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Implementation of Enhanced Recovery After Surgery for Adult Cervical Spine Fusion

Patients:

A Quality Improvement Project

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Introduction

Back pain and spine disorders are common conditions that affect our healthcare system. Ten to fifteen percent of the population suffers from chronic back pain (Cram et al., 2019). While some back pain and conditions are alleviated with conservative measures, other patients need to undergo spinal surgery. Every year there are nearly 900,000 American adults who experience spine surgery with costs that can vary from \$4,500 to \$30,000 and above, depending on the type of procedure and location (Cram et al., 2019). Complications from spine surgery are a concern for any patient and surgeon as these types of surgeries can cause personal and economic effects, along with creating a negative quality of life (Reis & Botelho, 2015).

Swong et al. (2019) report that spinal surgeries are extremely complex, and up to 37% of patients undergoing spinal fusion procedures suffer from postoperative complications such as an ileus, deep vein thrombosis (DVT), myocardial infarction, and death. It is important for medical staff and providers to ensure that patients have a safe and successful surgical journey and to implement practices that can benefit patient healthcare outcomes. One way to improve outcomes for a patient undergoing cervical spine surgery, is through the implementation of an Enhanced Recovery after Surgery (ERAS) protocol (Dietz et al., 2019).

The ERAS protocol was introduced in 1997 with the goal of improving surgical outcomes (Debono et al., 2019). An ERAS protocol focuses on all aspects of the surgical areas including preoperative, intraoperative, and postoperative care. ERAS protocols have been shown to substantially improve patient outcomes, reduce patient recovery time and length-of-stay (LOS) by two to three days, and decrease complication rates by 30-50% (Ljungvist, 2014).

Surgical trauma activates the stress response in the body leading to imbalances. Every body system can be affected due to stress. The ERAS protocol was created to reduce these

stressors for a patient through enhancing nutritional and functional status, limiting preoperative fasting, managing individualized fluid imbalances, reducing the use of opioids intraoperatively and postoperatively, and implementing early mobilization and feeding postoperatively (Brown et al., 2018). The ERAS protocol is currently being utilized in hospitals worldwide for a variety of surgical procedures with great success, resulting in better patient outcomes. Most major surgeries have similar problems postoperatively, such as attaining normal bowel function, resuming diet, controlling pain, and mobilizing patients (Ljungqvist, 2014). ERAS is associated with shorter lengths of hospital stays, a decrease in patient and hospital costs, improvement in bowel function postoperatively, and a decrease in postoperative complications, such as infections, DVTs, or an ileus (Elsarrag et al., 2019).

Background of Problem

There is data to support the increase in rates and cost of spine surgery in the United States, along with complications from the surgeries (Missios & Bekelis, 2015). Missios and Bekelis (2015) conducted a retrospective cohort study involving 672,591 patients who underwent spine surgery and were registered in the National Inpatient Sample from 2005–2010; 53.1% who underwent fusions and 46.9% were non-fusion surgeries, and concluded that the median hospitalization cost was \$14,202. Complications following spine surgery have been identified in 16.4% to as high as 80% of cases for complex spine surgeries (Dietz et al., 2019).

ERAS for spine surgery may benefit patient outcomes, improve surgeon and patient decision making, and advance the rehabilitative journey. Opportunities for improving patient outcomes and decreasing complication rates make neurosurgery an excellent setting for ERAS protocol implementation. The majority of research has been focused on ERAS implementation in other surgical areas, but there is limited focus on research on ERAS protocols utilized for

neurosurgical patients, especially concerning cervical spine patients undergoing surgery.

Monaghan et al. (2019) found that an ERAS protocol for cervical spine surgery patients reduces the LOS, decreases complications and mortality, and reduces readmission rates for patients. By providing an ERAS protocol for cervical spine surgery patients, patient outcomes will be improved in the preoperative, intraoperative, and postoperative areas.

Problem Statement and Aim

The purpose of this quality improvement project is to implement an Enhanced Recovery after Surgery (ERAS) protocol for adult cervical spine surgery patients at a tertiary care teaching center in central Illinois. The focus is implementing ERAS into all aspects of surgical care for adult cervical spine patients undergoing surgery, including the preoperative, intraoperative, and postoperative areas. Project aims include:

1. Review the literature and outcomes to develop an ERAS protocol for adult cervical spine surgery patients.
2. Implement ERAS for adult cervical spine surgery patients at the tertiary care teaching center in central Illinois.

Clinical Significance

The neurosurgical practice where this DNP project will be implemented, focuses on ‘every patient, every time; serving with the greatest care and love’. To do this, the practice must protect the surgical patients and ensure that patients have a safe and successful surgical journey, beginning from the preoperative period and extending into the intraoperative and postoperative periods. The goal is to make sure that the surgical patients have excellent and safe outcomes from surgery while considering reducing the hospital length of stays, readmissions, and overall costs. The priority is putting patients first and treating everyone with the same respect and love that they would with their family member(s); patients are considered a part of the practice’s extended family. With this as a priority, the neurosurgical team collaborates with the surgical team members in the outpatient setting as well as the inpatient setting, including the intraoperative staff and anesthesiology department. Many times, the staff tries to include patients in their care plan and work together to ensure a positive surgical experience and outcome. The staff strives for the patients to decrease the use of opioids (which can lead to further complications), mobilize quickly after surgery to decrease the chance of postoperative complications such as ileus, deep vein thrombus, pneumonia, and pulmonary embolisms, and decrease other postoperative complications that patients could encounter. The tertiary care center in central Illinois currently does not have a protocol in place which could positively and consistently affect these areas for patient improvement regarding surgery. A change that could positively affect surgical patients at the tertiary care center, while involving patients in their surgical treatment care plan and while improving patient outcomes, is the implementation of an ERAS protocol for the neurosurgical patients.

The goal of an ERAS protocol is to improve surgical outcomes, improve patient quality of life, decrease hospital stays, and reduce complications and is included in the preoperative, intraoperative, and postoperative periods (Heo & Park, 2019). Liu et al. (2019) found that the implementation of an ERAS protocol can considerably reduce the postoperative length of stay, increase functional recovery, decrease readmissions, and reduce complications while leading to an improvement in patient outcomes. Applying an ERAS protocol to neurosurgery patients has the potential to improve patient care, outcomes, and decrease costs. The tertiary care teaching center in central Illinois does not currently have an ERAS protocol in place for adult cervical spine surgery patients, which allows this project to be clinically significant.

Literature Review

Search Strategy

A literature search was conducted using electronic databases including MEDLINE, PubMed, Cochrane Database of Systematic Reviews (CDSR), and Cumulative Index for Nursing and Allied Health Literature (CINAHL) for literature regarding implementation of ERAS in neurosurgical patients, along with ERAS implementation for surgical patients throughout other surgical areas. All searches were limited to literature published in English and since 2014. General search terms yielded over 12,086 results. Refined search terms included: ERAS, ERAS in neurosurgical patients, ERAS in lumbar spine patients, ERAS in cervical patients, ERAS and pain control, ERAS and early mobilization, ERAS and staff experiences, ERAS and cost savings, ERAS and length of stay, ERAS and readmissions, ERAS and opioid use, ERAS and postoperative complications, ERAS and general surgery, ERAS and barriers, ERAS and anesthesia, ERAS and nausea and vomiting, benefits of ERAS, ERAS and spine surgery, ERAS and ileus, and ERAS and patient satisfaction. Search terms yielded over 3000 results, by utilizing refined terms and inclusion criteria, with PubMed producing the most valuable literature. Inclusion criteria for the search included literature since 2014, systematic reviews, random control trials (RCTs), quasi-experimental studies, qualitative research articles, cohort studies, case-controlled studies, and quality improvement research. Literature that was produced prior to 2013 was excluded as the most up-to-date literature was desired.

Results

ERAS was created to decrease the stress response associated with surgery, along with positively affecting all areas of a patient's surgical experience including the preoperative, intraoperative, and postoperative phases. ERAS focuses on a patient's journey through surgery,

includes a multidisciplinary approach, interventions that will decrease pain, morbidity and recovery time, and improvement in patient outcomes (Brusko et al., 2019). Kılıç et al. (2019) state that an ERAS protocol will decrease the surgical stress response in the body, end prolonged fasting before surgery, maintain physiologic function, increase mobility, decrease complication rates, and reduce hospital length of stay. Brown et al. (2018) discuss the goals of ERAS to include blunting the surgical response to stress, improving nutritional and functional status, limiting preoperative fasting, using opioid-sparing analgesia, and providing early mobilization and feeding postoperatively.

Preoperative ERAS

The use of the ERAS protocol begins in the preoperative period. This involves educating patients prior to surgery, beginning in the office setting. Patients should be educated on the type of surgery that is planned, what to expect prior, during and after surgery, smoking and alcohol cessation, and nutritional status (Gillis et al., 2017). Before surgery, patients should be educated on ways in which to decrease stressors (Gillis et al., 2017). Proper education can be managed through printed and written educational materials, videos, a preoperative spine surgery class, along with providing resources that the patient may need for smoking or alcohol cessation, diabetic control, and nutrition (Smith et al., 2019).

The preoperative goals of an ERAS protocol involve smoking and alcohol cessation prior to surgery, reduction in opioid use, use of Tylenol or Gabapentin prior to surgery, weight management, diabetic control, recognizing patients that are anemic and treating those patients appropriately, identifying those at risk for nutritional deficiencies, and correcting deficiencies prior to surgery (Brown et al., 2018). It is important to remove or improve these risk factors before surgery to ensure that the patient has the best surgical outcomes possible. Patients with a

BMI over 40 should be referred to a bariatric center prior to surgery, as obesity increases the risk of death, DVTs, and cardiac complications postoperatively; diabetics should have a goal of an A1C under 8% to promote wound healing, and patients should have a hemoglobin level above 11.5 in order to decrease the risk for blood loss complications and thromboembolic events intraoperatively and postoperatively (Chakravarthy et al., 2019).

On the morning of surgery, the patient should avoid preoperative fasting and should be directed to have clear liquids up to two hours prior to surgery along with ingesting a carbohydrate clear liquid drink the morning of surgery (Brown et al., 2018). Gatorade Zero would be an appropriate carbohydrate drink for all patients. Carr et al. (2019) allowed patients to drink 300 ml of a clear carbohydrate load two hours prior to hospital arrival to decrease the surgical stress response and allow for preoperative nutrition, along with having patients take 1000 mg of Tylenol the night prior to surgery.

Before surgery, research suggests giving patients 1000 mg of Tylenol and 300-650 mg of Gabapentin the morning of surgery to reduce postoperative pain (Chakravarthy et al., 2019). Smith et al. (2019) suggest administering Tylenol 975 mg orally and Gabapentin 900 mg orally prior to the intraoperative phase, mentioning that this will decrease postoperative pain. Smith et al. (2019) also recommend giving 40 mg of Aprepitant, or another antiemetic, to patients who are at high risk for postoperative nausea and vomiting. Carr et al. (2019) administered 1.2 g of Gabapentin to patients in the preoperative area to decrease pain.

Intraoperative ERAS

The intraoperative focus is to reduce the use of opioids, decrease nausea and vomiting with the use of antiemetics, decrease the use of catheters or other drains, utilize ketamine as appropriate, use local or regional anesthesia if appropriate, and incorporate the use of Lidocaine

(Brown et al., 2018). In addition, Toradol has been recommended because it aids in decreasing morphine use and can aid in pain relief in lower doses without affecting the spinal fusion success; in addition, Ketamine infusions are opioid-sparing and can provide exceptional pain relief (Chakravarthy et al., 2019). Chakravarthy et al. (2019) recommend intraoperative analgesia to include nonsteroidal anti-inflammatories (if possible), long-acting narcotic infusions, lidocaine infusions, epidural pain catheters, and infiltration of local wounds with long-acting analgesic solutions. Staartjes et al. (2019) mention the importance of standardizing anesthesia and avoiding long-acting opioids and using local anesthesia when possible, limiting muscle relaxants, and minimization over or under hydration intraoperatively, while preventing hypothermia in the intraoperative phase. Another study by Kılıç et al. (2019) limited fluid to 500 ml during surgery to achieve euvolemia for all patients and utilized a 30 ml bolus of Marcaine that was injected into the local subcutaneous tissue after the closure of the surgical wound, along with 1000 mg of Tylenol given intravenously; these patients were undergoing microdiscectomies. In another study by Carr et al. (2019), patients received Zofran intravenously for nausea and vomiting, along with Ketamine at 0.5 mg/kg bolus and Tylenol intravenously.

Postoperative ERAS

Postoperatively, the ERAS protocol involves early mobilization, early feeding within twenty-four hours postoperatively, reduction in the use of opioids, use of nonpharmacological drugs for pain, and removing catheters or drains as early as possible. Early mobilization has been proven to decrease the risk and amount of DVTs, ileus, and can aid in wound healing (Patil et al., 2019). Brown et al. (2018) encourage early mobilization to decrease the length of a hospital stay and decrease muscle loss, weakness, and thromboembolic disease. All spine patients should be mobilized within eight hours of surgery to decrease postoperative complications and decrease the

length of stay (Chakravarthy et al., 2019). Brusko et al. (2019) noted that the average distance ambulated in ERAS patients was longer on the day of surgery and post-op day one, which was thought to have led to a component of reduction in postoperative complications. Elsarrag et al. (2019) conducted a systematic review and found that early mobilization decreased the rates of infection and length of stay, also allowing a quicker return to the patient's baseline level of function.

Urinary catheters are often used intraoperatively and postoperatively to measure a patient's urine output and prevent bladder distention but can lead to complications such as urinary tract infections, thus leading to postoperative complications. Debono et al. (2021) state that urinary catheters will increase the risk of urinary tract infections, increase the risk of surgical site infections, and can cause postoperative urinary retention over time. Limiting urinary catheters can decrease complications and increase mobility. Williams (2020) recommends that patients have the catheter removed on the day of surgery, mobilize patients on the day of surgery, start a high protein diet early to reduce ileus occurrences, and transition to oral pain medications within twenty-four hours postoperatively to benefit the patient's surgical recovery. Brown et al. (2018) support eliminating urinary catheters versus early removal of catheters postoperatively to decrease urinary tract infections, which can lead to postoperative complications; while Smith et al. (2019) advise removing urinary catheters (when used) the morning after surgery at 0600.

Studies have shown that a postoperative ileus occurs in 7% of patients (Swong et al., 2019). Postoperative ileus can increase hospital and patient costs, as well as the hospital LOS. Postoperative ileus can cause a patient discomfort, vomiting, use of nasogastric tubes, and gastrointestinal surgery (Fineberg et al., 2014). The use of opioid pain medications increases the risk for ileus. The higher amounts of opioids used, the greater chance of paralytic ileus occurring

(Jalanko et al., 2018). Brown et al. (2018) state that a postoperative ileus can be reduced through decreasing the use of opioids, avoiding nasogastric tubes, preventing fluid overload during and after surgery, and introducing early feeding. Complex spine surgeries result in higher incidences of an ileus. Early prediction and detection of postoperative ileus is crucial in avoiding severe complications that lead to lengthy hospital stays and increase costs, and cause a reduction in a patient's quality of life (Bureta et al., 2018). It is also important to begin a diet postoperatively when the patient begins having bowel sounds and passing flatus. Starting a diet early, results in the return of bowel function quickly, leading to less postoperative complications (Bureta et al., 2018). Gum chewing is also effective postoperatively in reducing postoperative ileus, as it promotes peristalsis and decreases inflammation in the gut (Vilz et al., 2017).

Pain scores

A goal of ERAS is to decrease the use of postoperative opioids. Wang et al. (2019) found that opioid use, in this case morphine, was significantly reduced after minimally invasive spine surgery versus an open spine surgery. However, this study was focused on surgeons who utilized minimally invasive spine surgery techniques versus open spine surgery, and less focused on how ERAS impacted the opioid reduction for all types of surgeries. A systematic review by Dietz et al. (2019) suggested that nonopioid drugs can achieve a reduction in postoperative nausea, pain, ileus, and length of stay, leading to a decreased use in postoperative opioids and a decrease in complications. In addition, Chakravarthy et al. (2019) performed a study concluding that the use of epidural analgesia and local anesthesia, when possible, can further improve pain scores; the authors suggest that a lidocaine infusion can decrease postoperative pain and opioid consumption. Chakravarthy et al. (2019) premedicated elective spine surgery patients with 1000 mg of Tylenol and 300-650 mg of Gabapentin, and intraoperatively administered a combination

of nonsteroidal anti-inflammatory drugs, ketamine, a long-acting narcotic infusion, lidocaine, epidural pain catheters, and wound infiltration with long-acting analgesics. In comparison, a study by Smith et al. (2019), found a small decrease in the use of long-acting opioid use with no difference in postoperative pain, or short-term opioid use with the ERAS protocol, but did find that none of the post-operative ERAS patients required patient-controlled analgesia (PCA) pump after twenty-four hours. Liu et al. (2020) found that ERAS patients had better pain control compared with the control group in this study, and the total number of patients using a PCA was lower in the ERAS group. Flanders et al. (2020) performed a historical cohort with findings showing a significant reduction of PCA usage postoperatively and consistently lower use of opioids in the postoperative period even as far as six months.

Soffin et al. (2019) stated that previous findings suggested a relationship between preoperative opioid use and poor outcomes postoperatively, but this study found no such association between opioid use and inferior outcomes in patients undergoing anterior cervical fusion surgeries. Soffin et al. (2019) found that the use of short-term nonsteroidal anti-inflammatory medications, which have been thought to delay fusion surgery healing in the past, can be beneficial in postoperative pain management and can lead to less use of opioids.

An interesting discussion by Brusko et al. (2019), recognizes that pain is challenging for spine patients because these types of patients have been in pain for long periods of time, have become sensitized to pain triggers, may already be opiate dependent, are undergoing spine surgeries which involve deep muscle tissue dissection and retraction (resulting in higher levels of pain), and misconceptions from the patient's point of view on what to expect. These are factors that need to be considered when comparing if an ERAS protocol will reduce postoperative pain.

Length of stay and Readmission rates

Decreasing the length of stay in the hospital is a goal for hospital organizations and patients and is important in order to decrease costs, infection, complications, and improve patient outcomes. In a study by Liu et al. (2020), ERAS was examined for patients undergoing intraspinal tumor surgery, and it was found that patients receiving ERAS protocol had a reduction in LOS and an increase in functional recovery. Postoperative complications or readmission rates were not increased due to a decrease in the patient's LOS (Liu et al., 2020). This created positive outcomes for the included patients. The study by Liu et al. (2020) found that an ERAS protocol increased patient satisfaction and reduced overall costs. This is a positive outcome for both the hospital and the patients involved. In a study by Soffin et al. (2019), ERAS was implemented for anterior cervical spine patients undergoing surgery, with a five-hour minimum post-anesthesia care unit (PACU) observation requirement. Results for thirty-three patients showed no readmissions for patients but did result in an increased LOS due to the five-hour minimum PACU requirement, along with three patients experiencing respiratory issues postoperatively (Soffin et al., 2019). While there was an increase in LOS, the lack of readmissions for the patients is a positive outcome.

Elsarrag et al. (2019) performed a systematic review of spinal surgery patients and found that an ERAS protocol decreased the LOS for thirty-five patients, by four days, undergoing a cervical fusion and laminoplasty, compared to a twenty-patient control group who had a nine-day hospital stay. This study did not discuss the readmission rates for these patients but stated it was minimal. Elsarrag et al. (2019) stated that the reduction in LOS and minimal complications were due to the ERAS protocol allowing for limitation of opioids, early mobilization, and avoiding the use of drains and blood transfusions in most patients. In patients recovering from lumbar

surgeries, Brusko et al. (2019), compared fifty-seven patients receiving ERAS protocol to forty non-ERAS protocol patients and found that the ERAS protocol patients were discharged in two-three days from the hospital in comparison to three-four days in non-ERAS patients. This study is useful for lumbar spine patients but would need to be expanded to patients undergoing cervical spine surgery to see if LOS is reduced in that patient population. A systematic review by Dietz et al. (2019), examined 19 studies on patients undergoing spinal surgeries and found a reduction in LOS, leading to a reduction in hospital and patient costs with a 15.2% savings per surgery. This equates to significant savings for hospital organizations.

Smith et al. (2019) state that many factors, such as postoperative bleeding, drains, late mobilization, and delayed discharge, are related to LOS and readmission rates, and not solely comorbidities. This 230-patient study found no significant decrease in LOS but attributed this to the delay in physical therapy assessing the patient and poor compliance with implementing the ERAS protocol by hospital staff (Smith et al., 2019). The lack of compliance could be an issue with obtaining solid data examining LOS and readmission rates. Kılıç et al. (2019) found that ERAS protocol is successful in reducing LOS and readmission rates but suggests there be an international guideline for the ERAS protocol to standardize comparisons. Kılıç et al. (2019) studied 120 patients undergoing same-day microdiscectomy surgeries, 60 ERAS patients, and 60 non-ERAS patients, and found that the ERAS patients had a quicker discharge by four hours along with lower hospital costs, including surgical costs. An extended five-year study by Staartjes et al. (2019) consisted of 2592 patients undergoing spinal fusion surgery and found that over time patients receiving the ERAS protocol have a decrease in LOS and readmission rates. The 60-day readmission rate over this time frame was only 1.4 percent, and 94% of patients were

discharged after a one-night hospital stay; this resulted in a p-value of < 0.001 for discharges and LOS, and a p-value of $< .05$ in postoperative complications and readmissions.

Debono et al. (2019) studied patients undergoing anterior cervical fusions and anterior and posterior lumbar fusions and included 1563 non-ERAS patients and 1920 ERAS patients. The study found a significant reduction in LOS by two-four days. D'Astorg et al. (2020) conducted a study of 386 patients, with half of the patients in the ERAS group and half in the control group, and found a significant decrease in LOS by two-four days as well. This study showed a reduction in readmission rates as well (d'Astorg et al., 2020).

Mobilization

d'Astorg et al. (2020) discuss the benefits of an ERAS protocol for neurosurgical patients, including decreasing pain postoperatively, increasing mobility, and decreasing LOS and costs overall, but states that the ERAS protocol could be difficult to implement in complex spine surgery patients. d'Astorg et al. (2020) study shows patient improvement with early mobilization postoperatively for those receiving the ERAS protocol and believes that ERAS protocol will revise previous habits in the surgical journey to provide enhanced care for patients. Increasing mobilization postoperatively leads to a decrease in hospital LOS and a reduction in patient complications (d'Astorg et al., 2020). Flanders et al. (2020) found a substantial increase in postoperative early mobility in ERAS patients compared to non-ERAS patients (63.5% vs 20.7%). The study concluded that early mobilization aided in a reduction in LOS, an increase in patient satisfaction, and a decrease in postoperative complications (Flanders et al., 2020). Dietz et al. (2019) suggest that patients should ambulate two hours post-surgery with supervision from physical therapy, and ERAS protocols will aid in providing early mobilization postoperatively. Brusko et al. (2019) found postoperatively that ERAS patients ambulated sooner and further (109

ft) than non-ERAS patients (41.4 ft). Brusko et al. (2019) mention that historically spine surgery patients were not mobilized quickly due to bracing and the belief that immobilization would allow for bony fusion; however, this is not supported by evidence and immobilization will lead to postoperative complications. Elsarrag et al. (2019) performed a systematic review of the literature and found that early ambulation, along with enteral nutrition and a decrease in opioid use, resulted in a faster return to baseline without readmissions. Elsarrag et al. (2019) found that early mobilization decreases the risk of infections and medical complications as well. Patil et al. (2019) found that early mobilization decreases postoperative complications such as DVTs and returns the patient to his/her baseline faster.

Summary

The literature review is focused on the essentials of an ERAS protocol for neurosurgical patients throughout the perioperative period. The review of literature determined that an ERAS protocol can be beneficial to a patient's surgical journey leading to a decrease in the patient's surgical response to stress, increasing nutritional and functional status, early mobilization, decreasing pain, reducing LOS and costs, and decreasing postoperative complications. An ERAS protocol has been shown to increase a patient's outcomes for a better recovery throughout the perioperative phase.

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