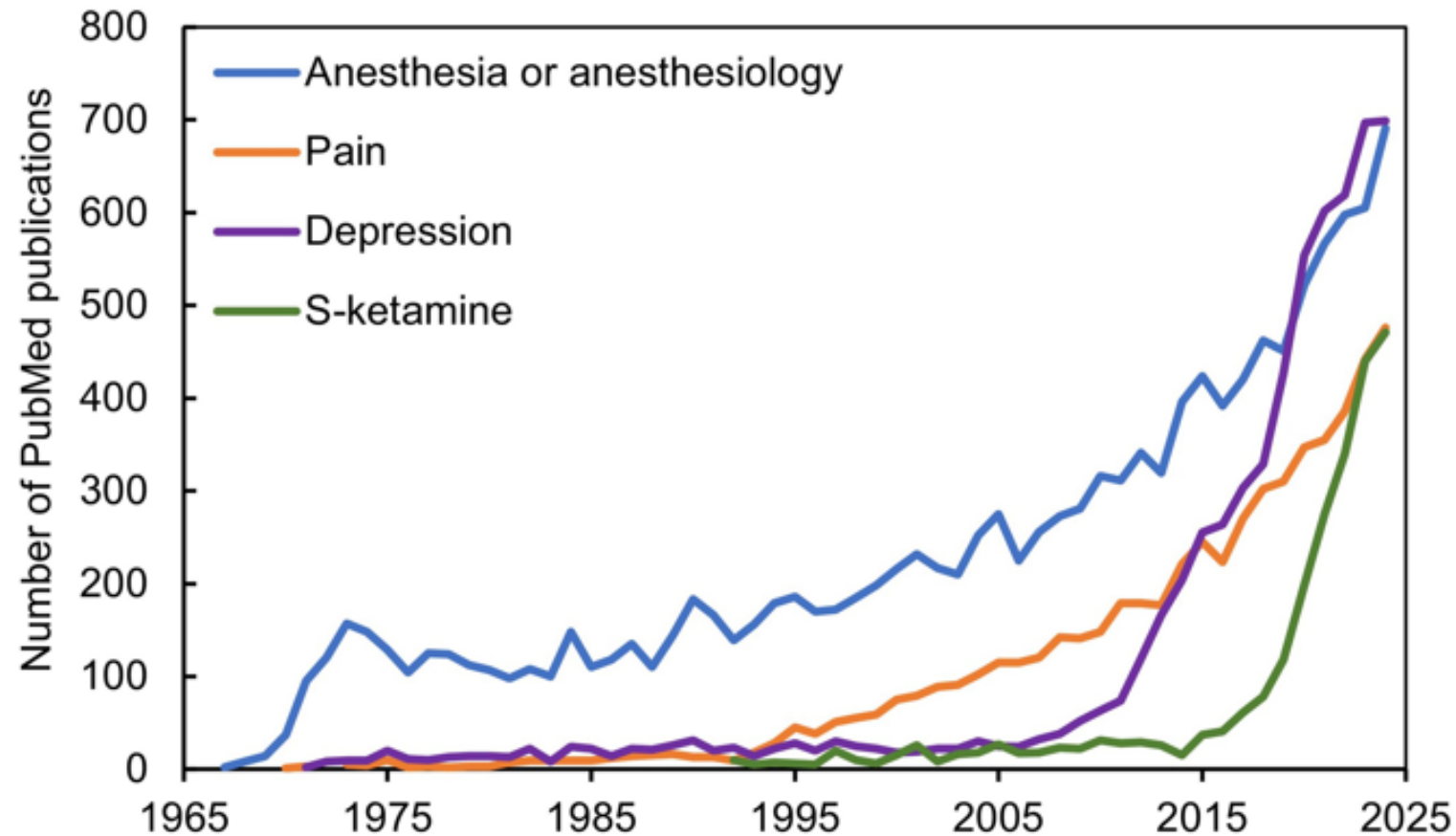
Ketamin je...?

- anestetikum
 - analgetikum
 - rychle účinkující antidepresivum
 - anxiolytikum? - premedikace
 - antikonvulzivum, neuroprotektivum
 - imunomodulans
-
- halucinogen, delirogen
 - neurotoxin
 - „psychedelický heroin“ - psychonauti
 - rekreační, pouliční, párty droga – „super K, vitamin K, látká“



Ketamin je vděčné téma

The Nine Lives of Ketamine: From CI-581 to Present Day Clinical Application—Commentary on Domino et al.



Disociativní anestetikum

- hypnotická složka
 - psychomimetické jevy v nízkých koncentracích
 - sedace a ztráta vědomí při vyšších koncentracích
- výrazná analgezie (spíše anti-nocicepce)
- zvýšená aktivita sympatiku
- zachování ventilace a napětí svalů HCD
- krátké bolestivé výkony
- úvod do anestezie
 - oběhově nestabilní pacient
 - císařský řez
 - nespolupracující pacient (dítě)
- Opiod Free Anesthesia
- pooperační péče, analgezie
 - dospávací pokoj
 - intenzivní péče

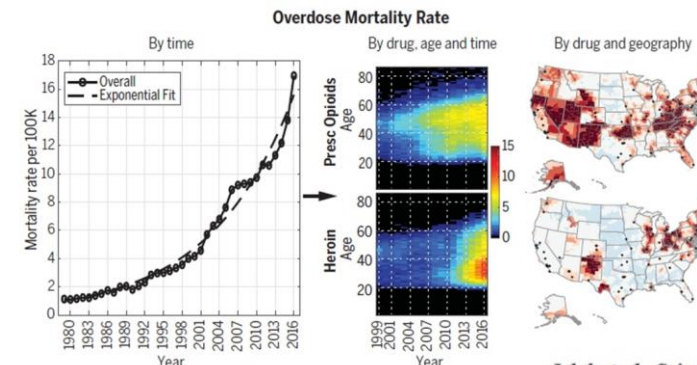
0,5–2 mg/kg i.v. (+ BZD, Prop.)

1-1,5 mg/kg i.v. (+ Indukce)

2–5 mg/kg i.m.

0,25–0,5 mg/kg i.v. á 15 min. (+CA)

0,25 mg/kg i.v.



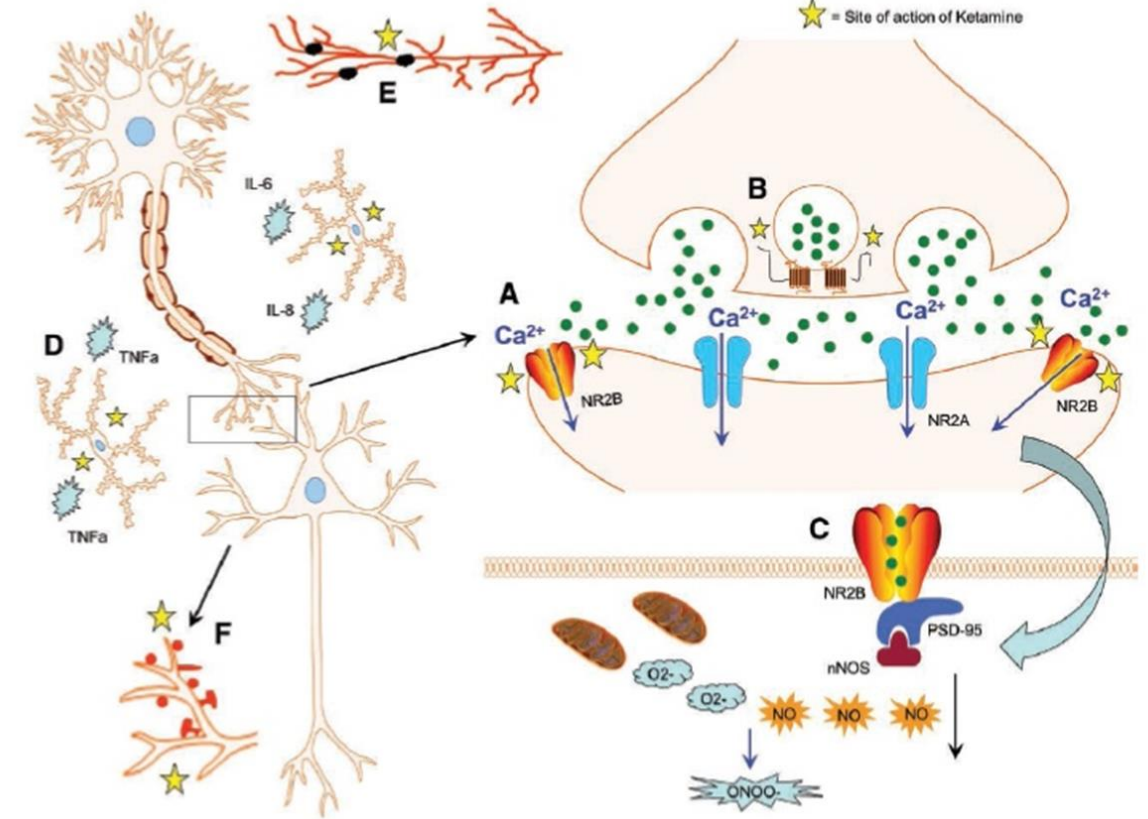
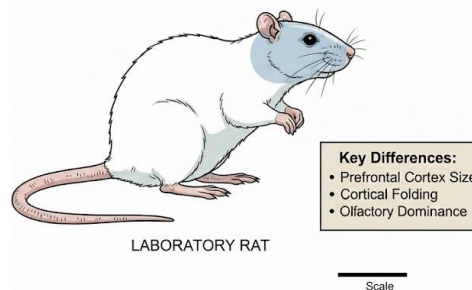
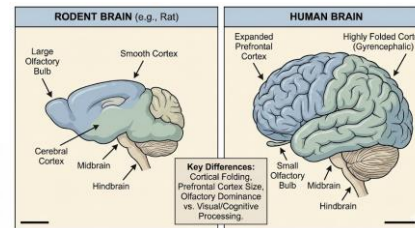
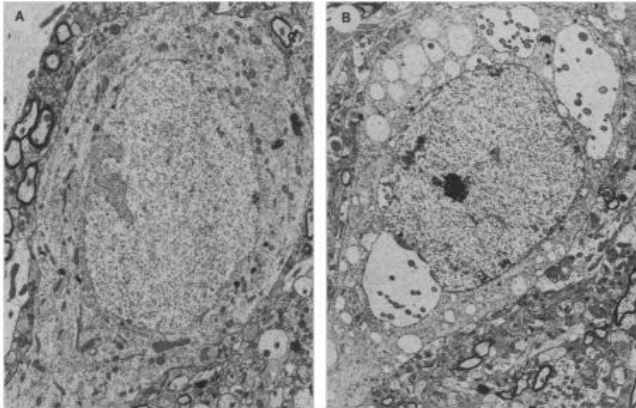
Neuroprotektivum

Ketamin vykazuje spíše neuroprotektivní vlastnosti než neurotoxicitu

Pathological Changes Induced in Cerebrocortical Neurons by Phencyclidine and Related Drugs

JOHN W. OLNEY, JOANN LABRUYERE, MADELON T. PRICE

Phencyclidine (PCP), a dissociative anesthetic and widely abused psychotomimetic



April 2017 • Volume 124 • Number 4
www.anesthesia-analgesia.org

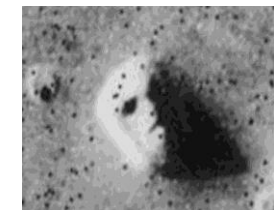
Neuroscience and Neuroanesthesiology

Section Editor: Gregory J. Crosby

NARRATIVE REVIEW ARTICLE

In Vogue: Ketamine for Neuroprotection in Acute Neurologic Injury

Josh D. Bell, MD, PhD



MUNI
MED

Ketamin nezvyšuje nitrolební tlak

PAIN MANAGEMENT AND SEDATION/EDITORIAL

Ketamine and Intracranial Pressure: No Contraindication Except Hydrocephalus

Steven M. Green, MD*; Gary Andolfatto, MD; Baruch S. Krauss, MD, EdM

*Corresponding Author. E-mail: steve@stevegreenmd.com.

- | | |
|----------------------------|---|
| 1969 Tjaden ¹ | Fifty children underwent ketamine-assisted pneumoencephalography with "consistent" but unreported elevations of ICP; none had sequelae. |
| 1971 Evans ² | Four children undergoing ketamine-assisted neurodiagnostic procedures were noted to have ICPs of 210 to 300 mm H ₂ O; none had sequelae. |
| 1971 Gardner ³ | Eleven healthy adults had ICP increases with ketamine, averaging 253 mm H ₂ O and ranging up to 433 mm H ₂ O; none had sequelae. |
| 1972 Gibbs ⁴ | Six of 9 adults with intracranial space-occupying lesions had an average of 12 mm Hg ICP increases after ketamine; none had sequelae. |
| 1972 List ⁵ | An infant with hydrocephalus and a "flat" fontanelle was given ketamine; shortly thereafter, apnea ensued, with a "tense and bulging" fontanelle. Treatment included ventricular puncture and drainage of cerebrospinal fluid. Seven subsequent children with hydrocephalus had ICP measured before and after ketamine; the increases averaged 247 mm H ₂ O and ranged up to 550 mm H ₂ O; none had sequelae. |
| 1972 Lockhart ⁶ | Two infants with symptomatic hydrocephalus developed apnea and bradycardia shortly after intramuscular ketamine and required intubation. |
| 1972 Shapiro ⁷ | Five children with ventriculostomies were noted to have ICPs increase by an average of 42 mm Hg after ketamine was administered, with increases ranging up to 60 mm Hg. They were treated with mask hyperventilation and thiopental. |
| 1972 Wyte ⁸ | One child with obstructive hydrocephalus had an ICP increase from 8 to 72 mm Hg after ketamine; he was treated with thiopental. |
| 1975 Crumrine ⁹ | Twenty-six children underwent ventriculostomy revision; 25 were noted to have ICP elevations ranging from 2 to 8 times baseline (highest increase 1,600 mm H ₂ O), peaking a mean of 4 minutes after ketamine. Several were treated with CSF removal, but no other treatment or sequelae are described. |

doi: 10.1111/j.1742-6723.2006.00802.x

Emergency Medicine Australasia (2006) 18, 37–44



ORIGINAL RESEARCH

Ketamine for rapid sequence induction in patients with head injury in the emergency department

Rajesh S Sehdev, David AD Symmons and Korana Kindl
Emergency Department, The Townsville Hospital, Townsville, Queensland, Australia

PAIN MANAGEMENT AND SEDATION/SYSTEMATIC REVIEW–META-ANALYSIS

The Effect of Ketamine on Intracranial and Cerebral Perfusion Pressure and Health Outcomes: A Systematic Review

Lindsay Cohen, MD; Valerie Athaide, MD, FRCP(C); Maeve E. Wickham, MSc; Mary M. Doyle-Waters, MA, MLIS;
Nicholas G. W. Rose, MD, FRCP(C); Corinne M. Hohl, MD, FRCP(C)*

Annals of Emergency Medicine 43 Volume 65, NO. 1 : January 2015

Neuroprotection by Ketamine: A Review of the Experimental and Clinical Evidence

Judith A. Hudetz, PhD, and Paul S. Pagel, MD, PhD

Journal of Cardiothoracic and Vascular Anesthesia, Vol 24, No 1 (February), 2010: pp 131-142

Ketamin je antidepresivum

EJA

Eur J Anaesthesiol 2019; **36**:4–5

INVITED COMMENTARY

Targeting the affective component of pain with ketamine

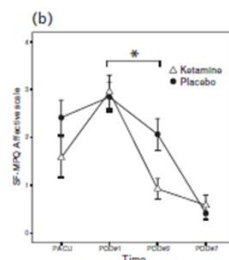
A tool to improve the postoperative experience?

Bianca Robu and Patricia Lavand'homme

Effects of a single subanaesthetic dose of ketamine on pain and mood after laparoscopic bariatric surgery

A randomised double-blind placebo controlled study

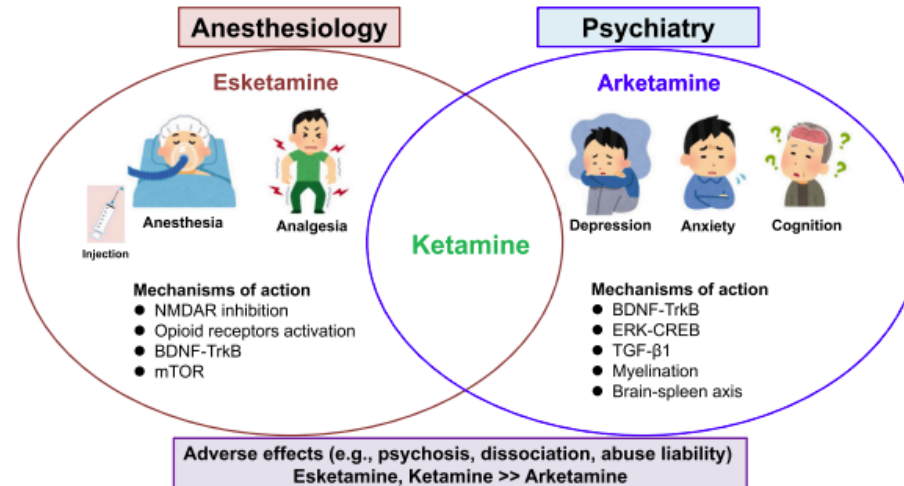
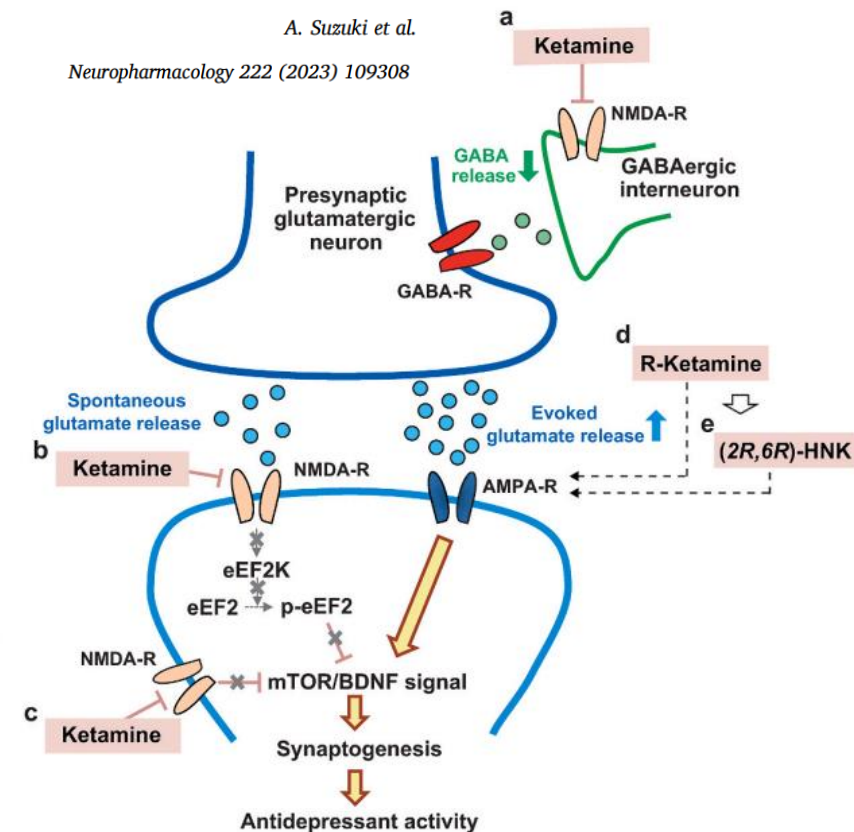
Jing Wang, Ghislaine C. Echevarria, Lisa Doan, Nydia Ekasumara, Steven Calvino, Floria Chae, Erik Martinez, Eric Robinson, Germaine Cuff, Lola Franco, Igor Muntyan, Marina Kurian, Bradley F. Schwack, Andrea S. Bedrosian, George A. Fielding and Christine J. Ren-Fielding



antidepresivní účinek nefunguje u memantinu (NMDA antagonist)

Akutní středa 22.11.2024

?? platí jen pro racemický ketamin, (R)-ketamin zprostředkovává antidepresivní účinek (Robu, BJA, 2019)???

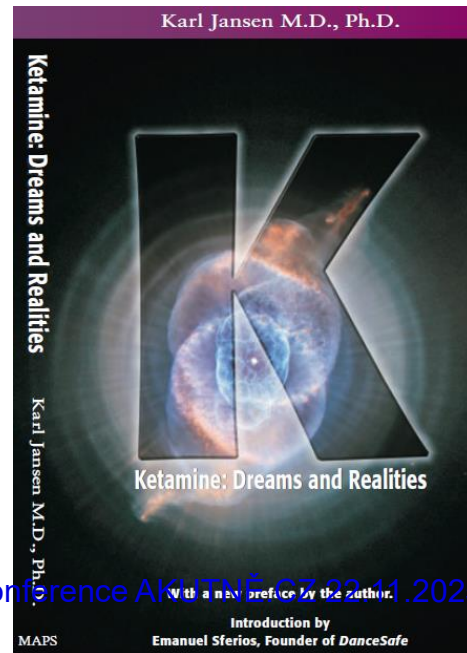


Ketamin odpojuje

disociativní příznaky:

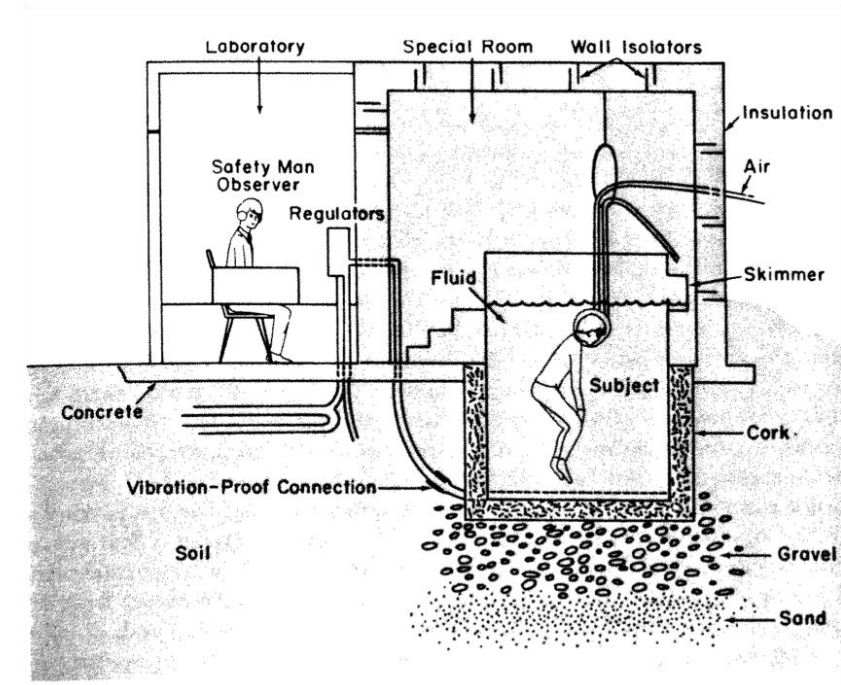
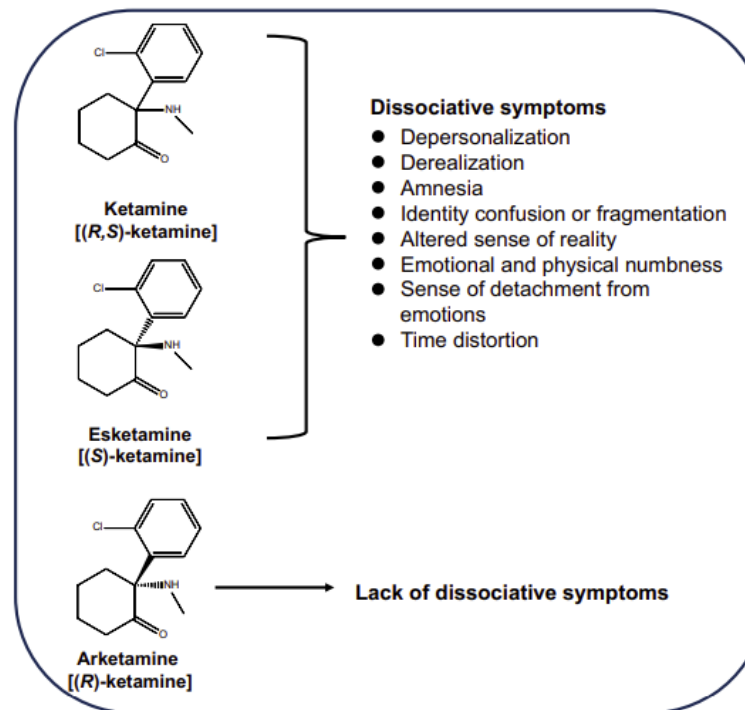
- depersonalizace
- derealizace
- amnézie
- narušení vnímání vlastní identity
- změněné vnímání reality
- zkreslení vnímání času

- mystický zážitek
- 70. léta, psychonauti
- „psychedelický heroin“



XVII. Konference AKUTNĚ CZ 22.11.2025

European Archives of Psychiatry and Clinical Neuroscience (2025) 275:1333–1346



John Lilly (1915-2001)

MUNI
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Mystické zážitky

zřejmě nesouvisí s antidepresivním efektem

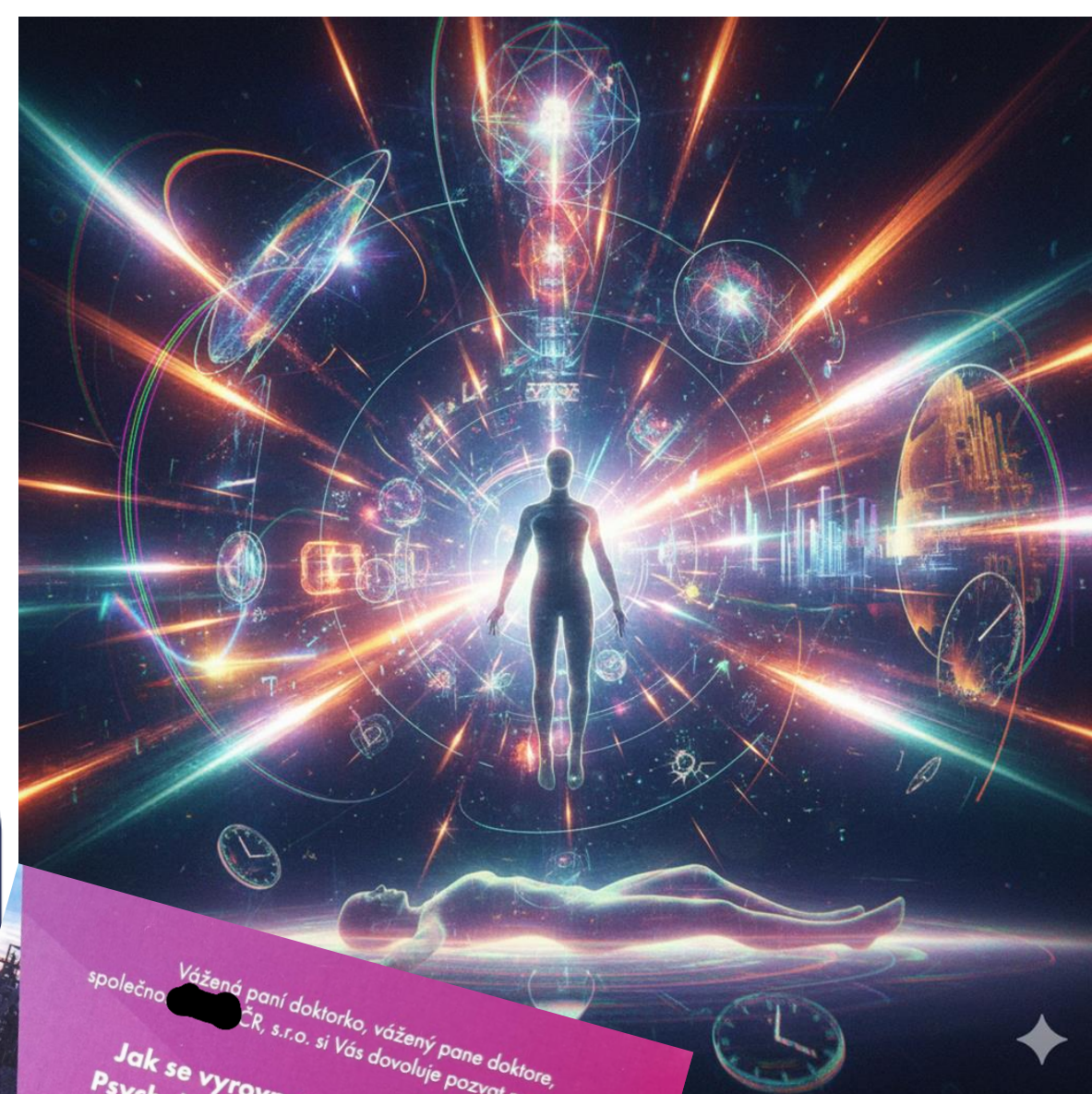
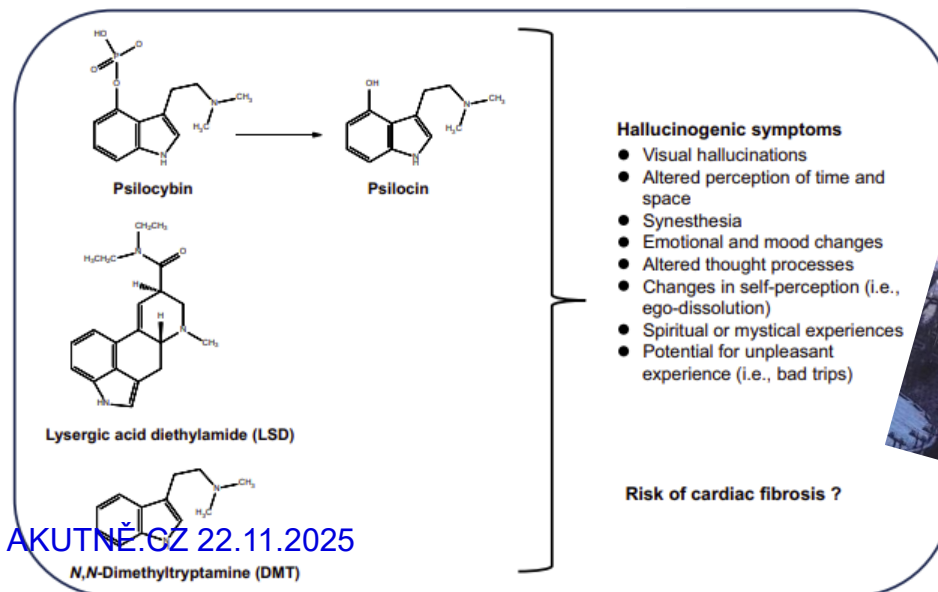
European Archives of Psychiatry and Clinical Neuroscience (2025) 275:1333–1346
<https://doi.org/10.1007/s00406-024-01770-7>

INVITED REVIEW

Are “mystical experiences” essential for antidepressant actions of ketamine and the classic psychedelics?

Kenji Hashimoto¹ 

Received: 15 December 2023 / Accepted: 22 January 2024 / Published online: 27 February 2024
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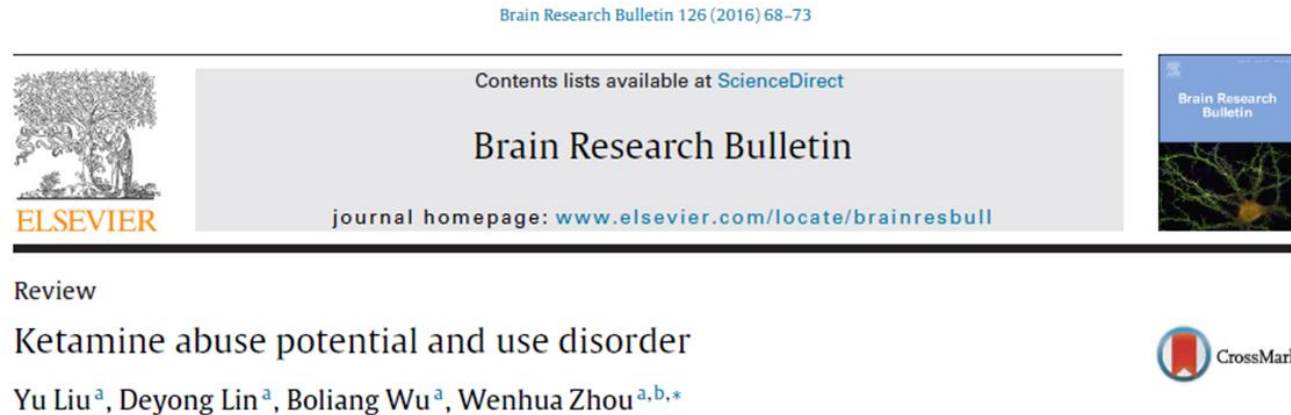
Vážená paní doktorko, vážený pane doktore,
společně s ČR, s.r.o. si Vás dovoluje pozvat na sympozium
Jak se vyrovnat s vlastní konečností?
Psychologie smrtelnosti a možná řešení
prof. MUDr. Jiří Horáček, Ph.D., FCMA
Národní ústav duševního zdraví

XVII. Konference AKUTNĚ.GZ 22.11.2025

MUNI
MED

Ketamin je rekreační droga

- kouří se to
- šňupe se to
- pije se to
- píchá se to



- 2,3 milionu adolescentů a dospělých užilo ketamin někdy v životě v UK 2006 (Administration, S.A.M.H.S, 2008)
- úmrtí po užití ketaminu se v UK zvýšilo 10x v letech 1999-2008 (Morgan et al., 2012)
- 40 % uživatelů párty drog přiznalo užití ketaminu (Breen et al., 2008)
- 4-násobné zvýšení uživatelů ketaminu v Malajsii 2006-2012 (Singh et al., 2013)
- zvýšení z 21,5 % na 40 % (2001-2009) u reg. uživatelů drog v Číně (Jia et al., 2015)
- 3. nejčastěji detekovaná droga u řidičů s pozitivním testem na psychoaktivní látky v Šanghaji (Zhuo et al., 2010)
- 9 % řidičů s fatální autonehodou bylo pozitivních na ketamin v Hong Kongu (Cheng et al., 2005)

IEEE
Sensors Letters VOL. 3, NO. 8, AUGUST 2019

6001604 IEEE
Sensors Council

Sensor applications

An Electronic Nose System for Rapid Detection of Ketamine Smoke

Cheng-Chun Wu, Shih-Wen Chiu, and Kea-Tiong Tang*

#ketamineismedicine



WFSA
WORLD FEDERATION OF SOCIETIES OF
ANAESTHESIOLOGISTS

FACT SHEET KETAMINE

Ketamine is an essential medicine

It is the only anaesthetic that does not require oxygen, electricity, anaesthetic equipment, or trained anaesthesia providers, all of which remain limited in low and middle income countries.



work in LMICs. This huge shortage means nurses & clinical assistants give the most anaesthetics



people in rural areas in LMICs already lack access to essential medicines



of medical facilities in 22 LMICs recently surveyed had ketamine available. Oxygen was consistently available only 46% of the time

ESM – KETAMINE™ SAFETY CHECKLIST

For emergency/essential surgery and procedural sedation

- ☐ Complete ESM-Ketamine Clinical Record
- ☐ Confirm ketamine concentration
- ☐ Confirm equipment function
 - Pulse Oximeter
 - Blood Pressure Device
 - Oxygen Source/Facemask
 - Suction
 - Bag Valve Mask
- ☐ Place IV of normal saline
- ☐ Place pulse oximeter onto the same side as the IV
- ☐ Place blood pressure cuff on arm opposite the pulse oximeter and IV
- ☐ Place oxygen on patient
- ☐ Titrate appropriate IV ketamine dosing:
 - 1) Emergency/Essential surgery:
 - 2 mg/kg initially over 30-60 seconds
 - 1-2 mg/kg every 10-15 minutes
 - 2) Procedural Sedation:
 - 1 mg/kg initially over 30-60 seconds
 - 0.25-1 mg/kg additionally as needed
- ☐ Complete ESM-Ketamine Clinical Record



Novinky lékových forem ketaminu

- sublingvální ketamin
 - iX Biopharma (původní vývoj) – Wafermine
 - racemický ketamin
 - biologická dostupnost cca 30 %
 - dávkování: 25 – 50 (75) mg
 - 50 mg sublingválně odpovídá 15 mg intravenózně podaného ketaminu
 - indikace u akutní středně silné až silné bolesti
 - dokončena 2. fáze klin. zkoušek
 - pooperační, procedurální
 - indikace u KRBS a deprese (MDD)
 - dokončena 1. fáze klin. zkoušek
- slow release ketamin
 - R-107 (Douglas Pharmaceuticals)
 - KET01 (HMNC Brain Health a Develco Pharma)



Shrnutí

- ketamin je výborné analgetikum
 - využití v širokém spektru aplikací (urgentní medicína, intenzivní medicína)
 - použitelný i v anestezii (stabilní oběh, spontánní ventilace)
 - k vychutnání jízdy na koni nemusíte mít koně
-
- nízké dávky 0,25 – 0,5 mg/kg i.v.
 - akutní antidepresivní efekt
 - pozor na disociaci a nezanedbatelný adiktivní potenciál

Děkuji za pozornost

