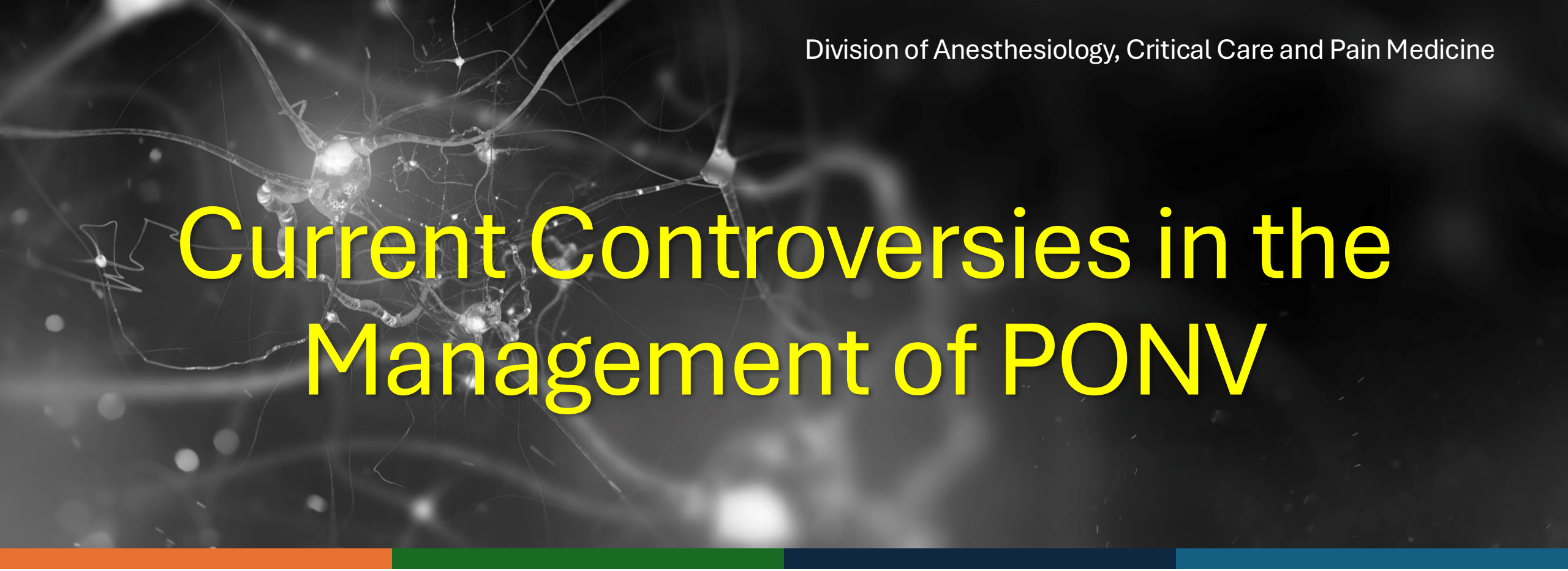

Current Controversies in the Management of PONV

T. J. Gan, M.D., M.B.A., F.R.C.A., M.H.S.
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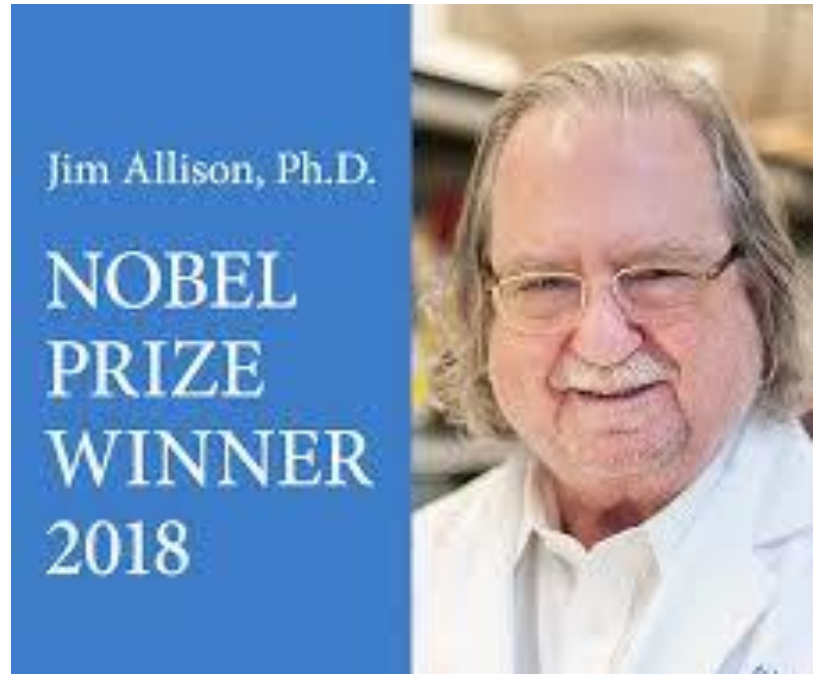


Disclosures

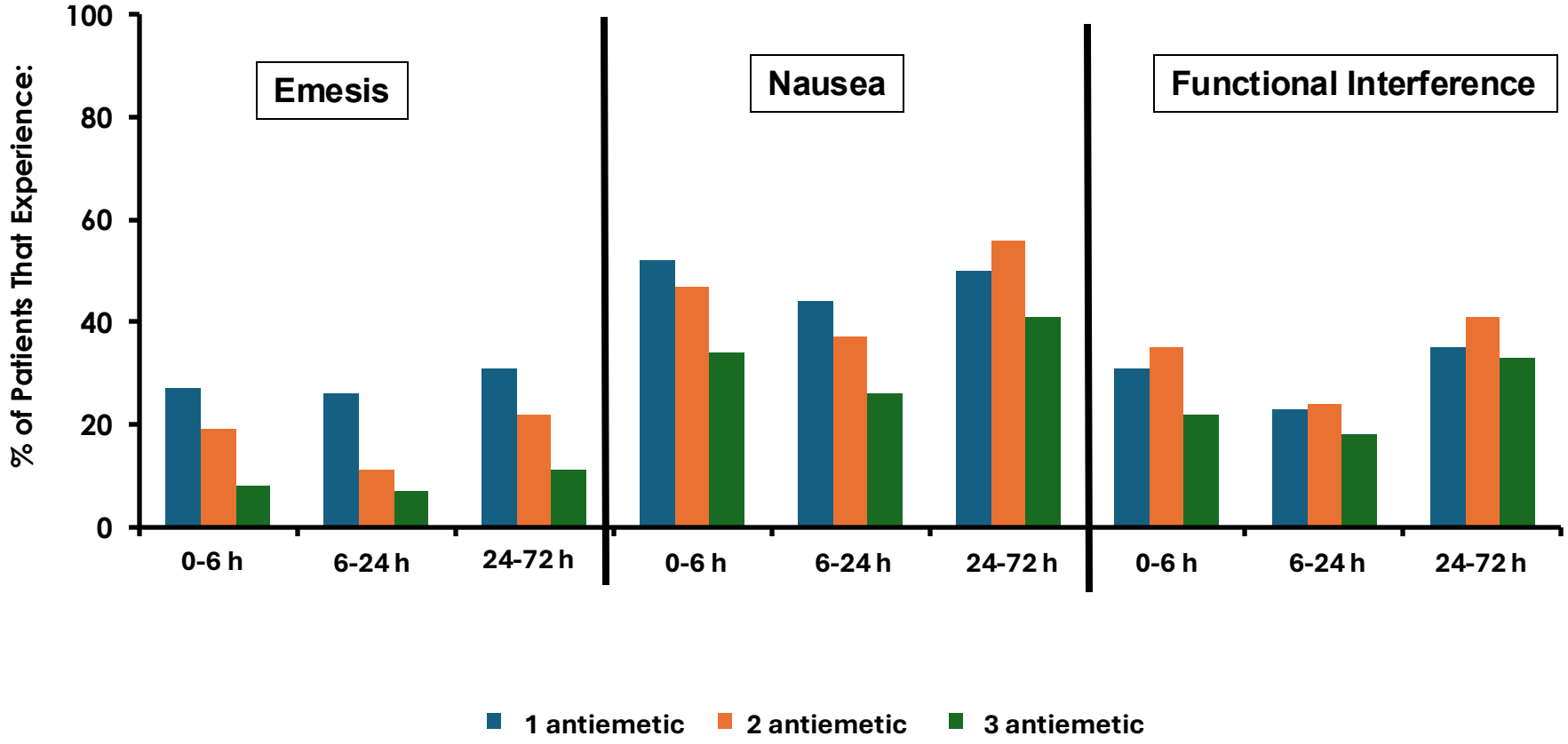
- Honoraria from Baxter, Haisco, Masimo and Vertex

Outline

- Incidence of PONV
- Baseline risks for PONV
- Antiemetic choices and side effects
- Effective strategies to reduce baseline risks
- PONV management in ERAS protocol
- 5th Consensus Guidelines on PONV Management

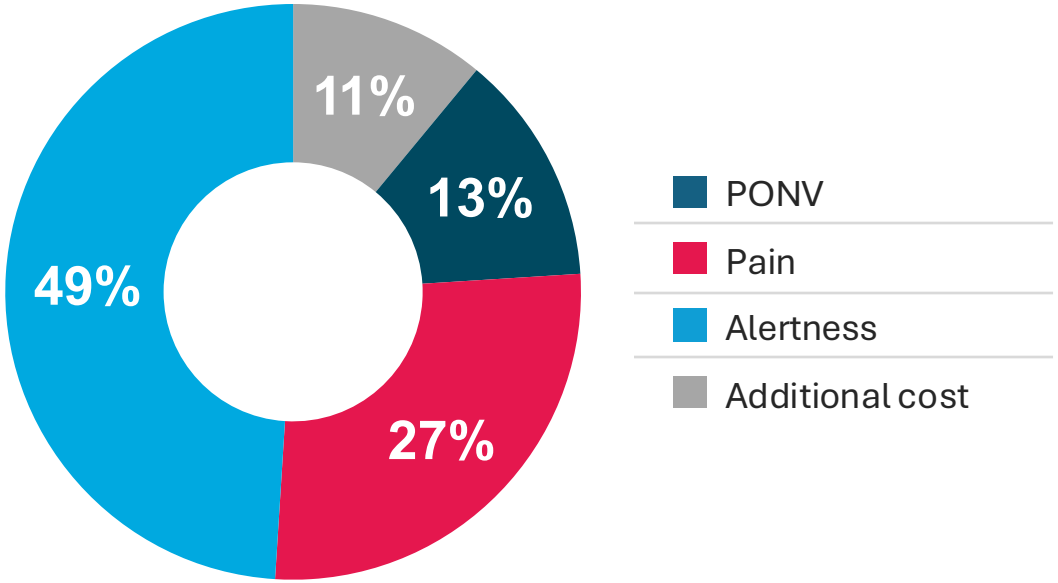
Functional Interference Due to Nausea and/or Vomiting

White et al. Anesth Analg 2008;107:452-8



Patients Perceive PONV To Be Worse Than Pain

Relative Importance of Patient Postoperative Recovery Concerns (%) (N=220)[1]

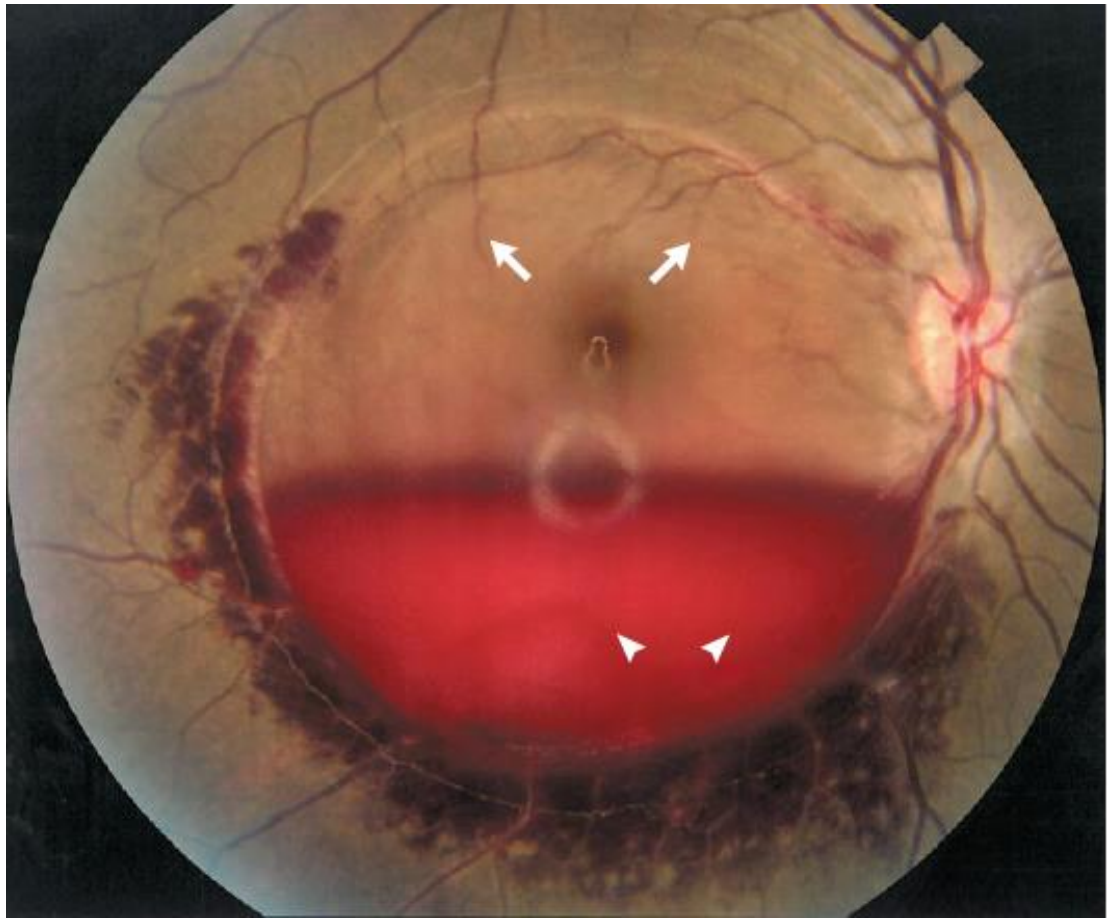


PONV

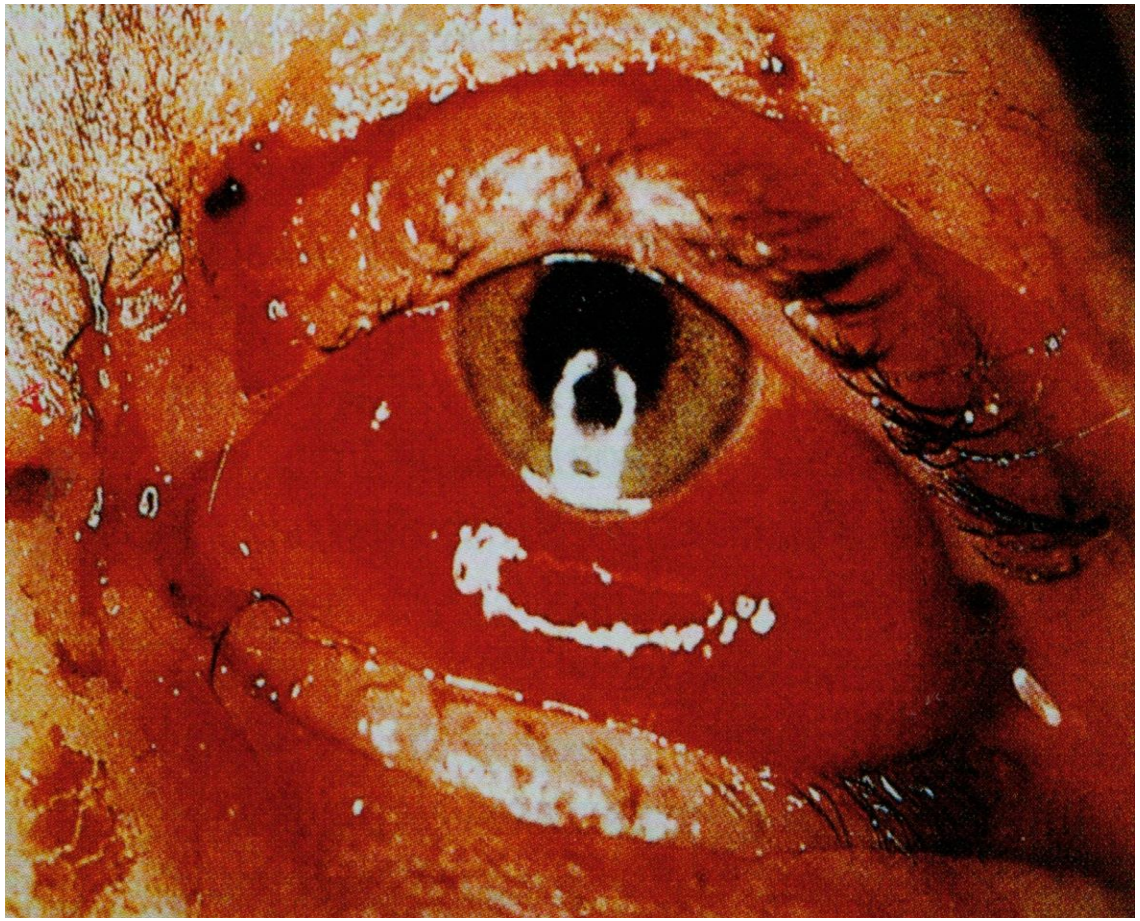
- The most common reason for poor patient satisfaction during the perioperative period[2]
- A greater concern for some patients than pain, alertness, or additional cost[1,3]

1. Eberhart LH, et al. Anesthesiology. 2002;89(5):760-761. 2. Hill RP, et al. Anesthesiology. 2000;92:958-967. 3. Gan TJ, et al. Br J Anaesth. 2004;92(5):681-688.

Loss of Vision After Vomiting



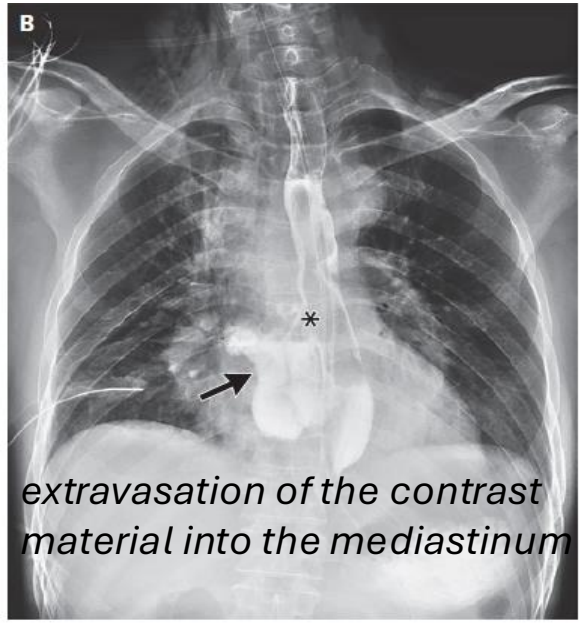
Retching Following Blepharoplasty

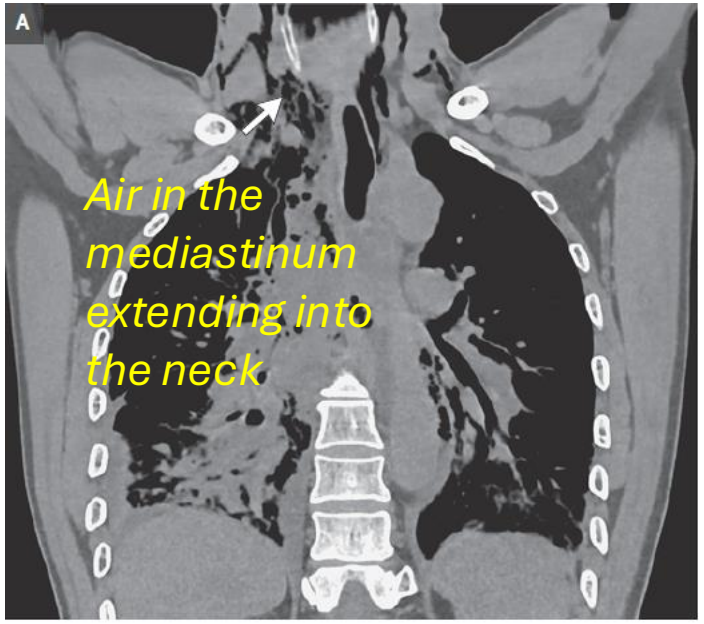


Zhang GS & Mathura JR. NEJM 2005;352;17

Boerhaave Syndrome

- Previously healthy 59-year-old man presented to the ED with a 5-hour history of severe, pleuritic chest pain.
- Half an hour before the onset of symptoms, he had vomited a large amount of gastric contents after eating street food.
- On physical examination, his breathing was found to be rapid and shallow.
- Emergency thoracoscopic repair of the esophageal perforation
- Hospitalized for 35 days





DOI: 10.1056/NEJMicm2500300

American Journal of Surgery

QUARTERLY SUPPLEMENT of ANESTHESIA and ANALGESIA

[American Journal of Anesthesia and Analgesia]

OFFICIAL ORGAN

of the American Association of Anesthetists and Scottish Society of Anesthetists

OCTOBER INTRODUCTORY NUMBER A. D. 1914

CONTENTS

ORIGINAL ARTICLES

DEPARTMENTS

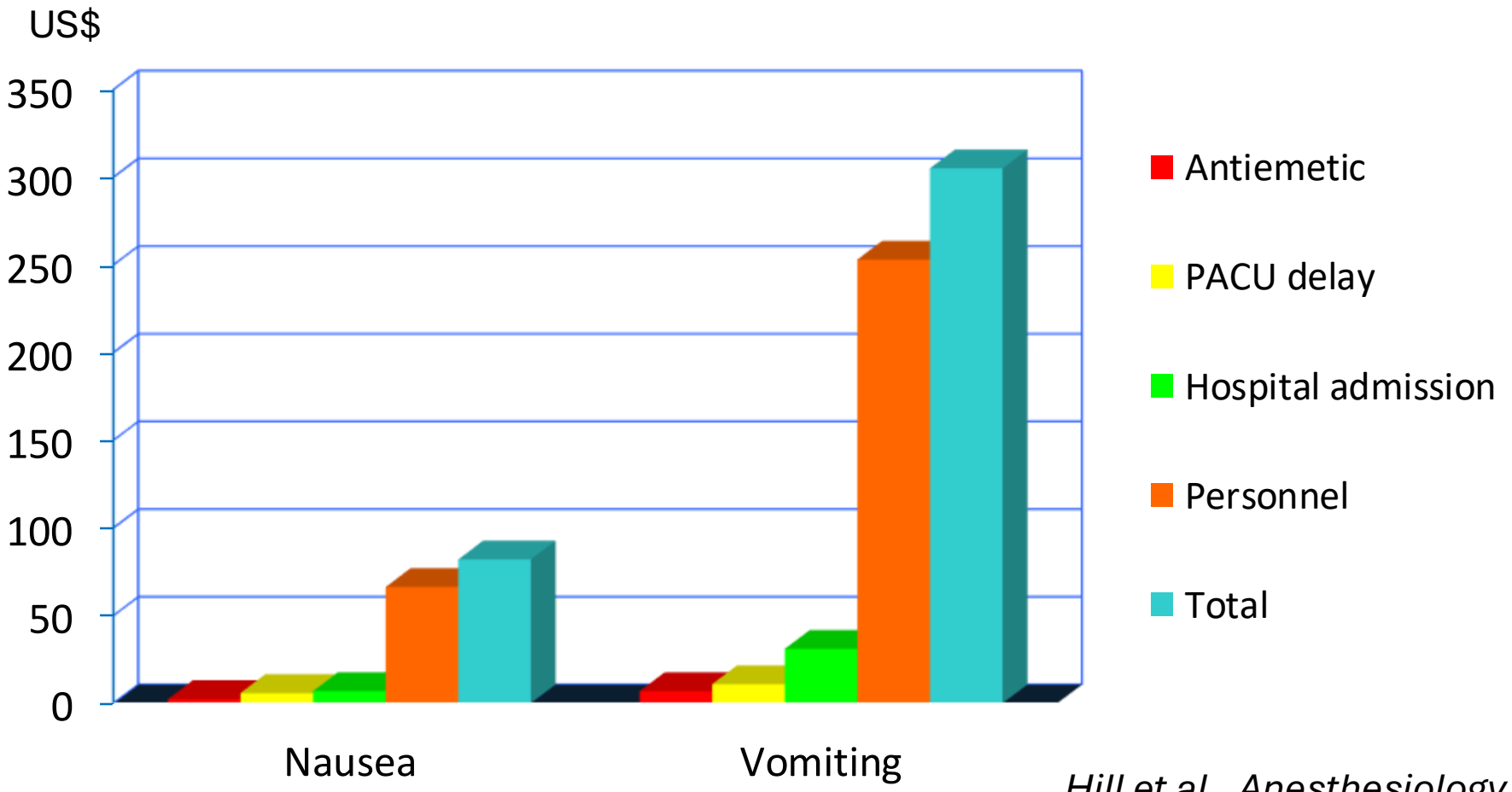
The Use of Olive Oil to Prevent or Relieve Postanesthetic Vomiting

"The oil was administered by mouth immediately after partial restoration of consciousness. The oil in the stomach absorbed any ether that might be there."

Ferguson RH. *New York Medical Journal* 1912;95:1359-61.

Costs per Episode of Nausea and Emesis

- Each episode of PONV prolongs PACU stay by about 30 min
- Cost of PACU : $15/min, Cost of OR: $34/min

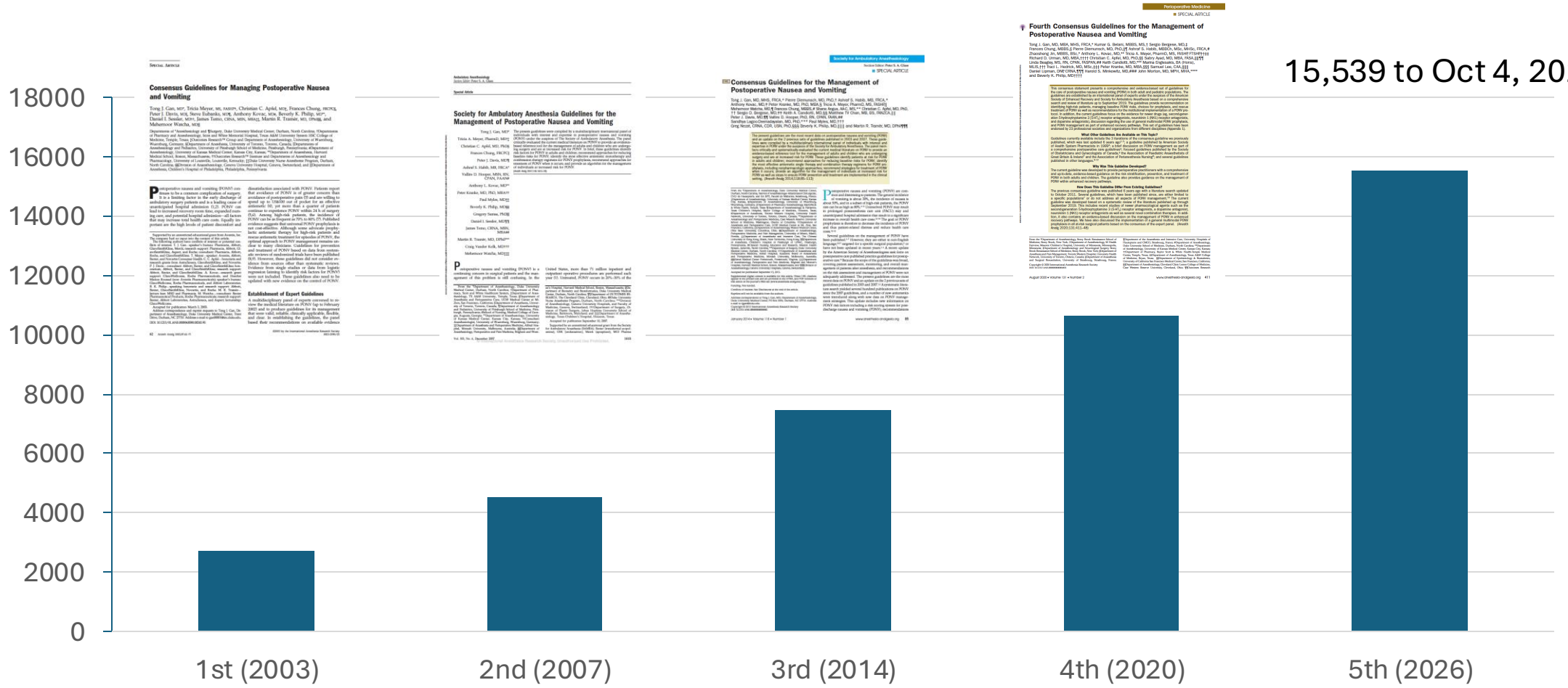


Hill et al., Anesthesiology 2000;92:958-67

Number of Publications on PONV

PubMed Search: Postoperative Nausea, Vomiting

15,539 to Oct 4, 2023



PONV Consensus Guidelines

4th PONV Consensus Guidelines
Endorsed by 23 professional organizations

Perioperative Medicine

SPECIAL ARTICLE

Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting

Tong J. Gan, MD, MBA, MHS, FRCA,* Kumar G. Belani, MBBS, MS,† Sergio Bergese, MD,‡ Frances Chung, MBBS,§ Pierre Diemunsch, MD, PhD,‖¶ Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA,# Zhaosheng Jin, MBBS, BSc,* Anthony L. Kovac, MD,** Tricia A. Meyer, PharmD, MS, FASHP, FTSHP††‡‡‡ Richard D. Urman, MD, MBA,†††† Christian C. Apfel, MD, PhD,§§ Sabry Ayad, MD, MBA, FASA,‖‖¶¶ Linda Beagley, MS, RN, CPAN, FASPAN,## Keith Candiotti, MD,*** Marina Englesakis, BA (Hons), MLIS,††† Traci L. Hedrick, MD, MSc,‡‡‡ Peter Kranke, MD, MBA,§§§ Samuel Lee, CAA,‖‖‖ Daniel Lipman, DNP, CRNA,¶¶¶ Harold S. Minkowitz, MD,### John Morton, MD, MPH, MHA,**** and Beverly K. Philip, MD††††

This consensus statement presents a comprehensive and evidence-based set of guidelines for the care of postoperative nausea and vomiting (PONV) in both adult and pediatric populations. The guidelines are established by an international panel of experts under the auspices of the American Society of Enhanced Recovery and Society for Ambulatory Anesthesia based on a comprehensive search and review of literature up to September 2019. The guidelines provide recommendation on identifying high-risk patients, managing baseline PONV risks, choices for prophylaxis, and rescue treatment of PONV as well as recommendations for the institutional implementation of a PONV protocol. In addition, the current guidelines focus on the evidence for newer drugs (eg, second-generation 5-hydroxytryptamine 3 [5-HT_3] receptor antagonists, neurokinin 1 (NK1) receptor antagonists, and dopamine antagonists), discussion regarding the use of general multimodal PONV prophylaxis, and PONV management as part of enhanced recovery pathways. This set of guidelines have been endorsed by 23 professional societies and organizations from different disciplines (Appendix 1).

What Other Guidelines Are Available on This Topic?

Guidelines currently available include the 3 iterations of the consensus guideline we previously published, which was last updated 6 years ago[1–3]; a guideline published by American Society of Health System Pharmacists in 1999[4]; a brief discussion on PONV management as part of a comprehensive postoperative care guidelines[5]; focused guidelines published by the Society of Obstetricians and Gynecologists of Canada,[6] the Association of Paediatric Anaesthetists of Great Britain & Ireland[7] and the Association of Perianesthesia Nursing[8]; and several guidelines published in other languages.[9–12]

Why Was This Guideline Developed?

The current guideline was developed to provide perioperative practitioners with a comprehensive and up-to-date, evidence-based guidance on the risk stratification, prevention, and treatment of PONV in both adults and children. The guideline also provides guidance on the management of PONV within enhanced recovery pathways.

How Does This Guideline Differ From Existing Guidelines?

The previous consensus guideline was published 6 years ago with a literature search updated to October 2011. Several guidelines, which have been published since, are either limited to a specific populations[7] or do not address all aspects of PONV management.[13] The current guideline was developed based on a systematic review of the literature published up through September 2019. This includes recent studies of newer pharmacological agents such as the second-generation 5-hydroxytryptamine 3 (5-HT_3) receptor antagonists, a dopamine antagonist, neurokinin 1 (NK1) receptor antagonists as well as several novel combination therapies. In addition, it also contains an evidence-based discussion on the management of PONV in enhanced recovery pathways. We have also discussed the implementation of a general multimodal PONV prophylaxis in all at-risk surgical patients based on the consensus of the expert panel. (Anesth Analg 2020;131:411–48)

From the *Department of Anesthesiology, Stony Brook Renaissance School of Medicine, Stony Brook, New York; †Department of Anesthesiology, M Health Fairview, Masonic Children's Hospital, University of Minnesota, Minneapolis, Minnesota; ‡Department of Anesthesiology and Neurological Surgery, Stony Brook Renaissance School of Medicine, Stony Brook, New York; §Department of Anesthesia and Pain Management, Toronto Western Hospital, University Health Network, University of Toronto, Ontario, Canada; ‖Department of Anaesthesia and Surgical Resuscitation, University of Strasbourg, Strasbourg, France; ¶Department of the Anaesthesia and Intensive Care, University Hospitals of Hautepierre and CMCO, Strasbourg, France; #Department of Anesthesiology, Duke University School of Medicine, Durham, North Carolina; **Department of Anesthesiology, University of Kansas Medical Center, Kansas City, Kansas; ††Department of Pharmacy, Baylor Scott & White Health-Temple Medical Center, Temple, Texas; ‡‡Department of Anesthesiology, Texas A&M College of Medicine, Bryan, Texas; §§Department of Epidemiology & Biostatistics, University of California San Francisco Medical Center, San Francisco, California; ‖‖Department of Anesthesiology, Cleveland Clinic Lerner College of Medicine, Case Western Reserve University, Cleveland, Ohio; ¶¶Outcomes Research

DOI: 10.1213/ANE.0000000000004833

TJ Gan

- American Society for Enhanced Recovery
- American Society of Health Systems Pharmacists
- American Society of Peri Anesthesia Nurses
- American Society of Anesthesiologists
- American Academy of Anesthesiologist Assistants
- American Association of Nurse Anesthetists
- American College of Clinical Pharmacy Perioperative Care Practice and Research Network
- Australian Society of Anesthetists
- Brazilian Society of Anesthesiology
- Chinese Society of Anesthesiology
- European Society of Anesthesiologists
- Indian Society of Anesthesiologists
- Japanese Society of Anesthesiologists
- Korean Society of Anesthesiologists
- Malaysian Society of Anesthesiologists
- Royal College of Anesthesiologist Thailand
- Singapore Society of Anesthesiologists
- Society for Ambulatory Anesthesia
- Society for Pediatric Anesthesia
- South African Society of Anesthesiologists
- Taiwan Society of Anesthesiologists
- Society of American Gastrointestinal & Endoscopic Surgeons

5th PONV Consensus Guidelines Endorsed by 25 Professional Societies

- American Society for Enhanced Recovery
- American Academy of Anesthesiologist Assistants
- American Association of Nurse Anesthesiology
- American Academy of Ambulatory Care Nursing
- American College of Clinical Pharmacy
- American Society of Health Systems Pharmacists
- American Society of Peri Anesthesia Nurses
- Australian and New Zealand College of Anesthetists
- Australian Society of Anesthetists
- Canadian Anesthesiologists' Society
- College of Anesthesiologists of Ireland
- European Society of Anesthesiology
- German Society of Anesthesiology
- Hong Kong College of Anesthesiologists
- Indian Society of Anesthesiology
- Indonesian Society of Anesthesiologists and Intensive Therapy
- Japanese Society of Anesthesiologists
- Korean Society of Anesthesiologists
- Malaysian Society of Anesthesiologists
- Royal College of Anesthesiologist Thailand
- Royal College of Anaesthetists United Kingdom
- Singapore Society of Anesthesiologists
- Society for Ambulatory Anesthesia
- Society for Pediatric Anesthesia
- South African Society of Anesthesiologists

Gan et al. Fifth Consensus Guidelines for the Management of PONV. Anesth Analg 2025 (In press)

PONV Risk Factors in Adults

Evidence	Risk Factors
Positive overall	Female sex (B1) History of PONV or MS (B1) Nonsmoking (B1) Younger age (B1) General vs. regional anesthesia (A1) Use of volatile anesthetics and nitrous oxide (A1) Postoperative opioids (A1) Duration of anesthesia (B1) Type of surgery (cholecystectomy, laparoscopic, gynecological, urological, bariatric) (B1) Lower preoperative physical fitness (B1) Lower preoperative hematocrit (B1) BMI > 25 (B1) Genetic polymorphism
Conflicting	Menstrual cycle (B1) Level of anesthetist's experience (B1)
Disproven or of limited clinical relevance	Anxiety (B1) Nasogastric tube (A1) Migraine (B1) Supplemental oxygen (A1) Preoperative carbohydrate loading (A1)

Gan TJ et al. Anesth Analg 2025 (In press)

Adult PONV Risk Factors

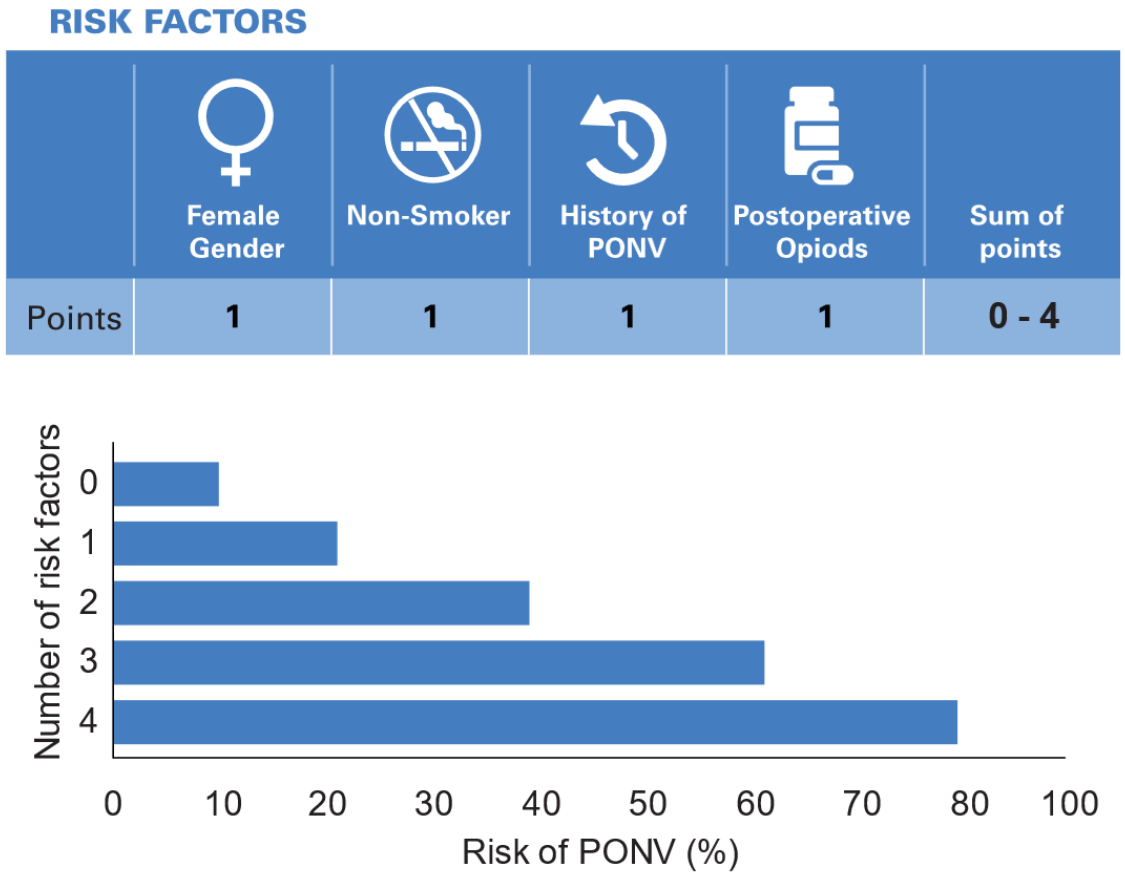


Figure 1a:

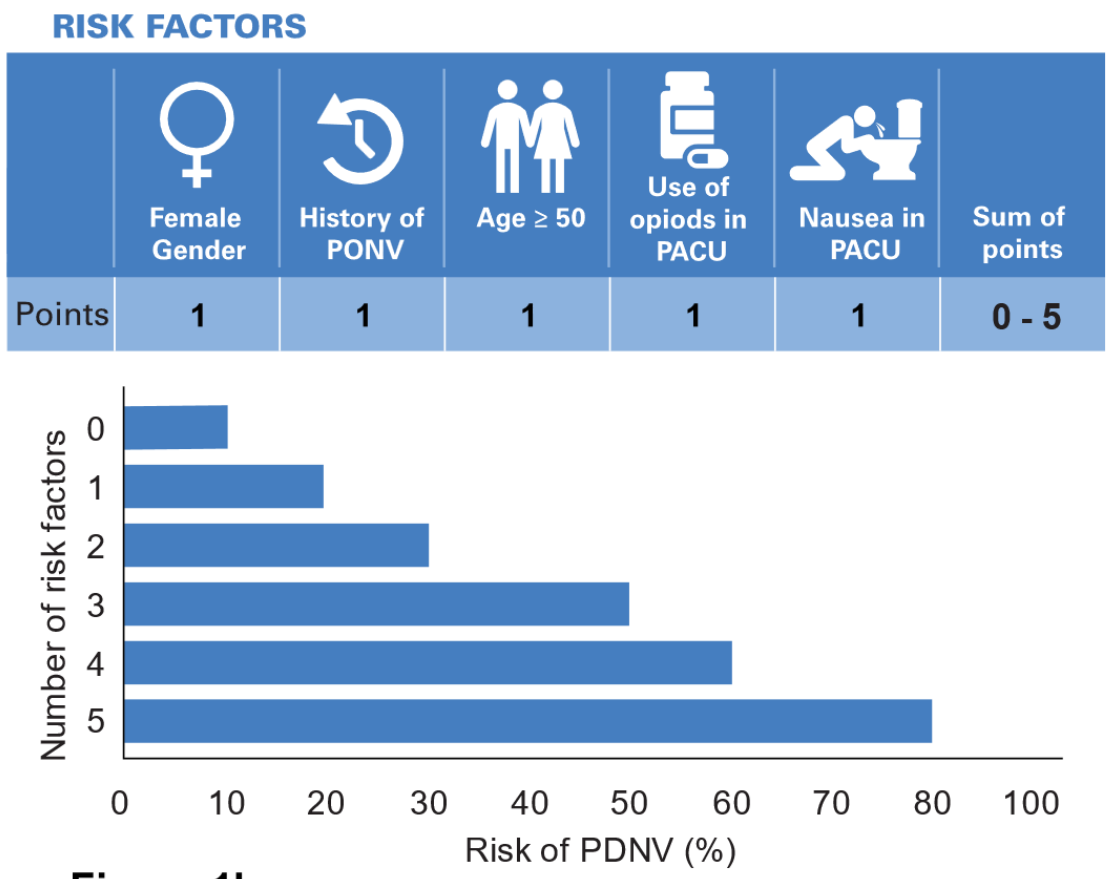


Figure 1b:

Gan TJ et al. Anesth Analg 2025 (In press)

Pediatric PONV Risk Factors

RISK FACTORS

	Age*	PONV or Motion sickness**	Anesthesia > 45 minutes	Multiple doses of opiods	High-risk surgery***	Sum of points
Points	0 - 2	1	1	1	1	0 - 6

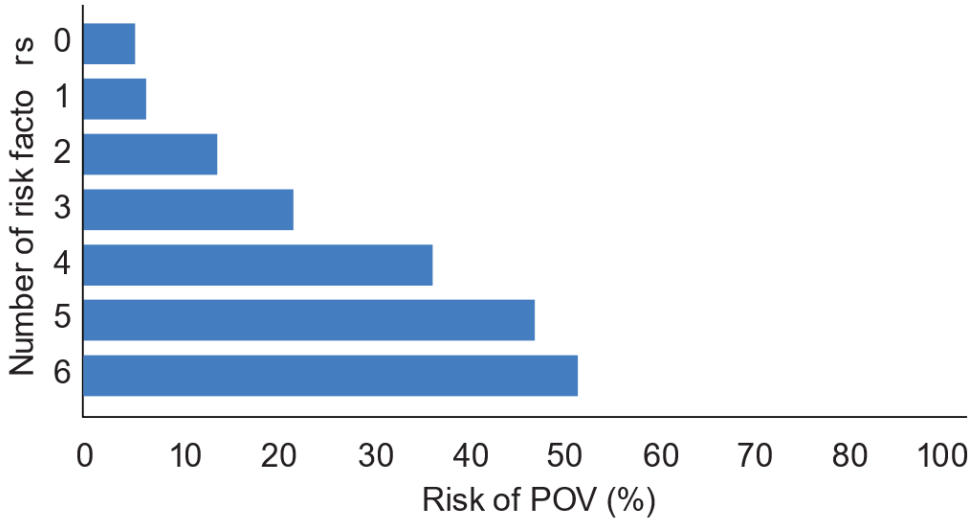


Figure 3a:

RISK FACTORS

	Surgery ≥ 30 minutes	Age ≥ 3 years	Strabismus surgery	History of POV or family history of PONV	Sum of points
Points	1	1	1	1	0 - 4

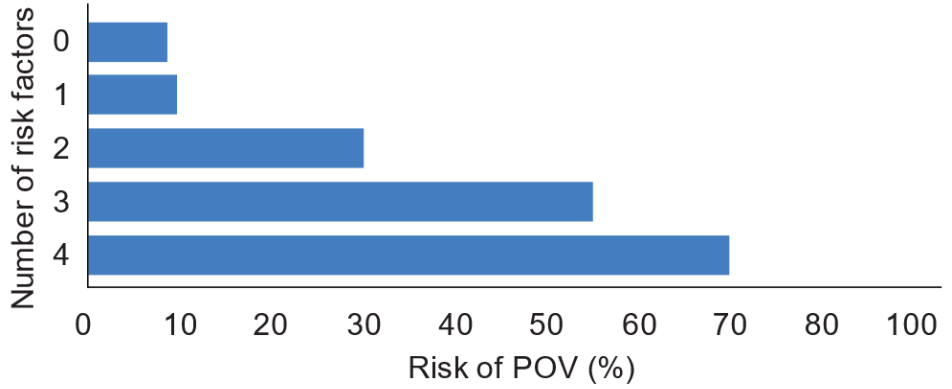
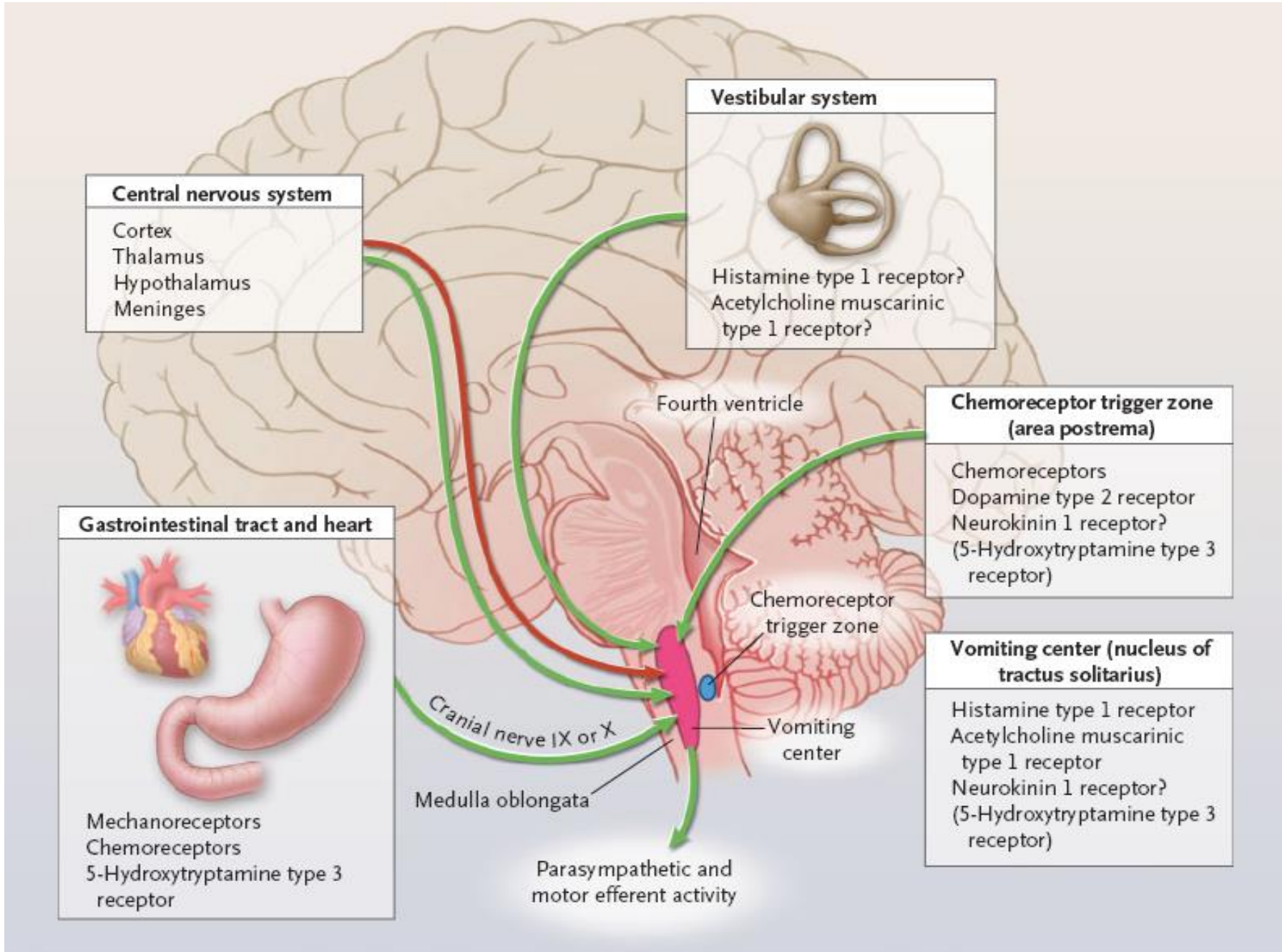
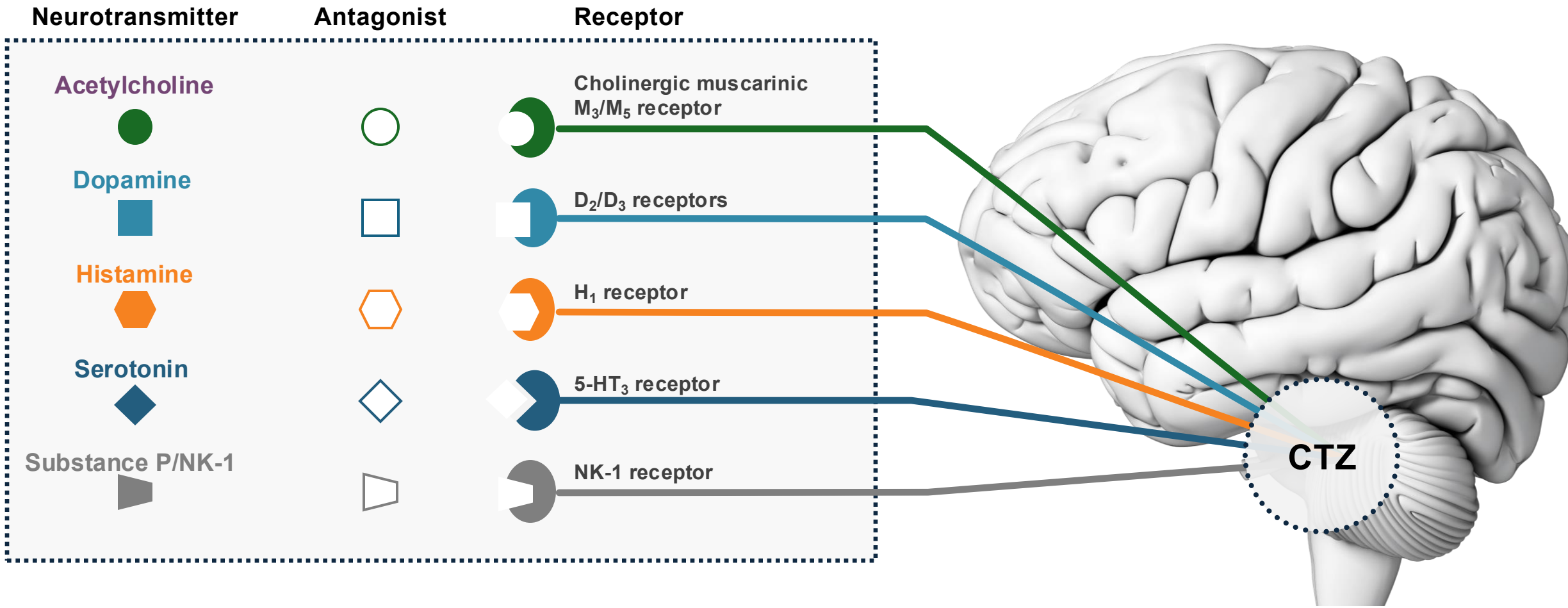


Figure 3b:

Gan TJ et al. Anesth Analg 2025 (In press)


Central nervous system
Cortex
Thalamus
Hypothalamus
Meninges
Vestibular system
Histamine type 1 receptor?
Acetylcholine muscarinic type 1 receptor?
Fourth ventricle
Chemoreceptor trigger zone (area postrema)
Chemoreceptors
Dopamine type 2 receptor
Neurokinin 1 receptor?
(5-Hydroxytryptamine type 3 receptor)
Chemoreceptor trigger zone
Gastrointestinal tract and heart
Cranial nerve IX or X
Vomiting center
Medulla oblongata
Vomiting center (nucleus of tractus solitarius)
Histamine type 1 receptor
Acetylcholine muscarinic type 1 receptor
Neurokinin 1 receptor?
(5-Hydroxytryptamine type 3 receptor)
Mechanoreceptors
Chemoreceptors
5-Hydroxytryptamine type 3 receptor
Parasympathetic and motor efferent activity

Multiple Neurotransmitters and Their Receptors in CTZ



D_3=dopamine-3. H_1=histamine. M_3=muscarinic 3. M_5=muscarinic 5. NK-1=neurokinin-1.

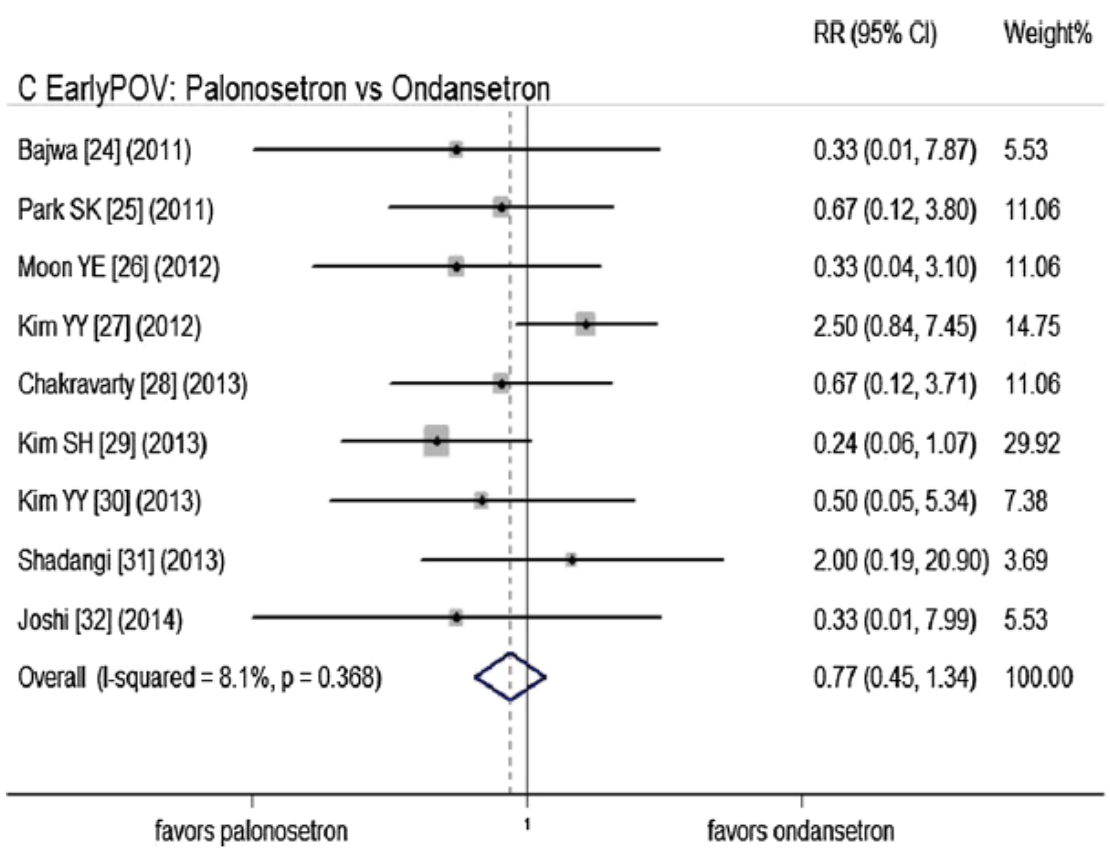
1. Watcha MF, et al. *Anesthesiology*. 1992;77(1):162-184. 2. Shaikh SI, et al. *Anesth Essays Res*. 2016;10(3):388-396. 3. Kovac AL. In: Gan TJ, Habib A. eds. *Postoperative Nausea and Vomiting: A Practical Guide*. Cambridge, UK: Cambridge University Press; 2016:13-22. 4. Darmani NA, et al. *J Neural Transm.* 1999;106:1045-1061.

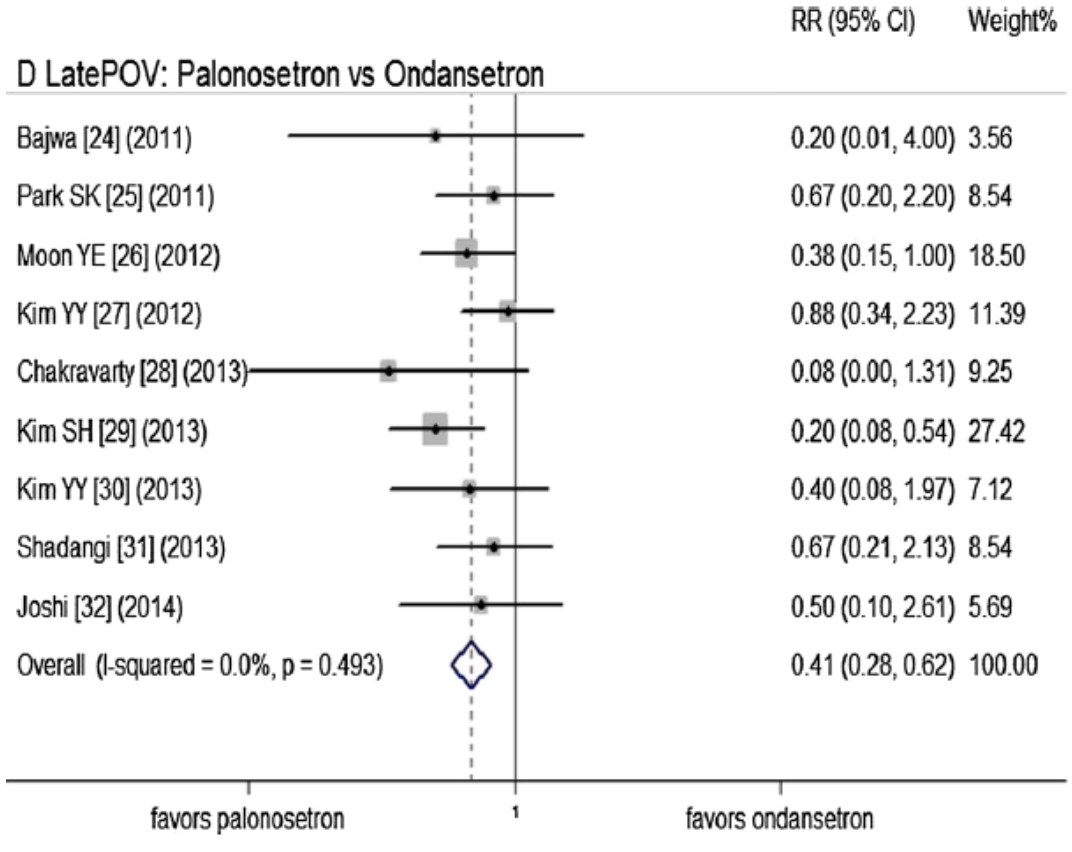
Serotonin (5HT-3) Antagonists

	Ondansetron	Tropisetron	Granisetron	Palonosetron
Dose (mg)	4	2 mg	0.1–1.0	0.075
Half-life (h)	3–5	6–8	5–8	40
Route of Adm	IV, Tab, ODT Solution,	IV, oral	IV, Tab, Patch, Solution	IV, oral
Metabolism	Primarily hepatic (CYP1A2, CYP2D6, CYP3A4),	• Primarily hepatic via CYP2D6 • significant variability based on genetic polymorphism.	Primarily metabolized by CYP3A4, with no involvement of CYP2D6.	• 50% metabolized in the liver by CYP2D6, CYP3A4, and CYP1A2. • 40% excreted unchanged by the kidneys. • Clinical effects are not significantly impacted by CYP2D6 genetic variations.
QT Prolongation Effect	Yes	Yes	Yes	No

https://doi.org/10.1016/j.anclin.2017.01.003; Individual drugs prescribing information

Palonosetron vs. Ondansetron Early and Late Vomiting



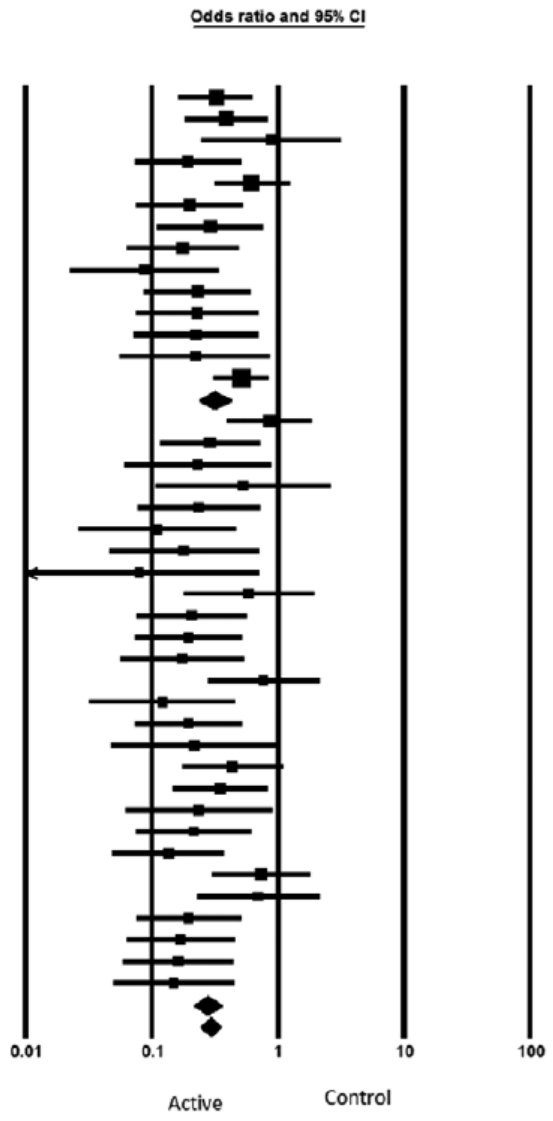


Less QTc prolongation than ondansetron and granisetron 2.45 versus 5.13 ms, $p = 0.002$

Xiong C. Can J Anesth 2015;62:1268-78
Popovic M. Support Care Cancer 2014;22:1685e97

Dexamethasone – Doses and Efficacy

Group by Comparison	Study name	Comparison	Outcome	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	Events / Total Dexamethasone	Events / Total Control
4-5 mg	Chu ref 54	4-5 mg	PONV 24 hr	0.323	0.166	0.630	-3.314	0.001	28 / 74	49 / 75
4-5 mg	Chu 2 ref 54	4-5 mg	PONV 24 hr	0.389	0.183	0.825	-2.460	0.014	14 / 74	27 / 72
4-5 mg	Numazaki ref 63	4-5 mg	PONV 24 hr	0.868	0.243	3.099	-0.217	0.828	11 / 30	6 / 15
4-5 mg	Wang ref 73	4-5 mg	PONV 24 hr	0.193	0.073	0.510	-3.316	0.001	10 / 39	25 / 39
4-5 mg	Coloma ref 74	4-5 mg	PONV 24 hr	0.623	0.316	1.227	-1.369	0.171	25 / 70	33 / 70
4-5 mg	Wang ref 76	4-5 mg	PONV 24 hr	0.200	0.075	0.530	-3.237	0.001	10 / 38	25 / 39
4-5 mg	Tzeng ref 77	4-5 mg	PONV 24 hr	0.289	0.110	0.758	-2.522	0.012	10 / 38	21 / 38
4-5 mg	Wang ref 78	4-5 mg	PONV 24 hr	0.176	0.064	0.487	-3.348	0.001	8 / 39	22 / 37
4-5 mg	Lee ref 81	4-5 mg	PONV 24 hr	0.087	0.022	0.340	-3.512	0.000	16 / 45	19 / 22
4-5 mg	Huang ref 82	4-5 mg	PONV 24 hr	0.229	0.088	0.598	-3.009	0.003	11 / 39	24 / 38
4-5 mg	Shung-Tai ref 84	4-5 mg	PONV 24 hr	0.227	0.074	0.694	-2.600	0.009	9 / 42	12 / 22
4-5 mg	Wang ref 85	4-5 mg	PONV 24 hr	0.222	0.072	0.690	-2.600	0.009	8 / 44	11 / 22
4-5 mg	Wang 89	4-5 mg	PONV 24 hr	0.220	0.056	0.861	-2.175	0.030	4 / 43	7 / 22
4-5 mg	Janknegt ref 93	4-5 mg	PONV 24 hr	0.513	0.312	0.845	-2.620	0.009	45 / 130	86 / 130
4-5 mg				0.312	0.235	0.415	-8.032	0.000	209 / 745	347 / 641
8-10 mg	Alghanem ref 46	8-10 mg	PONV 24 hr	0.857	0.397	1.851	-0.392	0.695	18 / 60	20 / 60
8-10 mg	Yeo ref 49	8-10 mg	PONV 24 hr	0.290	0.116	0.727	-2.641	0.008	14 / 40	26 / 40
8-10 mg	Makhdoom ref 50	8-10 mg	PONV 24 hr	0.231	0.061	0.869	-2.167	0.030	7 / 20	14 / 20
8-10 mg	Makhdoom 2 ref 50	8-10 mg	PONV 24 hr	0.529	0.108	2.598	-0.784	0.433	3 / 20	5 / 20
8-10 mg	Gautam ref 53	8-10 mg	PONV 24 hr	0.238	0.079	0.718	-2.547	0.011	5 / 47	16 / 48
8-10 mg	Erhan ref 55	8-10 mg	PONV 24 hr	0.111	0.027	0.465	-3.009	0.003	5 / 20	15 / 20
8-10 mg	Koc ref 56	8-10 mg	PONV 24 hr	0.179	0.046	0.704	-2.463	0.014	7 / 20	15 / 20
8-10 mg	Koc 2 ref 56	8-10 mg	PONV 24 hr	0.079	0.009	0.713	-2.261	0.024	1 / 20	8 / 20
8-10 mg	Moussa ref 57	8-10 mg	PONV 24 hr	0.583	0.178	1.913	-0.890	0.374	6 / 30	9 / 30
8-10 mg	Biachin ref 58	8-10 mg	PONV 24 hr	0.208	0.077	0.563	-3.094	0.002	10 / 36	24 / 37
8-10 mg	Nasek-Adam ref 59	8-10 mg	PONV 24 hr	0.194	0.073	0.513	-3.301	0.001	9 / 40	24 / 40
8-10 mg	Nasek-Adam 2 ref 59	8-10 mg	PONV 24 hr	0.175	0.057	0.538	-3.040	0.002	5 / 40	18 / 40
8-10 mg	Wu ref 60	8-10 mg	PONV 24 hr	0.765	0.277	2.114	-0.517	0.605	13 / 30	15 / 30
8-10 mg	Mckean ref 64	8-10 mg	PONV 24 hr	0.121	0.032	0.458	-3.111	0.002	7 / 24	17 / 22
8-10 mg	Feo ref 65	8-10 mg	PONV 24 hr	0.194	0.074	0.512	-3.315	0.001	7 / 49	24 / 52
8-10 mg	Yusek ref 67	8-10 mg	PONV 24 hr	0.216	0.048	0.977	-1.990	0.047	11 / 20	17 / 20
8-10 mg	Bisgaard ref 68	8-10 mg	PONV 24 hr	0.436	0.176	1.079	-1.795	0.073	13 / 40	21 / 40
8-10 mg	Piper ref 70	8-10 mg	PONV 24 hr	0.351	0.148	0.828	-2.389	0.017	9 / 75	21 / 75
8-10 mg	Biswas ref 71	8-10 mg	PONV 24 hr	0.234	0.062	0.889	-2.134	0.033	3 / 60	11 / 60
8-10 mg	Tzeng ref 79	8-10 mg	PONV 24 hr	0.214	0.075	0.607	-2.897	0.004	7 / 38	19 / 37
8-10 mg	Liu ref 83	8-10 mg	PONV 24 hr	0.135	0.049	0.370	-3.887	0.000	8 / 40	26 / 40
8-10 mg	Tzeng ref 88	8-10 mg	PONV 24 hr	0.732	0.300	1.785	-0.685	0.493	17 / 38	21 / 40
8-10 mg	Tzeng 2 ref 88	8-10 mg	PONV 24 hr	0.700	0.229	2.137	-0.626	0.531	7 / 37	9 / 36
8-10 mg	Wang ref 91	8-10 mg	PONV 24 hr	0.197	0.076	0.507	-3.363	0.001	14 / 41	29 / 40
8-10 mg	Wang ref 92	8-10 mg	PONV 24 hr	0.169	0.063	0.457	-3.506	0.000	9 / 40	24 / 38
8-10 mg	Wang ref 94	8-10 mg	PONV 24 hr	0.161	0.059	0.441	-3.560	0.000	13 / 38	29 / 38
8-10 mg	Wang ref 95	8-10 mg	PONV 24 hr	0.150	0.050	0.447	-3.405	0.001	6 / 38	20 / 36
8-10 mg				0.274	0.215	0.350	-10.346	0.000	234 / 1001	497 / 999
Overall				0.290	0.241	0.349	-13.081	0.000	443 / 1746	844 / 1640



Dexamethasone 4-5 mg:

NNT = 3.7 (3, 4.7)
OR: 0.312 (0.235, 0.415)

Dexamethasone 8-10 mg:

NNT = 3.8 (3, 4.3)
OR 0.274 (0.215, 0.350

(95 % CI)

De Oliveira Jr GS. Anesth Analg 2013;116:58-74

Dexamethasone and Surgical Site Infection

	Dexamethasone (4372)	Placebo (4353)	Risk Ratio/Median Difference
SSI at 30 days	8.1%	9.1%	0.89 (0.77 – 1.03)
Deep or organ space SSI at 90 days	1.9	2.0	0.94 (0.55 – 1.60)
PONV (24h)	42.2%	53.9%	0.78 (0.75 – 0.82)
Hyperglycemia events (without diabetes)	0.6%	0.2%	
QoR 15 (day 1)	109 (93 – 123)	104 (87 – 118)	5.0 (3.8 – 6.2)
New-onset chronic postsurgical pain at 6 months	8.7%	7.1%	1.23 (1.06 – 1.42)

Corcoran TB et al. N Engl J Med 2021;384:1731-41

Perioperative Dexamethasone in Diabetic Patients: A Systematic Review and Meta-Analysis of Randomized, Placebo-Controlled Trials

Ian A. Jones, MD,* Michael A. LoBasso, MD,† Julian Wier, MD,‡ Brandon S. Gettleman, BS,‡ Mary K. Richardson, BS,‡ Christina E. Ratto, MD,§ Jay R. Lieberman, MD,‡ and Nathanael D. Heckmann, MD‡

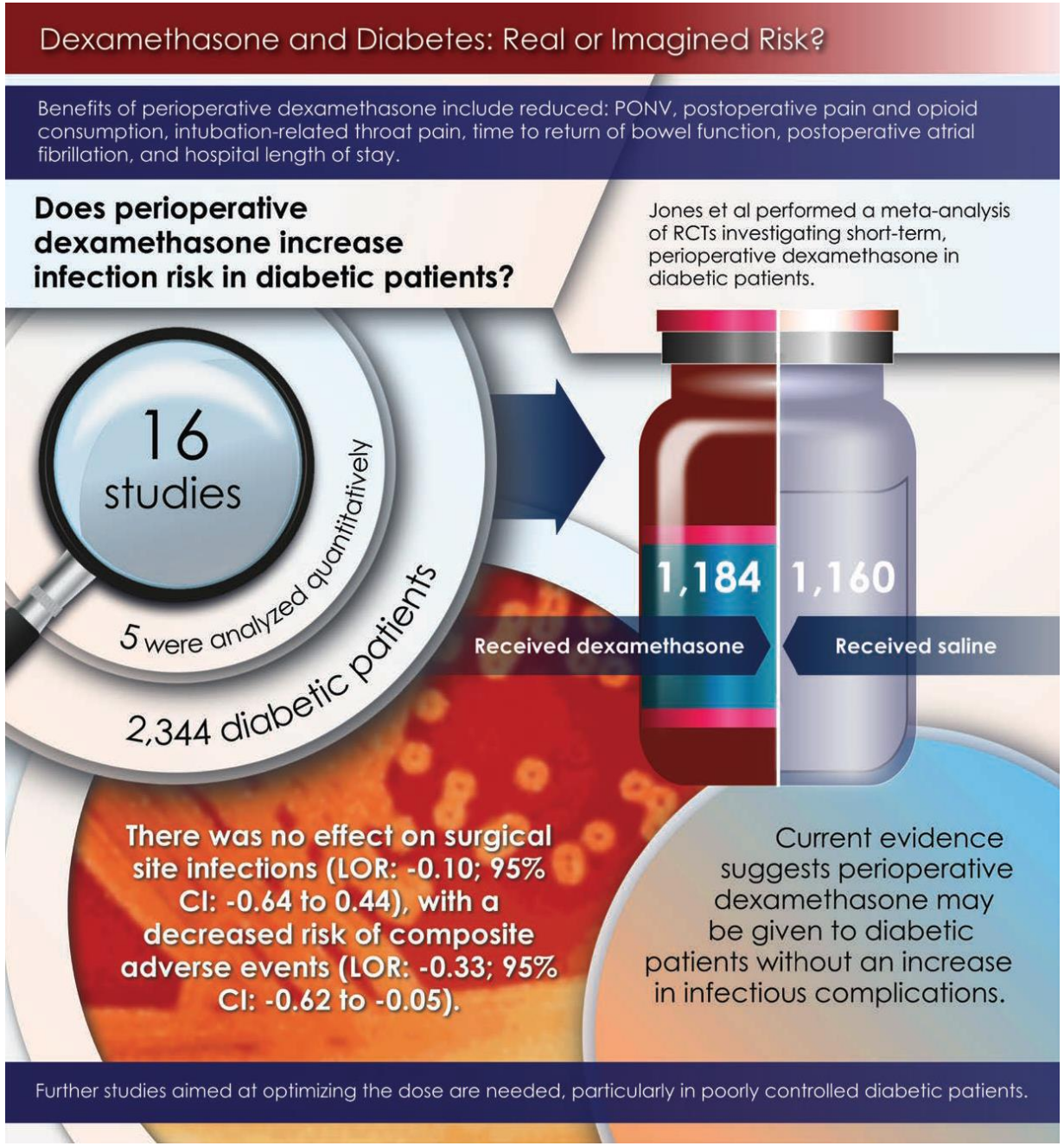
See Article, page 453

BACKGROUND: The perioperative use of dexamethasone in diabetic patients remains controversial due to concerns related to infection and adverse events. This study aimed to determine whether clinical evidence supports withholding dexamethasone in diabetic patients due to concern for infection risk. We hypothesized that there is no difference in infectious outcomes between dexamethasone-treated patients and controls.

METHODS: A literature search was performed on November 22, 2022 to identify randomized, placebo-controlled trials investigating short-course (<72 hours), perioperative dexamethasone that explicitly included diabetic patients and measured at least 1 clinical outcome. Pertinent studies were independently searched in PubMed, Embase, and Cochrane. Authors for all identified studies were contacted with the aim of performing quantitative subgroup analyses of diabetic patients. The primary end point was surgical site infection and the secondary end point was a composite of adverse events. Qualitative remarks were reported based on the total available data and a quality assessment tool. Meta-analyses were performed using inverse variance with random effects. Heterogeneity was assessed via standard χ^2 and I^2 tests.

RESULTS: Sixteen unique studies were included, 5 of which were analyzed quantitatively. Of the 2592 diabetic patients, 2344 (1184 randomized to dexamethasone and 1160 to placebo) were analyzed in at least 1 quantitative outcome. Quantitative analysis showed that the use of perioperative dexamethasone had no effect on the risk of surgical site infections (log odds ratio [LOR], −0.10, 95%; 95% confidence interval [CI], −0.64 to 0.44) while significantly reducing the risk of composite adverse events (LOR, −0.33; 95% CI, −0.62 to −0.05). Qualitative analysis reinforced these findings, demonstrating noninferior to superior results across all clinical outcomes. There was high heterogeneity between the included studies.

CONCLUSIONS: Current evidence suggests perioperative dexamethasone may be given to diabetic patients without increasing the risk of infectious complications. Prospective investigations aimed at optimizing dose, frequency, and timing are needed, as well as studies aimed explicitly at exploring the use of dexamethasone in patients with poorly controlled diabetes. (Anesth Analg 2024;139:479–89)

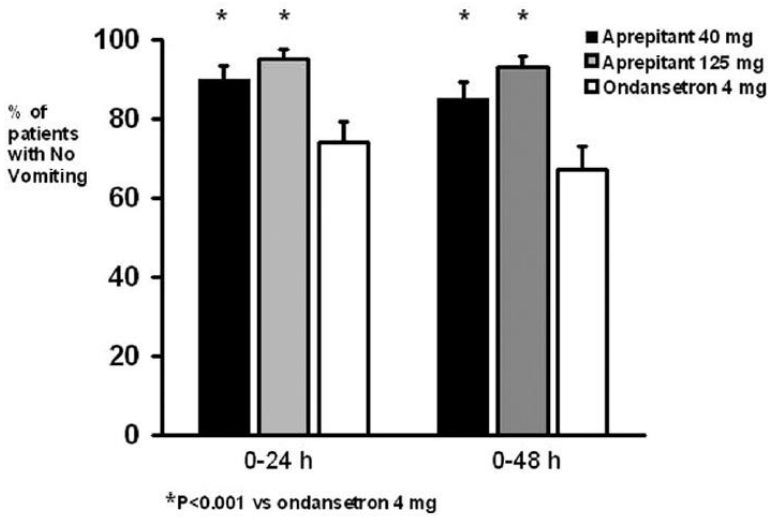


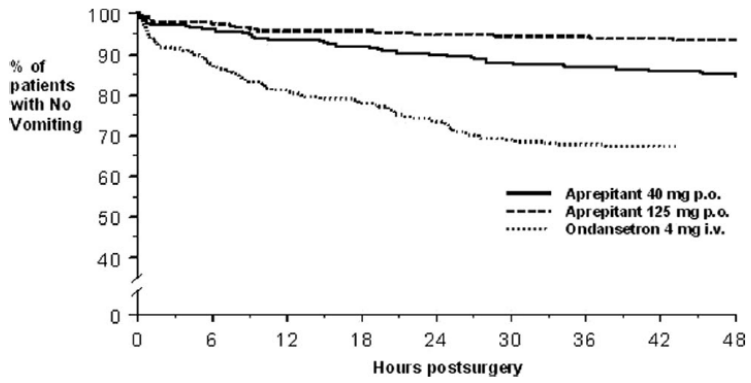
Jones IA et al. Analg 2024;139:479–89

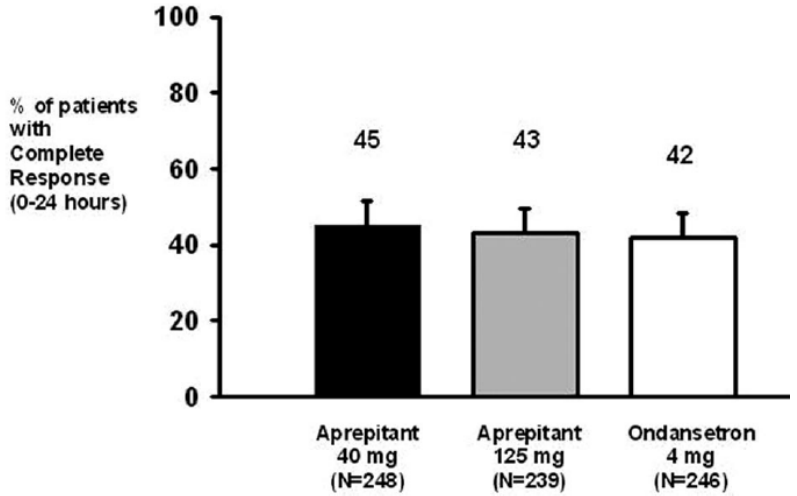
NK-1 / Tachykinin Receptors

- Discovered in 1931 by Von Euler and Gaddum from horse intestine and brain
- G-Protein coupled receptors
- Selective affinity to tachykinins
  - Subsptance P
  - Neurokinin A and Neurokinin B
- NK-1 antagonists
  - Oral: Aprepitant, Rolapitant, Casopitant
  - IV: Fosaprepitant (CINV)
  - IV: aprepitant – APONVIE (PONV indication)

Aprepitant vs. Ondansetron



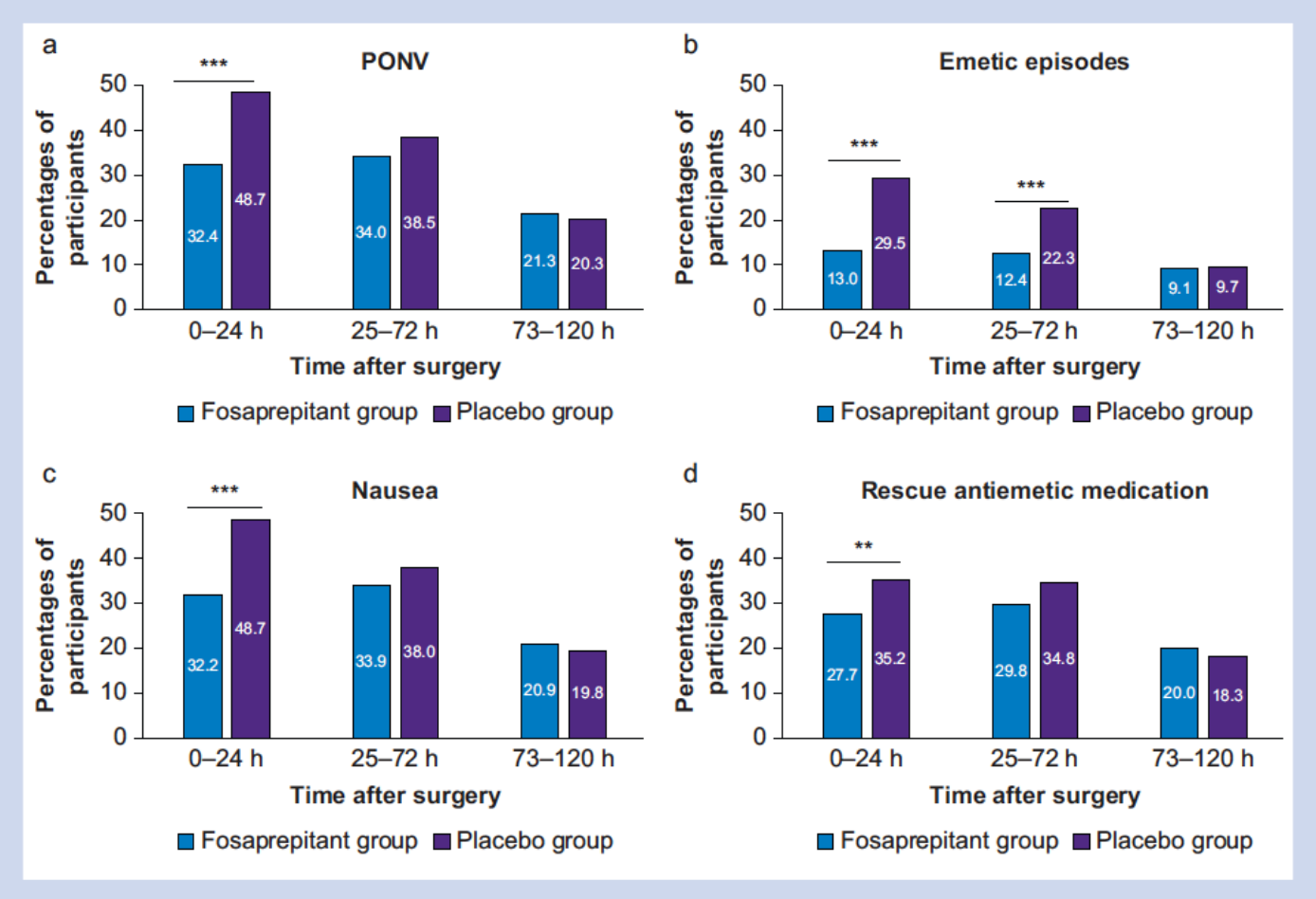




Gan, et al. Anesth Analg 2007;104:1082-9

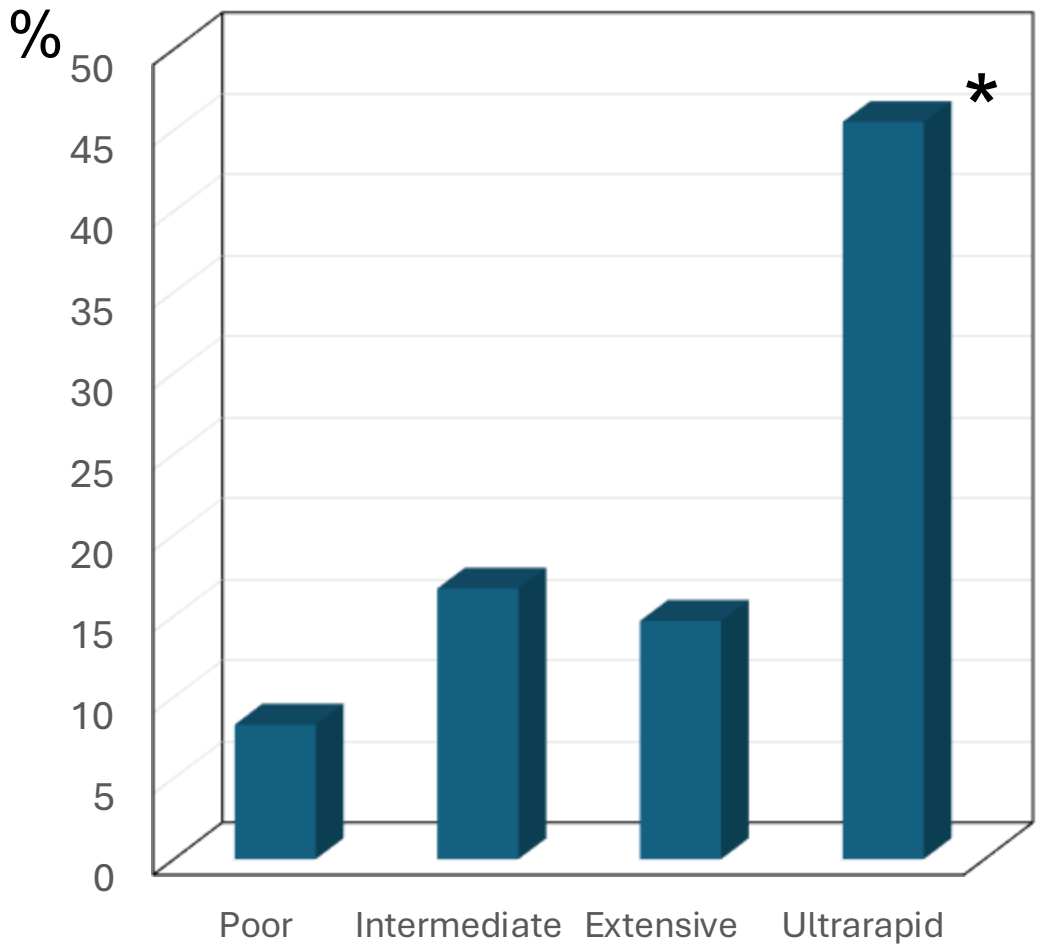
Fosaprepitant for postoperative nausea and vomiting in patients undergoing laparoscopic gastrointestinal surgery: a randomised trial

- 1154 high risk patients
- Laparoscopic GI surgery
- Dexamethasone 5 mg and palonosetron 0.075 mg were given in both groups.
- The primary outcome: incidence of PONV (defined as nausea, retching, or vomiting) during the first 24 h



Huang et al. British Journal of Anaesthesia 2023; 131: 673-681

Genetic Factor - 2D6 Polymorphism
Incidence of Vomiting



* $p<0.05$

Candiotti KA, et al. Anesthesiology. 2005 Mar;102:543-9

Genetic factors Associated with Increased Risk of PONV

Polymorphism /genetic factors studied	PONV rate (with allele/without allele)	Observation period	Relative Risk (95% Confidence interval)
CHRM3	G (38.1%/46.2%)	24 h	1.39 (1.07-1.81)
CHRM3	GG/GA/AA (28.8%/ 42.5%/ 46.4%)	2, 6, (24)h	AA vs GA: 1.3 (1-1.7) AA vs GG: 1.2 (1.1-1.4)
CHRM3	GG ref GA AA (not reported)	2, 6, 24 h	 2 (1.3-3.1) 2.2 (1.1-4.1)
KCNB2	33.5%/44/5% (TC/CC)	2, 6, 24 h	1.6 (1.1-2.4)
5HTR2C	G = 57.5%, C = 30.2%	6, 12, 24 h	01.652 (0.003-2.723)
5HT3BR	85.7%/39.7% (with/without AAG deletion)	2, 24 h	2.2 (1.5-3.0)
5HTTLPR	60%/49.5% (SS/LL+SL)	24 h	Cohort A 1.5 (1.1-2.1) Cohort B 1.8 (1.4-2.3)
MIR4300HG	26.6%/16.5% (major/minor)	24 h	0.16 (0.05-0.51)
PTPRD	25.6%/16/8%	24 h	0.48 (0.16-1.44)
CARMN	20.3%/26/6%	24 h	Not on MVA
CYP2D6	45.5%/14.7% (3 or more alleles/1 or 2 alleles)	24 h	3.6 (1.4-9.2)
DRD2 Taq IA	51.2%/48.8% (IA/A1A2 + A1A1)	6, 24 h	1.6 (1.1-2.4)

Gan TJ et al. Anesth Analg 2025 (In press)

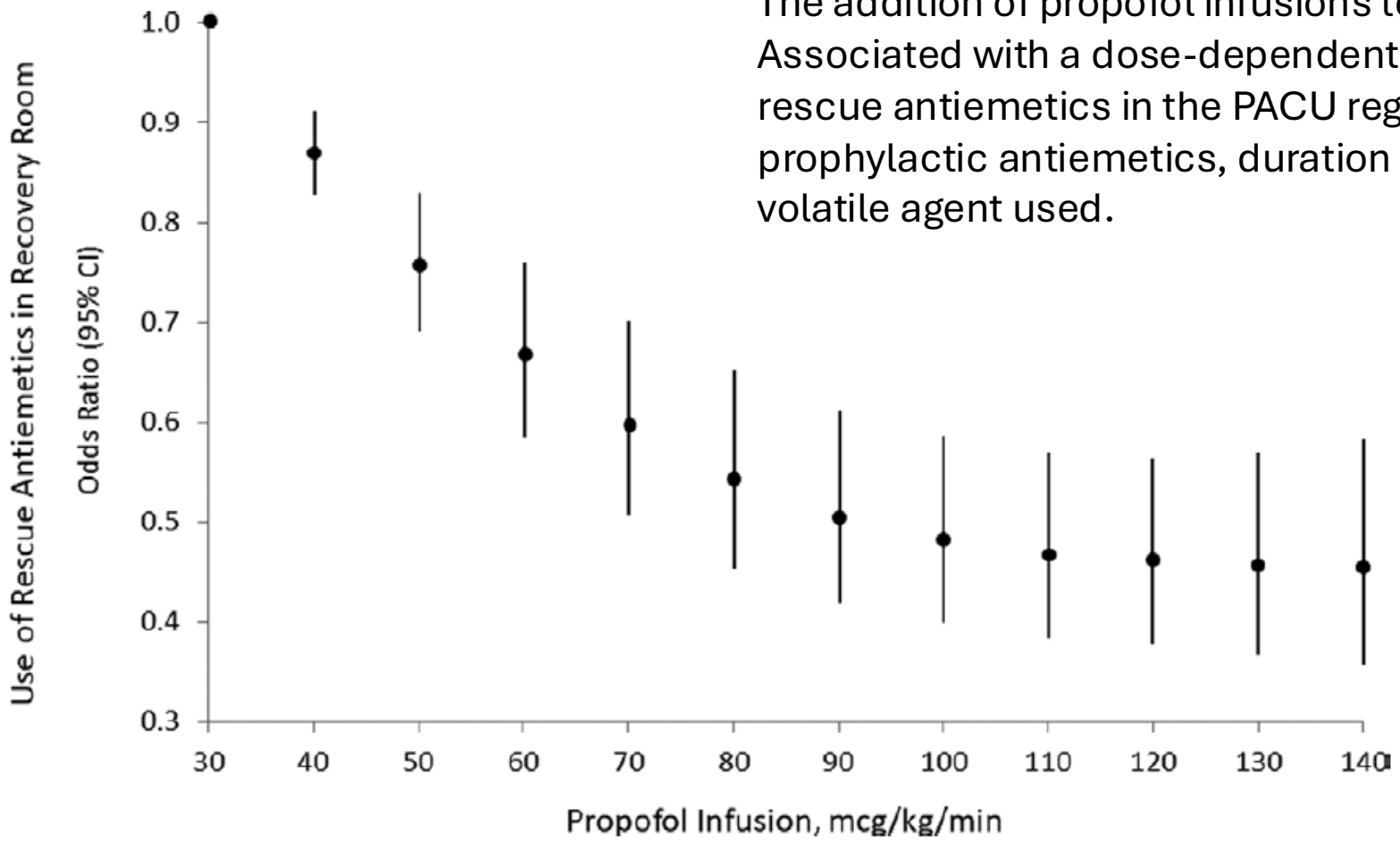
Propofol vs. inhalational agents to maintain general anaesthesia in ambulatory and in-patient surgery: a systematic review and meta-analysis

- Meta-analysis on 229 RCTs
- 20,911 patients

Outcome	Relative Risk (RR)	p value
PONV	0.61 (0.53 – 0.69)	<0.00001
Pain Score	-0.51 (-0.81 – -0.20)	0.001
PACU Stay	-2.9 (-5.47 – -0.35)	0.03
Patient Satisfaction Score	1.06 (1.01 – 1.10)	0.02

Schraag et al. BMC Anesthesiology 2018;18:162

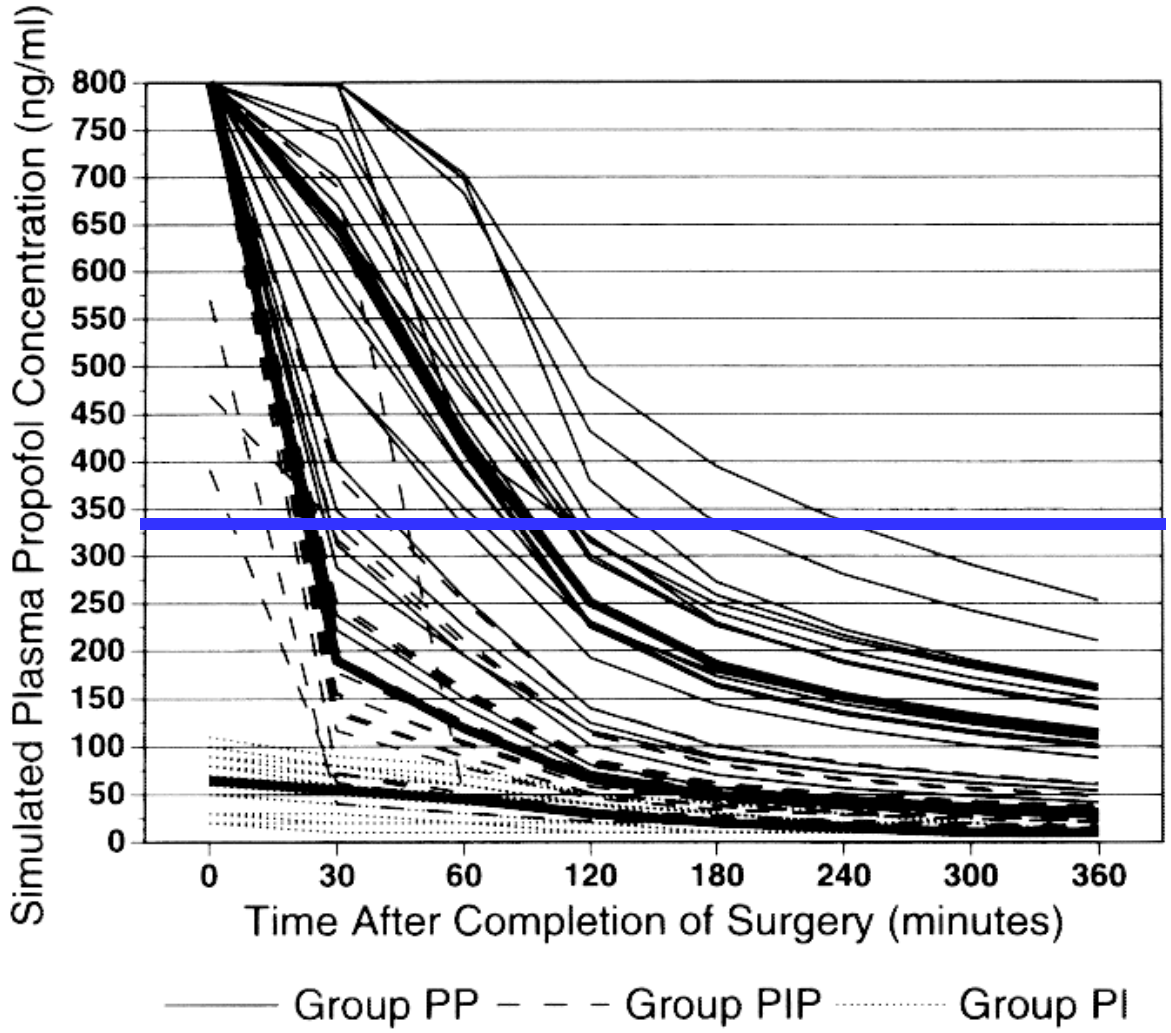
Effect of Propofol Infusion on Need for Rescue Antiemetics in Postanesthesia Care Unit After Volatile Anesthesia: A Retrospective Cohort Study



The addition of propofol infusions to volatile-based anesthesia is Associated with a dose-dependent reduction in the need for rescue antiemetics in the PACU regardless of the number of prophylactic antiemetics, duration of procedure, and type of volatile agent used.

Sprung J et al. Anesth Analg 2024;139:26–34

Propofol Administration Techniques for PONV Reduction



Simulations of Plasma Propofol Concentrations

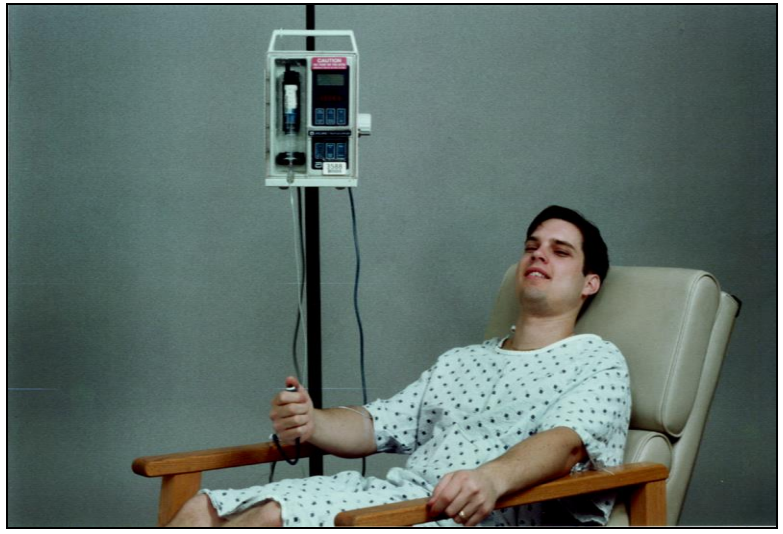
PP: Propofol induction and maintenance
PIP: Propofol – Inhalational – Propofol
PI: Propofol induction - Inhalational

Gan et al. Anesthesiology 1996;85:1036-1042

	2 h			24 h		
	Propofol 20 mg (n = 24)	Propofol 40 mg (n = 22)	Placebo (n = 23)	Propofol 20 mg (n = 24)	Propofol 40 mg (n = 22)	Placebo (n = 23)
Complete response*	19 (79)	16 (73)	5 (22)§	12 (50)	12 (55)	8 (35)
Vomiting	3 (12)	5 (23)	13 (56)¶	8 (33)	8 (36)	10 (43)
Rescue antiemetic	4 (17)	5 (23)	16 (70)**			
PACU discharge readiness† (min)	131 ± 35	141 ± 34	191 ± 92††			
Patient satisfaction‡						
Satisfied	23 (96)	21 (95)	10 (43)	22 (92)	16 (76)	12 (52)
Neither satisfied nor dissatisfied	1 (4)	1 (5)	3 (13)	2 (8)	2 (10)	4 (17)
Dissatisfied	0	0	10 (44)	0	3 (14)	7 (31)

Table 4. The Total Dose of Propofol Administered, the Number of Successful Deliveries, and Undelivered Patient Demands

	Propofol 20 mg (n = 22)	Propofol 40 mg (n= 22)	Placebo (n = 23)	*P* Value
Total propofol (mg)	100 ± 60	200 ± 80	0	
Successful deliveries	5 ± 3	5 ± 2	8 ± 3	0.0003
Undelivered demands	3 ± 4	2 ± 4	68 ± 136	0.0001



TJ Gan

Gan et al. Anesthesiology 1999;90:1564-70

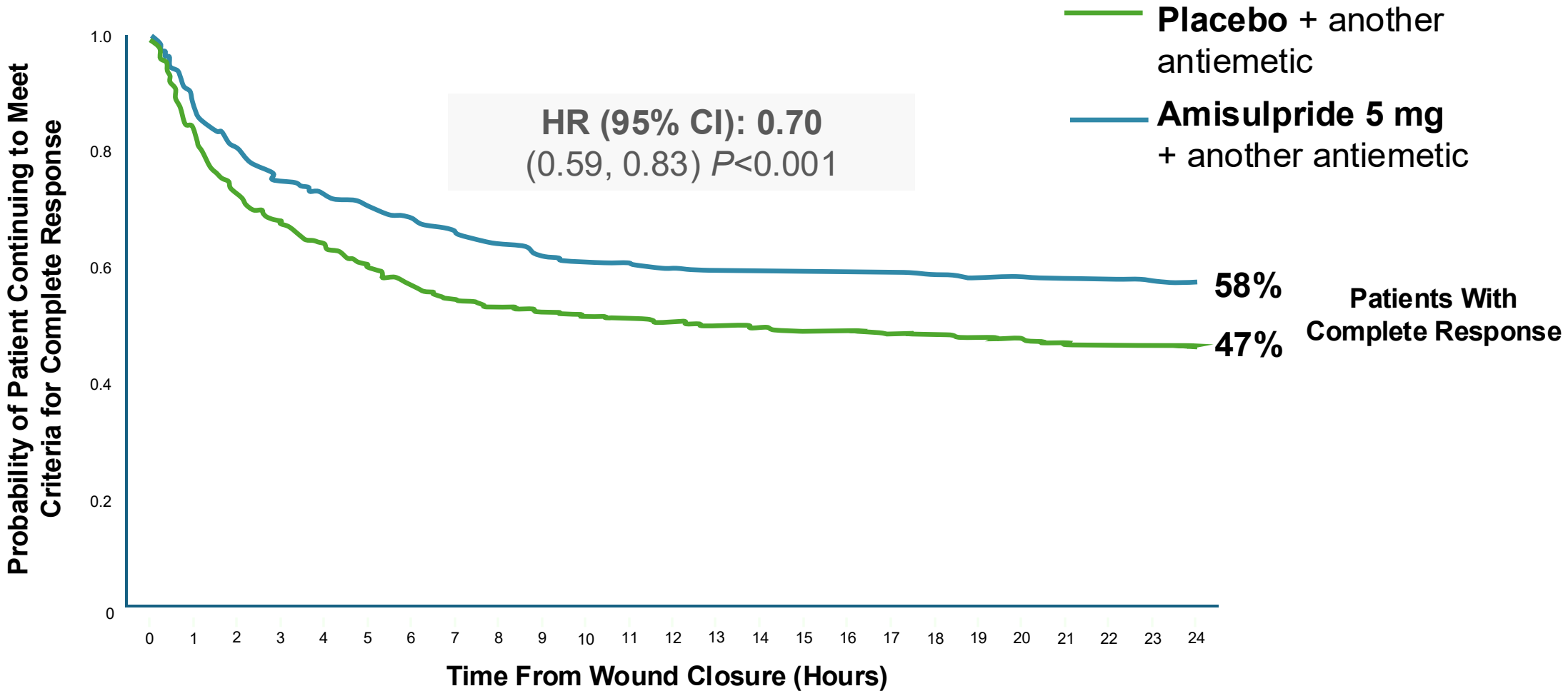
Nitrous Oxide and PONV

	Placebo	N_2O 50%	N_2O 70%
PONV n(%)	15 (33)	21 (46)	28 (62)*
Nausea n(%)	12 (26)	16 (35)	25 (56)*
Nausea Score	10.9±20.5	12.7±19.5	20.5±21.8*

* $p<0.05$

Mraovic et al. Anesth Analg 2008;107:818-23

Amisulpride for Prophylaxis: Complete Response Over Time



Kranke P, et al. *Anesthesiology*. 2018;128(6):1099-1106

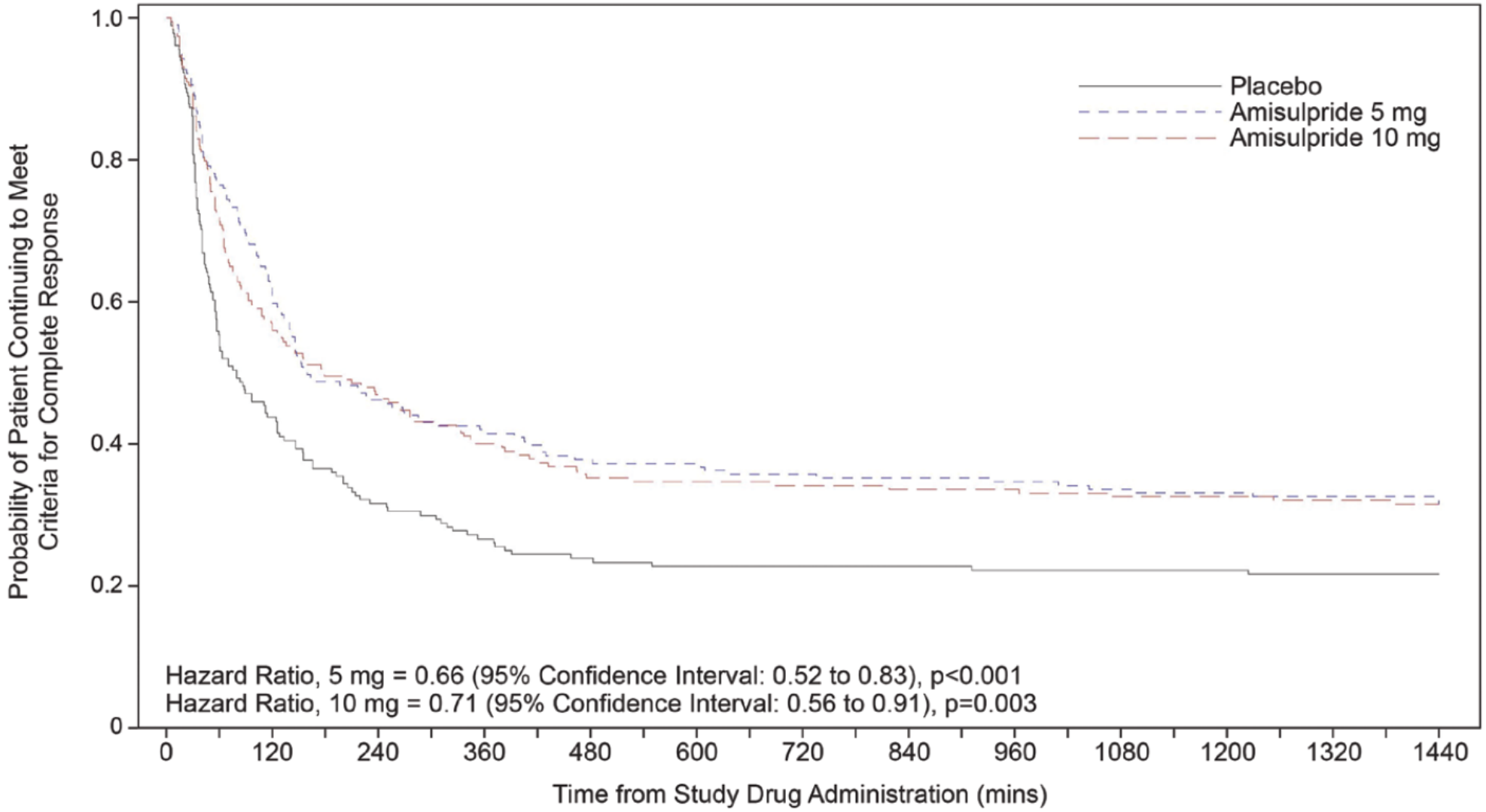
Intravenous Amisulpride for the Prevention of Postoperative Nausea and Vomiting

Two Concurrent, Randomized, Double-blind, Placebo-controlled Trials

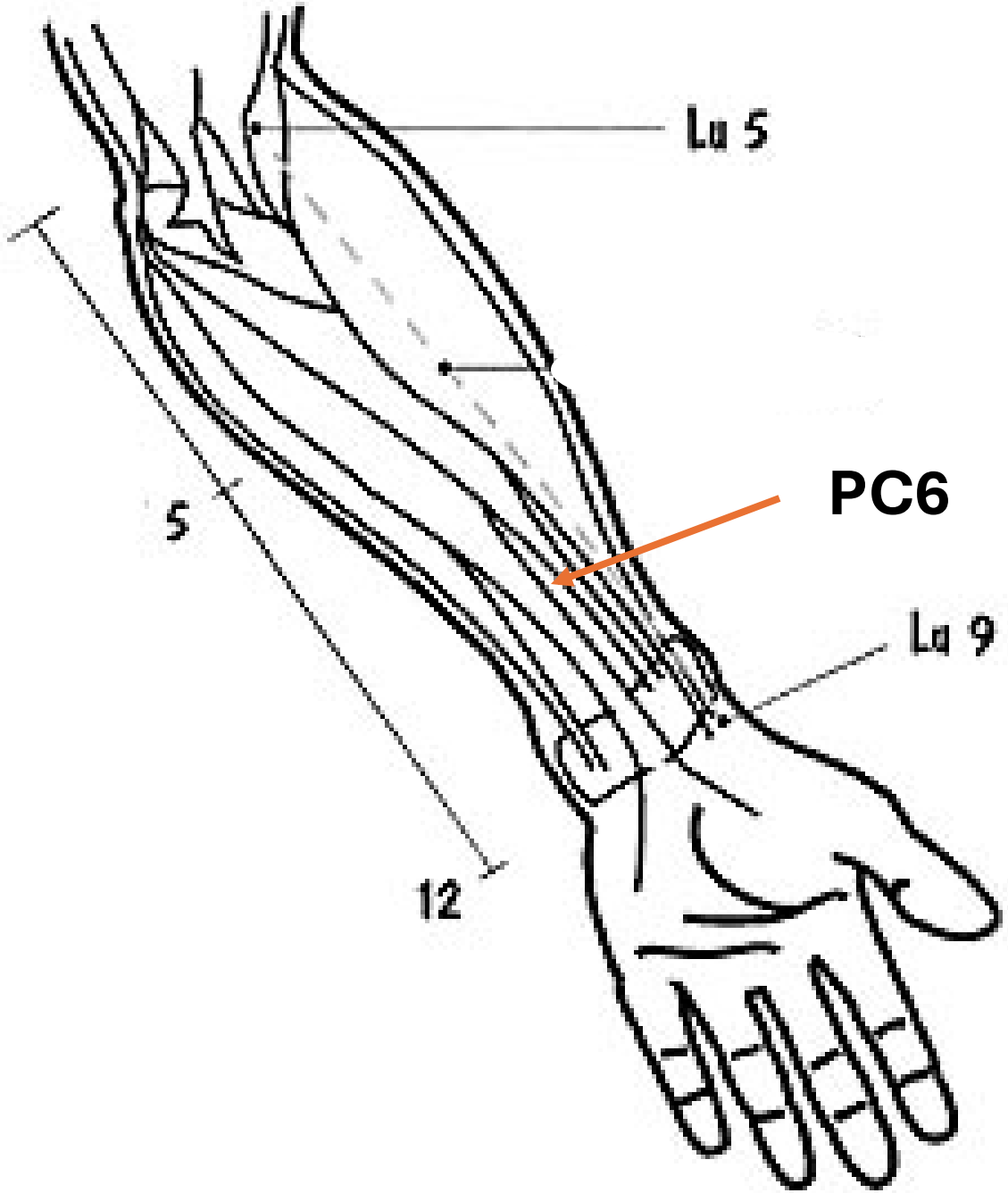
	European Study			U.S. Study			Pooled		
	Amisulpride (n = 155)	Placebo (n = 163)		Amisulpride (n = 160)	Placebo (n = 148)		Amisulpride (n = 315)	Placebo (n = 311)	
	n (%)	n (%)	*P* Value	n (%)	n (%)	*P* Value	n (%)	n (%)	*P* Value*
CR, 0–24 h, 95% CI	89 (57.4), 49.2–65.3	76 (46.6), 38.8–54.6	0.070	75 (46.9), 39.0–54.9	50 (33.8), 26.2–42.0	0.026	164 (52.1), 46.4–57.7	126 (40.5), 35.0–46.2	0.005
CR, 0–72 h	84 (54.2)	68 (41.7)	0.035	67 (41.9)	46 (31.1)	0.065	151 (47.9)	114 (36.7)	0.006
Emesis, 0–24 h	34 (21.9)	45 (27.6)	0.299	34 (21.3)	36 (24.3)	0.610	68 (21.6)	81 (26.0)	0.224
Significant nausea, 0–24 h	62 (40.0)	83 (50.9)	0.066	69 (43.1)	82 (55.4)	0.041	131 (41.6)	165 (53.1)	0.005
Any nausea, 0–24 h	73 (47.1)	95 (58.3)	0.059	91 (56.9)	100 (67.6)	0.070	164 (52.1)	195 (62.7)	0.009
Rescue medication use, 0–24 h	59 (38.1)	80 (49.1)	0.062	83 (51.9)	97 (65.5)	0.021	142 (45.1)	177 (56.9)	0.004

Gan et al. Anesthesiology 2017; 126:268-75

Successful Treatment of PONV Over Time



Candiotti K et al. Anesth Analg 2019;128:1098–105


Lu 5
PC6
Lu 9
5
12

Acupuncture and Incidence of PONV

- Cochrane Review
- 40 trials involving 4858 participants

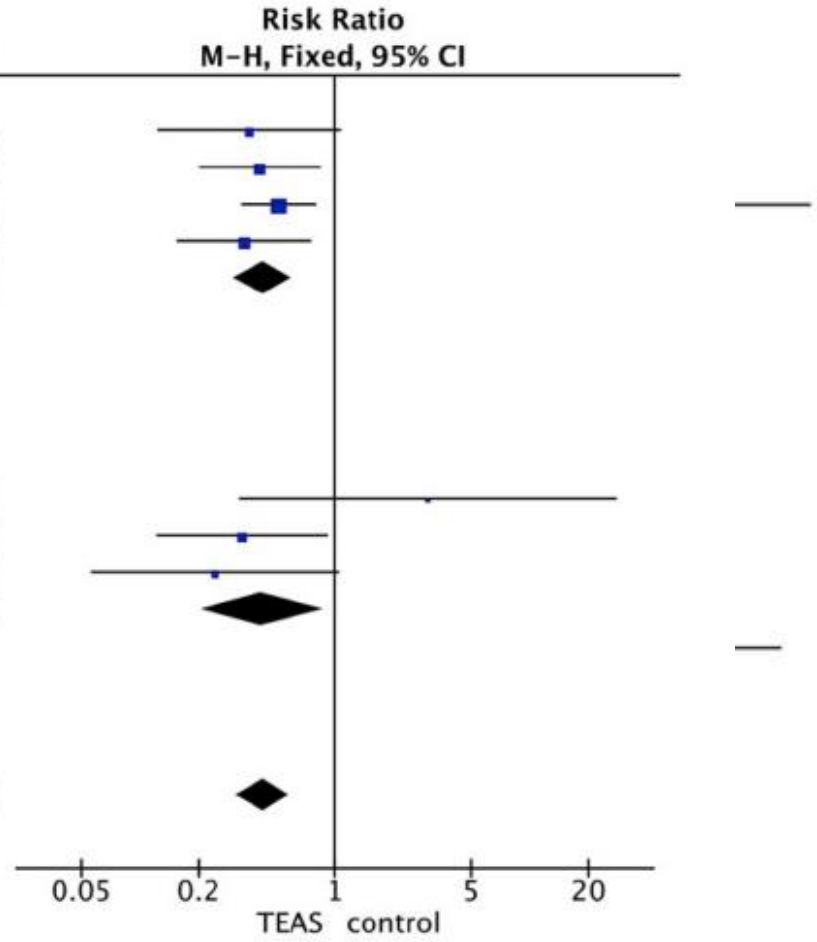
	RR	95% CI
Nausea	0.71	0.61 to 0.83
Vomiting	0.7	0.59 to 0.83
Rescue Antiemetic	0.69	0.57 to 0.83
Vs. antiemetic (nausea)	0.82	0.60 to 1.13
Vs. antiemetic (vomiting)	1.01	0.77 to 1.31

- Efficacy no different between acupuncture and antiemetics
- Similarly effective in adults and children
- Side effects minimal

Lee A, Fan LTY. Stimulation of the wrist acupuncture point P6 for preventing postoperative nausea and vomiting. Cochrane Database of Systematic Reviews 2009, Issue 2. Art. No.: CD003281. DOI: 10.1002/14651858.CD003281.pub3.

Transcutaneous electrical acupoint stimulation for preventing postoperative nausea and vomiting after general anesthesia: A meta-analysis of randomized controlled trials

Study or Subgroup	TEAS Events	TEAS Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.2.1 Dizziness						
Tu et al, 2019	4	60	11	60	11.7%	0.36 [0.12, 1.08]
Wang et al, 2014	7	30	17	30	18.1%	0.41 [0.20, 0.85]
Yao et al, 2015	14	35	28	36	29.4%	0.51 [0.33, 0.80]
Zhang et al, 2014	6	33	17	32	18.4%	0.34 [0.15, 0.76]
Subtotal (95% CI)		**158**		**158**	**77.5%**	**0.43 [0.31, 0.60]**
Total events	31		73			
Heterogeneity: $Chi^2 = 1.07$, df = 3 (P = 0.78); $I^2 = 0\%$						
Test for overall effect: Z = 4.98 (P < 0.00001)						
1.2.2 Pruritus						
Tu et al, 2019	3	60	1	60	1.1%	3.00 [0.32, 28.03]
Wang et al, 2014	4	30	12	30	12.8%	0.33 [0.12, 0.92]
Zhang et al, 2014	2	33	8	32	8.6%	0.24 [0.06, 1.06]
Subtotal (95% CI)		**123**		**122**	**22.5%**	**0.42 [0.21, 0.87]**
Total events	9		21			
Heterogeneity: $Chi^2 = 3.72$, df = 2 (P = 0.16); $I^2 = 46\%$						
Test for overall effect: Z = 2.33 (P = 0.02)						
Total (95% CI)		**281**		**280**	**100.0%**	**0.43 [0.31, 0.58]**
Total events	40		94			
Heterogeneity: $Chi^2 = 4.80$, df = 6 (P = 0.57); $I^2 = 0\%$						
Test for overall effect: Z = 5.46 (P < 0.00001)						
Test for subgroup differences: $Chi^2 = 0.00$, df = 1 (P = 0.99), $I^2 = 0\%$						



TJ Gan

Chen J et al. https://doi.org/10.1016/j.ijsu.2019.10.036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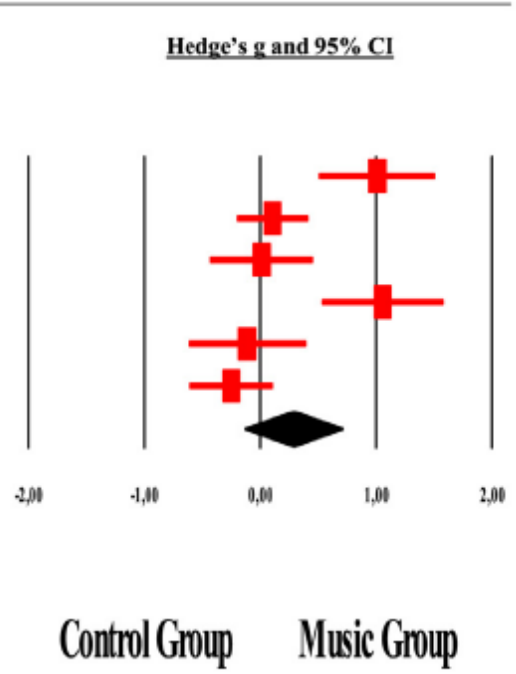
ReliefBand

Effectiveness of Music Intervention on Postoperative Nausea and Vomiting: A Systematic Review and Meta-analysis

Study name	Statistic for each study						Sample size		Weight (random)
	Hedge's g	Standard error	Lower limit	Upper limit	Z-value	p-value	Music group	Control group	Relative weight
Cetinkaya. 2019	1.012	0.257	0.508	1.516	3.937	0.000	32	35	15.83
Gallagher et al.. 2018	0.108	0.156	-0.198	0.414	0.695	0.487	84	79	18.52
Graversen & Sommer, 2013	0.014	0.229	-0.435	0.463	0.063	0.950	40	35	16.61
Jayaraman et al.. 2006	1.061	0.268	0.535	1.586	3.952	0.000	39	34	15.51
Nilsson et al.. 2001	-0.110	0.259	-0.618	0.399	-0.423	0.673	30	28	15.76
Nilsson et al.. 2003	-0.247	0.186	-0.612	0.117	-1.329	0.184	59	56	17.78
Overall	0.286	0.213	-0.132	0.703	1.342	0.180	284	267	



Heterogeneity Chi^2= 28. 463. df=5. I^2=82% (95% CI)

Test for overall effect Z=1.342 (p=0.180)

Music interventions significantly reduced postoperative vomiting (95% CI: 0.01 to 0.63) but had no statistical significant effect on postoperative nausea (95% CI: -0.13 to 0.70).

Ergezen FD et al. Journal of PeriAnesthesia Nursing 37 (2022) 717–727

Metoclopramide

Wallenborn et al. Prevention of postoperative nausea and vomiting by metoclopramide combined with dexamethasone: randomised double blind multicentre trial BMJ 2006; 333(7563): 324.

RCT:
1. **Meto 10 mg IV (783)**
2. **Meto 25 mg IV (781)**
3. **Meto 50 mg IV (788)**
4. **No treatment (788)**

All patients received dex 8 mg IV 30-60 minutes before end of surgery

PONV at 24h: 10 mg: NNT 30 25 mg: NNT 16 50 mg: NNT 11
Dyskinesia or extrapyramidal symptoms:
Controls: 0.1%; 10 mg: 0.4%; 25 and 50 mg: 0.8% (NNH with 25 or 50 mg: 140)

Dose-response Metoclopramide 10 mg is under-dosed.
Baseline risk low (PONV incidence in controls only 20.6%) – due to Dex

Antiemetic Doses and Timing for Prevention of PONV in Adults

Drugs	Dose	Evidence	Timing	Evidence
Aprepitant	40- 80 mg PO 32 mg IV	A1	At induction	A2
Amisulpride	5 mg IV	A2		
Dexamethasone	4-8 mg IV	A1	At induction	A1
Dimenhydrinate	25-50 mg IV[b]	A1		
Droperidol[a]	0.625mg IV	A1	End of surgery	A1
Ephedrine	0.5 mg/kg IM	A2		
Granisetron	0.1-3 mg IV	A1	End of surgery	A1
Haloperidol	0.5-<2 mg IM/IV	A1		
Metoclopramide	10 mg	A1		
Ondansetron	4 mg IV 16 mg ODT	A1	End of surgery	A1
Palonosetron	0.075 mg IV	A1		
Promethazine[a]	6.25mg	A2		
Ramosetron	0.3 mg IV	A1	End of surgery	A2
Rolapitant	70 – 200 mg PO	A3	At induction	
Scopolamine	Transdermal patch	A1	Prior evening or 2 hrs. before surgery	A1
Tropisetron	2 mg IV	A1	Before induction	

Gan TJ et al. Anesth Analg 2025 (In press)

Antiemetic Doses and Timing for Prevention of PONV in Children

Drug	Dose	OR (95% CI)	RR (95% CI)	Evidence
Ondansetron	0.1 mg/kg up to 4 mg	0.37 (0.35-0.39)	0.54 (0.51-0.56)	A1
Dolasetron	0.35 mg/kg up to 12.5 mg	0.16 (0.09-0.27)	0.39 (0.25-0.56)	A2
Granisetron	0.04 mg/kg up to 0.6 mg	0.16 (0.10-0.20)	0.31 (0.20-0.45)	A2
Palonosetron	0.5-1.5 mcg/kg	NR	NR	A2
Tropisetron	0.1 mg/kg up to 2 mg	0.17 (0.12-0.22)	0.41 (0.34-0.50)	A1
Droperidol	10-15 mcg/kg up to 1.25 mg	0.48 (0.37-0.61)	0.62 (0.52-0.74)	A1
Dimenhydrinate	0.5 mg/kg up to 25 mg	NR	NR (relative benefit 1.80; 1.31-2.47)	A1
Dexamethasone	0.15 mg/kg up to 4 mg	0.31 (0.28-0.34)[1]	0.53 (0.49-0.56)[1] 0.45 (0.38-0.55)[4]	A1
Aprepitant	3 mg/kg up to 125 mg	NR	NR	A3
Acupuncture (PC6)	Reduces immediate nausea, mixed long-term effects	NR	0.74, (0.60 -0.91)	A1
Aromatherapy (Isopropyl Alcohol)	Provides short-term relief, effect not sustained	NR	NR	B2
Combination therapy				
Ondansetron + Dexamethasone	More effective compared to ondansetron or dexamethasone alone	0.12 (0.03-0.44) vs placebo 0.25 (0.20-0.31) vs monotherapy		A1
Ondansetron + Droperidol		0.10 (0.04-0.23) vs placebo		
Tropisetron + Dexamethasone	More effective vs tropisetron alone	OR 0.31 (0.20-0.49) vs tropisetron		

Gan TJ et al. Anesth Analg 2025 (In press)

Combination Antiemetics

- 5HT-3 antagonists
- Dexamethasone
- Aprepitant
- Dopamine antagonists
- Transdermal scopolamine
- Propofol
- Acupuncture

Table 5. Pharmacologic Combination Therapy for Adults and Children

Adults
- 5-HT_3 receptor antagonists + dexamethasone
  - Ondansetron: (A1)[158,159]
  - Palonosetron: (A2)[160–164]
  - Ramosetron: (A2)[165,166]
  - Granisetron: (A3)[167]
  - Tropisetron: (A3)[168]; with methylprednisolone (A3)[169]
- 5-HT_3 receptor antagonists + aprepitant
  - Ondansetron: (A2)[170,171]
  - Ramosetron: (A3)[172]
  - Palonosetron: (A3)[173]

Aprepitant + dexamethasone: (A2)[174,175]
- 5-HT_3 + droperidol
  - Ondansetron + droperidol: (A3)[176]
  - Granisetron + droperidol: (A3)[177]
  - Palonosetron + droperidol: (A3)[178]
- Other 5-HT_3 combination therapies:
  - Ondansetron + haloperidol: (A3)[179]
  - Haloperidol + dexamethasone + ondansetron: (A3)[180]
  - Ondansetron + betahistine: (A2)[181,182]
  - Ramosetron + gabapentin: (A3)[183]
  - Midazolam + ramosetron: (A3)[184]
- Other antidopaminergic combination therapies
  - Dexamethasone + haloperidol: (A2)[185,186]
  - Metoclopramide + dimenhydrinate: (A3)[187]
  - Amisulpride +1 nondopaminergic antiemetic: (A3)[188]
  - Haloperidol + midazolam: (A2)[189,190]

Acupoint stimulation + pharmacoprophylaxis: (A2)[191,192]
- Others
  - Propofol + dexamethasone: (A3)[193]
  - Dexamethasone + dimenhydrinate:[194] (A3)
  - Gabapentin + dexamethasone: (A3)[195]

Children
- Ondansetron + dexamethasone: (A1)[196]
- Ondansetron + droperidol (A3)[197]
- Tropisetron + dexamethasone (A3)[198]

Gan TJ et al. Anesth Analg 2020;131:411–48

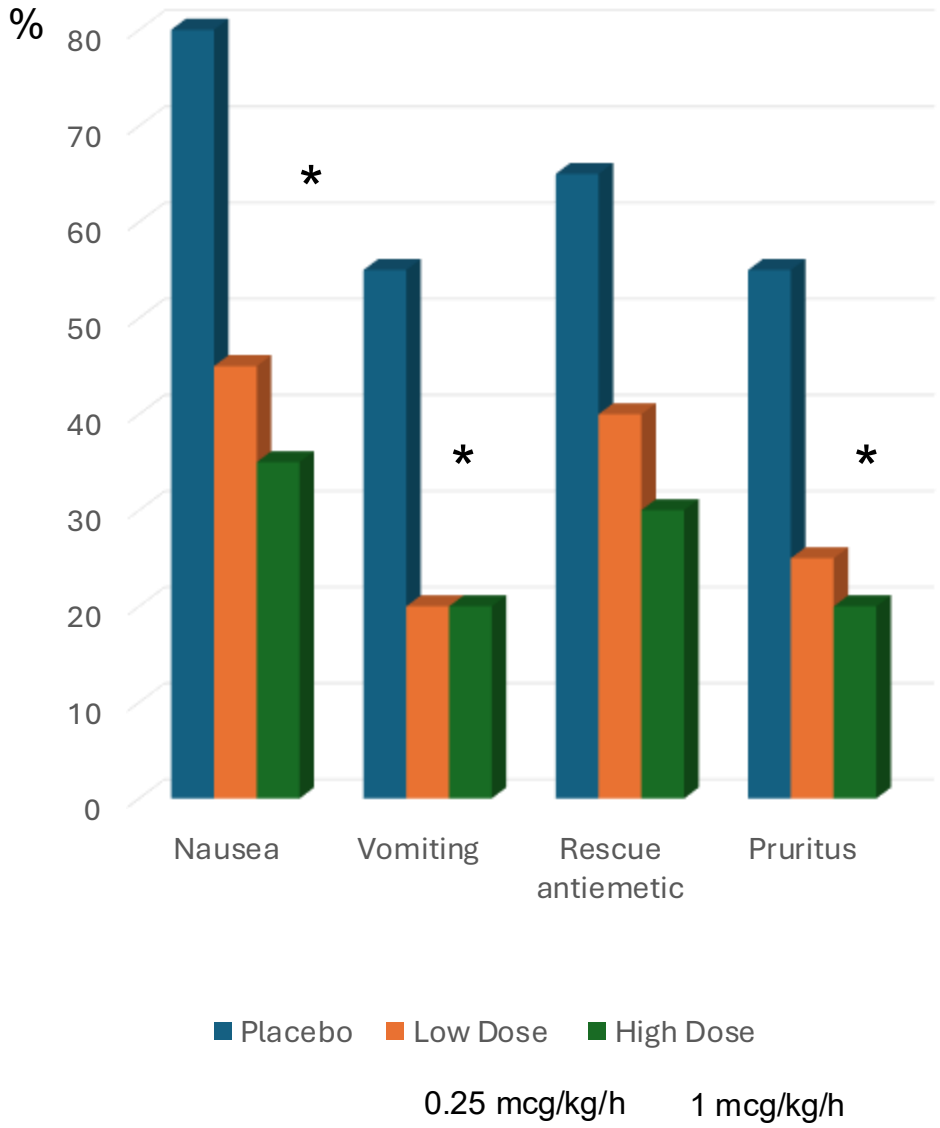
Analgesic impact of intra-operative opioids vs. opioid-free anaesthesia: a systematic review and meta-analysis

- 23 RCTs with 1304 patients

	Opioid	Opioid Free	Risk Ratio	p value
Pain Scores (2 h) VAS	3.6 (2.7–4.5)	3.4 (2.5–4.4)	-0.2 (-0.5 to 0.2)	ns
Morphine equivalent (24 h) mg			0.9 (-1.1 to 2.9)	ns
PONV (%)	24	19	0.77(0.61–0.97)	0.03
PACU Stay (min)			0.6 (-8.2 to 9.3)	ns

Frauenknecht J et al. Anaesthesia 2019;74:651–662

Naloxone and Opioid Side Effects



* p<0.05

Gan et al. Anesthesiology 1997;87:1075-81

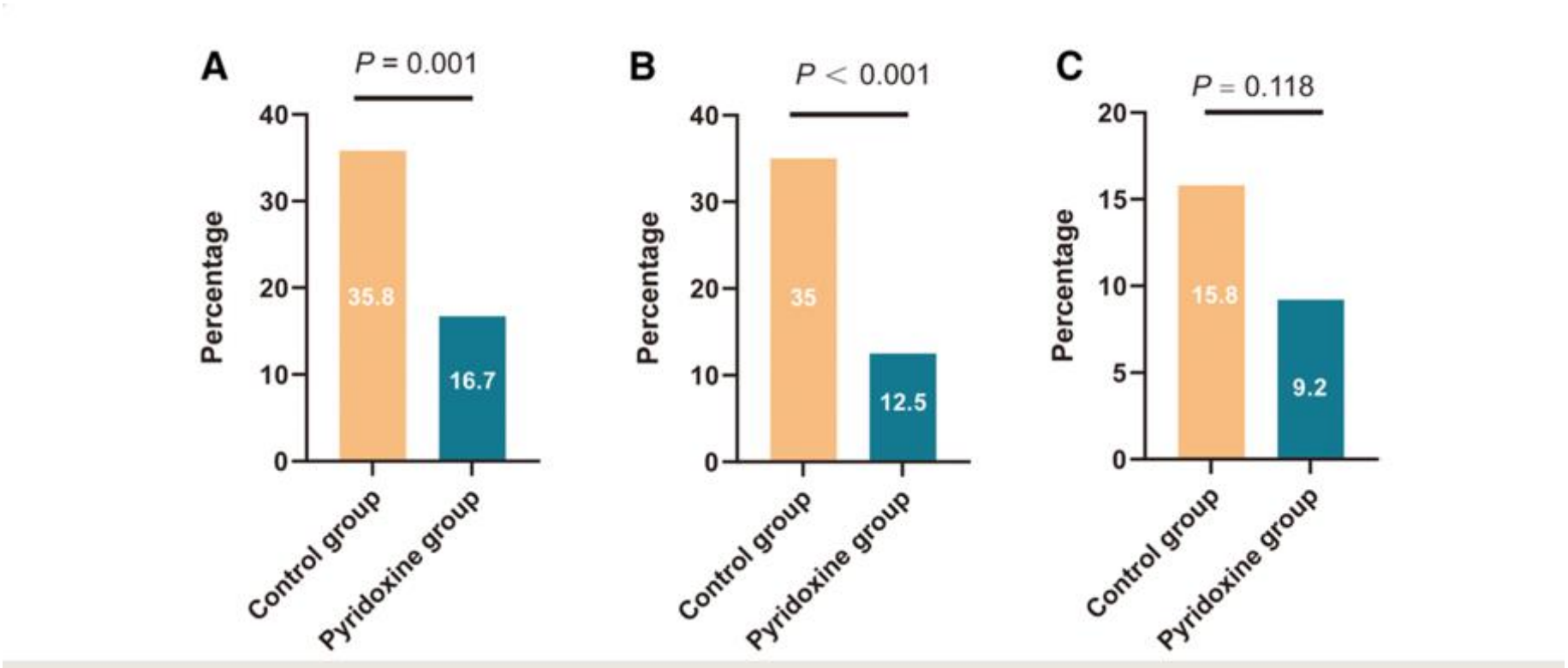
TDS – PONV Efficacy

Outcome/ Time Interval	No. of Studies	Active/ Inactive Patients	RR (95% CI)	*P*
PN				
PACU[b]	8	754/742	0.77 (0.61–0.98)	0.03
0–24 h[c]	16	952/953	0.59 (0.48–0.73)	<0.001
24–48 h[d]	4	108/101	0.94 (0.60–1.49)	0.80
PV				
PACU[e]	11	1004/996	0.75 (0.64–0.87)	<0.001
0–24 h[f]	15	939/938	0.68 (0.61–0.76)	<0.001
24–48 h[g]	6	333/329	0.53 (0.28–1.00)	0.05
PONV				
PACU[h]	4	484/480	0.84 (0.73–0.96)	0.009
0–24 h[i]	7	499/490	0.73 (0.60–0.88)	0.001
24–48 h[j]	3	84/77	0.80 (0.56–1.13)	0.20

Apfel et al. Clin Thera 2010;32:1987-2002

Pyridoxine (Vitamin B6) - Prevention of Postoperative Nausea andVomiting

Both groups received Dex 10 mg and Ondansetron 8 mg

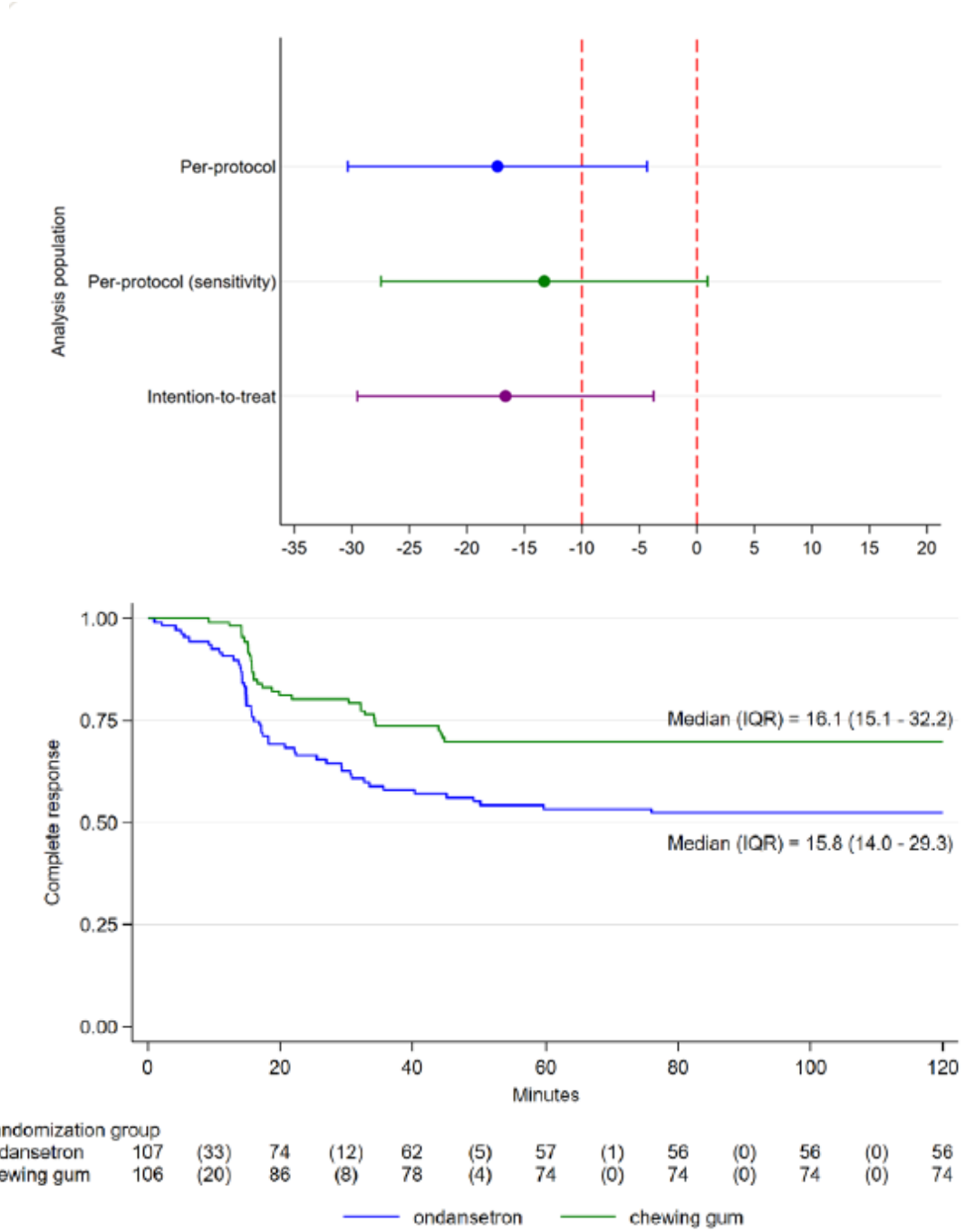


PONV Nausea Vomiting

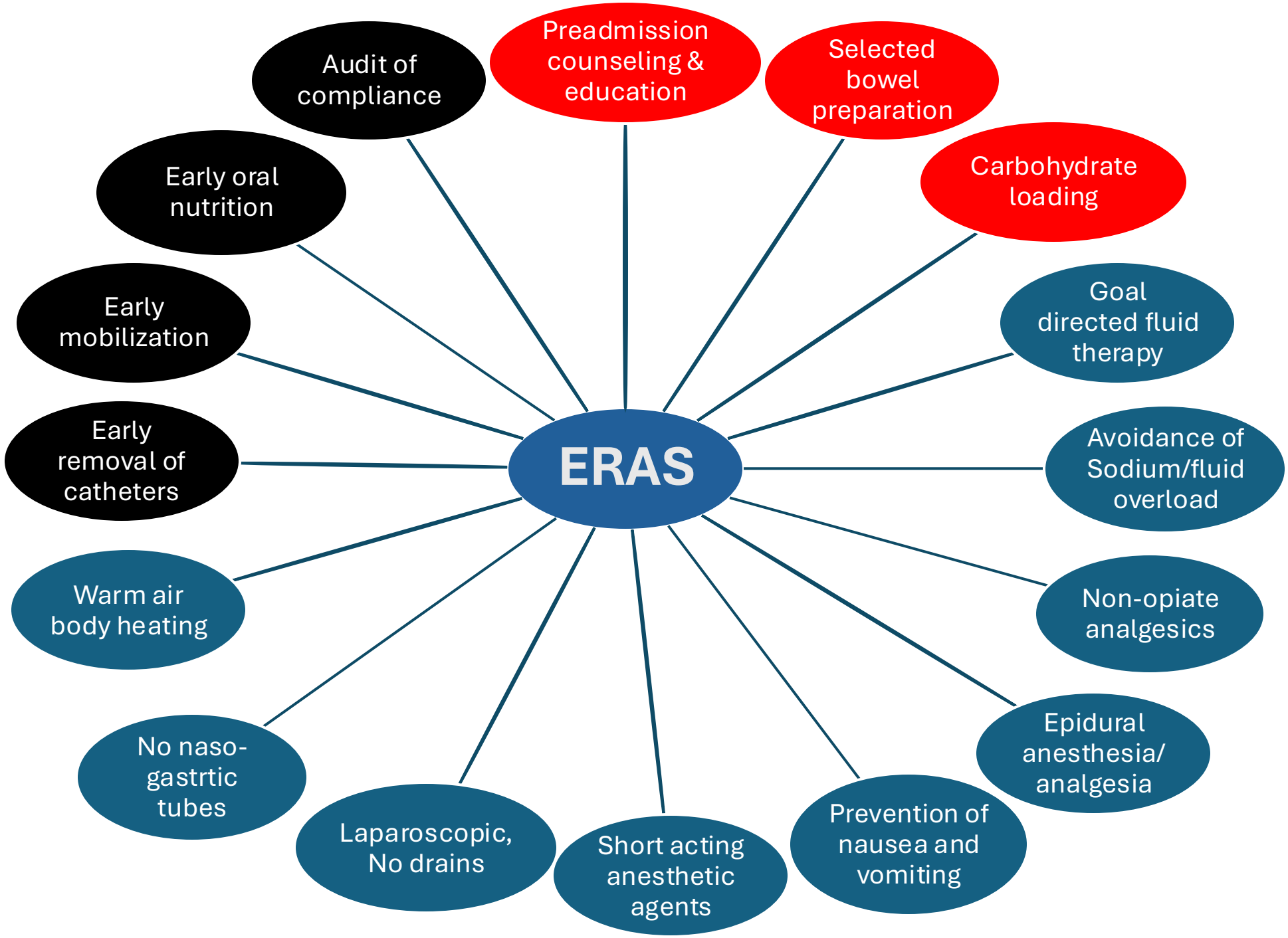
Zhang Q et al. Anesthesiology 2025; 142:655–65

Chewing Gum to Treat PONV

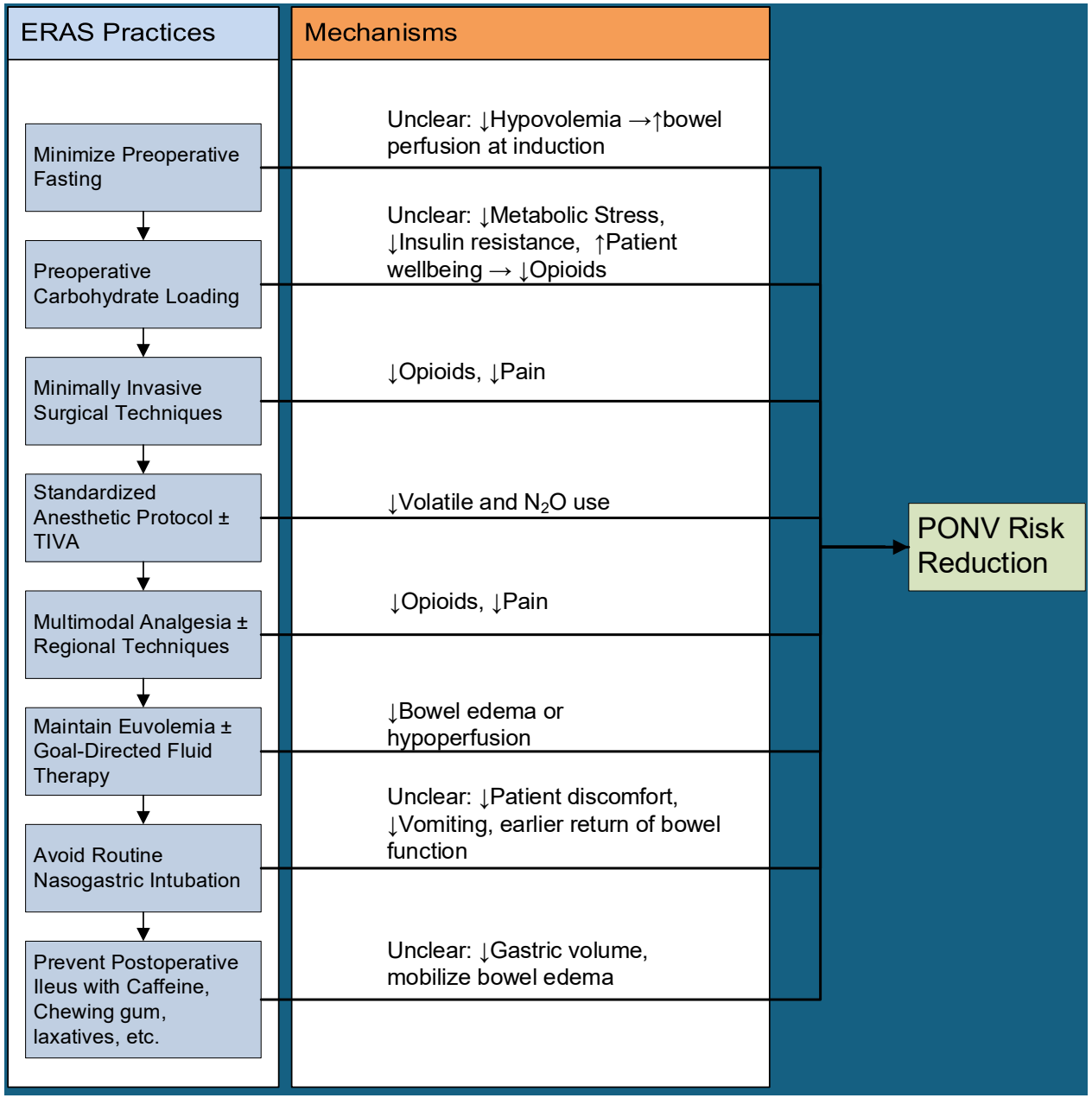
- 2 Groups
  - *15 min of chewing gum*
  - *4 mg intravenous ondansetron*
- *Prophylaxis*
  - *2-3 RF - 4 mg dexamethasone*
  - *4 RF - 4 mg dexamethasone and*
  - *droperidol up to 0.625 mg*



Darvall et al. Anesthesiology 2025; 142:454–64


ERAS
Audit of compliance
Preadmission counseling & education
Selected bowel preparation
Early oral nutrition
Carbohydrate loading
Early mobilization
Goal directed fluid therapy
Early removal of catheters
Avoidance of Sodium/fluid overload
Warm air body heating
Non-opiate analgesics
No naso-gastrtic tubes
Epidural anesthesia/ analgesia
Laparoscopic, No drains
Short acting anesthetic agents
Prevention of nausea and vomiting

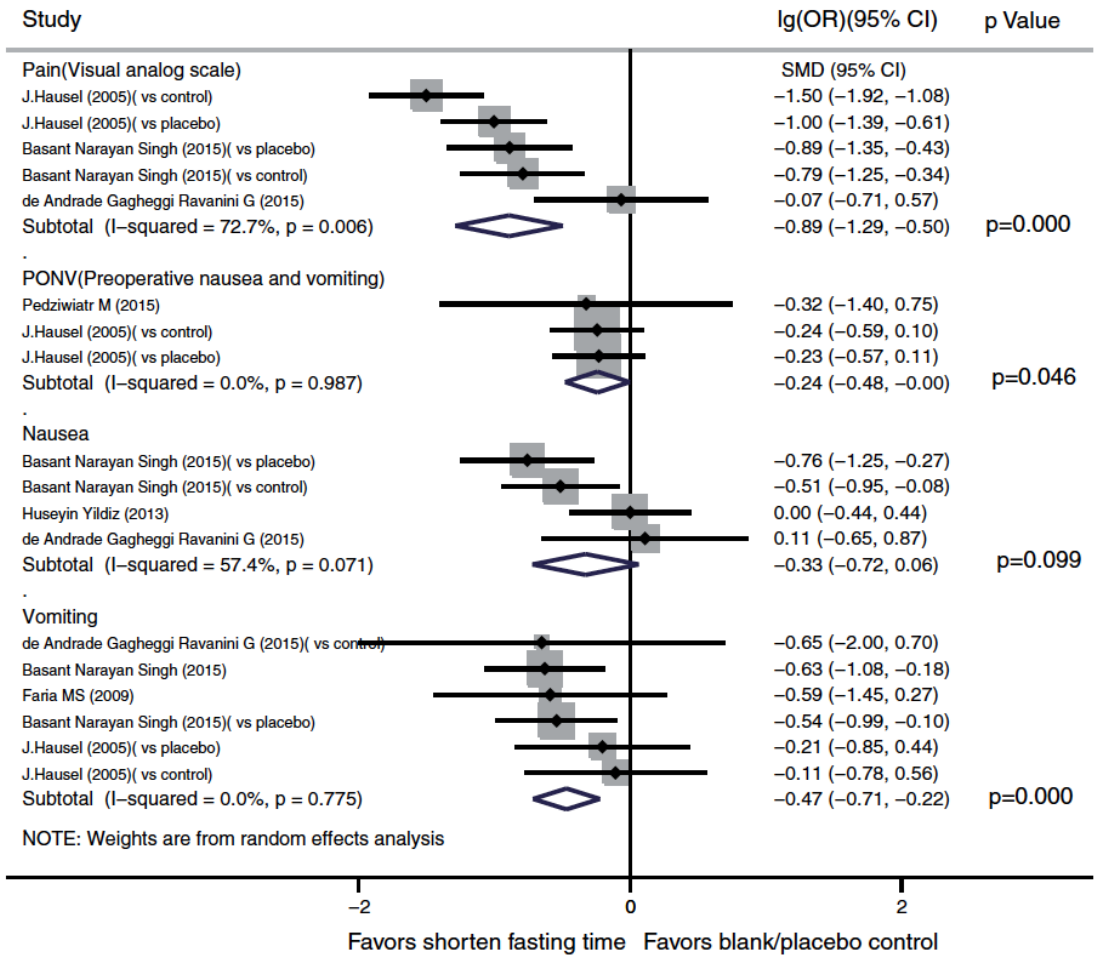
The Role of ERAS in PONV Risk Reduction

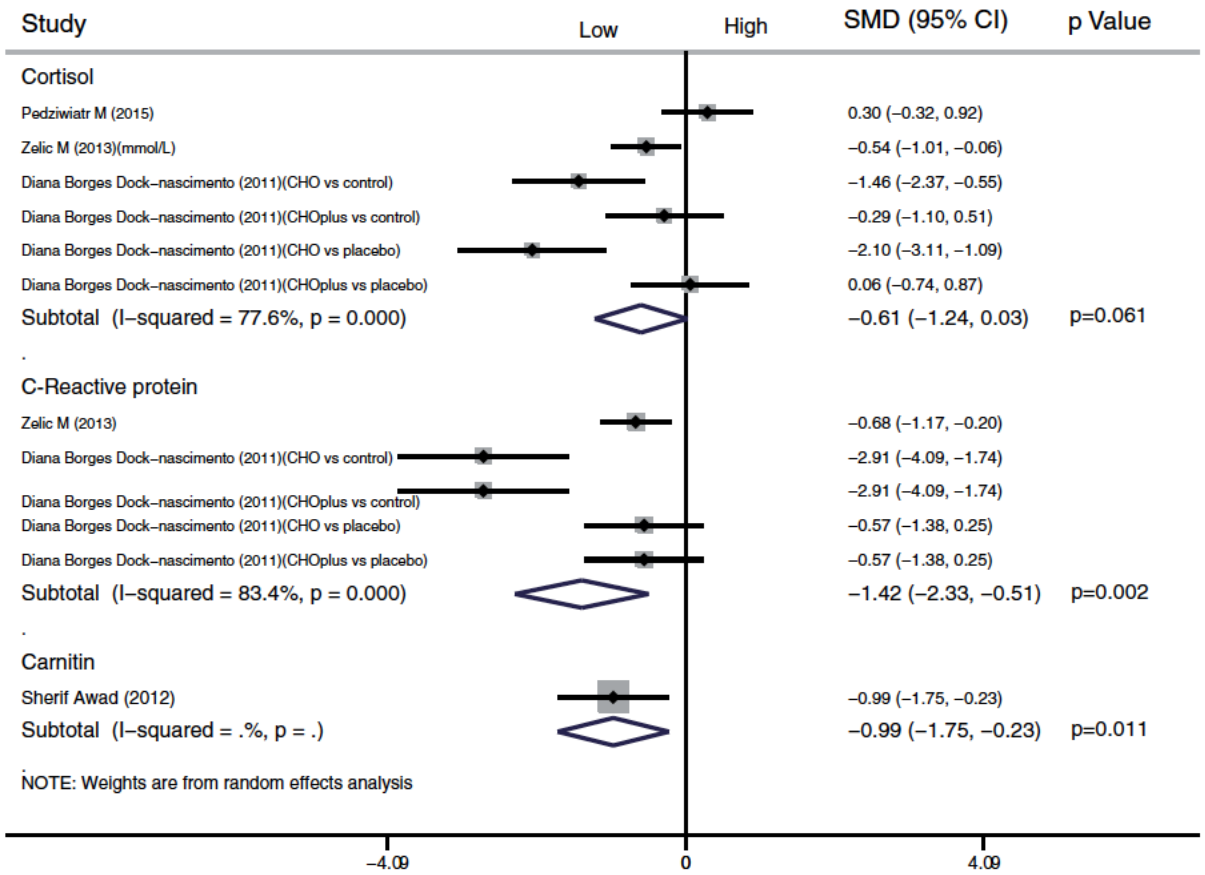


TJ Gan

Schwartz J and Gan TJ. Best Pract Res Clin Anaesthesiol. 2020;34:687-700

Shortened Preoperative Fasting and PONV





Xu D et al. Journal of International Medical Research 2017, Vol. 45(1) 22–37

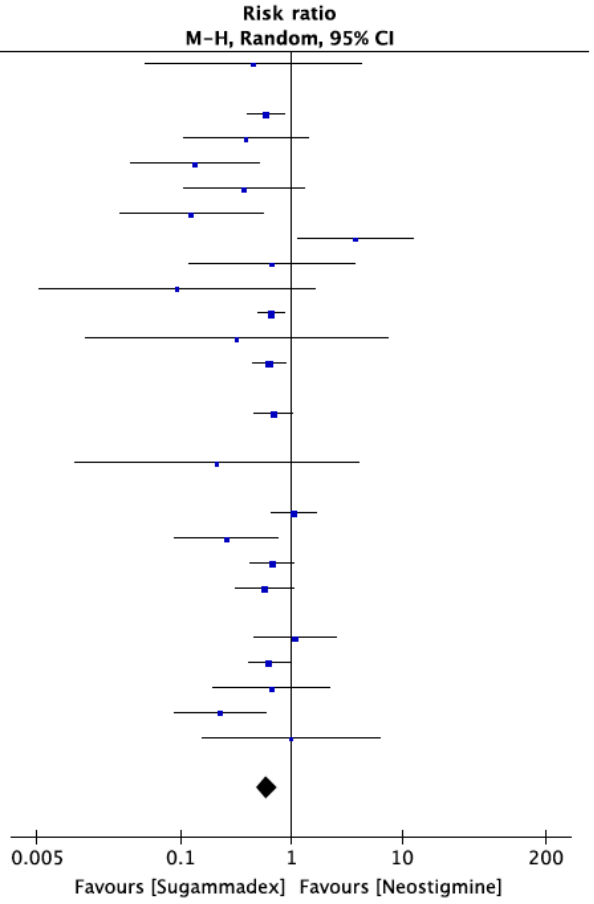
Sugammadex vs Neostigmine – Risk of Adverse Events

PONV - RR (95%CI) 0.52 (0.28–0.97), n = 389, NNT: 16, GRADE: low quality

Study or subgroup	Sugammadex Events	Sugammadex Total	Neostigmine Events	Neostigmine Total	Weight	Risk ratio M-H, Random, 95% CI
Adamus 2011	1	11	2	10	0.8%	0.45 [0.05, 4.28]
Balaka 2011	0	20	0	20		Not estimable
Blobner 2010	20	48	34	48	9.7%	0.59 [0.40, 0.86]
Brueckmann 2015	3	74	8	77	2.1%	0.39 [0.11, 1.41]
Carron 2013	2	20	15	20	2.0%	0.13 [0.03, 0.51]
Castro 2014	3	44	8	44	2.2%	0.38 [0.11, 1.32]
Cheong 2015	2	60	8	30	1.7%	0.13 [0.03, 0.55]
Flockton 2008	10	34	3	39	2.4%	3.82 [1.15, 12.76]
Gaszynski 2011	2	35	3	35	1.3%	0.67 [0.12, 3.75]
Geldner 2012	0	66	5	67	0.5%	0.09 [0.01, 1.64]
Hakimoglu 2016	19	30	29	30	11.4%	0.66 [0.50, 0.87]
Illman 2011	0	24	1	23	0.4%	0.32 [0.01, 7.48]
Jones 2008	19	37	31	38	10.2%	0.63 [0.44, 0.89]
Kaufhold 2016	0	45	0	45		Not estimable
Khuenl-Brady 2010	20	48	29	48	9.2%	0.69 [0.46, 1.03]
Kizilay 2016	0	45	0	45		Not estimable
Koc 2015	0	16	2	17	0.5%	0.21 [0.01, 4.10]
Kogler 2012	0	16	0	15		Not estimable
Koyuncu 2015	21	50	20	50	8.2%	1.05 [0.66, 1.68]
Kvolik 2012a	3	17	13	19	2.9%	0.26 [0.09, 0.75]
Lemmens 2010	18	46	21	36	8.4%	0.67 [0.43, 1.06]
Mekawy 2012	8	20	14	20	6.3%	0.57 [0.31, 1.05]
Pongracz 2013	0	59	0	16		Not estimable
Sabo 2011	9	51	8	49	4.0%	1.08 [0.45, 2.57]
Schaller 2010	17	43	32	51	8.9%	0.63 [0.41, 0.96]
Woo 2013	4	60	6	60	2.4%	0.67 [0.20, 2.24]
Wu 2014	5	149	21	142	3.5%	0.23 [0.09, 0.59]
Yagan 2015	2	18	2	18	1.1%	1.00 [0.16, 6.35]
Total (95% CI)		**1186**		**1112**	**100.0%**	**0.60 [0.49, 0.74]**
Total events	188		315			

Heterogeneity: $Tau^2 = 0.07$; $Chi^2 = 36.96$, df = 22 ($p = 0.02$); $I^2 = 40\%$

Test for overall effect: $Z = 4.86$ ($p < 0.00001$)

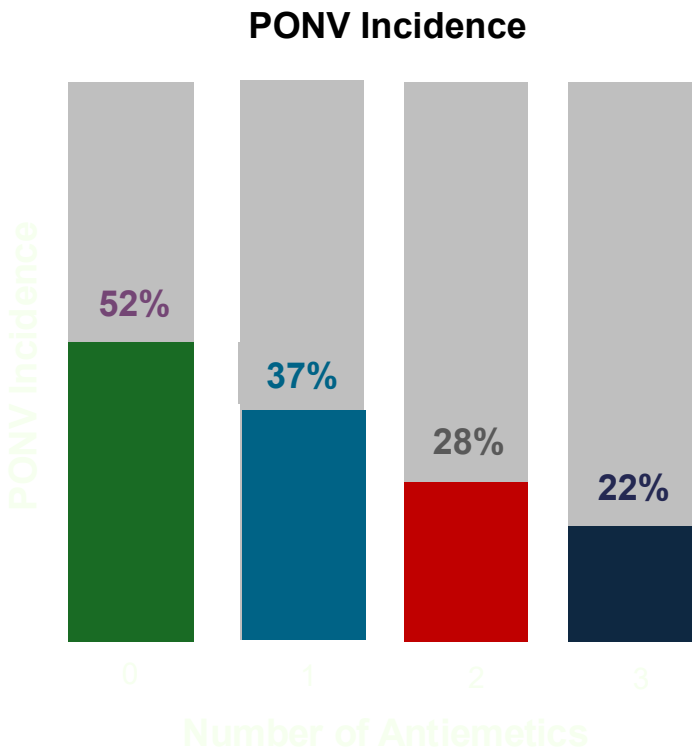


Hristovska AM et al. Anaesthesia 2018, 73, 631–64

Combination Prophylaxis in Patients at Moderate or High Risk May Reduce Incidence of PONV

Therapy Type

- No antiemetic
- Monotherapy
- Combination prophylaxis with 2 antiemetics
- Combination prophylaxis with 3 antiemetics



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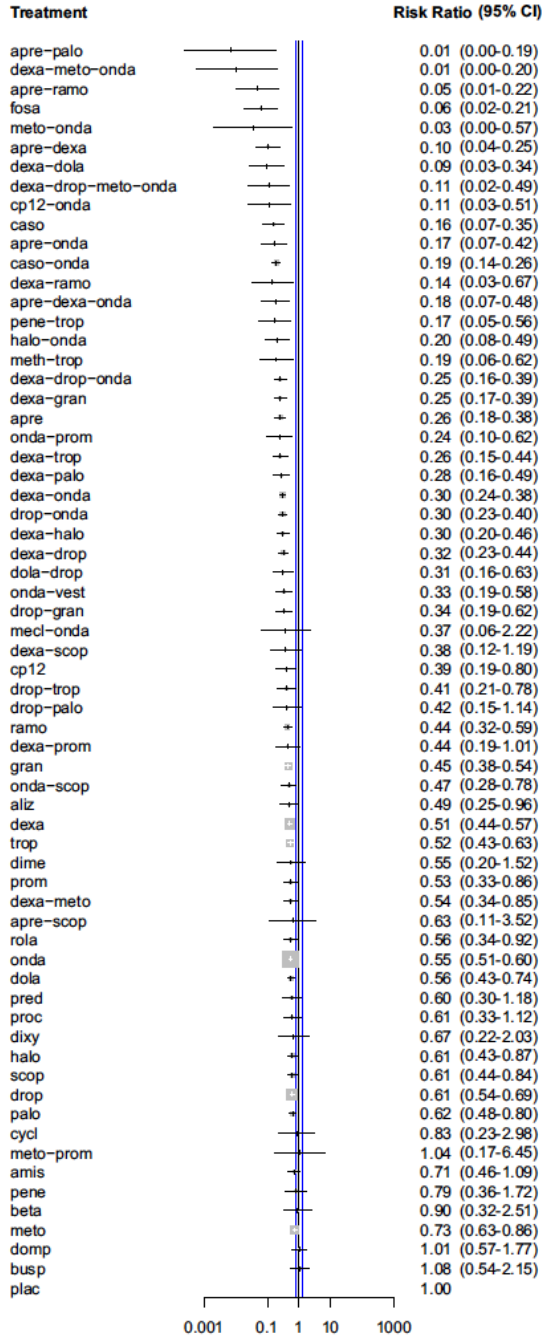
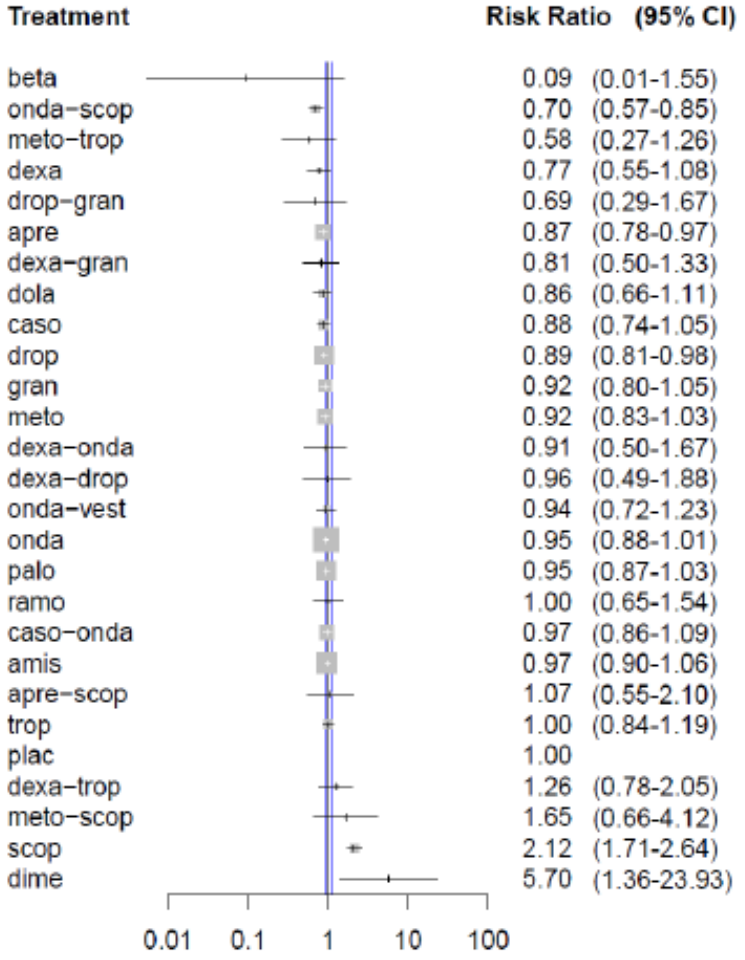
Apfel CC, et al. N Engl J Med. 2004;350:2441-2451

Antiemetics – Efficacy and Adverse Events

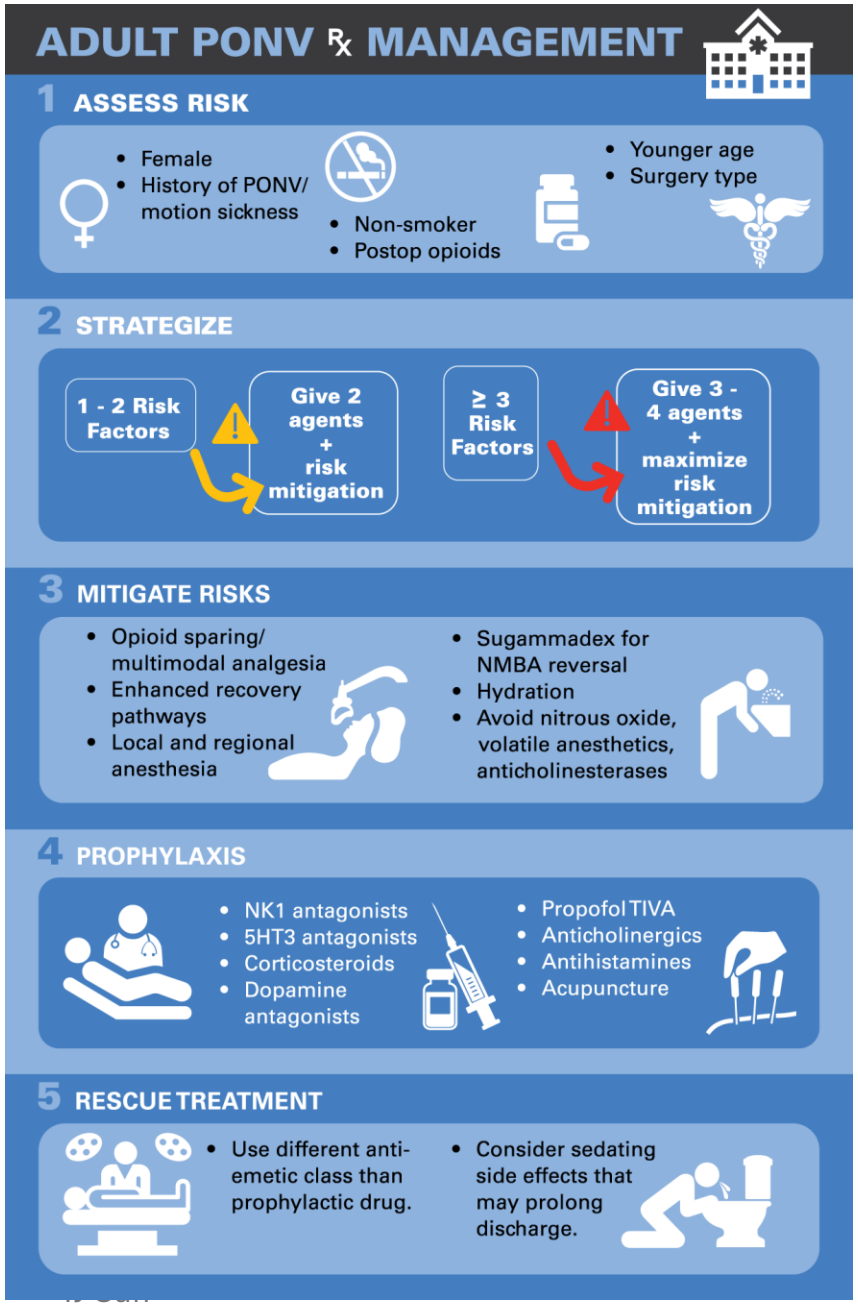


Efficacy



Adverse Events

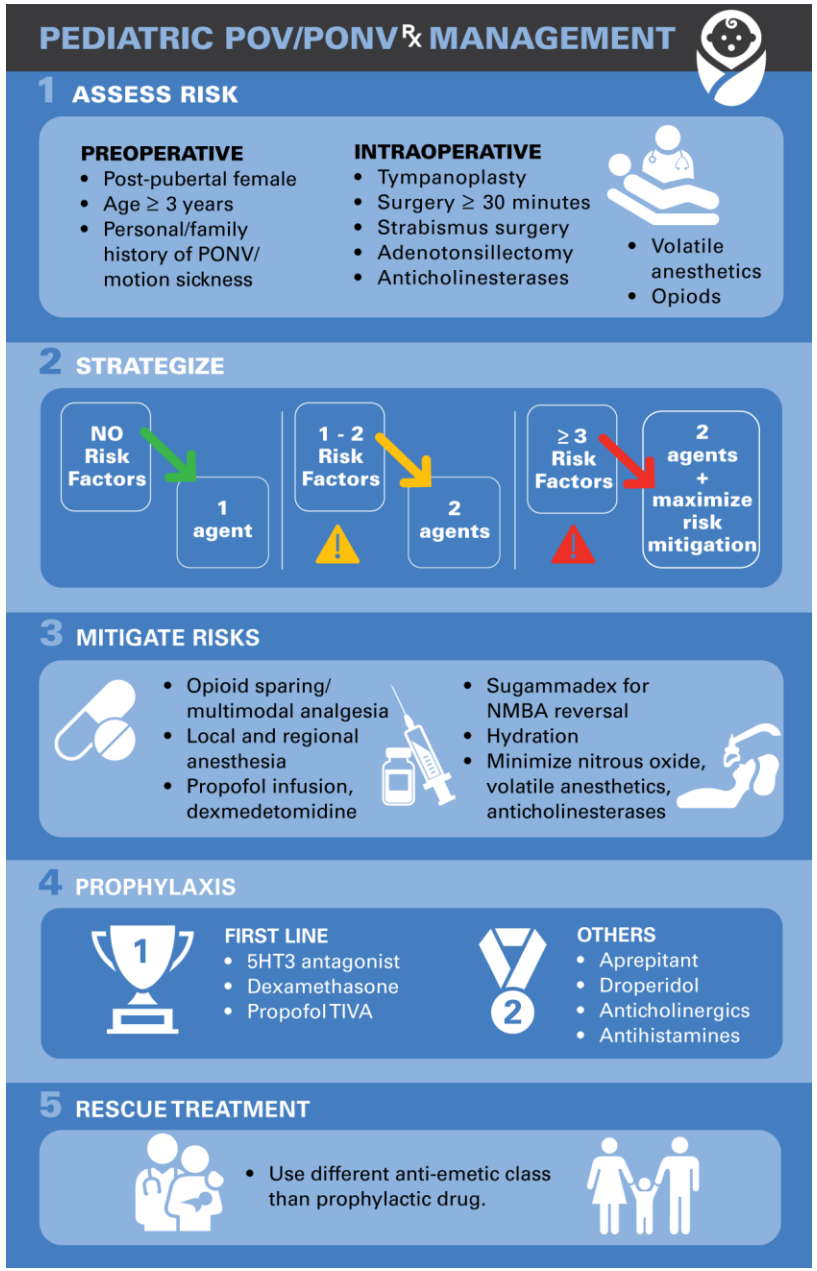
Weibel S et al. Anaesthesia 2021, 76, 962–973



PONV Treatment Algorithm for Adults

- Two antiemetics now recommended for prevention in patients with 1-2 risk factors
- 3-4 antiemetics + risk mitigation for ≥3 RF
- For rescue, administering repeated doses from the same class within 6 hrs does not confer additional benefit
- If more than 6 hours, administer a 2nd dose of 5HT-3 RA is acceptable
- If no prophylaxis, a 5HT-3 RA remain 1st line

Gan TJ et al. Anesth Analg 2025 (In press)



PONV Treatment Algorithm for Pediatric Patients

- No risk factor – 1 antiemetic
- 2 antiemetics in patients with 1-2 risk factors
- 2 antiemetics + risk mitigation for ≥3 RF
- Use different anti-emetic class than prophylactic drug for rescue
- If no prophylaxis, a 5HT-3 RA remain 1st line

Gan TJ et al. Anesth Analg 2025 (In press)

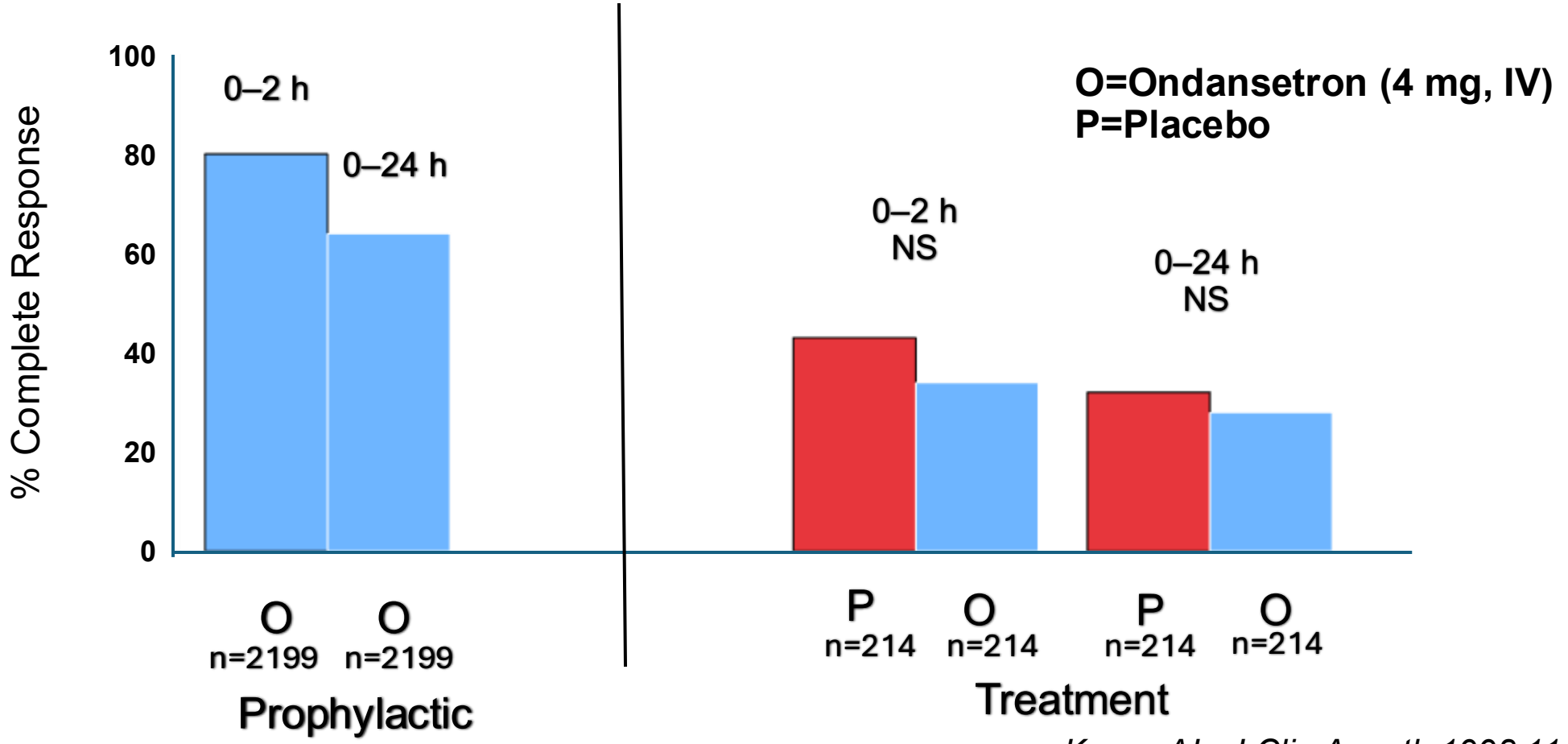
Reduce Baseline Risks

- Regional anesthesia (A1)
- Use of propofol for induction and maintenance of anesthesia (A1)
- Avoidance of nitrous oxide in surgeries (A1)
- Avoidance of volatile anesthetics (A2)
- Minimization of intraoperative (A1) and postoperative opioids (A1)
- Adequate hydration (A1)
- Goal directed fluid therapy in major surgery (A3)
- Using sugammadex instead of neostigmine for the reversal of neuromuscular blockade (A1)

Gan TJ et al. Anesth Analg 2020;131:411–48

Treatment of PONV - Ondansetron Retreatment Study

Not Significantly Different From Placebo

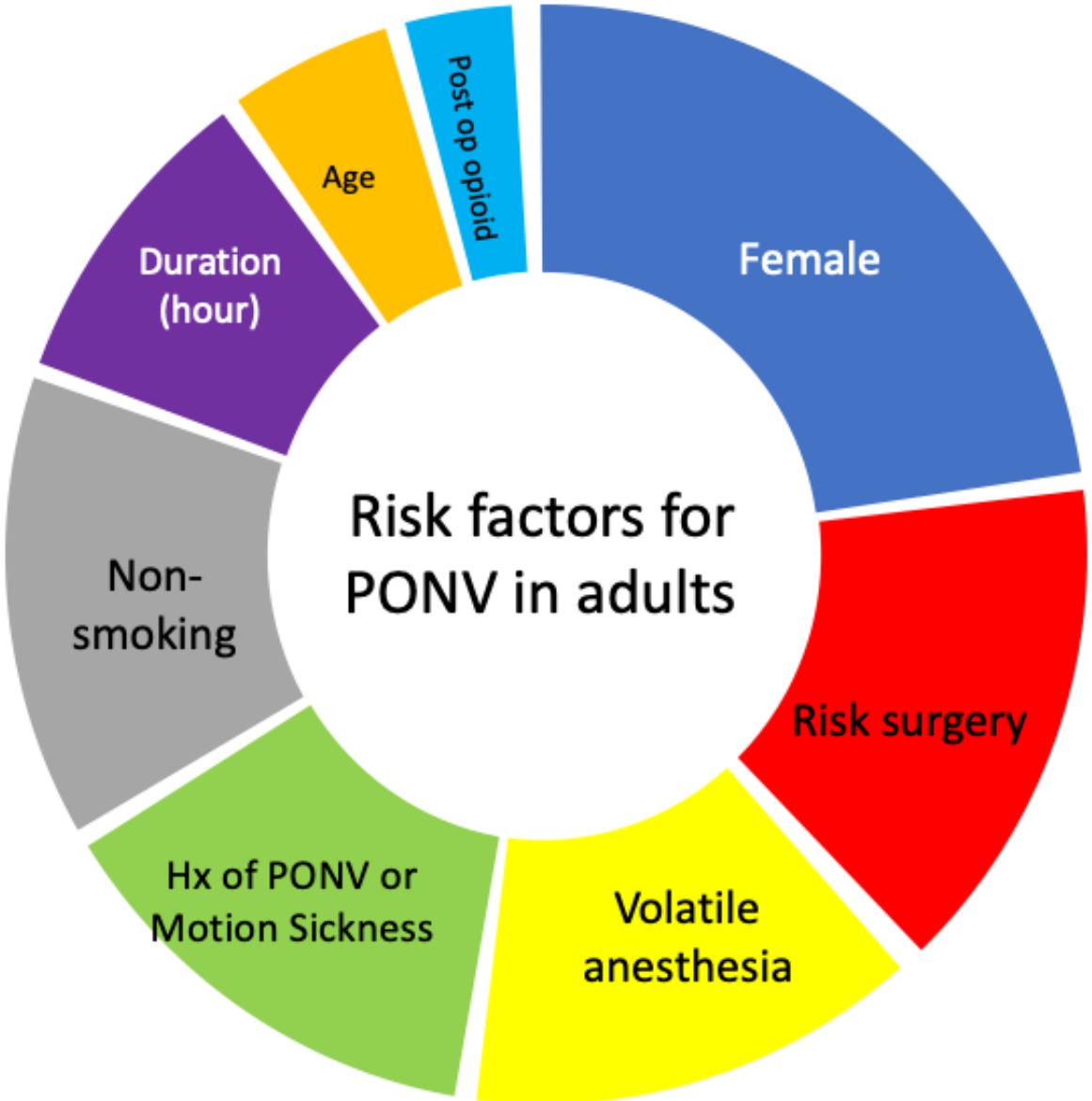


Kovac AL. J Clin Anesth 1998;11:453–459

Take Home Messages

- PONV are common and preventable
- PONV decrease patient satisfaction and increase costs
- Establish risk factors
- Use combination antiemetic strategy
- Implement PONV protocol in ERAS strategy
- Prompt treatment following failure of prophylaxis
- Use antiemetic from different class in the PACU

Questions?



Gan TJ et al. Anesth Analg 2020;131:411–48