

MI PUO' CAPITARE!

L'URGENZA IN PEDIATRIA

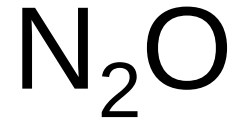
sul territorio, in pronto soccorso, in reparto

Protossido d'azoto:
uso sempre più diffuso nel PS

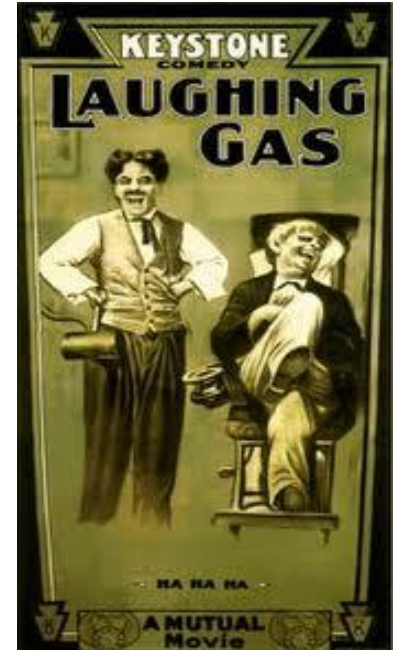


Dott.ssa Elena Neri
Pediatria d'Urgenza con Servizio di PS
IRCCS Burlo Garofolo Trieste





- Gas esilarante (ansiolitico)
- inodore ed incolore
- Sedativo blando
- Moderato analgesico
- Uso in mantenimento dell'anestesia generale



Meccanismo d'azione

somministrazione respiratoria



Gas alveolare



Bassa solubilità nel sangue



Circolo ematico



SNC

- ↑Metabolismo O₂
- ↑del flusso cerebrale
- ↑pressione intracranica

**Effetto dipendente
dalla concentrazione**

Effetto sedativo

Inibizione recettori glutamato

Inibizione rec. GABA

Inibizione canali K

Effetto analgesico

Stimolo ipotalamico con
rilascio peptidi oppioidi endogeni
e conseguente
riduzione stimolo nocicettivo

NON VIENE METABOLIZZATO MA ESALATO

SEDAZIONE COSCIENTE

- respiro autonomo,
- mantenimento riflessi protettivi delle vie aeree,
- capacità di rispondere a stimoli verbali

Come

- Miscela con ossigeno
- Bombole trasportabili N₂O al 50%
- Ventilatore con possibilità di settaggio N₂O tra il 30 ed il 70%
- Sufficiente che vi sia un recupero del gas espirato dal paziente



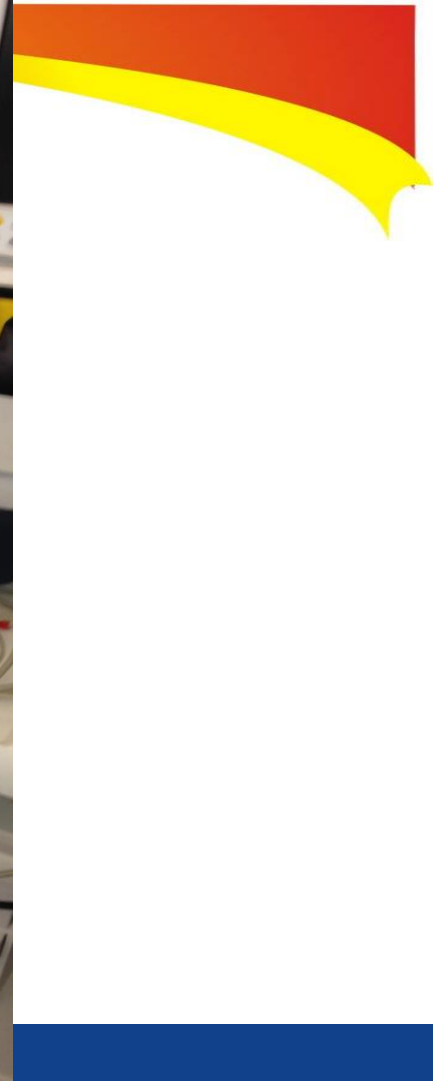




PediSedate ®



FIGURE 1. Nasal hood is placed on the nose. It is connected to the breathing circuit (circle) through which sevoflurane gas is delivered.



Maschera facciale

Vantaggio del rebreathing
(maschere nasali disperdono
se si respira a bocca aperta)

L'esalato viene correttamente
smaltito con tubo d'uscita



Controindicazioni

- PNX, ipertensione polmonare, sacche enfisematose, embolia gassosa e difficoltà respiratoria in genere
- Trauma cranico chiuso, aumento della pressione endocranica
- Ostruzione intestinale
- Otite e sinusite
- Intossicazioni da farmaci (relativa)
- Ovviamente nei traumi facciali dove si applicherebbe la maschera

- Efficacia dopo 3-4 minuti dall'inizio dell'inalazione in maschera
- Fino a 5 minuti dopo la sospensione
- 30 min massimo





Vantaggi

- Sicuro (minimi eff. coll. al 50%)
- Rapida efficacia e rapida ripresa (il PS è il contesto giusto)
- Semplice (suff. monitoraggio SaO2 e FC)
- Ben accetto dai bb e dai genitori (aiuto il bb, non lo “addormento”, non sono invasivo, non serve accesso venoso)
- Facile d'uso, maneggevole
- Somministrabile a stomaco pieno
- Relativamente economico

Ad uso infermieristico ed ostetrico in UK, France, USA, Australia

In Italia ufficialmente è registrato come gas anestetico

AIFA: “deve essere sempre somministrato alla presenza di personale medico, che decide se il medicinale può essere somministrato ed in quale dose, in struttura adeguata che permetta la rianimazione d'emergenza cardio-respiratoria”





ORIGINAL RESEARCH CONTRIBUTION

Nitrous Oxide for Early Analgesia in the Emergency Setting: A Randomized, Double-blind Multicenter Prehospital Trial

Jean-Louis Ducassé, MD, Georges Siksik, MD, Manon Durand-Béchu, MD, Sébastien Couarraze, RN, Baptiste Vallé, MD, Nathalie Lecoules, MD, Patrice Marco, RN, Thierry Lacombe, PharmD, and Vincent Bounes, MD

60 francesi adulti

Trasporto per trauma (non ipertensione endocranica, perdita di coscienza, PNX, chirurgia oculare recente, enfisema, ileo, sinusite, trauma facciale)

N₂O 50% per 15 min



- ansiolisi
 - componente di amnesia anterograda
 - analgesia per dolori lievi moderati
- “non chiedere quello che non può dare”

**Combinazione con altri
analgesici/ansiolitici**

Quali usi

Procedure dolorose/ansiogene

- Venipuntura e incannulamento venoso
- Medicazioni di ustioni
- Suture
- Artrocentesi
- Riduzione di fratture scomposte
- Riduzione di lussazioni

Quali usi

- Rimozione corpi estranei orecchio
- Aspirazione/drenaggio ascessi
- Biopsie
- Puntura lombare
- Rimozione suture bb. autistici
- Procedure odontoiatriche (rimozione dentaria)

Suture di ferite



Limited analgesic efficacy of nitrous oxide for painful procedures in children

F E Babl, E Oakley, A Puspitadewi, L N Sharwood

A Randomized Clinical Trial of Continuous-Flow Nitrous Oxide and Midazolam for Sedation of Young Children During Laceration Repair

ANNALS OF EMERGENCY MEDICINE 37:1 JANUARY 2001

Conclusion: For facial suturing in 2- to 6-year-old children, regimens including continuous-flow nitrous oxide were more effective in reducing distress, and had fewer adverse effects and shorter recovery times than midazolam.

204 pz
Maschera nasale
LET

L'iniezione di anestetico locale produce disagio al paziente, aumenta "ansia da ago", può alterare i margini della ferita.

Lidocaina 4%: analgesia pronta
Adrenalina 0.05%: vasocostrizione
Tetracaina 0.5%: analgesia long lasting

2-5 ml in sede per
30-60 minuti

basso costo:
4 ml 70 c





A Randomized Comparison of Nitrous Oxide Versus Intravenous Ketamine for Laceration Repair in Children

Jin Hee Lee, MD,* Kyuseok Kim, MD, PhD,* Tae Yun Kim, MD, PhD,* You Hwan Jo, MD, PhD,*
Seung Ho Kim, MD, PhD,† Joong Eui Rhee, MD, PhD,* Chan Yeong Heo, MD, PhD,‡
and Seok-Chan Eun, MD, PhD‡

Conclusions: Nitrous oxide inhalation was preferable to injectable ketamine for pediatric patients because it is safe, allows for a faster recovery, maintains sufficient sedation time, and does not induce unnecessarily deep sedation.

TABLE 1. General Patient Characteristics

	Ketamine Group (n = 14)	N ₂ O Group (n = 18)	P
Age, mean (SD), years	4.7 (1.6)	5.9 (1.8)	0.06
Male, n (%)	12 (85.7)	14 (77.8)	0.67
Weight, mean (SD), kg	18.4 (4.0)	21.8 (6.9)	0.11
ASA class, n (%)			
Class I	14 (100)	18 (100)	
Fasting time			
Water, median (IQR), min	176.0 (123.6–315.8)	217.5 (135.5–305.0)	0.56
>2 h, n (%)	11 (78.6)	15 (83.3)	0.73
Food, median (IQR), min	176.0 (123.6–315.8)	184.0 (135.5–300.3)	0.38
>6 h, n (%)	2 (14.3)	1 (5.6)	0.40
Laceration site, n (%)			0.11
Head	12 (85.7)	15 (83.3)	
Limbs	2 (14.3)	3 (16.7)	
Total sedation time, median (IQR), min	38.5 (30.8–51.3)	25.0 (16.8–34.3)	0.01
Total procedure time, median (IQR), min	7.5 (6–12)	11.0 (7.8–21.5)	0.14

Riduzione di fratture scomposte



Riduzione di lussazioni





LMA | **MAD Nasal™**
INTRANASAL MUCOSAL
ATOMIZATION DEVICE

Manufactured By:
Wolfe Tory Medical, Inc.
79 West 4500 South
Salt Lake City, Utah 84107

CE
0050

U.S. Patents 6,112,743
Packaged Clean
Contents: 1 unit
Single Patient Use Only

See Instructions
 Latex Free

Refer to www.lmaco.com
for instruction for use
Wolfe Tory Medical, Inc.
is a wholly owned subsidiary of
LMA North America, Inc.
4660 La Jolla Village Dr., Suite 900
San Diego, California 92122
www.LMANA.com

REF

MAD300
+M560MAD300-1

LOT

130432
+S\$0416130432



Use by: 2016-04



clonazepam 10mg
intranasal
10ml
NON INIETTARE
Prep.: 09/01/2014
soluzione NON sterile

1000mg, sodio cloruro 0,9% soluzione, sodio
acido citrico monoidrato.
Farmacologia Clinica, via dell'Istria 65/1 - Trieste

FENTANYL e.n.
1-1,5 μ /Kg

MIDAZOLAM
0,5 mg/Kg

PROTOSSIDO
50%

“TRIO PERFETTO”

ORIGINAL RESEARCH CONTRIBUTION

Intranasal Fentanyl and High-concentration Inhaled Nitrous Oxide for Procedural Sedation: A Prospective Observational Pilot Study of Adverse Events and Depth of Sedation

Robert W. Seith, MBChB, MRCPCH, FRACP, FACEP, Theane Theophilos, RN, MPH, and Franz E. Babi, MD, MPH, FRACP, FAAP

2012; 19:31–36

41 pz tra 1 e 14 anni, Melbourne
1,5 µ/Kg fentanest e.n.
N2O 50%-70% full face mask (98% con 70%)

Non eff collaterali gravi
19,5% vomito (2 durante)
57% livello sedazione 2 o 3
(max 4, min 0)



Table 1
Characteristics of ED Patients Receiving Inhaled Nitrous Oxide and INF for PSA (n = 41)

Characteristic	Value
Age, yr	
Mean (±SD)	6.7 (±2.9)
Median (IQR)	6.3 (5.2–8.8)
Sex, male, n (%)	29 (70.7)
Strength N ₂ O, n (%)	
70%	40 (98)
50%	1 (2)
Length N ₂ O, minutes	
Mean (±SD)	11.4 (±6.3)
Median (IQR)	10 (5.5–15)
INF, number of doses*(%)	
1	32 (78)
2	8 (19.5)
3	1 (2.4)
Time pre-N ₂ O, minutes†	
Mean (±SD)	14.5 (±14.3)
Median (IQR)	10 (5–25)
Procedures, n (%)	
Orthopedic	33 (80.5)
Reduction fracture	21 (51.2)
LAMP	4 (9.8)
Reduction dislocation	2 (4.9)
Application of plaster	6 (14.6)
Laceration repair	4 (9.8)
Facial	3 (7.3)
Nonfacial	1 (2.4)
Other	4 (9.8)
Abscess drainage	1 (2.4)
Removal foreign body	2 (4.9)
Burns dressing	1 (2.4)

INF = intranasal fentanyl; IQR = interquartile range; LAMP = local anesthesia, manipulation, and plaster; PSA = procedural sedation and analgesia.
*Within 2 hours of administering N₂O.
†If multiple doses of fentanyl, then dose closest to N₂O is used.

Use of Combined Transmucosal Fentanyl, Nitrous Oxide, and Hematoma Block for Fracture Reduction in a Pediatric Emergency Department

Ana Jiménez, MD, Daniel Blázquez, MD, Jaime Cruz, MD, Alba Palacios, MD, Olga Ordóñez, MD, Milagros Marín, PhD, and Jesús Ruiz-Contreras, PhD

Conclusions: The association of NO + TMF + HB in the reduction of radioulnar fractures in PED improves pain control compared with the NO + HB combination. New studies are required to confirm the benefit and safety of this drug combination.

TABLE 1. Data on Sex: n (%), Duration of the Procedure Less Than 15 Minutes: n (%), Mean Age in Years, and Mean Pain Expected by the Child Before the Procedure (From 0 = No Pain to 10 = Severe Pain), in Both Groups (NO + HB and NO + TMF + HB)

	NO + HB		NO + Fentanyl + HB		P
	n (%)		n (%)		
Sex					
Male	12 (70.6)		46 (71.9)		0.94
Female	5 (29.4)		18 (28.1)		
Procedure duration					
<15 min	13 (76.5)		50 (78.1)		0.76
15–30 min	4 (23.5)		14 (21.9)		
	Mean	95% CI	Mean	95% CI	
Age, y	10.6	8.9–12.4	9.4	8.6–10.3	0.18
Pain expected before the procedure	7.1	5.5–8.7	7.2	6.2–8.2	0.78

TABLE 2. Data on Pain Referred by the Child, the Nurse, and the Doctor (From 0 = No Pain to 10 = Severe Pain), Overall Satisfaction of the Medical Professionals (From 1 to 10, 10 Being Completely Satisfied), and Number (n) and Percentage (%) of Adverse Effects, With the Technique in Both Groups (NO + HB and NO + TMS + HB)

	NO + HB		NO + Fentanyl + HB		P
	Mean	95% CI	Mean	95% CI	
Pain assessment, child	4	2.5–5.5	2.5	1.8–3.1	0.035
Pain assessment, nurse	3.9	2.3–5.5	2.7	2–3.3	0.10
Pain assessment, doctor	4	1.6–6.3	2.6	2–3.2	0.17
Satisfaction, professionals	6.8	5.4–8.3	8.8	8.6–10.3	0.006
	n (%)	95% CI	n (%)	95% CI	
Adverse effects					
Yes	6 (40)	19.8–64.2	9 (15.3)	8.2–26.5	0.08
No	9 (60)	35.7–80.1	50 (84.7)	73.4–91.7	

On comparing the group who received NO + TMF + HB against NO + HB, assessment of pain during the process was 2.5 (95% confidence interval [CI], 1.8–3.1) compared with 3.9 (95% CI, 2.3–5.5) by the child, respectively ($P = 0.035$), 2.6 (95% CI,

Effetti collaterali

- Euforia
- Singhiozzo
- Nausea e vomito
- “ansia della maschera”
- Stordimento, capogiri

Tutti regrediscono dopo
pochi minuti dalla sospensione

Safety of High-Concentration Nitrous Oxide by Nasal Mask for Pediatric Procedural Sedation

Experience With 7802 Cases

Judith L. Zier, MD, FAAP* and Meixia Liu, MS†

TABLE 2. Total Adverse Events During Nitrous Oxide Administration

Adverse event,* n (%)	
No adverse events	7470 (95.7)
Apnea	0
Oxygen saturation <92%	8 (0.1)
Diaphoresis	33 (0.4)
Nausea	128 (1.6)
Vomiting	171 (2.2)
Other	59 (0.8)

TABLE 1. Patient and Procedure Characteristics

	n (%)
Age, y	
<1	116 (1.5)
1–4	3751 (48.1)
5–10	3050 (39.1)
11–18	885 (11.3)
Procedure	
Urinary catheterization	4928 (63.6)
Peripheral venous cannulation	826 (10.7)
Lumbar puncture	340 (4.4)
Noninvasive procedure (eg, echocardiogram, computed tomographic scan)	206 (2.7)
Enteral tube (eg, nasogastric, gastrostomy) placement	197 (2.5)
Peripherally inserted central catheter placement	100 (1.3)
Minor surgical procedure (eg, abscess incision and drainage)	72 (0.9)
Laceration suturing	52 (0.7)
Bone marrow biopsy	2 (0)
Other (eg, electromyelogram, botulinum toxin injection)	1020 (13.2)

10^c



+15 min aumentano reaz avverse

Lancet 2001 ; 358 : 1514-15

	Number of cases	Minor adverse events	Major adverse events
Emergency-department procedures*	2095	136 (6.5%)	7 (0.3%)
Lumbar puncture	1559	76 (4.9%)	4 (0.3%)
Dressing changes	1315	67 (5.1%)	10 (0.8%)
Bone-marrow aspiration	976	30 (3.1%)	1 (0.1%)
Flexible bronchoscopy	471	24 (5.1%)	3 (0.6%)
Gastroscopy	275	5 (1.8%)	0
Venous puncture	264	17 (6.4 %)	0
Miscellaneous†	556	20 (3.6 %)	0
Total	7511	375 (5.0%)	25 (0.3%)

*Examples include laceration repair, fracture reduction, cast remodelling, abscess drainage. †Examples include renal or liver biopsy, bladder catheterisation, placement of nasogastric tube.

Adverse events associated with sedation by premixed 50% nitrous oxide and oxygen



0.33% rate of potential life threatening events

EFFETTI COLLATERALI MAGGIORI

Desaturazione

ostruzione vie aeree

apnea

- associazione con 2 farmaci (oppioide e bdz)
- **associazione con singolo farmaco non aumenta il rischio (oppioide o bdz)**

High-Concentration Nitrous Oxide for Procedural Sedation in Children: Adverse Events and Depth of Sedation

Franz E. Bahl, MD, MPH, Ed Oakley, MBBS, Cameron Seaman, MBBS, Peter Barnett, MBBS, MSc, Lisa N. Shanwood, RN, BN, MPH

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The authors have indicated they have no financial relationships relevant to this article to disclose.

PEDIATRICS Volume 121, Number 3, March 2008

90% N2O al 70%

Livello di sedazione analoga tra 50%e 70%

1 dolore toracico

1 desaturazione

Maggiori vomiti



TABLE 1 Characteristics of ED Patients Who Received N₂O for PSA (n = 762)

Characteristic	Value
Age, y	
Mean (SD)	6.5 (4.0)
Median (range)	6.0 (1–17)
Male gender, n (%)	459 (60.0)
% N ₂ O, n (%)	
70	548 (71.9)
60	16 (2.0)
50	101 (13.2)
30–40	6 (0.8)
Missing*	91 (11.9)
Adjunctive agents, n (%)†	
N ₂ O alone	693 (90.0)
Codeine‡	46 (6.0)
Morphine intravenous/intramuscular§	38 (5.0)
Procedures, n (%)	
Orthopaedic	293 (38.4)
Reduction fracture	167
LAMP¶	46
Reduction dislocation	40
Application of plaster	41
Laceration repair	223 (29.2)
Facial	124
Nonfacial	99
Foreign body removal	71 (9.3)
Vascular access	37 (4.8)
Other	148 (19.4)
Abscess drainage	26
Urinary catheter	13
Wound debridement	13
Lumbar puncture	12
Other**	85

LAMP indicates local anesthesia, manipulation, and plaster.

* Highest N₂O concentration not decided.

† Within 2 hours before N₂O administration.

‡ Codeine alone or in combination with paracetamol.

§ Five patients had received 2 agents (morphine plus codeine).

¶ Pacifimols reduction, anastria, orthocentesis, drawing change, insertion of nasogastric or gastrostomy tubes, pelvic examination, examination under sedation, dental procedures, vaccination, and suprapubic aspiration.

Costi (carrello)

bombola da 10 L: 400 euro circa

maschera rebreathing riutilizzabile dopo sterilizzazione 200 euro ca

Sterilizzazione 75 cent

Filtro monouso 4 euro

10 min di protossido 50%
6 euro per protossido



Rischi

- Non effettuato bene l'anamnesi > vi sono controindicazioni che non ho tenuto in considerazione
- Interferenza vit B 12 (esposizione cronica ad alte dosi) > disordini neurologici, ematologici e immunologici
- Operatori (rischio cronico): infertilità
- Precauzione d'impiego (smaltimento del gas a muro)



Chicago 2013

Artrocentesi (AIG)

50 pz.

62% premedicazione con midazolam per os 0,5-0,7 mg/Kg

2 pz effetti avversi (1 vomito, 1 pavor)

70% non ricorda nulla dell'evento

Nitrous oxide induced myeloneuropathy: a case report

February 2014, Volume 21, [Issue 1](#), pp 85-88

35 anni, M, abuso N₂O

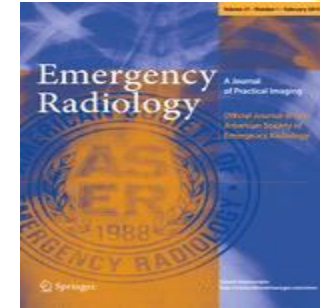
In PS con sensorio alterato, incontinenza urinaria, postura anomala delle mani
Babinski pos, alterazioni sensibilità mani, riflessi vivaci alle estremità, deficit
attentivo

RMN cervicale: malattia demielinizzante C2-C3 e C6-C7

EMG e dosaggio vit B12 dirimenti

Regressione completa ma lenta con supplementazione di vitamina B12

Ipotesi dell'inibizione della metionina sintetasi



Case report morti



Curiosità

Panna montata > perché siamo felici quando la mangiamo?

E' montata con il protossido d'azoto (con l'anidride carbonica inacidisce perché crea acido carbonico)

Wiston Churchill era uno sniffatore da salotto (sono sicuro che l'aria del paradiso deve essere questo meraviglioso gas delle delizie)

A Randomized Comparison of Nitrous Oxide Versus Intravenous Ketamine for Laceration Repair in Children

Jin Hee Lee, MD,* Kyuseok Kim, MD, PhD,
Seung Ho Kim, MD, PhD,† Joong Eu
and Seok-t

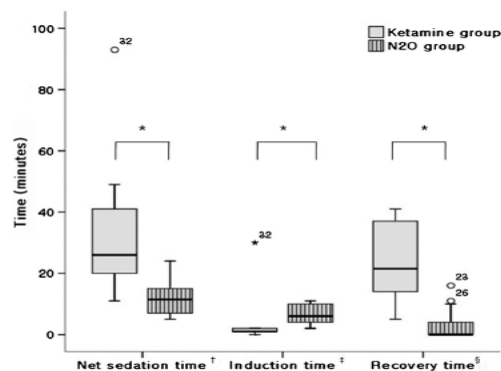


FIGURE 1. Time comparison for sedation. The N₂O group had shorter net sedation time and recovery time than that in the ketamine group. The ketamine group experienced shorter induction times. * $P < 0.05$. [‡]Net sedation time, total sedation time – total procedure time. [§]Induction time, from the moment the patient was medicated until they were sedated. [§]Recovery time, from the end of the procedure until consciousness was regained.

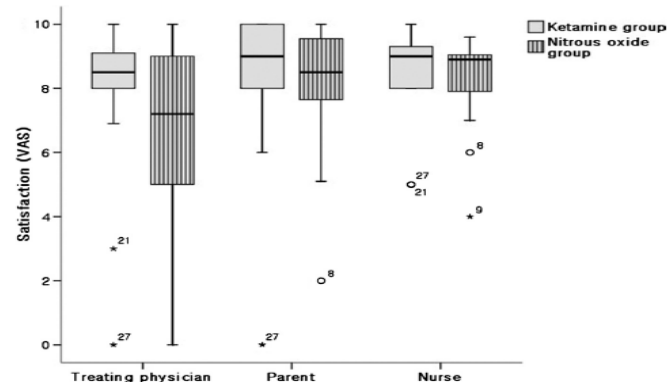


FIGURE 2. Satisfaction of treating physicians, patient's parents, and nurse regarding sedation. No difference in satisfaction level was observed between the 2 patient groups.

TABLE 4. Adverse Effects in the Hospital

	Ketamine (n = 14)	N ₂ O (n = 18)	Total (n = 32), n (%)
Hallucination	1 (7.1)	—	1 (3.1)
Dizziness	1 (7.1)	1 (5.6)	2 (6.3)
Nausea	3 (21.4)	—	3 (9.3)
Vomiting	3 (21.4)	—	3 (9.3)
Tachycardia	2 (14.3)	—	2 (6.3)