Marian University

Leighton School of Nursing

Doctor of Nursing Practice

Final Project Report for Students Graduating in May 2024

Methocarbamol: Effect on Postoperative Pain Following Laparoscopically Assisted Vaginal Hysterectomy (LAVH)

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Date of Submission: February 5, 2024

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Abstract

Background and Review of Literature: Laparoscopically assisted vaginal hysterectomy (LAVH) is a minimally invasive surgical procedure commonly performed to remove the uterus. While the LAVH technique offers many advantages, management of perioperative pain continues to be a concern. Methocarbamol, a centrally acting antispasmodic, has gained popularity by many anesthesia providers as a multi-modal pain adjunct.

Purpose: This project was developed to evaluate the effect of intraoperative methocarbamol administration on post operative pain scores in patients undergoing an LAVH procedure.

Methods: A retrospective chart review of patients who underwent an LAVH procedure was performed to analyze and compare postoperative pain scores between patients who received methocarbamol intraoperatively to those who did not receive methocarbamol.

Implementation: The medication administration record (MAR) of 80 patients was reviewed to determine if the patient received methocarbamol intraoperatively. Intraoperative and postoperative opioid administration were recorded separately. A two-sample t-test was utilized to compute significance of total opioid consumption and average post anesthesia care unit (PACU) pain scores between the two groups.

Results: The total intraoperative and postoperative opioid consumption between the methocarbamol (+) and methocarbamol (-) groups revealed no significance. Patients who received 1000 mg of methocarbamol intraoperatively had significantly lower pain scores at the 5, 15, and 30-minute time intervals (p=0.03, p=0.01, p=0.03) in the PACU.

Key words: laparoscopic assisted vaginal hysterectomy, methocarbamol, pain

Methocarbamol: Effect on Postoperative Pain Following Laparoscopically Assisted Vaginal Hysterectomy (LAVH)

This project is submitted to the faculty of Marian University Leighton School of Nursing as partial fulfillment of degree requirements for the Doctor of Nursing Practice, nurse anesthesia track. Laparoscopically assisted vaginal hysterectomy (LAVH) is a common gynecological procedure performed to remove the uterus through the vagina, with the aid of a laparoscope for surgical visualization (Choi, 2016). The LAVH procedure was introduced in 1989 as a new combined approach using vaginal and laparoscopic techniques to hysterectomy (Eggemann et al., 2018). Laparoscopic assisted operations offer several advantages for the patient such as lower morbidity, faster recovery times, and reduced blood loss (Sesti et al., 2014). Although gynecological laparoscopic surgery is less traumatic than more traditional approaches, such as a total abdominal hysterectomy, acute postoperative pain continues to remain a concern (Chen et al., 2021).

In recent years, emphasis has been placed on the implementation of opioid-sparing multimodal analgesic strategies to better improve patient outcomes during the perioperative period (Smith et al., 2019). Methocarbamol (Robaxin®) is an antispasmodic agent that has progressed in popularity among anesthesia personnel as part of their intraoperative pain management plan (Chen et al., 2021). Nevertheless, opioids will continue to play a critical role in acute pain management, however, if anesthesia professionals can play a greater role to mitigate opioid-related side effects, unwarranted outcomes in the immediate postoperative period may be reduced (Smith et al., 2019). This project will examine the effectiveness of intraoperative methocarbamol administration on post operative pain scores in patients who have undergone an LAVH procedure.

Background

Compared to more traditional approaches, LAVH offers a variety of advantages, which include lower morbidity, shorter duration of hospitalization, and faster recovery time (Choi, 2016). Despite advances in surgical technique, the incidence of moderate to severe postoperative pain following gynecological laparoscopic surgery remains between 25% and 35% (Wong et al., 2018). In patients undergoing LAVH, misperception of pain among anesthesia personnel may lead to inadequate pain medication coverage, resulting in higher postoperative pain scores, increased opioid administration and longer hospital stay (Choi, 2016).

During an LAVH, the surgeon will make small incisions into the abdominal viscera for insertion of trocars, devices used by the surgeon to help manipulate organs into view (Hickman & Propst, 2022). An additional incision will be made for insertion of the laparoscope, a small telescope like device that brings light into the abdomen to allow view of the pelvic organs (Hickman & Propst, 2022). Carbon dioxide (CO_2) is a colorless, inexpensive, nonflammable gas utilized by the surgeon to create a pneumoperitoneum, filling of the abdomen with gas, to further increase operative visualization (Orhurhu et al., 2022). Lastly, the surgeon will make an incision into the vagina for the uterus to be removed (Hickman & Propst, 2022).

An LAVH procedure, even though less surgically invasive, still brings a variety of opportunities for pain that must be taken into consideration by the anesthesia provider. In addition to incisional pain, the patient might experience discomfort from creation of the pneumoperitoneum, stretching of the abdominal cavity, and manipulation of the intra pelvic region (Choi, 2016). Methocarbamol is a centrally acting muscle relaxant that may have some benefit as part of a multimodal pain management strategy for LAVH procedures (Walters, 2017). While the exact mechanism of action is unclear, methocarbamol has been described as an

indirect inhibitor of the interneural junction of the spinal cord, having no direct action on the motor nerve fiber (Sibrack & Hammer, 2022). As the main effect of methocarbamol is to reduce muscle spasm, it may be hypothesized that relaxation of the abdominal and pelvic floor muscles will reduce post operative pain.

Problem Statement

Relief of post operative pain continues to be one of the most common challenges for healthcare providers (Murphy & Szokol, 2019). Traditionally, short-acting opioids are given to treat moderate to severe pain in the immediate postoperative period (Murphy & Szokol, 2019). However, clinical response to opioids can be labile, generating reactions that range from inadequate pain relief to severe sedation or respiratory depression (Murphy & Szokol, 2019). Methocarbamol is a centrally acting muscle relaxant that works by blocking nerve impulses (or pain sensations) that are sent to the brain (Aljuhani et al., 2017). Due to its comparatively long elimination half-life, and decreased risk of sedation and respiratory depression, methocarbamol administration intraoperatively has grown in popularity among anesthesia providers (Aljuhani et al., 2017). Discovering a lack of research and reported techniques regarding methocarbamol administration and its impact led to the following question to be developed: In patients who underwent a laparoscopically assisted vaginal hysterectomy, what was the effect of intraoperative methocarbamol administration on post operative pain scores compared to patients who did not receive methocarbamol?

Needs Assessment

Each year, in the U.S. alone, surgeons perform approximately 600,000 hysterectomies, making it the second most common surgical procedure for women (TriHealth, 2023). The hospital organization for this DNP project routinely performs hysterectomies, specifically LAVH

procedures, ranking in the top three surgeries they perform annually (TriHealth, 2023). In addition, anesthesia personnel at this organization commonly administer methocarbamol to patients intraoperatively. After observation, the organization appears to administer methocarbamol to a much greater degree in select cases, such as spinal procedures. When discussing with anesthesia providers at this facility, the majority reported having positive patient outcomes with methocarbamol administration and support the idea of its administration to patients undergoing gynecological procedures. In addition, after speaking with PACU registered nurses, they reported better overall post operative pain scores by patients who received methocarbamol intraoperatively.

Review of Literature

Search Methodology

Research for evidence to support this project was provided through the Cumulated Index to Nursing & Allied Health Literature (CINAHL) and PubMed databases. A PRISMA diagram detailing the selection of research evidence can be found in Appendix A. The initial database search created 12,506 articles and abstracts. However, only 110 articles were eligible for inclusion. Results were narrowed to include abstracts with full text published in English within the past five years (2017-2022). The review analyzes 10 articles in total. Inclusion criteria consisted of being female, ages 30-60 years old, human, and having an LAVH procedure. Exclusion criteria to this review were animal laboratory studies and being a male. There were no exclusion criteria for sample size or drug dose. Keywords and search terms included *Robaxin®, methocarbamol, LAVH, and visceral pain*. Boolean searches included *methocarbamol pain, methocarbamol intravenous, methocarbamol mechanism, abdominal visceral pain, postoperative visceral pain, laparoscopic visceral pain, and LAVH pain*.

LAVH procedure

In the United States, almost 70% of hysterectomies are carried out abdominally (Mohammed et al., 2017). However, within the past five years there has been a trend towards less invasive surgery, owing to the increased popularity of surgeons utilizing vaginal and laparoscopic techniques (Mohammed et al., 2017). Prior to introduction of LAVH, total laparoscopic hysterectomy (TLH) and vaginal hysterectomy (VH) were the alternative techniques to a total abdominal hysterectomy (AH) (Sesti et al., 2014). To compare operative data between surgical techniques, a study in 2014 selected 108 women who required a hysterectomy (Sesti et al., 2014). Using a computer-generated list, the women were randomly assigned an operative technique: TLH (n=36); LAVH (n=36); VH (n=36) (Sesti et al., 2014). Using a visual analog scale (VAS) which consisted of a 100-millimeter (mm) line ranging from zero (no pain) to 100 (pain as bad as it can be), women were asked to report pain over a 24-hour period (Sesti et al., 2014). Overall, 17 (47%) women reported no pain (VAS = 0) after VH, 19 (53%) after TLH, and five (14%) after LAVH (Sesti et al., 2014). Subsequently, ten (28%) women reported moderate pain after VH (VAS 1-25), eleven (30%) after TLH, and twenty-two (61%) after LAVH (Sesti et al., 2014). After VH, four women (11%) complained of moderate pain (VAS = 26-50), two (6%) complained of severe pain (VAS = 51-75), and three reported very severe pain (VAS 76-100) (Sesti et al., 2014). After TLH, two women (6%) reported moderate pain, three (8%) reported severe pain, and one reported (3%) very severe pain (Sesti et al., 2014). Four women (11%) reported moderate pain, four (11%) severe pain, and one (3%) very severe pain following LAVH (Sesti et al., 2014). Researchers found no significant differences for postoperative pain over a 24-hour period among these three different methods (p = 0.32) (Sesti et al., 2014).

Another prospective, randomized, double-blind study was designed to investigate postoperative pain after VH and LAVH with and without peritoneal closure, when the upper portion of the vagina is sutured shut after removal of the uterus (Eggemann et al., 2018). A total of 192 patients were divided into four groups: LAVH and VH with and without peritoneal closure (PC), respectively (Eggemann et al., 2018). Postoperative pain was assessed three times a day until patient discharge, using a 10-centimeter (cm) VAS scale (0-10), where zero indicated no pain and ten indicated "unbearable pain" (Eggemann et al., 2018). In addition, pain was assessed at months one, six and twelve during postoperative check-ups (Eggemann et al., 2018). Patients in the LAVH group (LAVH – PC, n=48; LAVH + PC, n=47) were significantly younger than those patients in the VH group (VH – PC, n=45; VH + PC, n=47), otherwise the patients' parity, BMI, previous abdominal operations, and uterine weight were reported as well balanced between the groups (Eggemann et al., 2018).

Operative time was significantly longer after LAVH (LAVH + PC 106 ± 29 min; LAVH − PC 99 ± 30) ($p < 0.0001$) and significantly shorter after VH (VH + PC 59 ± 17; VH − PC 56 ± 19) (Eggemann et al., 2018). The first three days after surgery, patients in the LAVH group (n=95) reported more pain than those in the VH group (n=92) (VAS score day 1: $p = < 0.0001$; VAS score day 2: $p = 0.021$; VAS score day 3: $p = 0.039$) (Eggemann et al., 2018). Peritoneal closure did not seem to have any influence on postoperative pain (+PC versus -PC: VAS score day 1, $p = 0.9399$) (Eggemann et al., 2018). After day three, researchers did not find any significant difference in pain scores between the groups (VAS score day 4: $p = 0.494$) (Eggemann et al., 2018).

A third, prospective observational cohort study was designed to compare the differences of acute postoperative pain between patients undergoing LAVH, laparoscopic myomectomy

(LM), and laparoscopic adnexectomy (LA) (Chen et al, 2021). Unlike LAVH, where the surgeon uses a laparoscope to guide removal of the uterus through the vagina, LM and LA solely use a laparoscope approach through the abdomen to remove uterine fibroids and ovaries, respectively (Chen et al, 2021). Data of 669 patients were analyzed, including 249 from the LAVH group, 210 from LM, and 210 patients from the LA group (Chen et al, 2021). Researchers in this study analyzed pain scores as well as the type of pain the patient was experiencing (visceral pain, incisional pain, low back pain, shoulder pain) (Chen et al, 2021).

Visceral pain occurs due to stretching of the abdominal cavity, and is the pain felt when internal organs are inflamed, damaged, or injured (Chen et al, 2021). Visceral pain had the highest incidence and most severe rating in the LAVH and LH groups, followed by low back pain (Chen et al, 2021). Of the patients in the LAVH group, up to 73.1% of patients reported moderate (*n*=64, 25.7%) to severe (*n*=49, 19.7%) visceral pain, and 61% of patients in the LM group reported moderate (*n*=46, 21.9%) to severe pain (*n*=40, 19%) (Chen et al, 2021). However, in the LA group, incisional pain was reported to be the most severe, with up to 39% of patients reporting moderate (*n*=26, 12.4%) to severe pain (*n*=9, 4.3%) (Chen et al, 2021). Opioid consumption in the PACU was highest in the LAVH group compared to both the LM or LA groups (Chen et al, 2021).

Advantages of methocarbamol

Opioids continue to be the mainstay of pain management in the perioperative setting (Aljuhani et al., 2017). However, nonopioid adjuncts have been recommended to provide more options for pain control and to reduce or eliminate the need for opioid medications (Aljuhani et al., 2017). Methocarbamol is a central nervous system depressant with both muscle relaxant and sedative properties (Aljuhani et al., 2017). The exact mechanism of action is unclear; however, it

is hypothesized that analgesia from muscle relaxation may be due to the inhibition of spinal transmission of noxious stimuli (Aljuhani et al., 2017). A single-blinded clinical trial was performed at a hospital in New York to investigate the efficacy methocarbamol for post operative pain control in patients undergoing breast augmentation (Hidalgo & Pusic, 2005). Like LAVH, breast augmentation surgery is generally performed in an outpatient manner with quick recovery times, yet patients still tend to report significant pain in the immediate post operative period (Hidalgo & Pusic, 2005).

The study was performed in two phases with a total of four treatment groups (n=100) (Hidalgo & Pusic, 2005). In the first phase, patients were randomly placed into two groups 24 hours before their surgery (Hidalgo & Pusic, 2005). One group received a preoperative intercostal neve block with 40 cc of 0.25% bupivacaine and pre/postoperative oral methocarbamol (Hidalgo & Pusic, 2005). The second group received pre/postoperative methocarbamol, but no intercostal nerve block (Hidalgo & Pusic, 2005). In the second phase, patients were randomly placed into two groups, where one group received intercostal nerve blocks but no methocarbamol, and the second group did not receive nerve blocks or methocarbamol (Hidalgo & Pusic, 2005). To maintain consistency with placement of the intercostal nerve blocks, a single surgeon was assigned to perform all blocks (Hidalgo & Pusic, 2005). Patients who received the oral methocarbamol were given 1500 mg preoperatively and then continued to take the drug every six hours in 500 mg tablets (Hidalgo & Pusic, 2005). Since the intercostal nerve block was performed by the surgeon in the operating room (OR), the PACU nurses were blinded to the treatment group assignments, however, PACU nurses and selected patients were aware that they were receiving methocarbamol (Hidalgo & Pusic, 2005).

Researchers primarily used a VAS tool to assess postoperative pain, however, they also measured narcotic use (Hidalgo & Pusic, 2005). Pain scores and narcotic use were recorded by PACU nurses at one and three hours after surgery, and then at 6 hours a study nurse called the patients at home to record pain and medication use (Hidalgo & Pusic, 2005). Patients who received methocarbamol had significantly lower VAS pain scores and reduced narcotic use in the first few hours after surgery than those who did not (P= 0.03). Beyond 6 hours after surgery there was no significant difference seen among those who received methocarbamol and those who did not (P= NS, not significant) (Hidalgo & Pusic, 2005). There was no significant difference in pain scores and narcotic use seen in patients who received intercostal nerve blocks compared to those who did not (P=NS) (Hidalgo & Pusic, 2005).

A retrospective cohort study was performed at an urban academic medical center in the United States to evaluate the effect of methocarbamol on hospital length of stay in patients with closed rib fractures (Patanwala et al., 2017). Using an electronic hospital database, patients 18 years and older who were admitted to the hospital for a closed rib fracture between April 2014 and December 2015 were selected for review (Patanwala et al., 2017). Variables relevant to the study included age, sex, race, ethnicity, need for endotracheal intubation, need for chest tube, discharge status, hospital length of stay, and injury severity scores (Patanwala et al., 2017). Patients were divided into two groups based on whether they received oral methocarbamol during their hospital stay (Patanwala et al., 2017). Severity of injury was considered because it is possible that the effect of methocarbamol may have been limited with a certain level of trauma (Patanwala et al., 2017).

A total of 592 patients were included in the final study cohort, 329 received methocarbamol and 263 did not receive methocarbamol (Patanwala et al., 2017). The mean

overall age was 55.6 ± 18.5 years, and 67.7% were male (Patanwala et al., 2017). The average time for discharge was 5 days in the methocarbamol group ($P < 0.001$) and 8 days for the methocarbamol negative group (Patanwala et al., 2017). Although the primary outcome of this study was length of hospital stay, researchers addressed pulmonary complications as a secondary outcome (Patanwala et al., 2017). Pulmonary complications consisted of bacterial pneumonia, ventilator associated pneumonia, aspiration pneumonia, and atelectasis (complete or partial collapse of a lung or lobe of the lung) (Patanwala et al., 2017). Patients who received methocarbamol were less likely to have pulmonary complications (11.3%, n = 37 compared to patients not receiving methocarbamol 23.2%, n = 61; P = < 0.001) (Patanwala et al., 2017).

A double-blinded, randomized placebo-controlled trial was conducted in 2019 to assess the efficacy of indomethacin (NSAID) and methocarbamol versus indomethacin alone in patients with acute low back pain (Zoofaghari et al., 2021). A total of 64 patients were randomly categorized into two groups (32 in each group) (Zoofaghari et al., 2021). Group one (I-M) received indomethacin 25 mg every 8 hours and placebo capsules every 8 hours, whereas group two (I+M) received 25 mg of indomethacin every 8 hours in addition to 500 mg methocarbamol tablets every 8 hours (Zoofaghari et al., 2021). Prior to initiation of treatment, researchers obtained baseline patient function using the Back Pain Function Scale (BPFS) and a baseline pain score using a VAS (Zoofaghari et al., 2021). Researchers contacted patients a week after treatment to assess if instructions were followed, pain level, BPFS status, and possible side effects the patient may have experienced (Zoofaghari et al., 2021).

Ten females (31.3%) and 22 males (68.7%) with an average age of 42.69 ± 8.89 years were in group one (indomethacin alone) (Zoofaghari et al., 2021). In group two, the indomethacin with methocarbamol group, there were 16 females (50%) and 16 males (50%) with

an average age of 39.22 ± 11.37 years ($p > 0.05$) (Zoofaghari et al., 2021). Before initiation of the intervention, pain scores and sex between both groups did not differ significantly ($p > 0.05$) (Zoofaghari et al., 2021). Both groups had significantly lower pain scores after the intervention, however, patients in group two (I + M) had significantly higher pain reduction than that of group one (3.66 ± 3.17 vs. 1.84 ± 1.53; $P < 0.001$) (Zoofaghari et al., 2021). In addition, the average BPFS score, or functional status, increased in group two (I + M) significantly higher than group one (I-M) (19.44 ± 8.66 vs. 4.75 ± 4.35; $P < 0.001$) (Zoofaghari et al., 2021).

A randomized, placebo-controlled, double-blind study was conducted in 2017 to evaluate the safety and efficacy of methocarbamol administration (Abd-Elsalam et al., 2019). The clinical trial included 100 patients with liver cirrhosis, with complaint of frequent muscle cramps (Abd-Elsalam et al., 2019). Patients were randomly assigned to a placebo and a control group via a computer-generated system (Abd-Elsalam et al., 2019). Group one was the "drug group" where 50 patients received 500 mg methocarbamol twice daily for one month, and group two consisted of 50 patients who received a placebo dose twice daily for one month (Abd-Elsalam et al., 2019). Muscle cramps were evaluated using a questionnaire, which included analysis of the nature, intensity (1-10 analog scale), duration (in minutes), and frequency of cramps (times/week) (Abd-Elsalam et al., 2019).

Researchers obtained a baseline response from all participants to the questionnaire prior to beginning the study, and there were no significant differences in muscle cramps, severity, duration, and frequency ($P > 0.05$) (Abd-Elsalam et al., 2019). After one week, participants in group one showed a significant decrease in the mean number of muscle cramps from 11 ± 4 (median 10.0) to 0.5 ± 1 (median 0.0) per week (Abd-Elsalam et al., 2019). The mean score of pain severity decreased from 6.52 ± 1.29 to 0.66 ± 1.18 compared to those receiving the placebo

($P < 0.001$ for each) (Abd-Elsalam et al., 2019). Few side effects of methocarbamol were reported, which included dry mouth ($P = 0.0026$) and drowsiness ($P = 0.0002$) (Abd-Elsalam et al., 2019).

When a patient is transferred to the PACU, there is potential that opioids will be given in addition to methocarbamol. A valid concern with concomitant use of prescription opioids and skeletal muscle relaxants is opioid overdose (Khan et al., 2022). A cohort study spanning from 2000 to 2019 using healthcare data was conducted to compare the risk of opioid overdose in patients who concurrently take skeletal muscle relaxants (Khan et al., 2022). Various skeletal muscle relaxants were studied, including methocarbamol (Khan et al., 2022). A 30-day analysis was performed to evaluate the acute risk of opioid overdose after initiation of skeletal muscle relaxant therapy (Khan et al., 2022). Researchers assessed comorbidities, pain conditions, and other active prescriptions to exclude any outliers from data retrieval (Khan et al., 2022). The mean age of participants was 53 years, with most being female (62%) (Khan et al., 2022).

Opioid overdose was defined using the International Classification of Diseases, ninth revision (ICD-9), in incidences that resulted in an emergency department (ED) visit or hospitalization (Khan et al., 2022). In the first 30 days, the highest number of opioid overdose events occurred with the cyclobenzaprine ($n = 278$) and baclofen ($n = 266$) groups (Khan et al., 2022). The hazard ratio (HR) for opioid overdose relative to methocarbamol was 1.00 (95% CI 0.45-2.20, adjusted P value > 0.99) (Khan et al., 2022). Compared to cyclobenzaprine and baclofen, no other muscle relaxants, such as methocarbamol, were correlated with an increased risk of opioid overdose (Khan et al., 2022).

Disadvantages of Methocarbamol

A retrospective cohort study was performed at an academic medical center in the United States observing adults (age greater than or equal to 18-years-old) who were admitted to the hospital because of a traumatic injury (Aljuhani et al., 2017). Data was collected from medical records, which included baseline demographics, vital signs, Glasgow Coma Score, pain scores, injury location, opioid use before admission, history of drug abuse, analgesics administered during hospital stay, surgeries performed, and adverse effects (Aljuhani et al., 2017). Pain scores were recorded on a zero to ten (0 = no pain, 10 = worst possible pain) scale (Aljuhani et al., 2017). All data was collected and recorded for the first three days after methocarbamol administration (Aljuhani et al., 2017). Patients who received methocarbamol were matched to a control group, consisting of patients who did not receive methocarbamol (Aljuhani et al., 2017). The International Classification of Disease (ICD) is a "propensity" score that was used to calculate severity of injury based on age and sex to ensure similarity between the two groups (Aljuhani et al., 2017). A total of 200 patients were included in the cohort (100 in each group) with the majority being men (67%) (Aljuhani et al., 2017). In the treatment group, the most common dose of methocarbamol was 750 mg every eight hours (Aljuhani et al., 2017). Patients in the methocarbamol group had higher opioid consumption on the first day ($p<0.001$) (Aljuhani et al., 2017). Mean baseline pain scores were 7.4 ± 2.6 and 6.8 ± 3.2 in the methocarbamol and control groups, respectively ($P=0.191$) (Aljuhani et al., 2017, p. e205).

A randomized, double-blind trial was conducted in two urban ED's to assess the effectiveness of methocarbamol with naproxen (non-steroidal anti-inflammatory drug) for acute low back pain (Friedman et al., 2018). Patients admitted with acute low back pain were enrolled in the study at discharge from the ED (Friedman et al., 2018). Every patient (n=240) received

naproxen and a brief low back pain educational session, and then were randomized to methocarbamol or a placebo (Friedman et al., 2018). Patients who received methocarbamol were instructed to take naproxen 500 mg tablets twice per day + methocarbamol 750 mg up to three times per day (Friedman et al., 2018). Researchers utilized the Roland Morris Disability Questionnaire (RMDQ) to assess back pain at one week, three months, and 6 months (Friedman et al., 2018).

The primary outcome researchers were looking for was improvement in the RMDQ score between discharge from the ED and one week follow-up (Friedman et al., 2018). One week after the ED visit, patients randomized to methocarbamol improved their RMDQ score by a mean of 8.1 points (95% CI 6.1 to 10.1) and patients with the placebo improved by a mean of 10.9 RMDQ points (95% CI 8.9 to 12.9) (Friedman et al., 2018). The difference between methocarbamol and the placebo was 2.8 (95% CI 0 to 5.7) suggesting that methocarbamol has no significant effectiveness when added to naproxen for the treatment of acute low back pain (Friedman et al., 2018).

Theoretical Framework

Betty Neuman's Systems Model is a nursing theoretical framework that will be used to guide this project (See Appendix B). Neuman's theory focuses on response of the patient to actual or potential environmental stressors, and the use of nursing intervention to improve patient well-being (Petiprin, 2016). The model suggests that every patient has individualistic characteristics and responses to their environment (Petiprin, 2016). Neuman emphasizes three components to her Systems Model, intrapersonal, interpersonal, and extra-personal stressors, which all surround a person, affecting stability of the system (Petiprin, 2016). Intrapersonal stressors are those contained within the patient, interpersonal stressors arise from interaction

surrounding the individual, and extra-personal stressors include all uncontrollable interactions outside of the individual (Ahmadi & Sadeghi, 2017).

For this project, pain will be viewed as the stressor, whether it be intrapersonal, interpersonal, or extra personally driven. To address the stressor, or pain, Neuman's Model incorporates primary, secondary, and tertiary interventions (Ahmadi & Sadeghi, 2017). Primary interventions are aimed at preventing exposure to stressors, secondary interventions involve treatment immediately after response to a stressor, and tertiary interventions support recovery (Ahmadi & Sadeghi, 2017). Intraoperative methocarbamol administration represents a primary intervention. The goal of methocarbamol administration intraoperatively is to prevent and/or reduce the severity of post operative pain. If successful, methocarbamol will prevent the patient from experiencing intrapersonal and interpersonal stressors, and the necessity of secondary intervention, such as post operative narcotic administration.

Project Aim/Objectives

The primary aim of this project is to determine the benefit of intraoperative methocarbamol administration on pain scores to patients undergoing LAVH procedures.

1. To determine the impact of methocarbamol administration on post operative pain scores in comparison to short-acting opioid medications.
2. To compare the relationship between intraoperative methocarbamol administration and intraoperative opioid/nonopioid pain medication administration.
3. To determine the relationship between intraoperative methocarbamol administration and post operative opioid use.

SWOT Analysis

Strengths

The hospital organization where the project will be conducted regularly performs LAVH procedures, which will allow for a greater sample size. Performing a retrospective chart review is a relatively low cost compared to prospective clinical trials (Kaasalainen et al, 2014). In addition, advances in technology have made access to medical charts readily available, with less risk of illegible data and missing charts.

Weaknesses

Incomplete data, unclear data abstraction, and inconsistency or mistakes in coding adequate pain scores are all potential weaknesses to this project (Kaasalainen et al, 2014). Together, these may negatively impact the validity and reliability of the retrospective chart review method (Kaasalainen et al, 2014).

Opportunities

Many of the anesthesia providers already use and support intraoperative methocarbamol administration. Key stakeholders such as PACU nurses and patients serve to benefit, especially if data suggests that methocarbamol administration reduces post operative pain and less narcotic administration. In addition, performing a retrospective chart review allows the patient to not be burdened with actively participating in the research process (Kaasalainen et al, 2014).

Threats

One threat to this project is the subjectivity of pain scores. Patients manifest pain differently and may under report or over report the amount of pain they are experiencing. Since anesthesia providers at this hospital organization regularly administer methocarbamol, there may not be enough patients who did not receive the medication for comparison. Global pandemics

and health crises, such as a COVID-19 outbreak, could cause surgery cancellations and hospital shutdowns, resulting in lack of access to data for this project (Appendix C).

Project Design/Methods

A retrospective chart review was conducted to analyze data of patients who underwent an LAVH procedure between April 1, 2021, and April 1, 2023. Pain scores were compared between patients who received methocarbamol intraoperatively to those who did not receive methocarbamol. Postoperative pain scores listed in the quantitative 0-10 (0 = no pain; 10 = most severe pain) grading scale will be evaluated and averaged for each patient while in the PACU. Using a standard data collection form, data will be abstracted from the electronic medical record (EMR). Data will be de-identified by the primary investigator to include pain scores, operation type, intraoperative and postoperative intravenous (IV) narcotic administration, intraoperative IV nonsteroidal anti-inflammatory medication administration, and intraoperative IV methocarbamol administration. Surgical diagnoses for this study will include polycystic ovary syndrome (PCOS), endometriosis, gynecologic cancer, and uterine fibroids. Collection of data will occur during the preoperative, intraoperative, and postoperative periods to ensure pertinent information is collected.

Project Site and Population

The project will be completed at a level II trauma medical center in the Midwest. The hospital chosen is one of two other medical centers which operate under a single organization. The main surgical suite of the hospital has 20 operating rooms (OR's), serving a variety of specialties such as cardiothoracic, vascular, gynecology, urology, and general surgery. In addition, attached to the medical center is a 10,000 square foot minimally invasive surgery center with four OR's, designed to focus on outpatient gynecology and general surgery cases.

The patient population includes adult female patients with an American Society of Anesthesiologist (ASA) physical status classification of 1, 2 or 3, between 30 and 60 years of age, who underwent an LAVH procedure and general anesthesia during the selected timeframe. The intervention was conducted by trained anesthesia professionals, including anesthesiologists and certified registered nurse anesthetists (CRNA's). Postoperative pain score documentation and postoperative narcotic administration was performed by PACU nurses.

Measurement Instruments

All data for this DNP project was manually and systematically collected from the EMR and inserted into an Excel spreadsheet. To test the hypothesis on the effect of intraoperative IV methocarbamol administration on post operative pain scores, a two-sample *t*-test was used to compare the means. Intraoperative and postoperative opioid consumption were recorded and converted to quantitative IV morphine milliequivalents (MME) to create a standardization due to the possibility of patients who received multiple types of opioids. Intraoperative Toradol, an NSAID commonly administered by anesthesia providers as a multi-modal pain adjunct, was also recorded for each patient in both groups. The groups were then compared using a two-sample t-test via SPSS software to determine statistical significance across multiple variables.

Data Collection Procedures

Data for this project was manually collected via a retrospective chart review utilizing patient EMR's. Patient charts were reviewed over a 2-year time frame, beginning April 1, 2021, through April 1, 2023. Patients between 30-60 years old who underwent an LAVH during the specified timeframe were included for review. Collected data was de-identified and entered into a Microsoft Excel sheet. The Excel sheet was saved to a password protected file on the primary investigator's private computer.

Upon access to patient EMR's, the preoperative evaluation was reviewed to determine patient age, ASA status, and surgical diagnosis. Next, the patient's MAR was reviewed to determine if the patient received methocarbamol intraoperatively, and if so, what dose of the medication the patient received. Patients were then be divided into two different groups, one group who received methocarbamol and one group who did not receive methocarbamol. The MAR was assessed to document each opioid the patient received. Opioids given were recorded separately, into intraoperative administration and postoperative administration. Lastly, the primary investigator reviewed the MAR to determine if Toradol was given, and a dose was recorded for each patient. PACU pain scores were then be documented and calculated for each patient.

Ethical Considerations

The Institutional Review Board (IRB) of the site facility approved this project before it was implemented. In addition, Marian University IRB approval was obtained prior to initiation. The official IRB determination form was submitted upon project proposal is approval (Appendix E). All participants were protected by the Health Insurance Portability and Accountability Act (HIPAA) of 1996 (OCR, 2021). HIPPA sets national standards for the protection and confidentiality of individually identifiable electronic patient health information by healthcare providers (OCR, 2021).

Patient confidentiality was assured by coding the participants using individual identification numbers. A check mark was given to identify other study variables (opioid administration, methocarbamol administration, Toradol administration, surgical diagnosis) specific to each patient reviewed for this project. The Excel spreadsheet containing data was kept on a password protected computer, only accessible to the primary investigator. All information

collected for this project will be displayed in a manner that upholds the organization's values and privacy statement.

Results

The EMR's of 80 patients who underwent an LAVH procedure during the period of April 1, 2021, through April 1, 2023, were reviewed to determine the impact of intraoperative methocarbamol administration on post operative pain scores. The sample was divided into two groups, patients who received methocarbamol intraoperatively (n=40) and patients who did not receive methocarbamol (n=40). Of the total sample, 1 patient was classified as an ASA 1 (1.25%), 64 patients were classified as an ASA 2 (80%), and 15 patients were classified as an ASA 3 (18.8%). Surgical diagnoses for this study were coded and analyzed (see Table 1.1). Some patients had 2 diagnoses (n=22), but between both groups, menorrhagia, heavy or prolonged menstrual bleeding (n=48), was the most common diagnosis.

Table 1.1

DIAGNOSIS	NUMBER OF PATIENTS (+) METHOCARBAMOL	NUMBER OF PATIENTS (-) METHOCARBAMOL
PCOS	0	0
ENDOMETRIOSIS	7	5
GYNECOLOGIC CANCER	8	3
UTERINE FIBROIDS	8	7
MENORRHAGIA	21	27
UTERINE PROLAPSE	1	3
PELVIC PAIN	9	2

The MAR for each group was analyzed to determine if patients received Toradol, and other opioids intraoperatively. Patients who received Toradol were all given a dose of 30mg (methocarbamol (-), n=18, 45%; methocarbamol (+), n= 21, 52.5%). Intraoperative opioids were recorded for each group, (Table 2.1 and Table 2.2) and then converted to MME's. In both groups, fentanyl was the most frequently administered intraoperative opioid (methocarbamol (-),

n=34, 85%; methocarbamol (+), n=38, 95%). Hydromorphone was given to 72.5% of the methocarbamol (-) group and 47.5% of the methocarbamol (+) group. Morphine was not given to any of the patients intraoperatively. Of the patients who received methocarbamol, a range of 3 doses were administered (500mg, 750mg, 1000mg). Dose choice was assumed to be provider preference, where 3 patients received 500mg, 1 patient received 750mg, and the remainder of patients were given 1000mg (n=36) of methocarbamol. Intraoperatively, the methocarbamol (-) group had a total opioid consumption of 630.4mg, whereas the methocarbamol (+) group had a total opioid consumption of 572.4mg (p=0.38).

Table 2.1

Intraoperative opioid administered – methocarbamol group (-)

IV OPIOID	NUMBER OF PATIENTS	TOTAL MME (MG)
FENTANYL	34	470
HYDROMORPHONE	29	160.4
MORPHINE	0	0

Table 2.2

Intraoperative opioid administered – methocarbamol group (+)

IV OPIOID	NUMBER OF PATIENTS	TOTAL MME (MG)
FENTANYL	38	480
HYDROMORPHONE	19	92.4
MORPHINE	0	0

Postoperative opioid consumption in the first hour of PACU stay was also converted to MME's. In the PACU, the methocarbamol (-) group had a total of 339.6mg of opioids, and the methocarbamol (+) group had a total of 327.5mg of postoperative opioids. The total MME per patient is lower for the methocarbamol (+) group, although the difference is not statistically significant (p=0.42). Postoperative pain scores for each group were recorded by PACU nurses (0-10 scale) at the 5-minute, 15-minute, 30-minute, and 1-hour time intervals after being admitted to the unit (Appendix D). An initial two sample t-test was performed at each respective

time interval to compare postoperative pain scores between the two groups. At the 5-minute and 15-minute intervals, patients who received methocarbamol reported significantly lower postoperative pain scores (p=0.04, p=0.03). However, pain scores at the 30-minute and 1-hour intervals were not significant between the two groups (p=0.1, p=0.08). A second two sample t-test was conducted between the two groups, eliminating the 4 patients who received less than 1000mg of methocarbamol. Patients who received 1000mg had significantly lower postoperative pain scores at the 5-minute, 15-minute, and 30-minute intervals (p=0.03, p=0.01, p=0.03), however, at 1-hour there was no significance (p=0.09).

Discussion

Overall, patients who received methocarbamol intraoperatively reported a significant improvement in postoperative pain scores compared to patients who did not receive methocarbamol. Initial data analysis, which included all patients who received methocarbamol, regardless of dose, suggested that improvement in postoperative pain scores was significant up to the first 15 minutes in the PACU. A second t-test was performed to exclude patients who received a dose of methocarbamol less than 1000 mg. Results from the second analysis suggested a more significant improvement in postoperative pain scores for a longer period. Intraoperative IV Toradol was given to more patients in the methocarbamol (+) group (n=21, 52.5%) than to those who did not receive methocarbamol (n=18, 45%). The methocarbamol (-) group received more intraoperative and postoperative opioids, however, the difference between the two groups was not significant.

Strengths

A strength of this project was the inexpensive ability to research and analyze existing data while providing a simplistic description of results. Upon initial investigation, there was

minimal data and research available regarding the efficacy of methocarbamol and its impact on postoperative pain following LAVH procedures. The hypothesis generated from this project may be used as an initial study to generate hypotheses for further, larger prospective studies.

Limitations

This project was designed to analyze pre-existing data, making the validity of data reliant on the availability and accuracy of the medical record. In addition, this project was subject to confounding evidence and biases. Although the ASA physical classification status and diagnoses were included, there is potential for other individual patient risk factors that were not measured. Pain is subjective and can present differently in every patient, resulting in a response bias that may influence accuracy of results.

Conclusion

Shorter recovery times, better cosmetic results, and less pain are benefits that have attracted many surgeons to perform minimally invasive surgical techniques. Specifically, the LAVH procedure is one of the most common hysterectomy techniques utilized by surgeons annually. After a thorough review of literature, there is evidence to suggest postoperative pain following an LAVH procedure continues to pose a challenge for anesthesia providers. A centrally acting skeletal muscle relaxant, such as methocarbamol, may provide pain relief while reducing PACU pain scores that may lead to decreased total opioid consumption. The results obtained from this project are limited but may yield to the development of a hypothesis for a much larger study, better suited to determine a causal relationship. To lessen the risks and side effects associated with opioids, while maintaining optimal pain control, future research of intraoperative pain management using methocarbamol should be considered.

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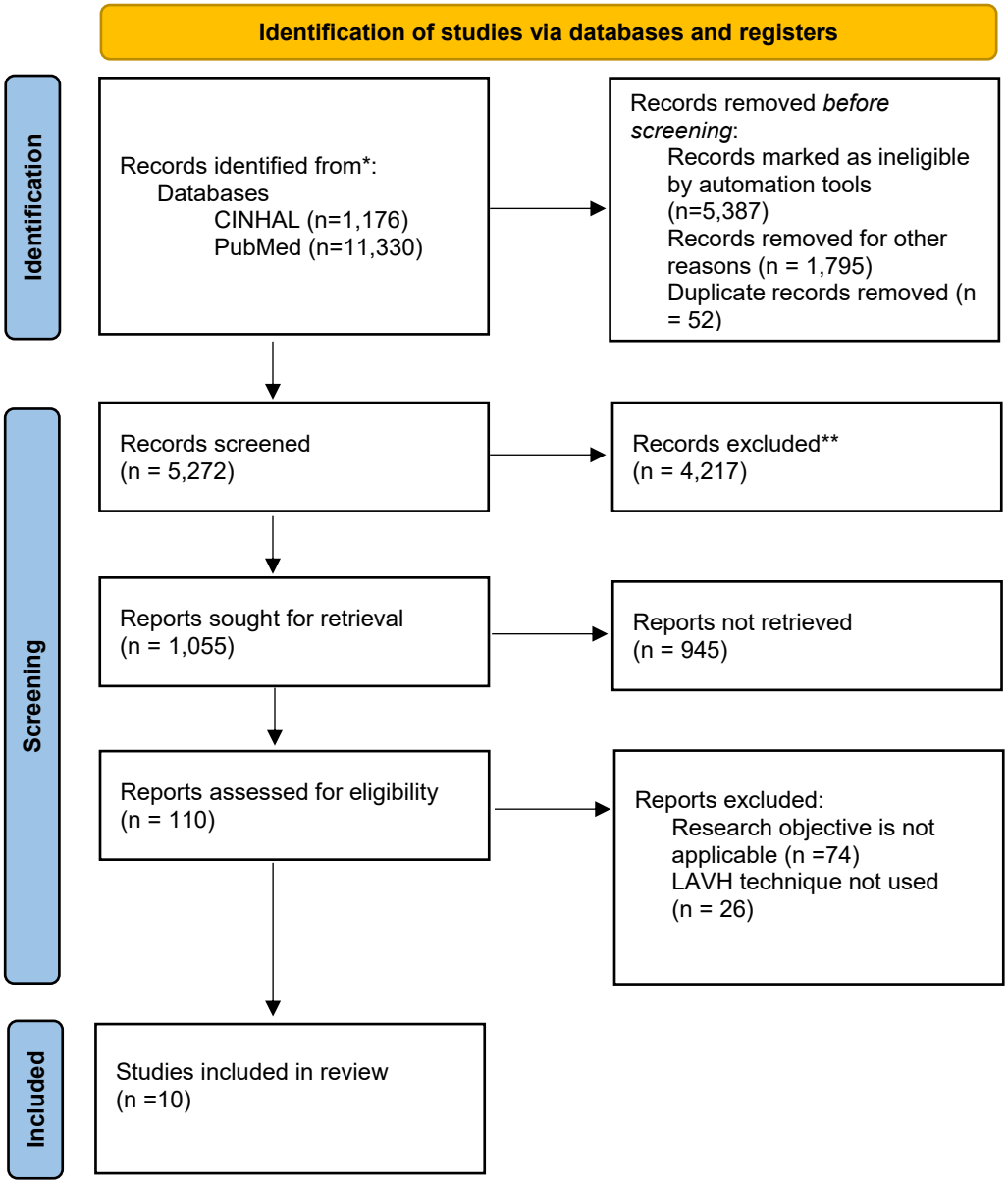
Appendix A


Identification of studies via databases and registers
Identification
Records identified from*:
Databases
CINHAL (n=1,176)
PubMed (n=11,330)
Records removed *before screening*:
Records marked as ineligible by automation tools (n=5,387)
Records removed for other reasons (n = 1,795)
Duplicate records removed (n = 52)
Screening
Records screened
(n = 5,272)
Records excluded**
(n = 4,217)
Reports sought for retrieval
(n = 1,055)
Reports not retrieved
(n = 945)
Reports assessed for eligibility
(n = 110)
Reports excluded:
Research objective is not applicable (n =74)
LAVH technique not used
(n = 26)
Included
Studies included in review
(n =10)

Appendix B

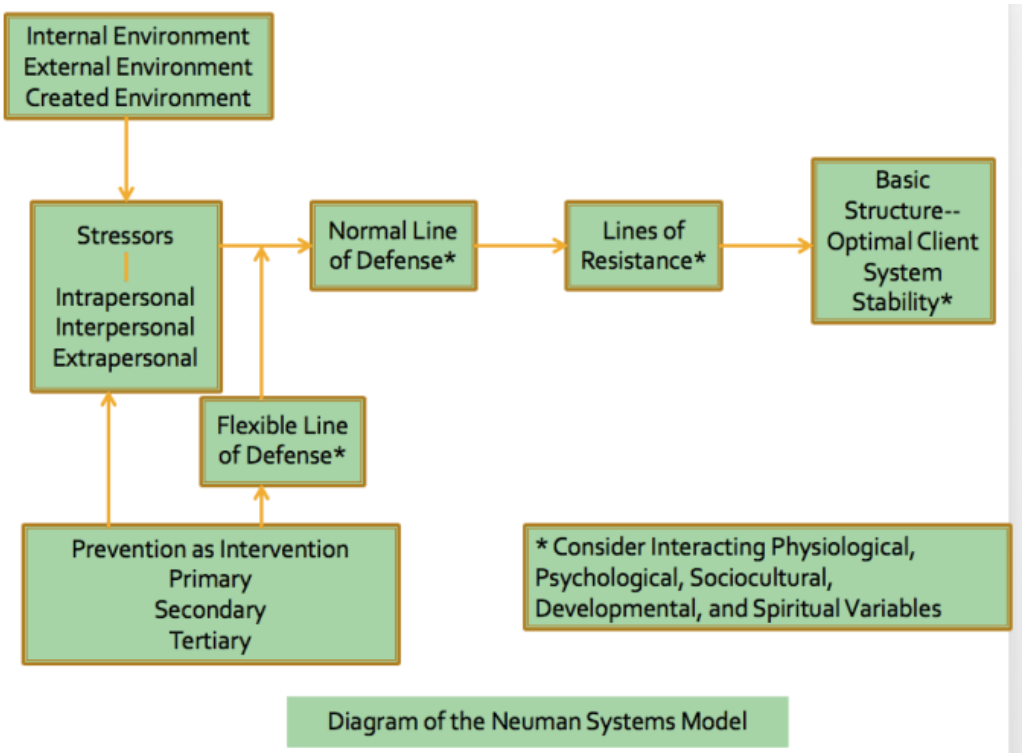
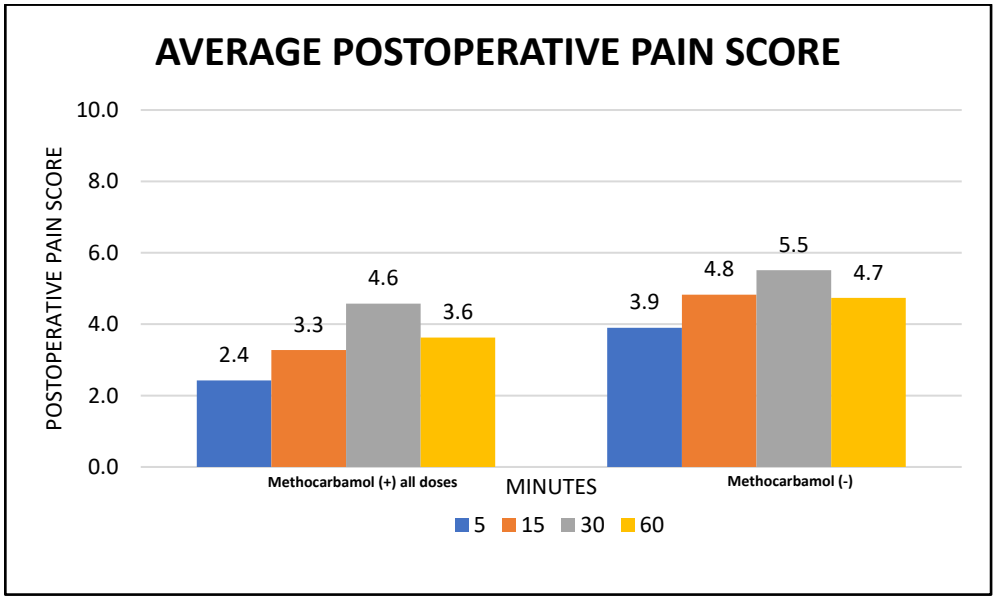


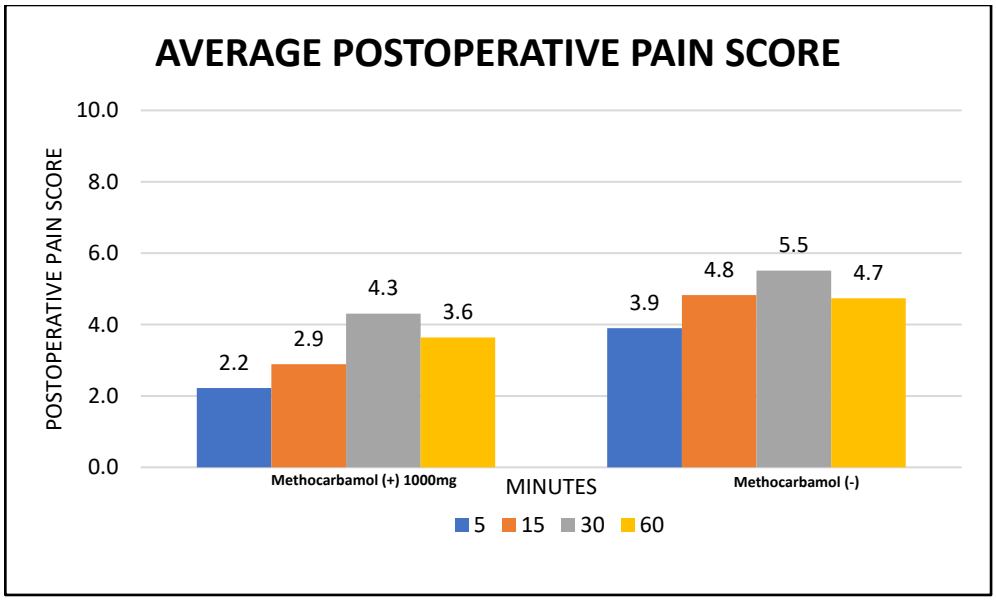
Diagram of the Neuman Systems Model

Appendix C


STRENGTHS
Cost effective and few resources required
Electronic medical records are readily available with less risk of intelligible data and missing charts
LAVH regularly performed at project site, allowing for a greater sample size
WEAKNESS
Possibility of incomplete or missing data
Inconsistency or mistakes made with data coding and extraction
Response bias
Small sample size
Limited data/results
SW
OT
OPPORTUNITIES
Key stakeholders serve to benefit
Patient is not burdened with actively participating in the research process
Initial hypothesis for future, larger prospective studies
THREATS
Subjectivity of the pain score scale
Methocarbamol is regularly administered at the project site. There may not be enough patients who did not receive the medication.
Global pandemics and health crises could result in lack of data available for this project

Appendix D


AVERAGE POSTOPERATIVE PAIN SCORE
POSTOPERATIVE PAIN SCORE
10.0
8.0
6.0
4.0
2.0
0.0
2.4
3.3
4.6
3.6
3.9
4.8
5.5
4.7
Methocarbamol (+) all doses
MINUTES
Methocarbamol (-)
5
15
30
60


AVERAGE POSTOPERATIVE PAIN SCORE
POSTOPERATIVE PAIN SCORE
10.0
8.0
6.0
4.0
2.0
0.0
2.2
2.9
4.3
3.6
3.9
4.8
5.5
4.7
Methocarbamol (+) 1000mg
MINUTES
Methocarbamol (-)
5
15
30
60

Appendix E

Citation	Research Design & Level of Evidence	Population / Sample size n=x	Major Variables	Instruments / Data collection	Results
Eggemann, H., Ignatov, A., Frauchiger-Heuer, H., Amse, T., & Costa, S. D. (2018). Laparoscopic-assisted vaginal hysterectomy versus vaginal hysterectomy for benign uterine diseases: A prospective, randomized, multicenter, double-blind trial (lava). *Archives of Gynecology and Obstetrics*, *297*(2), 479–485. https://doi.org/10.1007/s00404-017-4647-7	Randomized control trial (RCT) Level 4	N=192	Postoperative pain Peritoneal closure Parity, BMI, uterus weight, previous abdominal surgery, age Operating time	VAS Statistical analysis systems (SAS) Two one-sided (TOST) equivalence test	Operative time was significantly longer after LAVH (LAVH + PC 106 ± 29 min; LAVH − PC 99 ± 30) ($p < 0.0001$) and significantly shorter after VH (VH + PC 59 ± 17; VH − PC 56 ± 19). The first three days after surgery, patients in the LAVH group (n=95) reported more pain than those in the VH group (n=92) (VAS score day 1: $p = < 0.0001$; VAS score day 2: $p = 0.021$; VAS score day 3: $p = 0.039$). Peritoneal closure did not have any influence on postoperative pain (+PC versus -PC: VAS score day 1, $p = 0.9399$)

Sesti, F., Cosi, V., Calonzi, F., Ruggeri, V., Pietropolli, A., Di Francesco, L., & Piccione, E. (2014). Randomized comparison of total laparoscopic, laparoscopically assisted vaginal and vaginal hysterectomies for myxomatous uteri. *Archives of Gynecology and Obstetrics*, *290*(3), 485–491. https://doi.org/10.1007/s00404-014-3228-2	Randomized control trial (RCT) Level 4	N=108	Hospital discharge time Operating time, blood loss, paralytic ileus time, postoperative time, intraoperative complications, early postoperative complications Uterine size	Standard preoperative assessment with transvaginal ultrasound VAS The Student's *t*-test for analysis of continuous variables χ^2 test or Fischer's exact test for discrete variables General linear model (GLM) used to perform a regression analysis for dependent variables All analyses performed using SPSS	Overall, 17 (47%) women reported no pain (VAS = 0) after VH, 19 (53%) after TLH, and five (14%) after LAVH (Sesti et al., 2014). Subsequently, 10 (28%) women reported moderate pain after VH (VAS 1-25), eleven (30%) after TLH, and 22 (61%) after LAVH. No significant differences were found for postoperative pain over a 24-hour period among these three different methods (p = 0.32).

Chen, S., Du, W., Zhuang, X., Dai, Q., Zhu, J., Fu, H., Wang, J., & Huang, L. (2021). Description and comparison of acute pain characteristics after laparoscope-assisted vaginal hysterectomy, laparoscopic myomectomy and laparoscopic adnexectomy. *Journal of Pain Research*, *Volume 14*, 3279–3288. https://doi.org/10.2147/jpr.s335089	Cohort study Level 3	N=669	Postoperative pain Preoperative: Age, BMI, level of education, occupation, exercise habits, individual medical history, obstetric history, previous surgery history, preop chronic pain history, medical insurance type, indication for surgery, level of anxiety Intraoperative: number of trocars, intraoperative diagnosis, duration of surgery, blood loss, complications Postoperative: nausea and	Numerical rating scale (NRS) Stata 15 for statistical analysis Kolmogorov-Smirnov test to determine normality Chi-squared test to compare measurement data Bonferroni test for multiple comparisons	Visceral pain had the highest incidence and most severe rating in the LAVH and LH groups, followed by low back pain. Of the patients in the LAVH group, up to 73.1% of patients reported moderate (*n*=64, 25.7%) to severe (*n*=49, 19.7%) visceral pain, and 61% of patients in the LM group reported moderate (*n*=46, 21.9%) to severe pain (*n*=40, 19%). However, in the LA group, incisional pain was reported to be the most severe, with up to 39% of patients reporting moderate (*n*=26, 12.4%) to severe pain (*n*=9, 4.3%). Opioid consumption was highest in the LAVH group than the LM or LA group in the PACU.

			vomiting, pelvic drainage time, indwelling catheter time, and 24-h pelvic drainage		
Hidalgo, D., & Pusic, A. (2005). The role of Methocarbamol and intercostal nerve blocks for pain management in breast augmentation. *Aesthetic Surgery Journal*, *25*(6), 571–575. https://doi.org/10.1016/j.asj.2005.09.003	Randomized control trial (RCT) Level 4	N=100	Postoperative pain Narcotic use	VAS Wilcoxon 2-sample test with a 0.05 2-sided significant level Kruskal-Wallis test for overall differences among the 4 groups	Patients who received methocarbamol had significantly lower VAS pain scores and reduced narcotic use in the first few hours after surgery than those who did not (P= 0.03). Beyond 6 hours after surgery there was no significant difference seen among those who received methocarbamol and those who did not (P= NS, not significant). There was no significant difference in pain scores and narcotic use seen in patients who received intercostal nerve blocks compared to those who did not (P=NS).
Aljuhani, O., Kopp, B. J., & Patanwala, A. E. (2017). Effect of methocarbamol on acute pain after	Cohort study	N=200	Age, sex, injury severity,	International Classification	Patients in the methocarbamol group

traumatic injury. *American Journal of Therapeutics*, *24*(2). https://doi.org/10.1097/mjt.0000000000000364	Level 3		history of drug abuse, vital signs, Glasgow coma scale, injury location, opioid use before admission, surgeries performed, analgesics used during admission, and adverse effects Methocarbamol Mean pain scores on day 1, 2, 3 Opioid consumption Hospital length of stay	of Disease ninth Edition-derived Injury Severity Score (ICISS) The Student *t*-test for analysis of continuous variables χ^2 test or Fischer's exact test for categorical variables Linear regression analyses to determine effect of methocarbamol on mean pain score for each day	had higher opioid consumption on the first day ($p<0.001$). "The mean baseline pain scores were 7.4 ± 2.6 and 6.8 ± 3.2 and in the methocarbamol and control groups, respectively ($P=0.191$)" (Aljuhani et al., 2017, p. e205). There was no significant difference in opioid consumption on days 2 and 3. The mean length of hospital stay was similar for the methocarbamol and control groups (4.9 ± 2.8 vs. 5.4 ± 3.9 days, $P \pm 0.376$).
Patanwala, A. E., Aljuhani, O., Kopp, B. J., & Erstad, B. L. (2017). Methocarbamol use is associated with decreased hospital length of stay in trauma patients with closed rib fractures. *The American Journal of Surgery*, *214*(4), 738–742. https://doi.org/10.1016/j.amjsurg.2017.01.003	Cohort study Level 3	N=592	Age, sex, race, ethnicity, need for endotracheal intubation, need for blood	Log-rank test to compare methocarbamol and no methocarbamol groups	The average time for discharge was 5 days in the methocarbamol group ($P < 0.001$) and 8 days for the no methocarbamol

			component transfusion, need for chest tube, in hospital mortality, discharge status, ICD-9-CM diagnosis codes, Charlson Comorbidity Index, Injury Severity Score Hospital length of stay Pulmonary complications	Cox Proportional Hazards Model to determine likelihood of discharge χ^2 test or Fischer's exact test for categorical variables	group. Patients who received methocarbamol were less likely to have pulmonary complications (11.3%, n = 37 versus 23.2%, n = 61; P = < 0.001).
Abd-Elsalam, S., Arafa, M., Elkadeem, M., Elfert, A., Soliman, S., Elkhalawany, W., & Badawi, R. (2019). Randomized-controlled trial of Methocarbamol as a novel treatment for muscle cramps in cirrhotic patients. *European Journal of Gastroenterology & Hepatology*, *31*(4), 499–502. https://doi.org/10.1097/meg.0000000000001310	Randomized control trial (RCT) Level 4	N=100	Methocarbamol Muscle cramps	SPSS version 23 The Student *t*-test to compare quantitative variables χ^2 test or Fischer's exact test for qualitative variables	There were no significant differences in muscle cramps, severity, duration, and frequency (P > 0.05). After one week, participants in group one showed a significant decrease in the mean number of muscle cramps from 11 ± 4 (median 10.0) to 0.5 ± 1 (median 0.0) per week. The mean

				Mann-Whitney's test for non-normally distributed data	score of pain severity decreased from 6.52 ± 1.29 to 0.66 ± 1.18 compared to those receiving the placebo ($P < 0.001$ for each). Few side effects of methocarbamol were reported, which included dry mouth ($P = 0.0026$) and drowsiness ($P = 0.0002$)
Friedman, B. W., Cisewski, D., Irizarry, E., Davitt, M., Solorzano, C., Nassery, A., Pearlman, S., White, D., & Gallagher, E. J. (2018). A randomized, double-blind, placebo-controlled trial of naproxen with or without orphenadrine or Methocarbamol for acute low back pain. *Annals of Emergency Medicine*, *71*(3). https://doi.org/10.1016/j.annemergmed.2017.09.031	Randomized control trial (RCT) Level 4	N=240	Low back pain, naproxen, methocarbamol RMDQ scores	Roland-Morris Disability Questionnaire (RMDQ) SPSS version 21 Results reported as means with 95% CI	One week after the ED visit, patients randomized to methocarbamol improved their RMDQ score by a mean of 8.1 points (95% CI 6.1 to 10.1) and patients with the placebo improved by a mean of 10.9 RMDQ points (95% CI 8.9 to 12.9). The difference between methocarbamol and the placebo was 2.8 (95% CI 0 to 5.7) suggesting that methocarbamol has no significant effectiveness when added to naproxen for

					the treatment of acute low back pain.
Khan, N. F., Bykov, K., Barnett, M. L., Glynn, R. J., Vine, S. M., & Gagne, J. J. (2022). Comparative risk of opioid overdose with concomitant use of prescription opioids and skeletal muscle relaxants. *Neurology*, *99*(13). https://doi.org/10.1212/wnl.0000000000200904	Cohort study Level 3	N=544	Skeletal muscle relaxants: baclofen, cyclobenzaprine, metaxalone, methocarbamol, tizanidine, and chlorzoxazone Opioids Demographics, comorbidities, pain conditions, and other prescription fills, previous opioid utilization	Multinomial logistic regression model Matching weight (all of probabilities estimated) Cox proportional hazards model weighted by matching weights to estimate the HRs	In the first 30 days, the highest number of opioid overdose events occurred with the cyclobenzaprine (n = 278) and baclofen (n = 266) groups. The hazard ratio (HR) for opioid overdose relative to methocarbamol was 1.00 (95% CI 0.45-2.20, adjusted P value > 0.99). Compared to cyclobenzaprine and baclofen, no other muscle relaxants, such as methocarbamol, were correlated with an increased risk of opioid overdose.
Zoofaghari, S., Samsamshariat, S., Sharifi-Sade, M., Mehr, A. M., & Sabzghabaee, A. M. (2021). Efficacy of the combination of indomethacin and Methocarbamol versus indomethacin alone in patients with acute low back pain: A double-blind, randomized placebo-controlled clinical trial. *Journal of Research in Pharmacy Practice*, *10*(2), 96. https://doi.org/10.4103/jrpp.jrpp_21_31	Randomized control trial (RCT) Level 4	N=64	Low back pain, Indomethacin, methocarbamol Comorbidities: kidney failure, mental illness, heart disease, liver disease, active peptic	SPSS software Chi-square test Back pain function scale	Before initiation of the intervention, pain scores and sex between both groups did not differ significantly (p > 0.05). Both groups had significantly lower pain scores after the intervention, however, patients in

			ulcer, and hemorrhoids. Age, sex, BMI		group two (I + M) had significantly higher pain reduction than that of group one (3.66 ± 3.17 vs. 1.84 ± 1.53; $P < 0.001$). In addition, the average BPFS score, or functional status, increased in group two (I + M) significantly higher than group one (19.44 ± 8.66 vs. 4.75 ± 4.35; $P < 0.001$).