Nursing care in enhanced recovery after surgery (ERAS): Pathways for patients undergoing spinal surgery

Caroline Woon RN, BNCrit Care, MN[1 #], Stephen Kivunja RN, BN, MCN, MCLinN, MNEd, PhD Candidate[2,3], Dr. Linda Nichols RN, MCN, PhD[4], Diane Lear RN, MN[5]

1. Clinical Nurse Specialist, Neurosurgery, Wellington Hospital, Wellington, New Zealand, caroline.woon@ccdhb.org.nz
2. Clinical Nurse Specialist, Neurosciences, Western Sydney Local Health District, Westmead Hospital, Westmead, New South Wales, Australia
3. The University of Sydney, Faculty of Medicine and Health, Susan Wakil School of Nursing and Midwifery, Camperdown, New South Wales, Australia 0000-0002-0088-9239
4. Adjunct Researcher, University of Tasmania, Tasmania, Australia 0000-0003-3711-993X
5. Clinical Nurse Consultant, New South Wales, Australia

#Corresponding author

Caroline Woon, Clinical Nurse Specialist, Neurosurgery, Wellington Hospital, Wellington

Abstract

Pain is an expected outcome following spinal surgery. However, increasing evidence indicates that pain is often managed inadequately during the optimisation of patient recovery (Ali, et al, 2018). Following the expected early post-operative pain period, many patients undergoing spinal surgery may experience longer term moderate pain up to six months post-operatively (Prabhakar et al 2022). An exploration of the support required for patients with spine conditions following surgery is presented. Enhanced Recovery After Surgery (ERAS) programs have been introduced globally as evidenced based protocols to provide effective care for surgical patients and are aimed at achieving early and optimal recovery post-surgery (Debono et al., 2021). The aim of this paper is to discuss nursing roles, what constitutes pre-operative risk factors; post operative complications and outcomes; information required for enhanced recovery and effective medications for spinal surgery. A summary of ERAS Programs and the support that is required for patients post spinal surgery is also provided.

Keywords: Enhanced recovery after surgery, spinal surgery, pain, pre-operative risk factors, patient support, neuroscience nursing, neurosurgery.

Introduction

Spinal surgery encompasses surgical procedures that are performed in the cervical, thoracic, lumbar and sacral regions (Pahwa et al., 2024). While spinal surgery is practiced worldwide, there are varying strategies used by clinicians to manage pain among patients who undergo this form of surgery. The experience of pain post-surgery is unique for each patient and hence the challenges for pain management are complex for clinicians to address (Wijgert et al., 2025).

Questions or comments about this article should be directed to Caroline Woon
Email address:

DOI: 10.2478/ajon-2025-0005

Recent innovations in post-spinal surgical pain management have led to the inception of multidisciplinary teams that design and implement Enhanced Recovery After Surgery (ERAS) programs which are multimodal strategies targeted at enhancing patients' post-operative experiences by moderating physiological strain resulting from surgery (Pahwa et al., 2024).

The aim of this paper was to explore nursing roles and what constitutes pre-operative risk factors, information requirements for enhanced recovery and effective medications for patients after spinal surgery. An understanding of enhanced recovery following spinal surgery can empower neurosurgical nurses to prioritise interventions that optimise quality of care and maximise positive outcomes for surgical patients.

Preoperative experience

Patients' pre-operative function, risk factors and pre-operative education and support can affect their post operative recovery. Patients should have a clear understanding of expected post-operative pain before surgery. Pre assessment is important to identify patients taking high doses of opioids or chronic pain as these may be more difficult to manage post operatively (Bhatia & Buvanendran, 2019). Pre-operative risk factors for post-operative pain include catastrophizing, anxiety, depression, preoperative opioid use, pain sensitivity and females (Prabhakar et al., 2022). Fear of movement can occur pre-operatively and is associated with impaired mobility post operatively and should be addressed early to prevent immobility post-operatively (Ali, 2018). The patients' psychological state and high/low expectations have been linked to less optimal results post operatively in spinal surgery and are associated with increased pain sensation and immobility (Licina et al., 2021). Patients require different levels of information to support their surgical journey, and a balance of pre-operative information is important as too little or too much can increase anxiety (Wongkietkachorn et al., 2018).

Waiting time for spinal surgery may significantly impact patient post operative pain experience and their recovery. Longer waiting times may be more apparent with competing priorities such as brain tumours and trauma, as often spinal surgery is not considered as an emergency and occurs electively. Evidence suggests that patients who experienced pain for more than a year before surgery, were associated with poorer outcomes post-operatively (Hamilton et al., 2023). The outcomes assessed included pain, patient satisfaction and return to work. Patients who waited less than three months for surgery had the best outcomes which may be why patients take longer to recover or experience more pain post operatively with longer waiting times.

Post-operative experience

The experience of post-operative pain is unique for every patient and is influenced by compounding factors, some of which may be inherent or external to the person (Waelkens et al., 2021). Inadequately controlled early post-operative pain after spinal surgery can have significant effects on patient outcomes such as delayed mobility, sleep deprivation, inadequate nutrition, incontinence, constipation or increased length of hospital stay (Ali et al, 2018; Ali et al 2019; Licina et al, 2021).

Inadequately managed pain post-operatively can lead to prolonged bedrest.

However, there are several complications that are associated with prolonged bedrest including risk for pneumonia, muscle atrophy, venous thromboembolism, and delayed rehabilitation (Rajan et al., 2022). Therefore, it is important for nurses to ensure that patients are provided adequate pre-preoperative information to enhance the post-operative experience following elective spinal surgery and post operative pain is acknowledged and treated early through nursing assessments.

Patients following spinal surgery may be restricted in their mobility due to multiple factors. These include clinical attachments, such as intravenous fluids, patient-controlled analgesia, indwelling urinary catheter, sequential compression devises, cervical collar, surgical drains and their post-operative functional level (Rupich et al., 2018). Delayed mobilisation can also be associated with some neurosurgical protocols where, for instance, patients are to wait for a follow up CT scan prior to mobilisation (Licina et al., 2021). Fear of pain or anticipation of pain on movement may contribute to increased anxiety resulting in delayed mobilisation and some patients may require support from physiotherapists or a mobility aid to mobilise post-operatively which can cause significant delays. Therefore, facilitating early safe patient mobilisation is a fundamental intervention that nurses should prioritise to safeguard against complications associated with prolonged bed rest (Rupich et al., 2018; Smith et al., 2019). Every patient's surgical journey is unique and is dependent on factors such as the region of the spine being operated on, invasiveness of the surgery, level of pre-operative pain, mobility pre- and post-operatively, co-morbidities, tolerance of medications and pain (Waelkens et al., 2021).

Effective medications for spinal surgery

Several types of medications are used as strategic interventions in the management of pain for spinal surgical patients. Opioids are frequently prescribed during the pre-operative period for patients, but this may create drug tolerance making post-operative pain management challenging (Yerneni et al, 2020). The utilisation of opioids has traditionally been the preferred choice of pain relief following spinal surgery, but they are associated with a number of side effects including nausea, vomiting, drowsiness, urinary retention, constipation and respiratory depression (Rajan et al., 2022). This leads to longer hospital stays, difficult to manage pain cycles, and delayed rehabilitation. More recently practice has moved to a multimodal pain relief approach throughout the patient journey from pre-operatively, intra-operatively and post-operatively with the avoidance of opioids (Ali et al, 2018; Bae et al., 2022; Debono et al, 2021; Lucina et al, 2021). Triple pharmacy consisting of paracetamol, nonsteroidal anti-inflammatory drugs, and either a gabapentanoid or an adjunct such as duloxetine, epidural clonidine, lidocaine infusion dexamethasone, or magnesium infusion has been shown to reduce the use of opioids and improve the level of pain post-operatively (Bae et al,2022). Dehkordy et al. (2020) note that peri-operative magnesium infusion improves the post-operative analgesia, decreases the amount of morphine consumption following surgery and does not change the intra-operative bleeding in patients undergoing posterior spinal fusion surgery. Through ERAS programs, evidence has become clear that

limiting the use of opioids and focusing on multimodal pain relief can be effective in attaining positive post-operative outcomes for patients (Naftalovich et al, 2022).

Enhanced recovery after surgery [ERAS] programs

ERAS Programs are evidence based holistic protocols for the whole patient surgical journey and have led to improvements in outcomes for numerous surgical procedures through multimodal optimization of the patient pathway (Enhanced Recovery After Surgery [ERAS] Society, 2025). Originally, ERAS were popularised in the 1990s, as a systematic multi-model approach to managing perioperative patients via what was then referred to as Fast-Track Surgery (Debono et al., 2021).

The ERAS Society (www.erassociety.org) was founded in 2010 and continues to develop a range of guidelines that inform various types of surgeries worldwide (Debono et al., 2021; The ERAS Society, 2025). ERAS programs improve clinical outcomes, reduce complications, accelerate patient recovery, reduce hospital length of stay as well as improving patient satisfaction, and enabling early patient discharge from hospital (Choi et al., 2022; Dietz et al., 2019, Ljungqvist et al., 2017). One of the key benefits from ERAS protocols is reduction in hospital length of stay (Bansal, Sharan & Garg; 2022). These outcomes are achieved by addressing pre-operative, perioperative and post-operative factors in the patient's journey, that encompass not just pain management but also providing a holistic, and interdisciplinary approach to patient care (Ali et al, 2019). There is a nursing consideration that if patients are well prepared for surgery pre-operatively, their recovery post operatively may be accelerated.

Other key nursing considerations in the ERAS program may include pain management, nutrition, elimination, mobility, psychological needs, sleep, wound care and support as well as patient and family education with the patient at the centre of their care. Preoperative education and counselling, smoking and ethyl alcohol cessation, nutritional evaluation and optimisation of medications are all fundamental nursing considerations. All these nurse-led interventions are important as they contribute to reduced length of stay. ERAS programs ensure patients are educated pre-operatively to reconcile personal expectations with anticipated post-operative outcomes. However, according to Yoo et al. (2019) positive post-operative outcomes are linked to post-operative patient satisfaction but have no association with pre-operative patient expectations.

Rampersaud et al. (2022) demonstrated a link between patient expectations and outcomes suggesting that if patients had higher expectations pre-operatively, they were more likely to be less satisfied with their post-surgical outcomes. The nursing role is vital in addressing the patient's expectations in such instances. Perhaps it would be better to manage pre-operative expectations and provide education on the realistic recovery time, the importance of early mobilization, pain management, wound healing and overall outcomes. These models of patient care are in line with the New Zealand (NZ) Māori health model 'Te Whare Tapu Whā' which ensures four pillars of health, which are Taha tinana (physical health), Taha wairua (spiritual health), Taha whanau (family health) and Taha hinengaro

(mental health) giving the picture that if one of these walls is missing or unbalanced, the person may become unwell and in order for us to be successful in our patient outcomes, all four must be supported (Ministry of Health NZ, 2023). There are currently no ERAS programs in New Zealand, but Australia has these programs in operation, for instance, the Westmead ERAS Protocol (Pahwa et al., 2024). The limitations to ERAS programs are that they require commitment of ample time and healthcare resources to operate effectively and support the provision of holistic patient care throughout the surgical journey. Also, pre-operative and post-operative experiences are reliant on effective communication, sharing quality information and support. All these aspects are vital for success of any ERAS program, but require time and commitment from multiple members of the multidisciplinary team. If implemented successfully these interventions can reduce hospital stay and complications with a smoother journey through recovery for the patient but similarly, longer waiting times would complicate this process.

A summary of selected ERAS protocols in practice

The main goal of ERAS protocols is to utilise a combination of multimodal, multidisciplinary interventions to control pain and achieve positive patient outcomes post-surgery (Pahwa et al., 2024). As such, there are different ERAS protocols specific for surgical interventions (Naftalovich et al., 2022; Pahwa et al., 2024). A summary of six protocols from different institutions are outlined in Table 1 which largely focused on medication management (Naftalovich et al, 2022). Two key themes in the ERAS protocols reviewed are early mobilisation and multimodal pain relief tailored to individual patients for spinal surgery. It was noted that although dosage of multimodal medication was difficult to determine, the interventions can affect recovery time, complication and readmission rates (Bhatia & Buvanendran, 2019). However other pain management strategies can be considered such as yoga, cognitive behavioural therapy and music therapy (Grasu et al., 2018). These would be difficult to implement, standardise and would require allocation of ample time and resources from hospitals and a willingness to participate from patients.

These six protocols addressed various aspects of pre, intra and post-operative pain management and differed in their clinical approach. For ERAS protocols to be effective, they have to be adaptable to each individual, as patients experience pain differently and express varying pain thresholds. A unique note from the Perelman ERAS protocol which incorporated the practice of patients chewing gum as an intervention for post-operative pain management (Ali et al.,2018; Ali et al., 2019). Liao et al. (2022) also determined that chewing gum not only significantly reduced post-operative pain for patients following spinal surgery but also shortened the time between surgery and first bowel motion. Some ERAS protocols utilised minimum or regular pain relief with supplemental options as an intervention to contain break through pain (Pahwa et al., 2024). Nursing interventions such as early mobilisation, early nutrition, prevention of Venous Thromboembolism and early discharge are key features that support timely patient recovery post operatively (Ali et al.; 2019; Grazu et al.; 2018; Pahwa et al., 2024; Soffin et al.,2019)

Conclusion

This paper has illuminated factors that impact patients' recovery from spinal surgery. The use of ERAS programs has been explored as a strategic evidence-based approach that can facilitate early patient recovery and discharge. Support for the patient and their family through the recovery journey is fundamental. Preoperatively, it is important to discuss and manage surgical expectations, risk screening, managing anxiety, mobility and pain assessment and planning. Managing patients' expectations of pain and recovery following spinal surgery is vital and requires specialist neurosurgical nursing expertise. Considerations for effective nursing interventions in post-operative recovery include, thorough nursing assessment, effective communication, early patient mobilisation, prevention of constipation or other complications and effective multimodal pain relief. Further multi-centred research could be conducted in these areas to determine what comprises spinal surgical patient satisfaction in relation with post-operative care and to ascertain the aspects of nurse-clinician interventions that can be improved upon to enhance the patient experience and optimise recovery. All aspects of care are dependent on each other and therefore prevention of complications and early discharge from hospital is important. Important domains for careful nursing consideration are pain relief, elimination, early mobility, nutrition, wound care, culture and psychological support.

Pain management : ERAS or medication protocols

ERAS Protocol/medication protocol (Host/Institution)	Type of surgery and primary study	Pre-operative	Intra-operative	Post-operative	Outcomes
Enhanced recovery after surgery society guidelines	Debano et al, (2021) Society Guideline	Manage expectations and education. Patient optimization: Smoking cessation, alcohol nutrition and anaemia. Optimisation of medication Dosing of acetaminophen, NSAIDs, and gabapentinoids should ideally be adjusted based on age, renal function, and other comorbidities	Multimodal analgesia, opioid sparing. Hypothermia prevention Post-operative nausea and vomiting prevention Optimal fluid management Anti-microbial prophylaxis Anti-thrombotic therapy, catheter and management of drain/s.	Early mobilisation Nutrition management Multimodal analgesia, opioid sparing. Fluid management Prevention of Nausea and Vomiting Anti-thrombotic therapy Management of catheter and drain/s.	Optimisation of pain relief for patients
Rush University Medical Centre, USA	Spine surgery (Bhatia & Buvanendran, 2019). Pain medication Protocol	1,000mg IV acetaminophen 600mg Gabapentin Or 150mg pregabalin 10mg cyclobenzaprine 10mg oxycodone **Meds 1 hour before surgery**	Propofol infusion at induction, inhaled anaesthesia, ketamine at induction, dexamethasone, fentanyl, methadone, lidocaine, acetaminophen (see below)	NSAID Gabapentin Pregabalin Tramadol **Postoperative day 0** (I) Cold compresses applied to surgical area	Potential to make difference to length of stay.

		Cyclobenzaprine 10 mg (II) Pregabalin 150 mg (III) Oxycodone release 10 mg	**Induction of anaesthesia**—propofol 2 mg/kg plus ketamine 50 mg **Maintenance of anaesthesia**—sevoflurane with fentanyl 1–2 mg/kg titrated to clinical effect Additional medications administered intraoperatively (I) Bupivacaine 0.5% with epinephrine 1:200,000 injected at incision site (i) 20 mL per side if patient weight <70 kg (ii) 30 mL per side if patient weight ≥70 kg (II) Acetaminophen 1,000 mg IV (III) Dexamethasone 10 mg IV (IV) Ondansetron 4 mg IV (V) Famotidine 20 mg IV Oral pain medications if possible, in recovery room	(II) Pregabalin 75 mg q12h orally (III) Cyclobenzaprine 10 mg q8h orally (IV) Tramadol 50 mg q6h (V) Oxycodone immediate release (i) 5 mg q4h as needed for pain (NRS >3), opioid naïve patients (ii) 10 mg q4h as need for pain (NRS >4), opioid tolerant patients Postoperative day 1 (I) Cyclobenzaprine 10 mg PO prn for spasms (II) Hydrocodone 10 mg plus acetaminophen 325 mg (i) 1 tablet as needed for pain (NRS 1–5) (ii) 2 tablets as needed for pain (NRS 6–10)	
Weill Cornell Medical College, USA	Minimally invasive lumbar decompression spine surgery (Soffin et al.,2019)	oral acetaminophen (1000 mg) and gabapentin (300 mg) in the preoperative holding area	Total intravenous anaesthesia, ketorolac, lidocaine, dual antiemetic, prophylactic therapy	Acetaminophen, NSAID, Two 50mg tramadol or 5mg oxycodone based on NRS pain score	Potential for quicker discharge and reduced opioid use.

	Retrospective Matched cohort study (n = 18)		boluses of fentanyl (1–2 µg/kg, titrated to effect) or Dilaudid (up to 2 mg total), according to the judgment of the anesthesiologist to achieve optimal hemodynamic and anesthetic conditions for surgery. All patients received infusions of the following: 1) propofol (50–150 µg/kg/hr), adjusted to maintain the mean arterial pressure within ± 20% of each patient's baseline value, 2) ketamine (0.1–0.5 mg/min), and 3) lidocaine (2 mg/kg/hr until closure of the surgical incision). Inhaled halogenated agents (isoflurane or sevoflurane) were permitted, up to 0.5 minimum alveolar concentration (MAC), as needed. Dual antiemetic therapy with dexamethasone (4 or 8 mg) and ondansetron (4 mg) were provided. Ketorolac (15 or 30 mg, according to age and weight) was given during surgical closure.	Patients with reported NRS scores ≤ 4 should be treated with non-opioid analgesics (acetaminophen, ketorolac-, gabapentin, and/or non-pharmacotherapies, including ice, distraction, and position changes); for those with NRS scores 5–7, patients may receive two 50-mg doses of tramadol- if needed; and for those with NRS scores 8–10, patients may receive a 5-mg oxycodone. Further escalation of opioids requires assessment by the anesthesiologist. PONV are treated with metoclopramide (10 mg intravenously) or ondansetron (4 mg). Patients with refractory PONV are prescribed scopolamine (1.5 mg transdermal).	

University of Western Ontario, Canada	Spine surgery (Alboog et al., 2019) Review	Pregabalin, gabapentin 0.2mg per KG, methadone	Selective COX-2 inhibitors, ketamine administration (bolus or infusion), tramadol, analgesics mixture	NA	Recommend a combined use of gabapentinoids, ketamine, and opioids to achieve optimal analgesia
Perelman, School of Medicine, University of Pennsylvania, USA	Spine surgery (Ali et al.,2018; Ali et al., 2019; Ali et al.; 2023) ERAS Pilot study (n = 202) Randomised Controlled Trial (n = 142)	Education, nutrition, diabetes management, smoking cessation counselling, chronic opioid screen use, obstructive sleep apnoea screen, and discharge planning. 600mg Gabapentin	Metabolism management, multimodal analgesia, safe spinal surgery checklist, early mobilisation and wound care. NSAIDS opioids, anticonvulsants, other analgesia	Clinical team communication, wound care management, post-acute care neurosurgery triage pathway. 975mg 6 hourly acetaminophen, diazepam po, cyclobenzaprine, ketorolac, wound care, gum chewing (1 piece for 3 minutes daily), physiotherapy	ERAS protocol greatly improves postoperative mobilization and ambulation and, most importantly, has the potential to safely reduce opioid use both in the perioperative period and at 1 month after surgery, with important potential for relief of chronic opioid dependence.
University of Texas, USA	Spine surgery for metastatic tumours (Grasu et al., 2018) Preliminary analysis of implementation of ERAS (n = 97)	Education, sedation and anxiety management, pain management and pre-op fasting patient on ≥5 opioid tablets/day; patient on long-acting opioid medication; rapidly increasing opioid requirements; pain not responsive to prescribed	Fluid, temperature and transfusion management, surgical management IV anesthesia maximization: infusions of propofol, dexmedetomidine, ketamine, lidocaine, methadone (0.1–0.2 mg/kg) single upfront IV dose in opioid-tolerant patients; IV dexamethasone 10 mg every 6 hrs; consistent	Early ambulation, early oral intake, DVT prophylaxis, physical therapy Gabapentin 300 mg orally every 8 hrs, celecoxib 200 mg orally every 12 hrs, tramadol ER 200 mg orally every 12 hrs, acetaminophen 1 g orally every 6 hrs, continue preop long-acting opioids plus IV PCA; cancer pain consult if pain	Improved analgesia and decreased opioid consumption in the perioperative care of patients undergoing spine surgery for metastatic tumors
		analgesics; patient treated by an outside pain physician; significant psychosocial distress related to pain &/or surgery; current or history of recreational drugs use. Consider starting w/ low-dose (e.g., 100 mg/daily) gabapentin for neuropathic pain & patient <65 yrs of age Day of surgery: tramadol ER 300 mg orally + gabapentin 300 mg (or pregabalin 75 mg) orally + acetaminophen 1000 mg orally upon arrival in preoperative holding area; consider decreasing dosage if patient ≥65 yrs old	risk-based antiemetic, & DVT prophylaxis; emphasis on lung-protective mechanical ventilation strategies	poorly controlled, daily hydromorphone requirement >12 mg/day or morphine >60 mg/day, pain limits daily function/rehabilitation, significant psychosocial distress	
Westmead ERAS Protocol, Australia	Elective spinal (lumbar and cervical) decompression surgery (Pahwa et al., 2024) ERAS Protocol	Modern fasting, prioritised as first or second surgical case. Preceeded by: Period (1) Operative consultation (operative plan, patient education, ERAS inception) Period (2) Preadmission clinic	Post-operative nausea & vomiting prophylaxis Normovolemia Normothermia Microscope assisted Surgery No IDC No wound drains Local anaesthetic	Early mobilisation Multimodal analgesia Same day discharge (within 4 hours) Phone call follow up day 1 postoperatively Follow up in clinic on day 5 Routine follow-up at 6 weeks post-surgery	Early discharge post-surgery

		(patient re-education, ERAS principles & reinforcement) Pre-emptive analgesia: 200mg celecoxib, 75mg pregabalin, 1g paracetamol	General anaesthetic with minimal dose of bupivacaine and 0.25% adrenaline, 1mg/kg oxycodone, 10-20 mmol Magnesium sulphate & 2mcg/kg clonidine	8mg dexamethasone for post-operative nausea & vomiting Opioid sparing multimodal analgesia: (regular paracetamol, celecoxib, tapentadol as required (PRN) as provided as a script at time of discharge.	

ABBREVIATIONS: ER = Extended release; IDC= Indwelling urinary catheter; IV = Intravenous fluids; NSAID = Non-steroidal anti-inflammatory drugs; NRS = Numeric rating scale for pain; PCA: Patient-controlled analgesia; PO = By mouth; PONV = Post operative nausea and vomiting

Table 1: A summary of pre, peri and post-operative stages of medications in ERAS protocols from different institutions adapted from (Alboog et al., 2019; Ali et al.,2018; Ali et al., 2019; Ali et al.; 2023; Bhatia & Buvanendran ,2019; Debano et al, (2021); Grasu et al., 2018; Naftalovich et al., 2022; Pahwa et al., 2024; Soffin et al.,2019)

References

Alboog, A., Bae, S., & Chui, J. (2019). Anesthetic management of complex spine surgery in adult patients: a review based on outcome evidence. Current Opinion in Anaesthesiology, 32(5), 600–608. https://doi.org/10.1097/ACO.0000000000000765

Ali, Z. S., Ma, T. S., Ozturk, A. K., Malhotra, N. R., Schuster, J. M., Marcotte, P. J., Grady, M. S., & Welch, W. C. (2018). Pre-optimization of spinal surgery patients: Development of a neurosurgical enhanced recovery after surgery (ERAS) protocol. Clinical Neurology and Neurosurgery, 164, 142–153. https://doi.org/10.1016/j.clineuro.2017.12.003

Ali, Z.S., Flanders, T.M., Ozturk, A.K., et al. (2019). Enhanced recovery after elective spinal and peripheral nerve surgery: pilot study from a single institution. Journal of Neurosurgery. https://doi: 10.3171/2018.9.Spine18681. https://journals.lww.com/annalsofsurgery/abstract/2023/09000/a_randomized_controlled_trial_to_assess_the_impact.12.aspx

Ali, Z. S., Albayar, A., Nguyen, J., Gallagher, R. S., Borja, A. J., Kallan, M. J., ... & Malhotra, N. R. (2023). A randomized controlled trial to assess the impact of enhanced recovery after surgery on patients undergoing elective spine surgery. Annals of Surgery, 278(3), 408-416.

Bae, S., Alboog, A., Esquivel, K. S., Abbasi, A., Zhou, J., & Chui, J. (2022). Efficacy of perioperative pharmacological and regional pain interventions in adult spine surgery: a network meta-analysis and systematic review of randomised controlled trials. British Journal of Anaesthesia , 128(1), 98–117. https://doi.org/10.1016/j.bja.2021.08.034

Bansal, T., Sharan, A. D., & Garg, B. (2022). Enhanced recovery after surgery (ERAS) protocol in spine surgery. Journal of clinical orthopaedics and trauma, 31, 101944.

Bhatia, A., & Buvanendran, A. (2019). Anesthesia and postoperative pain control—multimodal anesthesia protocol. Journal of Spine Surgery, 5(S2), S160–S165. https://doi.org/10.21037/jss.2019.09.33

Choi, Y. S., Kim, T. W., Chang, M. J., Kang, S. B., & Chang, C. B. (2022). Enhanced recovery after surgery for major orthopedic surgery: a narrative review. Knee Surgery & Related Research, 34(1), 8. https://doi.org/10.1186/s43019-022-00137-3

Debono, B., Wainwright, T. W., Wang, M. Y., Sigmundsson, F. G., Yang, M. M. H., Smid-Nanninga, H., Bonnal, A., Le Huec, J.-C., Fawcett, W. J., Ljungqvist, O., Lonjon, G., & de Boer, H. D. (2021). Consensus statement for perioperative care in lumbar spinal fusion: Enhanced Recovery After Surgery (ERAS®) Society recommendations. The Spine Journal, 21(5), 729–752. https://doi.org/10.1016/j.spinee.2021.01.001

Dehkordy, M. E., Tavanaei, R., Younesi, E., Khorasanizade, S., Farsani, H. A., & Oraee-Yazdani, S. (2020). Effects of perioperative magnesium sulfate infusion on intraoperative blood loss and postoperative analgesia in patients undergoing posterior lumbar spinal fusion surgery: A randomized controlled trial. Clinical Neurology and Neurosurgery, 196, 105983–105983. https://doi.org/10.1016/j.clineuro.2020.105983

Dietz, N., Sharma, M., Adams, S., Alhourani,

A., Ugiliweneza, B., Wang, D., Nuño, M., Drazin, D., & Boakye, M. (2019). Enhanced Recovery After Surgery (ERAS) for Spine Surgery: A Systematic Review. World Neurosurgery, 130, 415–426. https://doi.org/10.1016/j.wneu.2019.06.181

Enhanced Recovery After Surgery Society. (ERAS). (2025). Enhanced recovery after surgery. https://erassociety.org/

Fearon, K. C. H., Ljungqvist, O., Von Meyenfeldt, M., Revhaug, A., Dejong, C. H. C., Lassen, K., Nygren, J., Hausel, J., Soop, M., Andersen, J., & Kehlet, H. (2005). Enhanced recovery after surgery: A consensus review of clinical care for patients undergoing colonic resection. Clinical Nutrition, 24(3), 466–477. https://doi.org/10.1016/j.clnu.2005.02.002

Grasu, R. M., Cata, J. P., Dang, A. Q., Tatsui, C. E., Rhines, L. D., Hagan, K. B., Bhavsar, S., Raty, S. R., Arunkumar, R., Potylchansky, Y., Lipski, I., Arnold, B. A.,McHugh, T. M., Bird, J. E., Rodriguez-Restrepo, A., Hernandez, M., & Popat, K. U. (2018). Implementation of an Enhanced Recovery After Spine Surgery program at a large cancer center: a preliminary analysis. Journal of Neurosurgery, 29(5), 588-598. https://doi.org/https://doi.org/10.3171/2018.4.SPINE171317

Hamilton, T., Bartlett, S., Deshpande, N., Hadi, M., Reese, J. C., Mansour, T. R., Telemi, E., Springer, K., Schultz, L., Nerenz, D. R., Abdulhak, M., Soo, T., Schwalb, J., Khalil, J. G., Aleem, I., Easton, R., Perez-Cruet, M., Park, P., & Chang, V. (2023). Association of prolonged symptom duration with poor outcomes in lumbar spine surgery: a Michigan Spine Surgery Improvement Collaborative study. Journal of Neurosurgery: Spine, 39(4), 452-461. https://doi.org/https://doi.org/10.3171/2023.5.SPINE23249

Liao, X., Li, S., Peng, Y., Chen, L., & Lin, Y. (2022). Effects of chewing gum on gastrointestinal function in patients following spinal surgery: a meta-analysis and systematic review. European Spine Journal, 31(10), 2536–2546. https://doi.org/10.1007/s00586-022-07304-w

Licina, A., Silvers, A., Laughlin, H., Russell, J., & Wan, C. (2021). Pathway for enhanced recovery after spinal surgery-a systematic review of evidence for use of individual components. BMC Anesthesiology, 21(1), 74–74. https://doi.org/10.1186/s12871-021-01281-1

Ljungqvist, O., Thanh, N. X., & Nelson, G. (2017). ERAS—Value based surgery. Journal of Surgical Oncology, 116(5), 608–612. https://doi.org/10.1002/jso.24820

Ministry of health New Zealand (NZ) .(2023). Maori health models. Accessed 22/5/24) https://www.health.govt.nz/our-work/populations/maori-health/maori-health-models/maori-health-models-te-whare-tapa-wha

Naftalovich, R., Singal, A., & Iskander, A. (2022). Enhanced Recovery After Surgery (ERAS) protocols for spine surgery – review of literature. Anaesthesiology Intensive Therapy, 54, 71-79. https://doi.org/10.5114/ait.2022.113961
Pahwa, A., Gong, H., Li, Yingda (2024). Enhanced recovery after elective spinal surgery: an Australian pilot study. Journal Spine Surgery 10(1): 30-39. https://doi.org/10.21037/jss-23-115

Prabhakar, N. K., Chadwick, A. L., Nwaneshiudu, C., Aggarwal, A., Salmasi, V., Lii, T. R., & Hah, J. M. (2022). Management of postoperative pain in patients following spine surgery: a narrative review. International Journal of General Medicine, 4535-4549. https://doi.org/10.2147/IJGM.S292698

Rajan, S., Devarajan, J., Krishnaney, A., George, A., Rasouli, J. J., & Avitsian, R. (2022). Opioid alternatives in spine surgery: A narrative review. Journal of Neurosurgical Anesthesiology, 34(1), 3–13. https://doi.org/10.1097/ANA.0000000000000708

Rampersaud, Y. R., Canizares, M., Perruccio, A. V., Abraham, E., Bailey, C. S., Christie, S. D., Evaniew, N., Finkelstein, J. A., Glennie, R. A., Johnson, M. G., Nataraj, A., Paquet, J., Phan, P., Weber, M. H., Thomas, K., Manson, N., Hall, H., & Fisher, C. G. (2022). Fulfillment of patient expectations after spine surgery is critical to patient satisfaction: A cohort study of spine surgery patients. Neurosurgery, 91 (1), 173–181. https://doi.org/10.1227/neu.0000000000001981

Rupich, K., Missimer, E., O'Brien, D., Shafer, G., Wilensky, E. M., Pierce, J. T., Kerr, M., Kallan, M.J., Dolce, D., & Welch, W. C. (2018). The Benefits of Implementing an Early Mobility Protocol in Postoperative Neurosurgical Spine Patients. The American Journal of Nursing, 118(6), 46–53. https://doi.org/10.1097/01.NAJ.0000534851.58255.41

Smith, J., Probst, S., Calandra, C., Davis, R.,

Sugimoto, K., Nie, L., Gan, T. J., & Bennett-Guerrero, E. (2019). Enhanced recovery after surgery (ERAS) program for lumbar spine fusion. Perioperative Medicine, 8(1), 4–4. https://doi.org/10.1186/s13741-019-0114-2

Soffin, E. M., Wetmore, D. S., Beckman, J. D., Sheha, E. D., Vaishnav, A. S., Albert, T. J., Gang, C. H., & Qureshi, S. A. (2019). Opioid-free anesthesia within an enhanced recovery after surgery pathway for minimally invasive lumbar spine surgery: a retrospective matched cohort study. Neurosurgical Focus, 46(4), E8. https://doi.org/https://doi.org/10.3171/2019.1.FOCUS18645

Waelkens, P., Alsabbagh, E., Sauter, A., Joshi, G. P., & Beloeil, H. (2021). Pain management after complex spine surgery: A systematic review and procedure-specific postoperative pain management recommendations. European Journal of Anaesthesiology, 38(9), 985–994. https://doi.org/10.1097/EJA.0000000000001448

Wijgert, I. H., Vissers, K. C. P., Fenten, M. G. E., Rood, A., Boekel, R. L. M., & Hooff, M. L. (2025). Development of a core outcome set of domains to evaluate acute pain treatment after lumbar spine surgery: A modified delphi study. European Journal of Pain, 29(2), e4784-n/a. https://doi.org/10.1002/ejp.4784

Wongkietkachorn, A., Wongkietkachorn, N., & Rhunsiri, P. (2018). Preoperative needs-based education to reduce anxiety, increase satisfaction, and decrease time spent in day surgery: A Randomized Controlled Trial. World Journal of Surgery, 42(3), 666–674. https://doi.org/10.1007/s00268-017-4207-0

Yerneni, K., Nichols, N., Abecassis, Z. A., Karras, C. L., & Tan, L. A. (2020). Preoperative opioid use and clinical outcomes in spine surgery: A systematic review. Neurosurgery, 86(6), E490–E507. https://doi.org/10.1093/neuros/nyaa050

Yoo, J. S., Patel, D. V., Mayo, B. C., Massel, D. H., Karmarkar, S. S., Lamoutte, E. H., & Singh, K. (2019). Postoperative satisfaction following lumbar spinal fusion surgery: patient expectation versus actuality. Journal of Neurosurgery: Spine SPI, 31(5), 676-682. https://doi.org/https://doi.org/10.3171/2019.5.SPINE19213

Get more from your levodopa/DDCI regimen:

Ongentys® works to bring more levodopa to the brain where it is needed^[1]

^Combining Ongentys® 50 mg with 400 mg levodopa provides higher bioavailability with avoidance of trough levels vs 500 mg levodopa[1]

ONgentys®
OPICAPONE

Ongentys® is indicated as adjunctive therapy to preparations of levodopa/DDCI in adult patients with Parkinson's disease and end-of-dose motor fluctuations who cannot be stabilised on those combinations.*[2]

Scan QR code to access Product Information

STADA
Caring for People's Health

*Post-hoc analyses of BI PARK-I & II where data from placebo vs OPC 50 mg patients with PD (n=517) were combined. OPC was associated with a statistically significant reduction in OFF-time and increased ON-time from baseline vs placebo in most of the subgroups ($p<0.05$).[1,3-4]

Ongentys® has a generally favourable safety and tolerability profile. The most common adverse reactions (incidence at least 4%) reported in clinical trials were dyskinesia, constipation, insomnia, and dry mouth. Other common adverse reactions include: Nausea, hallucinations, headache, orthostatic hypotension, vomiting, and muscle spasms.[2] Pooled pivotal study data demonstrated the majority of treatment-emergent adverse events (TEAEs) were mild in nature and discontinuation rates were low and comparable to placebo.[4,7]

Please review Product Information before prescribing.

Ongentys® is listed on the PBS. Refer to PBS Schedule for full authority and restricted benefit information.

▼ This medicinal product is subject to additional monitoring. This will allow quick identification of new safety information. Healthcare professionals are asked to report any suspected adverse events at www.tga.gov.au/reporting-problems.

COMT: catechol-O-methyltransferase; **DDCI:** dopa decarboxylase inhibitor; **OPC:** Opicapone; **TEAE:** treatment-emergent adverse event.

References: 1. Ferreira JJ, *et al. Mov Disord.* 2022 Nov;37(11):2272-2283. **2.** Ongentys® Approved Product Information. **3.** Rocha JF, *et al. Frontiers in Neurology.* 2021 Nov 5;12. **4.** Ferreira JJ, *et al. Lancet Neurol* 2016;15:154–65. **5.** www.michaeljfox.org. (n.d.). Ongentys (opicapone) | Parkinson's Disease. [online] Available at: https://www.michaeljfox.org/news/ ongentys-opicapone. **6.** COMTAN® (Entacapone) Approved Product Information. **7.** Lees A, *et al. J Parkinson Dis.* 2019;9:733–40.

STADA Pharmaceuticals Australia Pty Ltd. Suite 2.04, 26 Rodborough Road Frenchs Forest NSW 2086 Australia. Ph: +61 2 9452 6656. Email: info@stada.com.au
Distributed under license from BIAL. Ongentys® is a registered trademark of BIAL. STP019. ONG-PRO-1172-AUS-v1. Date of preparation: April 2025.