Introduction

- Effective pain management is paramount in the anesthetic care of surgical patients.
- Untreated pain can lead to: prolonged recovery, complications (atelectasis, pneumonia, thrombosis, etc.), a heightened stress response, and dissatisfaction with the overall service they receive.
- Anesthesia and surgical teams must collaborate closely to implement strategies for pain control.
- Interventions can target **multiple** receptors, reducing the exclusive reliance on opioids and thus mitigating their side effects.

Objectives

- Summarize the basics of pain physiology
- Articulate the consequences of unaddressed pain in surgical patients
- Familiarize yourself with contemporary multi-modal pain management strategies
- Explain Enhanced Recovery after Surgery (ERAS) protocols and its potential benefits for patients

Pain Terms

1 Eudynia

Normal pain; pain from tissue injury

2 Neuropathic pain

Pain that arises due to altered neuronal properties, rather than an actual painful stimulus; most often chronic

3 Maledynia

Chronic pain (>3 months)

4 Allodynia

Perception of an ordinarily nonnoxious stimulus (e.g. light touch) as pain

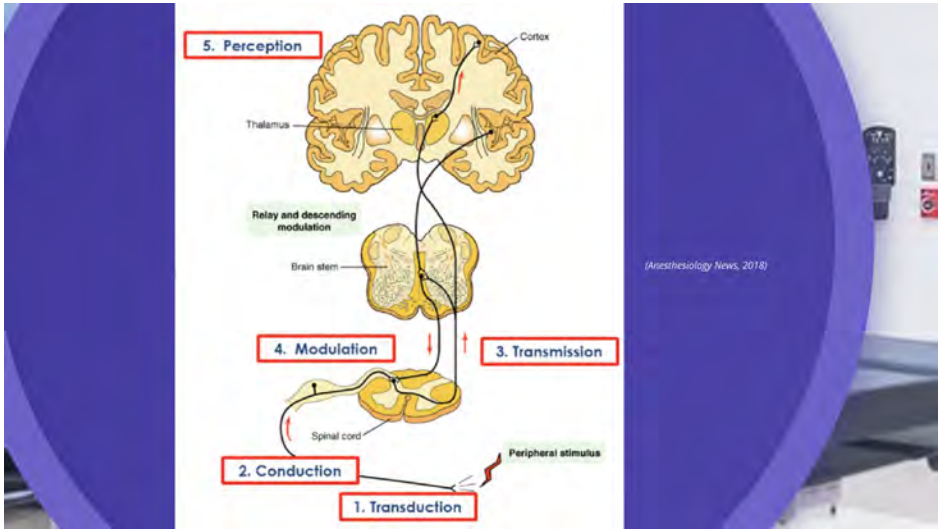
5 Hyperalgesia

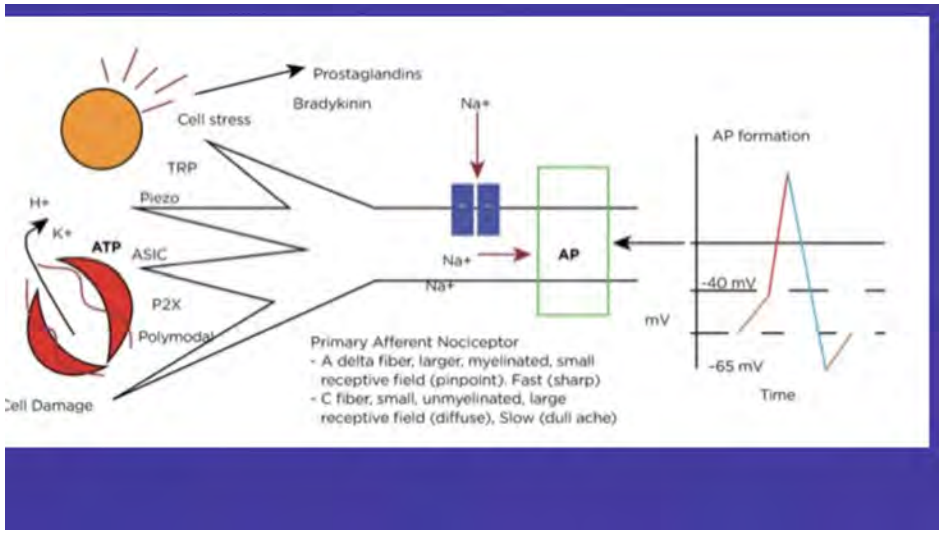
Heightened perception of a pain stimulus – increased sensitivity of pain receptor

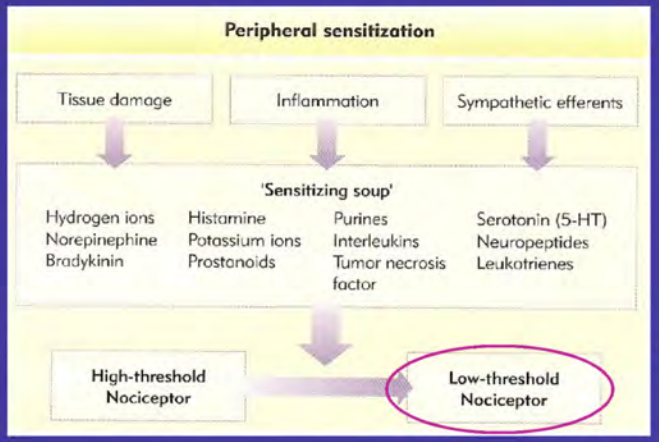
6 Neuralgia

Pain in the distribution of a nerve or a group of nerves

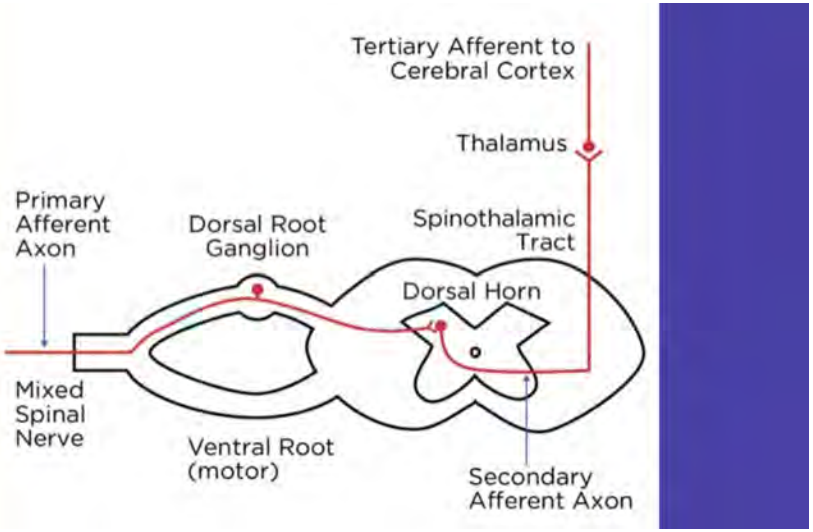
(International Association for the Study of Pain, n.d.)

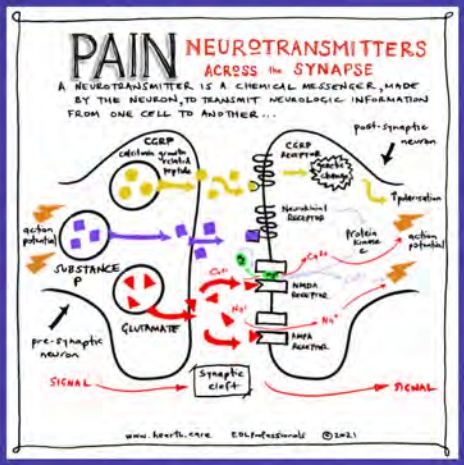




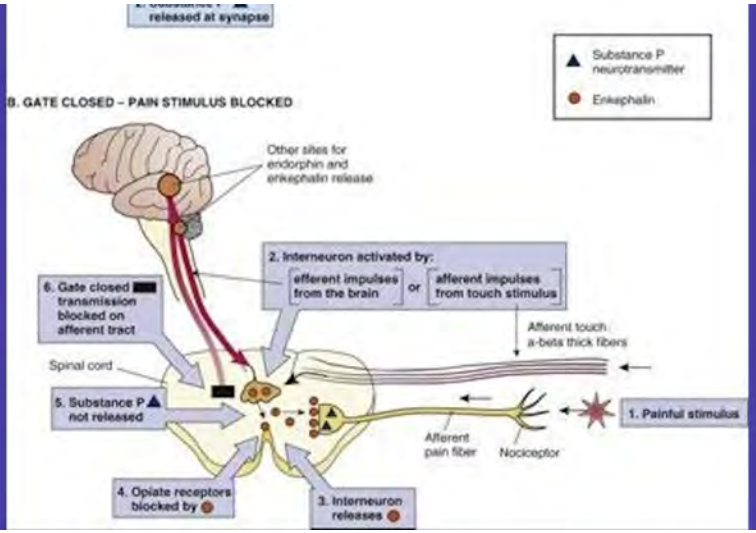


(Paul & Sapru, 2024)



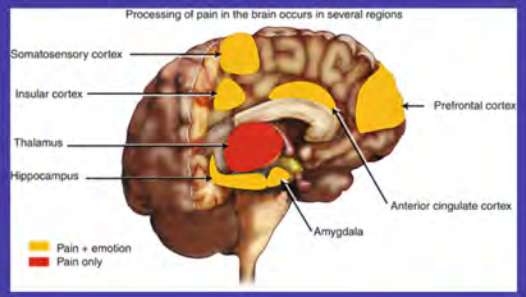


(Orient To Knowledge, n.d.)

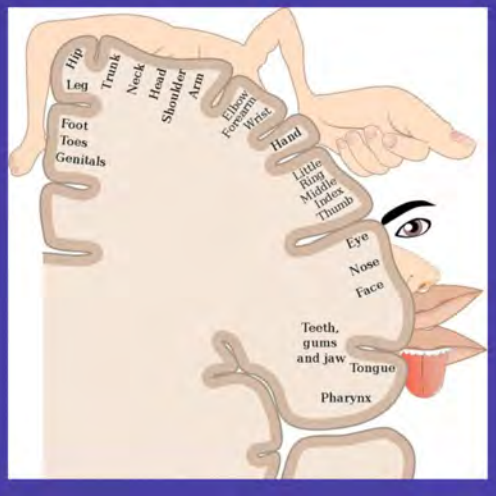


Perception

How the Brain Interprets the Signal and Produces "Pain"



(Mota & Marin, 2021)



(National Center for Biotechnology Information, 2021)

Under-treatment of acute or traumatic pain may lead to:

- Autonomic instability with tachycardia, hypertension, and increased myocardial oxygen consumption
- Depression, anxiety, insomnia, irritability, or phobias
- Chronic fatigue
- Atelectasis, pneumonia, hypoxia
- Immobility with risk for DVT
- Muscle spasms

(Paul & Sapru, 2024)

Multi-modal analgesia (MMA)

- MMA combines **various** pain management techniques, such as medications, nerve blocks, and non-pharmacological interventions, to target pain through **different pathways** simultaneously.
- MMA **reduces opioid consumption**, minimizes side effects, improves pain control, **promotes faster recovery**, and decreases the risk of chronic pain development (Pryce and Fryer, 2023)

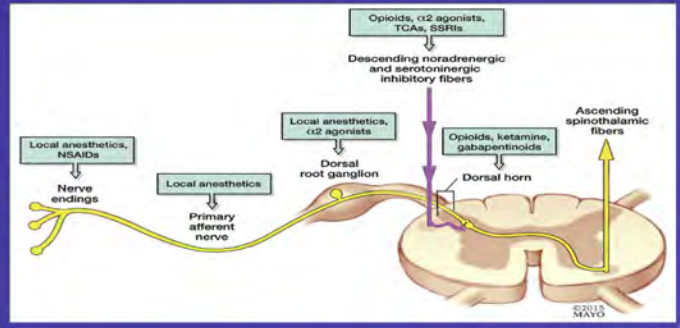
Preop

Intraop

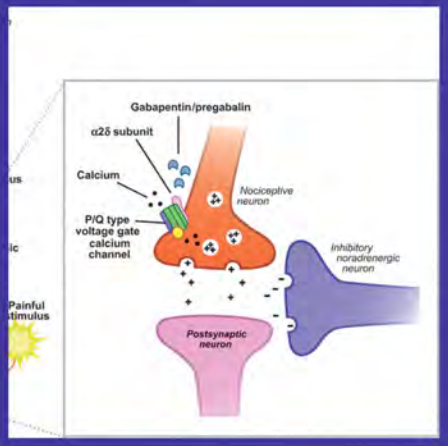
Nerve blocks

Sample protocol

(MMA)



(Mota & Marin, 2021)



Gabapentin (or pregabalin)

Dosaging: 600 mg PO preop X 1
300 mg PO tid x 4 days (optional)

Adverse effects: dizziness, blurred vision

Considerations: Caution in patients > 65 years of age

(StepWards, n.d.)

Pre-emptive 600 mg oral gabapentin reduces morphine requirements and postoperative pain following non-obstetric lower abdominal surgery

Abstract

Background: Postoperative pain following lower abdominal surgery is one of the most common complications reported by patients. Gabapentin given two hours before surgery as pre-emption analgesia has been reported to reduce postoperative pain and decrease postoperative analgesic requirements. The aim of this study was to determine the effectiveness of 600 mg oral gabapentin as a pre-emptive analgesia to reduce postoperative pain and morphine requirements following nonobstetric lower abdominal surgery.

Methods: A double-blind randomized clinical trial was conducted with 72 subjects acquired by consecutive sampling from November 2019 to February 2020 at Tangerang District Hospital. Eligible subjects were randomized to two groups: placebo or 600 mg oral gabapentin two hours before skin incision. The total morphine requirements, visual analogue scale (VAS) score, first-time analgesic demand, and side effects were assessed during the first 24 hours postoperatively.

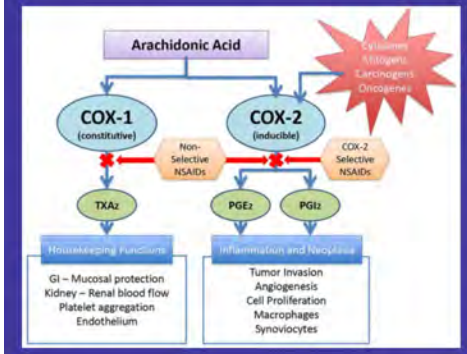
Results: The first 24-hour postoperative total morphine was higher in the placebo group (5.53 ± 1.97 mg vs. 2.47 ± 1.90 mg, P < 0.001). The pain scale at rest and movement during recovery, two hours postoperatively, and 24 hours postoperatively were significantly different between the two groups (P < 0.05). The Mann-Whitney test showed a significant difference in the first-time morphine required as rescue analgesia between the gabapentin group (181.5 (20-360) minutes) and placebo group (67.5 (10-371) minutes; P < 0.001). No significant difference was found in adverse events between the groups.

Conclusions: Following nonobstetric lower abdominal surgery, 600 mg oral gabapentin as a pre-emptive analgesia attenuates postoperative pain and reduces morphine requirements.

Keywords: VAS ; gabapentin; lower abdomen; morphine; pre-emptive analgesia.

Gabapentin (evidence)

- Double blind RCT with 72 subjects following lower abdominal surgery.
- Placebo group had higher 24-hour postoperative morphine use compared to the gabapentin group (P < 0.001), and pain scales at various postoperative time points showed significant differences between the two groups (P < 0.05).
- Gabapentin group required rescue analgesia significantly later than the placebo group (P < 0.001), with no significant difference in adverse events between the groups.



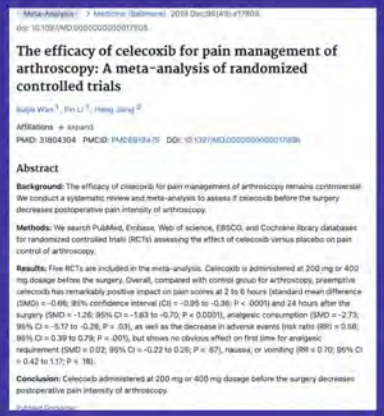
Celecoxib

Dosaging: 200 or 400 mg PO X 1

Adverse effects: GI bleed, clotting (MI/CVA), rash

Considerations: If giving celecoxib, do not give ketorolac.

(National Center for Biotechnology Information, 2021)



Meta-Analysis > Medicine (Baltimore). 2018 Dec;98(49):e17803.
doi: 10.1097/MD.0000000000017803

The efficacy of celecoxib for pain management of arthroscopy: A meta-analysis of randomized controlled trials

Bolin Wan[1], Pin Li[1], Heng Jiang[2]

Affiliations + expand
PMID: 31804304 PMCID: PMC6919475 DOI: 10.1097/MD.0000000000017803

Abstract

Background: The efficacy of celecoxib for pain management of arthroscopy remains controversial. We conduct a systematic review and meta-analysis to assess if celecoxib before the surgery decreases postoperative pain intensity of arthroscopy.

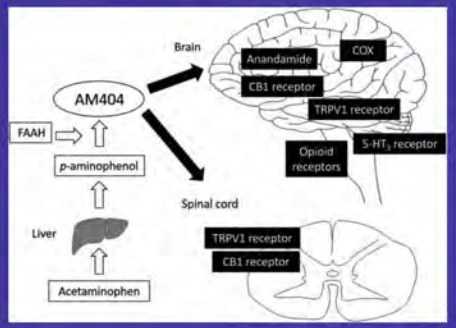
Methods: We search PubMed, Embase, Web of science, EBSCO, and Cochrane library databases for randomized controlled trials (RCTs) assessing the effect of celecoxib versus placebo on pain control of arthroscopy.

Results: Five RCTs are included in the meta-analysis. Celecoxib is administered at 200 mg or 400 mg dosage before the surgery. Overall, compared with control group for arthroscopy, preemptive celecoxib has remarkably positive impact on pain scores at 2 to 6 hours (standard mean difference (SMD) = −0.66; 95% confidence interval (CI) = −0.95 to −0.36; P < .0001) and 24 hours after the surgery (SMD = −1.26; 95% CI = −1.83 to −0.70; P < 0.0001), analgesic consumption (SMD = −2.73; 95% CI = −5.17 to −0.28; P = .03), as well as the decrease in adverse events (risk ratio (RR) = 0.58; 95% CI = 0.39 to 0.79; P = .001), but shows no obvious effect on first time for analgesic requirement (SMD = 0.02; 95% CI = −0.22 to 0.26; P = .87), nausea, or vomiting (RR = 0.70; 95% CI = 0.42 to 1.17; P = .18).

Conclusion: Celecoxib administered at 200 mg or 400 mg dosage before the surgery decreases postoperative pain intensity of arthroscopy.

Celecoxib (evidence)

- 5 RCTs studying pain after knee/hip arthroscopies published between 2006 and 2017, and a total sample size of 548.
- Preemptive administration of celecoxib (at dosages of 200 mg or 400 mg) before arthroscopy surgery revealed significantly reduced pain scores at 2 to 6 hours and 24 hours post-surgery, decreased analgesic consumption, and lower incidence of adverse events compared to control groups (all P < 0.0001).



(Masocha, 2022)

Acetaminophen

Dosaging: 1 gram PO X 1 (15 mg/kg), or IV intraop. Optionally, 1 gram X 6 hours post op.

Adverse effects: toxicity in daily dosaging > 4 grams

Considerations: Avoid/reduce with liver compromise or alcoholism.

Review > J Medicine (Baltimore). 2017 Nov;96(46):e8686.
doi: 10.1097/MD.0000000000008686

The efficiency of intravenous acetaminophen for pain control following total knee and hip arthroplasty: A systematic review and meta-analysis

Limin Liang[1], Ying Cai, Andrew Li, Chuangen Ma

Affiliations + expand
PMID: 29145272 PMCID: PMC6704817 DOI: 10.1097/MD.0000000000008686

Abstract

Background: This meta-analysis aimed to evaluate the efficiency and safety of intravenous acetaminophen as an adjunct to multimodal analgesia for pain control after total joint arthroplasty (TJA).

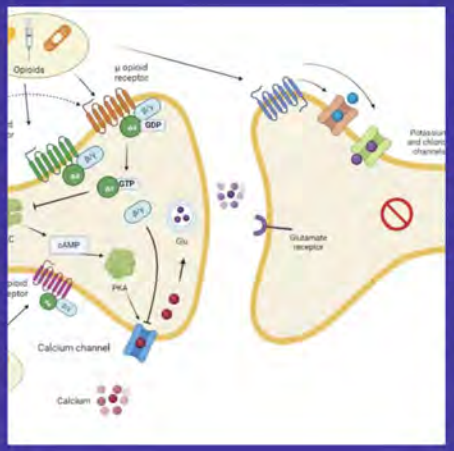
Methods: PubMed, Embase, Web of science, Medline, and Cochrane library databases were systematically searched. Randomized controlled trials (RCTs) and non-RCTs were included. Fixed/random effect model was used according to the heterogeneity tested by I statistic. Meta-analysis was performed using Stata 11.0 software.

Results: Four studies including 865 patients met the inclusion criteria. The present meta-analysis indicated that there were significant differences between groups in terms of pain scores at 24 hours (weighted mean difference [WMD] = −0.926, 95% confidence interval [CI]: −1.171 to −0.681, P = .000), 48 hours (WMD = −0.905, 95% CI: −1.198 to −0.612, P = .000), and 72 hours (WMD = −0.279, 95% CI: −0.538 to −0.021, P = .034). Significant differences were found regarding opioid consumption at 24 hours (WMD = −4.043, 95% CI: −5.041 to −3.046, P = .000), 48 hours (WMD = −5.885, 95% CI: −7.083 to −3.947, P = .000), and 72 hours (WMD = −6.338, 95% CI: −7.477 to −5.199, P = .000).

Conclusion: Intravenous acetaminophen was efficacious for reducing postoperative pain and opioid consumption than the placebo following total joint arthroplasty. Due to the limited quality of the evidence currently available, more RCTs are needed.

Acetaminophen (evidence)

- A meta-analysis of four studies involving 865 patients revealed significant differences between groups in pain scores at 24, 48, and 72 hours post-intervention, with weighted mean differences ranging from -0.279 to -0.926 (P < 0.05).
- Additionally, significant differences were observed in opioid consumption at 24, 48, and 72 hours post-intervention, with weighted mean differences ranging from -4.043 to -6.338 (P < 0.05).



Opioids

Dosaging: Varies per age, tolerance, and lifestyle of patient.
Fentanyl - 1-2 mcg/kg every 1-2 hours
Dilaudid - 10-15 mcg/kg every 2-3 hours

Adverse effects: nausea, constipation, respiratory depression, hypersensitivity to pain

Considerations: Synergistic effect with other analgesics/sedatives (midazolam, ketamine, etc). Caution near the end of the case when treating tachypnea (want patient to wake up comfortable, but also breathing stable and not overly somnolent).

(Agarwal & Khanna, 2014)

Analgesic efficacy of an opioid-free postoperative pain management strategy versus a conventional opioid-based strategy following laparoscopic radical gastrectomy: an open-label, randomized, controlled, non-inferiority trial

Abstract

Objective: In patients undergoing laparoscopic radical gastrectomy, the use of ultrasound transversus abdominis plane block (TAPB) to completely opioid-free postoperative pain management lacks convincing clinical evidence.

Methods: This study included 172 patients who underwent laparoscopic radical gastrectomy at the BIDITH Hospital of the Joint Logistics Support Force from October 2020 to March 2022. Patients were randomly divided into (1:1) continuous opioid-free STAPB (C-STAPB) group and conventional group. In the C-STAPB group, 0.2% ropivacaine (bilateral, 20 ml per side) was injected intermittently every 12 h through a catheter placed on the transverse abdominis plane for postoperative pain management. The conventional group was treated with a conventional intravenous opioid pump (2.5 μg/kg sufentanil and 10 mg tropisetron, diluted to 100 ml with 0.9% NS). The primary outcomes were the accumulative area under the curve of the numeric rating scale (NRS) score at 24 and 48 h postoperatively at rest and during movement. The secondary outcomes were postoperative recovery outcomes, postoperative daily food intake, and postoperative complications.

Results: After exclusion (n = 16), a total of 86 patients (C-STAPB group, n = 44; conventional group, n = 42) were included. We found there were no significant differences in the cumulative AUC of NRS score PACU-24 h and PACU-48 h between the C-STAPB group and conventional group at rest [mean difference, 1.33; 95% CI, − 2.21 to 4.88; P = 0.447], [mean difference, 1.22; 95% CI, − 6.20 to 8.65; P = 0.746] and at movement [mean difference, 2.90; 95% CI, − 3.61 to 9.40; P = 0.382], [mean difference, 4.32; 95% CI, − 4.46 to 13.1; P = 0.331]). The 95% CI upper bound of the difference between rest and movement in the C-STAPB group was less than the inferior margin value (6 and 14 points), indicating the non-inferiority of the analgesic effect of C-STAPB. The C-STAPB group had faster postoperative recovery profiles including earlier bowel movement, defecation, more volume of food intake postoperation, and lower postoperative nausea and vomiting compared to conventional groups (P < 0.001).

Conclusions: After laparoscopic radical gastrectomy, the analgesic effect of C-STAPB is not inferior to the traditional opioid-based pain management model.

Opioids (evidence)

Study 1:

RCT with 112 patients after radical gastrectomy, approximately half received OFA, other half received conventional treatment (IV opiates). OFA was "non inferior"

Study 2:

RCT with approximately 80 patients, half was OFA with ketamine / precedex, other half received sufentanil / remifentanil. OFA was non inferior, lower PONV post op.

Application of opioid-free general anesthesia for gynecological laparoscopic surgery under ERAS protocol: a non-inferiority randomized controlled trial

Abstract

Background: Enhanced recovery after surgery (ERAS) is now widely used in various surgical fields including gynecological laparoscopic surgery, but the advantages of opioid-free anesthesia (OFA) in gynecological laparoscopic surgery under ERAS protocol are inexact.

Aims: This study aims to assess the effectiveness and feasibility of OFA technique versus traditional opioid-based anesthesia (OA) technique in gynecological laparoscopic surgery under ERAS.

Methods: Adult female patients aged 18 ~ 65 years old undergoing gynecological laparoscopic surgery were randomly divided into OFA group (Group OFA, *n* = 39) with esketamine and dexmedetomidine or OA group (Group OA, *n* = 36) with sufentanil and remifentanil. All patients adopted ERAS protocol. The primary outcome was the area under the curve (AUC) of Visual Analogue Scale (VAS) scores (AUC_{VAS}) postoperatively. Secondary outcomes includes intraoperative hemodynamic variables, awakening and orientation recovery times, number of postoperative rescue analgesia required, incidence of postoperative nausea and vomiting (PONV) and Pittsburgh Sleep Quality Index (PSQI) perioperatively.

Results: AUC_{VAS} was (Group OFA, 16.72 ± 2.50) vs (Group OA, 15.89 ± 2.72) (*p* = 0.223). No difference was found in the number of rescue analgesia required (*p* < 0.252). There were no between-group differences in mean arterial pressure (MAP) and heart rate (HR) (*p* = 0.211 and 0.659, respectively) except MAP at time of surgical incision immediately ((Group OFA, 84.88 ± 11.08) vs. (Group OA, 79.00 ± 8.92), *p* = 0.022). Times of awakening and orientation recovery in group OFA (14.54 ± 4.22 and 25.69 ± 4.92, respectively) were both longer than which in group OA (12.63 ± 3.59 and 19.45 ± 4.69, respectively) (*p* = 0.036 and 0.033, respectively). The incidence of PONV in group OFA (10.1%) was lower than that in group OA (28.9%) significantly (*p* = 0.027). The postoperative PSQI was lower than the preoperative one in group OFA (*p* < 0.013).

Conclusion: In gynecological laparoscopic surgery under ERAS protocol, OFA technique is non-inferior to OA technique in analgesic effect and intraoperative anesthesia stability. Although awakening and orientation recovery times were prolonged compared to OA, OFA had lower incidence of PONV and improved postoperative sleep quality.

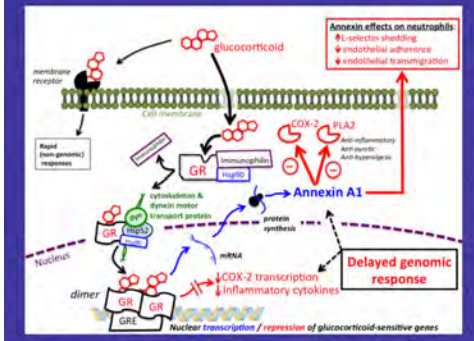
Opioids (evidence)

Study 1:

RCT with 112 patients after radical gastrectomy, approximately half received OFA, other half received conventional treatment (IV opiates). OFA was "non inferior"

Study 2:

RCT with approximately 80 patients, half was OFA with ketamine / precedex, other half received sufentanil / remifentanil. OFA was non inferior, lower PONV post op.



Dexamethasone

Dosaging: 0.1 mg/kg, normally 4-8 mg for adults. 8 mg for analgesic effect, and 4 mg for PONV.

Adverse effects: hyperglycemia, leukocystosis

Considerations: Caution with uncontrolled hyperglycemia (diabetics). Otherwise, relatively benign drug.

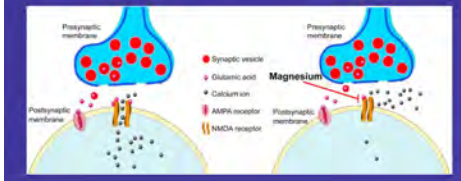
(Liang et al., 2022)

Effect of Intravenous Dexamethasone on Postoperative Pain in Patients Undergoing Total Knee Arthroplasty: A Systematic Review and Meta-Analysis

Abstract

Dexamethasone (evidence)

Meta-analysis of 1,671 patients who underwent TKA. Patients who received single dose of 8-10 mg dexamethasone had lower visual analog pain scores, and required less morphine at 24h and 48h. They also had a shorter hospitalization course.



Magnesium

Dosaging: 2 grams IV for most adults

Adverse effects: hypotension, heart block (decreased PR interval, increased QRS), loss of DTR at high dosages

Considerations: Avoid in patients with ESRD or cardiac conduction issues

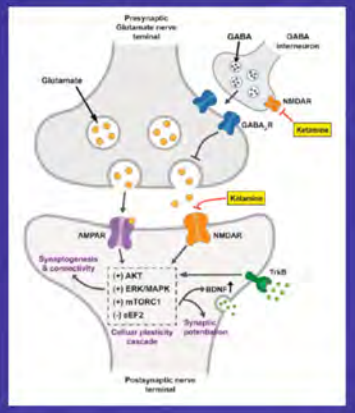
(International Association for the Study of Pain, n.d.)

Effects of Systemic Magnesium on Post-operative Analgesia: Is the Current Evidence Strong Enough?

Abstract

Magnesium (evidence)

Authors reviewed 27 RCTs with 1,504 patients.
MgSO4 reduced analgesic consumption in patients receiving urological, orthopedic, and cardiovascular surgeries. Particularly improved pain scores during movement at 24 hours pos-op.



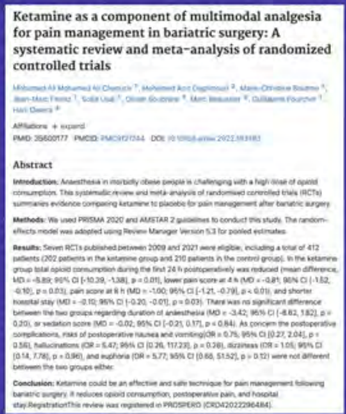
Ketamine

Dosaging: 0.3 - 0.5 mg / kg, or as a drip

Adverse effects: emergence delirium, hallucinations, hyper or hypotension, tachycardia, nystagmus

Considerations: Caution in patients with a history of psychosis

(Farasatinasab & Rahimi, 2022)



Ketamine as a component of multimodal analgesia for pain management in bariatric surgery: A systematic review and meta-analysis of randomized controlled trials

Affiliations + expand

PMID: 35600177

Abstract

Introduction: Anaesthesia in morbidly obese people is challenging with a high dose of opioid consumption. This systematic review and meta-analysis of randomised controlled trials (RCTs) summaries evidence comparing ketamine to placebo for pain management after bariatric surgery.

Methods: We used PRISMA 2020 and AMSTAR 2 guidelines to conduct this study. The random-effects model was adopted using Review Manager Version 5.3 for pooled estimates.

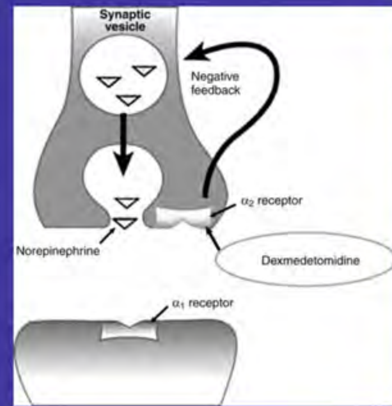
Results: Seven RCTs published between 2009 and 2021 were eligible, including a total of 412 patients (202 patients in the ketamine group and 210 patients in the control group). In the ketamine group total opioid consumption during the first 24 h postoperatively was reduced (mean difference, MD = -5.89; 95% CI [-10.39, -1.38], p = 0.01), lower pain score at 4 h (MD = -0.81; 95% CI [-1.52, -0.10], p = 0.03), pain score at 8 h (MD = -1.00; 95% CI [-1.21, -0.79], p < 0.01), and shorter hospital stay (MD = -0.10; 95% CI [-0.20, -0.01], p = 0.03). There was no significant difference between the two groups regarding duration of anaesthesia (MD = -3.42; 95% CI [-8.62, 1.82], p = 0.20), or sedation score (MD = -0.02; 95% CI [-0.21, 0.17], p = 0.84). As concern the postoperative complications, risks of postoperative nausea and vomiting(OR = 0.75; 95% CI [0.27, 2.04], p = 0.56), hallucinations (OR = 5.47; 95% CI [0.26, 117.23], p = 0.28), dizziness (OR = 1.05; 95% CI [0.14, 7.78], p = 0.96), and euphoria (OR = 5.77; 95% CI [0.65, 51.52], p = 0.12) were not different between the two groups either.

Conclusion: Ketamine could be an effective and safe technique for pain management following bariatric surgery. It reduces opioid consumption, postoperative pain, and hospital stay.RegistrationThis review was registered in PROSPERO (CRD42022296484).

Ketamine (evidence)

Authors reviewed 7 RCTs with 412 total patients. Ketamine group vs non-ketamine group. Ketamine group had less opioid consumption during the first 24 hours, less pain at 4 hours and 8 hours.

PONV, hallucinations, and dizziness were the same between the groups.



Dexmedetomidine

Dosaging: 0.2-0.5 mcg/kg IV push
Infusion: 0.2-1.0 mcg/kg/hr

Adverse effects: hypertension, hypotension, and bradycardia

Considerations: Caution with bradycardic patients. High dosages may delay emergence and discharge.

(Anesthesia.ucsf.edu, n.d.)

Medicine (Baltimore). 2017 Oct;96(43):e7938.

Efficacy of dexmedetomidine for pain management in knee arthroscopy: A systematic review and meta-analysis

Affiliations + expand

PMID: 29068980

Abstract

Background: Dexmedetomidine showed some potential in pain control in patients undergoing knee arthroscopy. We conducted a systematic review and meta-analysis to explore the efficacy of dexmedetomidine in patients undergoing knee arthroscopy.

Methods: We searched the randomized controlled trials (RCTs) assessing the effect of dexmedetomidine on knee arthroscopy in PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases. The primary outcome was pain scores. Meta-analysis was performed using the random-effect model.

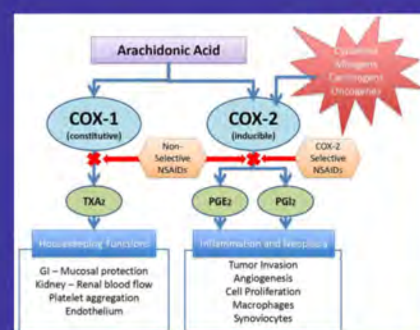
Results: Five RCTs were included. Overall, compared with control intervention in patients with knee arthroscopy, dexmedetomidine intervention could significantly reduce the pain scores [Std. mean difference = -0.84; 95% confidence interval (95% CI) = -1.24 to -0.44; P < .0001] and postoperative diclofenac sodium consumption (Std. mean difference = -1.76; 95% CI = -3.32 to -0.21; P = .03), improve duration of analgesic effect (Std. mean difference = 1.78; 95% CI = 0.56-3.00; P = .004), but showed no influence on hypotension [risk ratio (RR) = 0.93; 95% CI = 0.14-5.92; P = .94], bradycardia (RR = 4.93; 95% CI = 0.91-26.58; P = .06), nausea, and vomiting (RR = 1.96; 95% CI = 0.31-12.58; P = .48).

Conclusion: Dexmedetomidine intervention was able to significantly reduce the pain scores and postoperative diclofenac sodium consumption, and improve duration of analgesic effect in patients undergoing knee arthroscopy, but had no influence on hypotension, bradycardia, nausea, and vomiting.

Dexmedetomidine (evidence)

Authors reviewed 5 RCTs, comparing pain scores with knee arthroscopy between patients who did and did not receive dexmedetomidine.

Pain scores were reduced, as well as an improved duration of analgesic effect.



Ketorolac (toradol)

Dosaging: 15 mg if elderly or slightly elevated creatinine, otherwise 30 mg

Adverse effects: GI bleeding, may cause respiratory issues in SEVERE asthmatics

Considerations: Caution in the elderly, patients with renal compromise, and post-bariatric surgery patients.

(International Anesthesia Research Society, 2021)

Meta-Analysis > Orthop Surg. 2020 Feb;12(1):31-37. doi: 10.1111/os.12608.

Influence of Ketorolac Supplementation on Pain Control for Knee Arthroscopy: A Meta-Analysis of Randomized Controlled Trials

Kui-Jie Wan [1, 2], Shao-Fan Liu [2], Zhi-Ping Kuang [1, 2], Qiang Ren [2], Chen Zhao [1], Wei Huang [1]

Affiliations + expand

PMID: 32077265 PMCID: PMC7031550 DOI: 10.1111/os.12608

Abstract

Introduction: The efficacy of ketorolac supplementation on pain control for knee arthroscopy remains controversial. We conduct a systematic review and meta-analysis to explore the impact of ketorolac supplementation on pain intensity after knee arthroscopy.

Methods: We search PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases through September 2018 for randomized controlled trials (RCTs) assessing the effect of ketorolac supplementation vs placebo on pain management after knee arthroscopy. This meta-analysis is performed using the random-effect model.

Results: Ten RCTs involving 402 patients are included in the meta-analysis. Overall, compared with control group for knee arthroscopy, ketorolac supplementation is associated with notably reduced pain scores at 1 h (MD = -0.66; 95% CI = -1.12 to -0.21; P = 0.004) and 2 h (MD = -0.90; 95% CI = -1.74 to -0.07; P = 0.03), prolonged time for first analgesic requirement (MD = 1.94; 95% CI = 0.33 to 3.55; P = 0.02) and decreased number of analgesic requirement (RR = 0.41; 95% CI = 0.23 to 0.75; P = 0.003), but has no obvious impact on analgesic consumption (MD = -0.56; 95% CI = -1.14 to 0.02; P = 0.06), as well as nausea and vomiting (RR = 0.44; 95% CI = 0.12 to 0.21; P = 0.21).

Conclusions: Ketorolac supplementation is effective to produce pain relief for knee arthroscopy.

Ketorolac (evidence)

Authors conducted a meta-analysis of 10 RCTs with 402 patients who underwent knee arthroscopies. Results showed notably reduced pain scores at 1 h, 2h, and prolonged time for first analgesic requirement.

Meta-Analysis > J Am Coll Surg. 2021 May;232(5):765-790.e1. doi: 10.1016/j.jamcollsurg.2021.01.005. Epub 2021 Jan 27.

Systematic Review and Meta-Analysis of the Association Between Non-Steroidal Anti-Inflammatory Drugs and Operative Bleeding in the Perioperative Period

Affiliations + expand

Abstract

Background: It is increasingly recognized that non-opioid analgesia is an important analgesia in the perioperative period. Specifically, NSAIDs (nonsteroidal anti-inflammatory drugs) have been touted as an adjunct, or even replacement, for opioids. However, uptake of NSAIDs has been slow due to concern for side effects, including bleeding. We sought to understand the risk of bleeding caused by NSAIDs in the perioperative period.

Study design: A physician-librarian team performed a search of electronic databases (MEDLINE, EMBASE), using search terms covering the targeted intervention (use of NSAIDs) and outcomes of interest (surgical complications, bleeding), limited to English language articles of any date. We performed a systematic review and meta-analysis of the data.

Results: A total of 2,521 articles were screened, and 229 were selected on the basis of title and abstract for detailed assessment. Including reference searching, 74 manuscripts met inclusion criteria spanning years 1987-2019. These studies included 151,031 patients. Studies included 12 types of NSAIDs, the most common being ketorolac, diclofenac, and ibuprofen, over a wide-range of procedures, from otorhinolaryngology (ENT), breast, abdomen, plastics, and more. More than half were randomized control trials. The meta-analyses for hematoma, return to the operating room for bleeding, and blood transfusions showed no difference in risk in any of 3 categories studied between the NSAID vs non-NSAID groups (p = 0.45, p = 0.79, and p = 0.49, respectively). Quality scoring found a wide range of quality, with scores ranging from lowest quality of 12 to highest quality of 25, out of a total of 27 (average = 16).

Conclusions: NSAIDs are unlikely to be the cause of postoperative bleeding complications. This literature covers a large number of patients and remains consistent across types of NSAIDs and operations.

Ketorolac (no bleeding)

Meta-analysis of 229 studies between 1987 and 2019, including a total of 151,031 patients.

Procedure types: ENT, breast, abdomen, plastics.

Looked for hematomas, return to the operating room for bleeding, and blood transfusions.

Found that there was no difference in risk between NSAID and non NSAID group.

Block	Administration	Indication	Evidence†
Transversus abdominis plane blocks	Local anesthetic between the internal oblique and transversus abdominis muscle	Abdominoplasty	Strong
		Abdominal-based flap reconstruction (ie, TRAM flap)	Strong
		Abdominal wall reconstruction	Limited
Pectoralis blocks	Local anesthetic between the pectoral major and minor muscles	Breast surgery*	Strong
Modified pectoralis blocks	Local anesthetic between the pectoralis major and minor muscles and between the pectoralis minor and serratus anterior muscles	Breast surgery*	Strong
Serratus anterior plane blocks	Local anesthetic between superficial and deep to the serratus anterior muscle	Breast surgery*	Strong
Erector spinae plane blocks†	Local anesthetic between rhomboid major and erector spinae muscles	Breast surgeries*	Strong

(Wu, 2021)

Sample MMA Protocol

Drug	Dosaging	Comments
Acetaminophen	>50kg: **Preoperative/Intraoperative**: 1,000 mg PO or IV, or 15 mg/kg **Postoperative**: 1,000 mg q6h (or 15mg/kg q6h)	Max daily dose = 4g
Celecoxib	**Preoperative**: 400 mg PO **Postoperative**: 200 mg q 12 h	Inc. risk MI Dec. risk GI bleed
Gabapentin	**Preoperative**: 600-1200 mg PO **Postoperative**: 300 mg PO q8h	Can cause sedation, esp in elderly Reduce dose if CrCl low
Pregabalin	**Preoperative**: 150 mg PO **Postoperative**: 75mg q12h PO	Alternative to gabapentin
Dexamethasone	**Intraoperative**: 0.1 mg/kg, normally 4-8 mg for adults. 8 mg for analgesic effect, and 4 mg for PONV.	Reduced dosage for insulin resistant diabetics
Ketamine	**Intraoperative**: 0.25-0.3 mg/kg IV **Infusion**: 0.25 mg/kg/hr	Infusion more advantageous than one time bolus
Magnesium	**Intraoperative**: 1-2 grams	Avoid in ESRD or cardiac conduction defects
Dexmedetomidine	**Intraoperative**: 0.2-0.5 mcg/kg IV push **Infusion**: 0.2-1.0 mcg/kg/hr	Watch for bradycardia High dosage leads to delayed emergence/discharge
Fentanyl	**Intraoperative:** Fentanyl - 1-2 mcg/kg every 1-2 hours Dilaudid - 10-15 mcg/kg every 2-3 hours	Respiratory suppression, bradycardia
Ketorolac	**Intraoperative**: 15-30mg IV	Caution with GI bleeds, AKD/CKD, or coagulopathies

(Anesthesiology News, 2020)

Drug	Dosaging	Comments
Acetaminophen	>50kg: **Preoperative/Intraoperative**: 1,000 mg PO or IV, or 15 mg/kg **Postoperative**: 1,000 mg q6h (or 15mg/kg q6h)	Max daily dose = 4g
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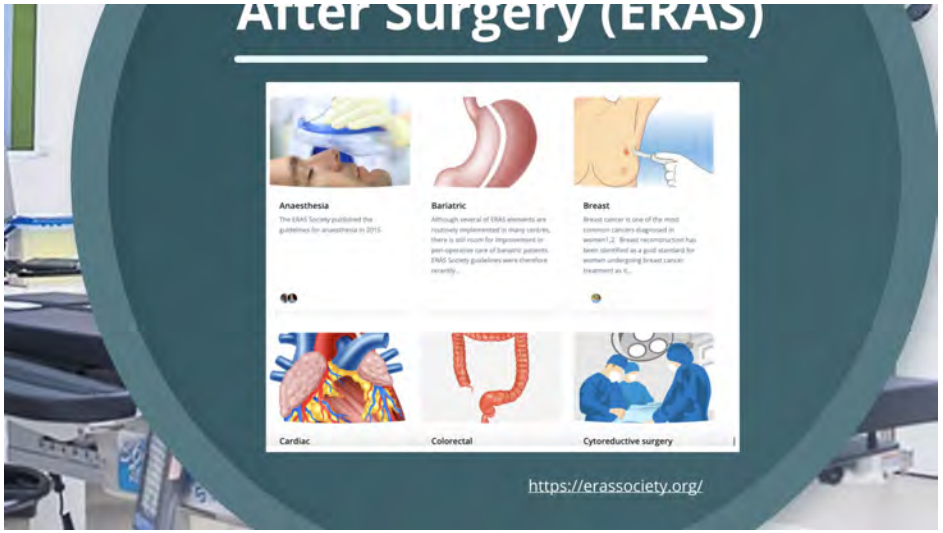
Ketorolac	**Intraoperative**: 15-30mg IV	Caution with GI bleeds, AKD/CKD, or coagulopathies

y News, 2020)



Strategies (preop)

ERAS protocols emphasize the following pre-operative optimizations:

- **Carbohydrate loading (CL)**: Improve metabolism and reduce fasting-associated catabolism. May consume up to 2 hours prior to surgery.
- **Patient education**: Counseling plays a vital role in managing expectations and enhancing compliance with ERAS principles.
- **Pre-operative medication**: Multi-modal analgesia, as well as avoiding long-acting benzodiazepines and opioids.

(Golder & Papalois, 2021)

Strategies (intraop)

- **Goal-directed fluid therapy (GDFT):** Aims to optimize oxygen delivery while avoiding fluid overload or inadequate resuscitation in perioperative care, potentially reducing post-surgical complications and length of stay (LOS) by 39% (Sinclair et al.)
- **Multi-modal analgesia:** Opioid sparing techniques.
- **Post-operative nausea and vomiting (PONV):** ERAS protocols advocate a multimodal approach to PONV, emphasizing antiemetics, total intravenous anesthesia with propofol, and avoiding nitrous oxide. Propofol-based TIVA shows the greatest promise in reducing PONV.
- **Patient Warming:** Usage of warming devices such as a Bair Hugger or Ranger fluid warmer. Prevention of hypothermia (causes delayed emergence, coagulopathy, etc).

(Golder & Papalois, 2021)

Strategies (postop)

- **Early mobilization (EM):** EM in ERAS pathways reduces complications in elective surgeries, cutting LOS notably. Adhering to EM protocols can be difficult, but immobile patients experience higher post-operative complications (atelectasis, pneumonia, constipation, DVT). Facilitated mobilization by dedicated staff improves adherence and patient outcomes.
- **Early enteral nutrition:** Post-operative nutrition should start early, with guidelines advocating for uninterrupted oral feeding soon after surgery. Studies show that initiating early oral feeding can reduce length of stay (LOS) by up to 1.44 days, has lower hospitalization costs, and fewer post-surgical complications, aligning with ERAS protocols.

(Golder & Papalois, 2021)

Review. J Gastrointest Surg. 2020 Apr;24(4):918-932. doi: 10.1007/s11605-019-04169-0. Epub 2020 Jan 3.

Enhanced Recovery After Surgery (ERAS) Reduces Hospital Costs and Improve Clinical Outcomes in Liver Surgery: a Systematic Review and Meta-Analysis

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Affiliations + expand

PMID: 31900738 PMCID: PMC7165160 DOI: 10.1007/s11605-019-04169-0

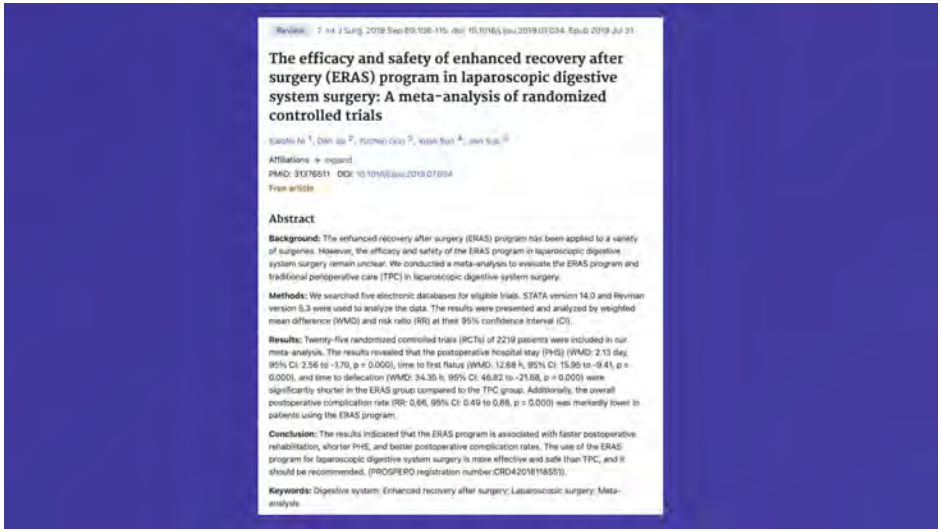
Abstract

Background: Enhanced recovery after surgery (ERAS) protocols are evidence-based, multimodal and patient-centred approach to optimize patient care and experience during their perioperative pathway. It has been shown to be effective in reducing length of hospital stay and improving clinical outcomes. However, evidence on its effective in liver surgery remains weak. The aim of this review is to investigate clinical benefits, cost-effectiveness and compliance to ERAS protocols in liver surgery.

Methods: A systematic literature search was conducted using CINAHL Plus, EMBASE, MEDLINE, PubMed and Cochrane for randomized control trials (RCTs) and cohort studies published between 2008 and 2019, comparing effect of ERAS protocols and standard care on hospital cost, LOS, complications, readmission, mortality and compliance.

Results: The search resulted in 6 RCTs and 21 cohort studies of 3739 patients (1777 in ERAS and 1962 in standard care group). LOS was reduced by 2.22 days in ERAS group (MD = -2.22; CI, -2.77 to -1.68; p < 0.00001) compared to the standard care group. Fewer patients in ERAS group experienced complications (RR, 0.71; 95% CI, 0.65–0.77; p < 0.00001). Hospital cost was significantly lower in the ERAS group (SMD = -0.98; CI, -1.37 to - 0.58; p < 0.0001).

Conclusion: Our review concluded that the introduction of ERAS protocols is safe and feasible in hepatectomies, without increasing mortality and readmission rates, whilst reducing LOS and risk of complications, and with a significant hospital cost savings. Laparoscopic approach may be necessary to reduce complication rates in liver surgery. However, further studies are needed to investigate overall compliance to ERAS protocols and its impact on clinical outcomes.



Review. Int J Surg. 2019 Sep;69:108-115. doi: 10.1016/j.ijsu.2019.07.024. Epub 2019 Jul 31.

The efficacy and safety of enhanced recovery after surgery (ERAS) program in laparoscopic digestive system surgery: A meta-analysis of randomized controlled trials

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PMID: 31376511 DOI: 10.1016/j.ijsu.2019.07.024

Free article

Abstract

Background: The enhanced recovery after surgery (ERAS) program has been applied to a variety of surgeries. However, the efficacy and safety of the ERAS program in laparoscopic digestive system surgery remain unclear. We conducted a meta-analysis to evaluate the ERAS program and traditional perioperative care (TPC) in laparoscopic digestive system surgery.

Methods: We searched five electronic databases for eligible trials. STATA version 14.0 and Revman version 5.3 were used to analyze the data. The results were presented and analyzed by weighted mean difference (WMD) and risk ratio (RR) at their 95% confidence interval (CI).

Results: Twenty-five randomized controlled trials (RCTs) of 2219 patients were included in our meta-analysis. The results revealed that the postoperative hospital stay (PHS) (WMD: 2.13 day, 95% CI: 2.56 to -1.70, p = 0.000), time to first flatus (WMD: 12.68 h, 95% CI: 15.96 to -9.41, p = 0.000), and time to defecation (WMD: 34.35 h, 95% CI: 46.82 to -21.88, p = 0.000) were significantly shorter in the ERAS group compared to the TPC group. Additionally, the overall postoperative complication rate (RR: 0.66, 95% CI: 0.49 to 0.88, p = 0.000) was markedly lower in patients using the ERAS program.

Conclusion: The results indicated that the ERAS program is associated with faster postoperative rehabilitation, shorter PHS, and better postoperative complication rates. The use of the ERAS program for laparoscopic digestive system surgery is more effective and safe than TPC, and it should be recommended. (PROSPERO registration number:CRD42018118551).

Keywords: Digestive system; Enhanced recovery after surgery; Laparoscopic surgery; Meta-analysis

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