Best Practice Analgesic Management for Minimally Invasive Gynecological Procedures at Corewell Health East- Royal Oak

by

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Abstract

Background: Non-opioid analgesics and analgesic adjuncts have been used successfully in a variety of surgical procedures, including minimally invasive gynecologic procedures that elicit pain via uterine muscle cramps. Non-steroidal anti-inflammatory drugs (NSAIDs) are considered the gold standard in the treatment of pain caused by uterine cramping. Additionally, research shows analgesic benefits of IV magnesium sulfate and acetaminophen.

Purpose: The purpose of this DNP project was to evaluate the current analgesic practice of perioperative opioid administration for minimally invasive gynecological procedures at Corewell Health East - Royal Oak. Additionally, an examination of whether opioid administration or non-opioid analgesia is considered evidence-based best practice for minimally invasive gynecological procedures.

Methods: Data on analgesic medication administration during hysteroscopy and/or dilation and curettage procedures was collected through a retrospective electronic medical record review of 59 patients. Data pertaining to patient age, type of surgical procedure, timing of analgesic medication administration and dosages were considered.

Results: Findings demonstrate that the average dose of fentanyl administered was 45.34 micrograms. There is no statistically significant difference in opioid administration between different phases of anesthesia, dosage of fentanyl between different age groups, or between procedures.

Conclusion: Current literature advocates for minimizing opioid administration, while supporting effectiveness of non-opioid analgesics, such as NSAIDs, magnesium sulfate and acetaminophen for the treatment of mild to moderate pain caused by uterine cramping following minimally invasive gynecological procedures.

Background and Significance

As integral members of the obstetrics/gynecology team, Certified Registered Nurse Anesthetists (CRNAs) play a vital role in keeping the patient comfortable, while providing safe and effective care throughout the operative course. After undergoing a hysteroscopy and/or dilation and curettage (D&C), one of the most common patient dissatisfiers is the experience of pain. The type of pain experienced by a patient is described as mild and cramping, which is not typically relieved by opioids (Kaiser Permanente, n.d.). Since the adverse effects of opioids are well cited in literature, it is preferred to use non-opioid alternatives for patient analgesia. According to Sahin et al., (2016), gynecological procedures have the highest unplanned admission rate to the hospital, accounting for more than 85% of the unplanned admissions. These unplanned admissions are due to uncontrolled pain, postoperative nausea and vomiting, or other reasons (Sahin et al., 2016). Some of the cited side effects, such as postoperative nausea and vomiting, could be attributed to opioid administration. Alternatives to opioids could be given to these patients to provide appropriate pain relief and improve patient satisfaction outcomes.

The purpose of this DNP project is to evaluate the current analgesic practices in anesthesia, focusing on perioperative opioid administration for minimally invasive gynecological procedures at Corewell Health East - Royal Oak. Additionally, we will examine whether opioid administration or non-opioid analgesia is considered evidence-based best practice for minimally invasive gynecological procedures. We will share the results of our project with the nurse anesthetists at Corewell Health East- Royal Oak and present best practice guidelines for these gynecologic procedures. The current literature supports the use of non-opioid alternatives, such as nonsteroidal anti-inflammatory drugs (NSAIDs) and magnesium sulfate, for some gynecologic procedures because NSAIDs are the first line treatment for uterine cramping

(Barcikowska et al., 2020). Additionally, magnesium sulfate is a useful adjunct to administer to this patient population because it directly causes uterine smooth muscle relaxation and reduces pain caused by cramping (Gao et al., 2020).

The importance of reducing or eliminating the administration of opioids for hysteroscopy and/or dilation and curettage is paramount due to the current opioid epidemic and the troublesome side effects that patients experience from receiving opioid analgesics. This proposal is relevant to anesthesia providers because patients are currently receiving fentanyl during these procedures, despite literature supporting the use of non-opioid analgesics for uterine cramping. Three current references from the literature search ((Kumar et al. (2021), Sahin et al. (2016), and Ali et al. (2015)) demonstrated that non-opioid analgesics are as effective as fentanyl in relieving pain after minimally invasive gynecological procedures. Other studies by Barcikowska et al. (2020), Deussen et al. (2020), Petrikovets et al. (2019), and Rakowski et. al. (2019) all support the use of NSAIDs (intravenous or oral acetaminophen) as the gold standard for the treatment of uterine cramping pain. Additionally, research by Gao et al. (2020), Taheri et al. (2015), and Uberti et al. (2020) support the addition of magnesium sulfate for uterine smooth muscle relaxation and pain relief caused by uterine cramping.

The following research questions will be answered:

"What are the current anesthetic practices of perioperative opioid administration for hysteroscopy and/or dilation and curettage at Corewell Health East- Royal Oak?"

"What analgesic medications are considered best practice for minimally invasive gynecologic procedures?"

According to the current literature, pain experienced after most gynecological procedures is described as mild cramping (Kaiser Permanente. (n.d.). For this type of pain, opioids are not

the recommended treatment option. Instead, NSAIDs are the gold standard for the treatment of mild to moderate pain caused by an inflammatory process (Barcikowska et al, 2020).

Literature Review

After a comprehensive literature search, a total of seven articles were included in the literature review. These articles were found through CINAHL, PubMed, and Google Scholar databases. Keywords used in the search include: “hysteroscopy”, “dilation and curettage”, “non-opioid”, “fentanyl”, “pain score”, “magnesium”, and “paracetamol”. Inclusion criteria consisted of full text articles, English language, patient ages 18 years old or older, and procedures including hysteroscopies and dilation and curettage. Initially, the articles were limited to those published within the last five years, but expanded to ten years to include additional articles relevant to our topic. Exclusion criteria were articles without full text, articles that did not discuss alternatives to fentanyl for pain relief, and articles that were not written in the English language. While conducting an extensive search of PubMed, a total of 30 articles were found and after a thorough assessment, three articles were kept for this literature review. While searching CINAHL, a total of 36 articles were researched and one was included. Another literature search was conducted of Google Scholar, yielding two additional articles. The final article was discovered by reviewing references of the articles that were previously chosen. All seven articles are randomized controlled trials that met the inclusion criteria.

Opioid vs. Non-opioid Alternatives

Hysteroscopies and dilation and curettage are procedures that do not typically cause significant amounts of pain; rather the pain is described like menstrual cramps, which is not normally relieved with opioids (Kaiser Permanente, n.d.). Despite this, the current practice for the treatment of pain during these procedures is administering fentanyl. The goal is to provide

adequate analgesia to patients, while avoiding opioid's adverse side effects. The focus of this literature review is to synthesize and critique the current research regarding pain levels after hysteroscopy and dilation and curettage, and what is considered best-practice for the treatment of this type of pain.

Studies That Support Non-Opioid Alternatives: Fentanyl vs. Paracetamol

Paracetamol (acetaminophen) is non-opioid analgesic and antipyretic, which acts on pain receptors via cyclooxygenase inhibition and indirectly by its serotonergic effects (Sahin et al. 2016). Fentanyl is an opioid analgesic, which binds to and activates opioid receptors in the brain, spinal cord, GI tract, and other organs. This causes pain signals to be blocked, as well as a massive release of dopamine (National Institute on Drug Abuse, 2021). Three randomized controlled trials compared the analgesic efficacy of IV paracetamol versus IV fentanyl (Kumar et al. (2021), Sahin et al. (2016), and Ali et al. (2015)). All three studies demonstrated no statistically significant difference in pain scores using the Visual Analogue Scale (VAS). This evidence supports that IV paracetamol is as effective in relieving pain after a hysteroscopy or dilation and curettage when compared to fentanyl.

A study by Kumar et al, (2021) is a prospective randomized control trial to assess the effects of fentanyl vs. paracetamol for intraoperative and postoperative pain after a rigid hysteroscopy in 60 ASA I and II patients, ages 18-65. Paracetamol 15 mg/kg given 15 minutes before surgery vs. fentanyl 2mcg/kg, with rescue 25 mcg of fentanyl given during the case when vital signs were >20% over baseline. Pain assessments included the pain level ranking of 0-10 using the Visual Analogue Scale. These assessments were completed at 0 minutes, 15 minutes, and 30 minutes after surgery. The results indicated pain scores between the fentanyl group and the paracetamol group were not statistically significant ($p > 0.05$). Limitations of the study

included a small sample size (60 patients) and the fact that anesthesia providers knew what medications were administered, which could have introduced bias.

A second randomized controlled study by Sahin et al. (2016) assessed postoperative pain scores in patients undergoing suction curettage for first trimester missed abortions. Researchers included 146 female patients, with ASA scores I-II. The patients were divided into two groups: 76 patients received fentanyl 1 mcg/kg and 70 patients received paracetamol 20 mg/kg. Both groups received propofol 1 mg/kg as well. Pain scores were assessed via the Visual Analog Scale, where 0 is no pain and 10 is worst pain imaginable. Upon conclusion of the study, researchers found that there was no significant difference between the IV paracetamol group and the fentanyl group when comparing the VAS scores at 60 minutes ($p>0.05$). This supports paracetamol is as effective in relieving pain for this procedure. Study limitations include small sample groups, single-blinded study, and short follow up times due to location (ambulatory setting).

A prospective, randomized interventional trial was conducted by Ali and colleagues (2015) to compare the effects of IV paracetamol and IV fentanyl for the treatment of pain during dilatation and curettage procedures. Sixty ASA I and II patients undergoing dilation and curettage for missed abortions were included in the study. All patients received 7.5 milligrams of oral midazolam thirty minutes before the procedure. Thirty of the patients received IV paracetamol 15mg/kg 15 minutes prior to the procedure, while the other thirty patients received IV fentanyl 2mcg/kg at induction. Pain scores postoperatively were assessed using the Visual Analogue Scale at the 5, 15, and 30-minute intervals. The researchers reported both groups had mild pain and no statistically significant difference between the paracetamol and fentanyl groups. Therefore, the study supported IV paracetamol is equally effective as fentanyl in relieving pain

after a dilatation and curettage procedure. The limitations of this research study included a small sample size, single-blinded nature, and short follow-up time.

Studies That Support Non-Opioid Alternatives: Addition of Magnesium Sulfate

The myometrium, or middle layer of the uterus, is a muscular layer made up of densely packed smooth muscle fibers. This is the layer that is responsible for uterine contractions (Arrowsmith et al., 2018). Due to uterine anatomical makeup, its smooth muscle component is responsible for uterine cramping and relaxation. Magnesium sulfate decreases intracellular calcium levels, prevents depolarization of uterine smooth muscle, and thus directly produces a state of muscle relaxation (Uberti et al., 2020). Magnesium's unique properties that contribute to uterine smooth muscle relaxation is directly related to reducing pain caused by uterine contraction. This synergistic effect on the uterus supports the administration of magnesium to an anesthetic regimen during hysteroscopies and dilatation and curettage procedures.

Taheri and colleagues (2015) found that administering 50 mg/kg of intravenous magnesium sulfate 15 minutes prior to induction of anesthesia in patients undergoing a hysterectomy significantly reduced postoperative pain and opioid requirements. Two groups of twenty patients were studied in a randomized control trial study. The first group of twenty patients received 50 mg/kg of magnesium sulfate in 100 milliliters of normal saline, while the second group of twenty patients received only 100 milliliters of normal saline. Postoperative pain scores were recorded on a numeric rating scale at 0, 6, 12, and 24 hours postoperatively. Researchers found that patients who received the magnesium sulfate infusion had less pain at the 6, 12, and 24-hour postoperative time ($P<0.05$). Additionally, pethidine (meperidine) use was significantly reduced within the 24-hour postoperative period ($P<0.0001$) in the group who received magnesium sulfate. Therefore, researchers concluded that a single infusion of

magnesium sulfate is an effective method of reducing pain and opioid requirements in the postoperative period following a total abdominal hysterectomy. It is important to note that a hysteroscopy or dilatation and curettage procedure is significantly less invasive than a total abdominal hysterectomy. However, magnesium sulfate infusion could be beneficial in smooth muscle relaxation and decreasing cramping pain. Limitations of the study include a small sample size and single facility.

Gao et al. (2020) compared patients who received fentanyl with patients that received fentanyl and magnesium sulfate infusions during hysteroscopies. Magnesium acts as a non-competitive NMDA receptor antagonist and demonstrates antinociceptive properties. Routinely, patients who are hospitalized demonstrate low magnesium levels and hypomagnesemia levels are shown to produce hyperalgesia (Gao et al., 2020). Patients were randomly assigned to the magnesium group or the isotonic control group. The magnesium sulfate group received 50 milligram per kilogram bolus 15 minutes before anesthesia and an infusion during the procedure at 15 milligram per kilogram per hour. The control group received the same amount of fluids with an isotonic infusion. Pain scores were evaluated at 1 minute, 15 minutes, 30 minutes, 1 hour, and 4 hours after surgery utilizing the verbal numerical rating score (VNRS). At the 15-minute, 30-minute, 1 hour, and 4-hour intervals, the magnesium group pain scores were statistically lower than the group that did not receive magnesium ($P< 0.05$). Patients in the experimental magnesium group received 31% less fentanyl compared to the control group that did not receive the magnesium infusion ($P< 0.001$). Satisfaction scores were not significantly different between the two groups, supporting that magnesium sulfate was a beneficial adjunct. While this article did not compare opioids to non-opioids, it demonstrated that the addition of magnesium sulfate reduced the total amount of fentanyl that was administered to patients when

compared to patients who just received fentanyl and no magnesium. The use of magnesium sulfate for hysteroscopy and/or dilation and curettage will result in a multimodal pain regimen. Limitations of this study included a small sample size and postoperative magnesium levels were not assessed.

Studies That Support an Opioid-Sparing Regimen for Pain Management

Petrikovets and colleagues (2019) conducted a randomized control trial to compare the effects of an opioid-sparing pain regimen with a standard, opioid-inclusive pain regimen for patients undergoing vaginal pelvic reconstructive surgery. Sixty-three patients were selected for this study. Thirty patients received the ICT-T therapy, which included around-the-clock ice packs, around-the-clock oral acetaminophen, and around-the -clock IV ketorolac, with IV hydromorphone for breakthrough pain. Thirty-three patients received the standard regimen of as-needed ibuprofen, as-needed acetaminophen/oxycodone, and IV hydromorphone for breakthrough pain. Pain was ranked using a Visual Analogue Scale (VAS) and patients were assessed for pain 96 hours after surgery. The group utilizing ice packs, acetaminophen, and ketorolac demonstrated statistically significant lower pain scores during morning rounds and at the 96-hour mark. This group also had lower opioid consumption and there was no difference in patient satisfaction scores. The authors concluded that the opioid-sparing regimen of ice packs, acetaminophen, and ketorolac reduced inpatient opioid use and eliminated the need for opioids after discharge home. This study supports that other methods for relieving pain, like ice and non-steroidal anti-inflammatory drugs, helps reduce pain that a patient experiences. While a vaginal pelvic reconstruction is significantly more invasive than a hysteroscopy or dilation and curettage, this evidence shows that these methods can help reduce pain for our patients.

Studies That Support Use of Less Potent Opiates: Fentanyl vs. Tramadol

A prospective, double-blind study by Tas and colleagues (2013) studied the effects of tramadol versus fentanyl in same day dilation and curettage procedures. The study investigated 100 women, ASA score I and II, and maintained anesthesia with 100 micrograms per kilogram of propofol. The patients were split into two groups: the first of 50 women were given 1 milligram per kilogram of tramadol and the second group 50 women were administered 1 microgram per kilogram of fentanyl. Researchers recorded the patients' pain scores using the Visual Analogue Scale found no statistically significant difference in pain scores between the two groups. While tramadol is still an opiate analgesic, it is not nearly as potent as fentanyl and demonstrates that it is equally effective in decreasing the pain during dilation and curettage. Tramadol is considered the weakest of the opioids and shows a lower risk of dependence and drug abuse (Mayo Clinic, n.d.). The limitations of the study by Tas and colleagues include a small sample size and insufficient patient follow-up.

Hemodynamic Stability

Hemodynamic stability can be assessed using noninvasive measures such as blood pressure and heart rate monitoring, which serves as an indirect measure of tissue perfusion (Bigatello and George, 2002). Hemodynamic instability, characterized as hypotension, hypertension, tachycardia, or bradycardia, is a common adverse effect of anesthesia. Hypotension is most common during an anesthetic and can lead to many other adverse effects including nausea, vomiting, dizziness, decreased cardiac output, and more (Ghaem et al., 2018). Conflicting results were found regarding blood pressure parameters in the fentanyl and paracetamol groups. A study by Ali et al. (2020) compared mean arterial pressure (mmHg), systolic blood pressure (mmHg), and diastolic blood pressure (mmHg) after surgery and found no statistically significant difference with a 95% confidence interval between the fentanyl and

paracetamol group. Kumar et al. (2021) found a statistically significant difference in systolic blood pressures at 10, 15, 20, 25, and 30 minutes, which was lower in the paracetamol group than in the fentanyl group ($p<0.05$). Diastolic blood pressures were also lower in the paracetamol groups at 20 and 25 minutes ($p<0.05$). Mean arterial pressures were significantly lower in the paracetamol group at the 20-minute interval only. In summary, Kumar and colleagues (2021) found that paracetamol resulted in statistically significant lower blood pressure parameters when compared to fentanyl. Researchers did not describe the above-mentioned hemodynamic parameters as hypotension nor did they require medical treatment or intervention.

In contrast to the previously mentioned study, research performed by Sahin et al. (2016) yielded conflicting results. Researchers found that systolic blood pressures in the fentanyl group at 5, 10, 15, and 20-minute intervals were significantly lower than in the paracetamol group. Diastolic blood pressures at 5 minutes were significantly lower ($p<0.05$) in the fentanyl group, however, there were no differences between groups at 10, 15, and 20-minute intervals. Overall, the results of this study showed a statistically significant decrease in blood pressures in the fentanyl group when compared to the paracetamol group. However, the study did not demonstrate hemodynamic instability in either group.

Tas and colleagues (2013) studied the effects of tramadol versus fentanyl in same day dilation and curettage procedures. Some of the measured outcomes of this study included assessment of blood pressure and heart rate between the two groups. Researchers found no statistically significant difference between blood pressure parameters and heart rate among the two groups. These results closely resemble the results found by Ali and colleagues (2015), who compared effects of fentanyl versus paracetamol.

Gao and colleagues (2020) conducted their study to include the administration of magnesium sulfate to treat postoperative pain during hysteroscopic procedures. Researchers found that patients had a lower heart rate, lower systolic pressure, and lower diastolic pressure in the magnesium group. However, none of the patients had episodes of hypotension or bradycardia. This supports the idea that although magnesium sulfate decreases these hemodynamic parameters, it does not negatively impact hemodynamic stability.

Postoperative Respiratory Stability

One of the most cited problems with opioids is its ability to cause respiratory depression. Only one out of three studies that compared the effects of fentanyl versus paracetamol in gynecological procedures assessed postoperative respiratory stability in their patients. Sahin et al. (2016) found that oxygen saturation (SpO2) values in the fentanyl group at 5 minutes was significantly lower ($p<0.05$) than in the paracetamol group, but no differences were found at 10, 15, or 20 minutes. Tas et al. (2013) studied the effects of respiratory depression between tramadol and fentanyl in same day dilation and curettage procedures. Similarly, to the above-mentioned study, researchers found that oxygen saturation at 5 minutes and at the end of the procedure was significantly lower in the fentanyl group. These research studies both found that paracetamol and tramadol offered superior safety and respiratory stability as compared to fentanyl, further demonstrating that opioids are respiratory depressants. Gao and colleagues (2020) also assessed patients' oxygen saturation values and found no statistically significant difference between the magnesium sulfate group and the group that did not receive magnesium infusion.

Postoperative Nausea and Vomiting

According to the critical appraisal of scientific literature, evidence suggests that opioid-free anesthesia leads to a reduction in postoperative nausea and vomiting (PONV) in patients undergoing gynecological surgery. A reduction in PONV leads to fewer cases of aspiration and unexpected hospital admissions, thereby improving patient outcomes and reducing medical costs (Elvir-Lazo et al., 2020). Due to the sufficient evidence for the use of opioid-free techniques, practice modifications may be suggested to improve patient outcomes. Two of six studies evaluated the incidence of postoperative nausea and vomiting in their patient population (Tas et al., (2013), Gao et al. (2020)). Tas et al. (2013) compared the potential side effects of fentanyl and tramadol and found no statistically significant difference in post-operative nausea and vomiting. Both fentanyl and tramadol are opiate derivatives and can similarly contribute to the incidence of postoperative nausea and vomiting. Gao et al (2020) studied the effects of adding magnesium sulfate for patients undergoing hysteroscopies and found no significant difference in the incidence of postoperative nausea and vomiting between the magnesium inclusive group versus the group who did not receive magnesium. This may be attributed to both groups receiving fentanyl. Although opioid-free or opioid-sparing regimens have been shown to reduce PONV, the remaining four studies did not assess postoperative nausea and vomiting, and more research should be conducted on this topic.

Mechanism of Action of NSAIDs vs. Opioids

Nonsteroidal anti-inflammatory drugs have a different mechanism of action than opioids. Arachidonic acid is released from cell membranes in response to cellular injury, which is then converted to prostaglandins and other inflammatory mediators. Nociceptors that contribute to the pain response are innervated by A-delta and C nerve fibers and are sensitized by the presence of prostaglandins, thus contributing to the sensation of pain. Nonsteroidal anti-inflammatory drugs

inhibit cyclooxygenase, which is an enzyme that converts arachidonic acid into prostaglandins, prostacyclin, and thromboxane. By inhibiting this process, inflammation and pain is reduced (Slater et al, 2010). Nonsteroidal anti-inflammatory drugs are not known to induce tolerance or possess addictive properties. The authors state that short-term use of nonsteroidal anti-inflammatory drugs is safe and effective, but long-term use is associated with an increased risk of gastrointestinal bleeding and renal failure, especially in the elderly (Slater et al, 2010).

Using nonsteroidal anti-inflammatory drugs is considered the gold standard in the treatment of mild to moderate pain that is caused by an inflammatory process, such as uterine menstrual cramps. Deussen and colleagues (2020) found that nonsteroidal anti-inflammatory drugs were better than opioids for adequate pain relief in women experiencing uterine cramping following childbirth. Since the pain following hysteroscopies or dilatation and curettage is cramping uterine pain, nonsteroidal anti-inflammatory drugs could be considered the most appropriate in relieving this type of pain.

Opioids, on the other hand, work on the mu, delta, and kappa opioid receptors. Mu receptors are mainly found in the substantia gelatinosa in the dorsal horn of the spinal cord. The opioid receptors are G-coupled protein receptors that bind to opioid ligands, causing a conformational change and a subsequent reduction in cyclic adenosine monophosphate (cAMP), a second messenger. The decrease in cAMP causes overactivation of the sodium potassium ATPase pump, which leads to hyperpolarization of the nerve cells and reduced neuronal transmission. Additionally, opioid receptor activation leads to inhibition of the voltage-gated calcium channels, thus reducing the release of many presynaptic neurotransmitters including substance P (which is implicated in pain perception). These processes lead to attenuation of the pain signals in the dorsal horn of the spinal cord and decrease pain perception in the brain.

However, repeated opioid use can lead to tolerance and hyperalgesia due to receptor upregulation, which is known to cause addiction (Slater et al, 2010). Additionally, opioids are associated with many side effects including constipation, nausea/vomiting, and respiratory depression.

Conclusion

In summary, all the articles surveyed in this literature review (Gao et al. (2020), Petrikovets et al. (2019), Tas et al. (2013), Kumar et al. (2021), Sahin et al. (2016), Ali et al. (2015), and Taheri et al. (2015)) found no statistically significant difference in pain scores among patients who received fentanyl versus patients who received opioid-free alternatives. Two of the authors, Sahin et al. (2016) and Tas et al. (2013), determined that paracetamol and tramadol offered superior safety and respiratory stability as compared to fentanyl, further demonstrating that opioids are respiratory depressants. Hemodynamic stability was variable among all of the studies. Ali et al. (2020) and Tas et al. (2013) found no significant difference in blood pressure parameters between the fentanyl group and non-opioid group, while Kumar et al. (2021), Sahin et al. (2016), and Gao et al. (2020) found a statistically significant difference between the fentanyl group and the non-opioid alternative group. Three of the research studies (Kumar et al. (2021), Sahin et al. (2016), and Ali et al. (2020)) found no statistically significant difference in heart rate among the fentanyl group and the opioid-free group. Two studies investigated the incidence of postoperative nausea and vomiting in their patient population (Tas et al., (2013) and Gao et al. (2020)) and found no statistically significant difference between the two groups. Additionally, Slater et al. (2010) described differences in the mechanisms of action of nonsteroidal anti-inflammatory drugs and opioids. Based on the mechanism of action of opioids in the human body, tolerance and hyperalgesia factors to consider. Alternatively,

nonsteroidal anti-inflammatory drugs do not possess addictive properties and are associated with fewer side effects. Taheri et al. (2015) found that patients who received diluted magnesium sulfate experienced a statistically significant reduction in postoperative pain scores and a statistically significant decrease in opioid consumption. According to these studies, it is reasonable to assume that non-opioid alternatives are safe and effective alternatives to traditional opioid use. Given this information, administering analgesic adjuncts and reducing or eliminating opioids for minimally invasive gynecological procedures, such as dilatation and curettage and hysteroscopies, would be beneficial to the gynecological patient population and contribute to improved patient outcomes.

Problem Statement

Intraoperative opioids are routinely administered by Certified Registered Nurse Anesthetists (CRNAs) to patients during minimally invasive gynecologic procedures. It is expected that the duration of action of intraoperative opioids will continue in the postoperative recovery period, enhancing patient comfort. Patients, however, have reported pain following minimally invasive procedures is similar to menstrual cramps, which is not usually treated with opioids outside of the hospital setting. The adverse effects of opioids are well established; if opioids are not necessary for pain relief, more appropriate alternatives to opioids, for comfort measures, should be included in the plan of care.

The consequences of the opioid epidemic are staggering. The Center for Disease Control and Prevention (2022) estimates that nearly 247,000 Americans have lost their lives due to prescription opioid overdoses between the years of 1999 and 2019. A retrospective cohort study by Hah et al. (2017) reviewed 36,177 opioid-naive patients undergoing minor surgery. The researchers found that new and persistent opioid use was seen in 5.9-6.5% of those patients. This

study demonstrates the dangers of perioperative opioid administration and the propensity for addiction. An exhaustive review of literature has demonstrated the safety and efficacy of non-opioid alternatives when treating perioperative pain in minimally invasive gynecological procedures, such as a dilatation and curettage and/or hysteroscopy. Therefore, our research will examine how much fentanyl is currently being administered to patients undergoing hysteroscopies and/or dilation and curettage at Corewell Health East- Royal Oak and discuss alternatives to help relieve the patient's pain.

Research Question

The following research questions will be answered:

- "What are the current anesthetic practices of perioperative opioid administration for hysteroscopy and/or dilation and curettage at Corewell Health East- Royal Oak?"
- "What analgesic medications are considered best practice for minimally invasive gynecologic procedures?"

According to the current literature, the pain that is experienced after these gynecological procedures is described as mild cramping. For this type of pain, opioids are not the recommended treatment option. Instead, nonsteroidal anti-inflammatory drugs are the gold standard for the treatment of mild to moderate pain caused by an inflammatory process (Barcikowska et al, 2020).

Aims of Study

The primary aim of this project is to determine how much fentanyl is currently being administered to patients undergoing a hysteroscopy and/or dilation and curettage procedure at Corewell Health East- Royal Oak. While it is pertinent to acknowledge that anesthesia providers may practice differently, the first step should be to determine how much fentanyl is being given

to this patient population. Specifically, perioperative fentanyl administration per the anesthesia provider only will be assessed.

The second aim of this research study is to determine which medications would provide adequate analgesia in the perioperative period and educate anesthesia providers in their use. Specifically, this study is focused on the use of nonsteroidal anti-inflammatory drugs, acetaminophen, and magnesium sulfate for patient analgesia instead of opioids. This is widely supported in the literature for minimally invasive gynecologic procedures like dilation and curettage and/or hysteroscopies. The thorough literature review will be used to educate anesthesia providers about the benefits of using nonsteroidal anti-inflammatory drugs, acetaminophen, and magnesium sulfate for this particular type of pain. We will also discuss with anesthesia providers the results of the chart review, focusing on current fentanyl administration practices and how they can be altered using non-opioid alternatives.

Framework

The framework for practice and research design of this DNP project is Evidence-Based Practice (EBP), which is defined as a "problem-solving approach to clinical decision-making within a healthcare organization" (Dang et al., 2021). Some of the goals of EBP include standardizing care and improving patient outcomes. The appropriateness of this framework is evident in the aims of this DNP project. Standardization of care is achieved by conducting a literature review to determine the best practice methods of pain control for these procedures. A chart review will be utilized to examine what is currently given to the patients undergoing the gynecologic procedures discussed. Specifically, Johns Hopkins Nursing Evidence-Based Practice Model most closely relates to this research topic. This model consists of three main phases: practice question, evidence, and translation (Dang et al., 2021). After these three phases are

completed, they progress to change in best practice guidelines. Initially, the PICO question was developed as a means of introducing the topic of interest. Then, a thorough literature search was conducted to evaluate the current standards of practice, alternatives to current practice, and to identify gaps in knowledge. Finally, this information was translated into practice by recommending best practice alternatives to opioids for minimally invasive gynecological procedures, such as hysteroscopies and/or dilatation and curettage.

The organizational theory that is used to provide support for this shift in practice is Lewin's Theory of Change. The theory of change is separated into three distinct stages: unfreezing, moving stage, and refreezing (Lewin's change theory, 2020). This theory will be useful for educating providers about current administration of fentanyl and other medication choices available to treat the type of pain that the patient may experience. Currently, the project is in the beginning of the transition from the unfreezing stage to the moving stage. The unfreezing stage refers to finding the problem that needs to be solved and discusses the resistance to change. The problem identified is that opioids are not the most appropriate form of analgesia for hysteroscopies and dilation and curettage. By providing patients with other forms of pain relief (nonsteroidal anti-inflammatory drugs and magnesium sulfate infusion), the dose of opioids administered to patients will be reduced. The moving stage refers to finding a solution to the identified problem, gathering resources needed to implement the change, and finally implementing the change. This will involve education, cooperation, and buy-in of key stakeholders, including obstetrics/gynecology physicians and anesthesia providers. Lastly, the refreezing stage is evaluating if the change has been accepted by the healthcare staff. If the change is accepted by the staff, then this change will become the new evidence-based practice implemented.

Project Methodology

This DNP project was developed to determine the current anesthesia practice for providing analgesia for minimally invasive gynecological procedures; specifically, dilatation and curettage and/or hysteroscopies. In addition, we aim to answer the question, "What type of analgesic medications are considered best practice for dilatation and curettage and/or hysteroscopies?". A retrospective chart review of sixty patients who had a hysteroscopy or dilatation and curettage procedures between the years 2019-2022 will be reviewed to determine current practice. For the retrospective chart review, we will research the following parameters:

- Type of procedure
- Patient's age
- Type of opioid administered
- Total dose of opioid administration, induction dose vs. intraoperative dose
- Other non-opioid analgesics and doses

This is a quality improvement project designed to educate and potentially adjust perioperative opioid administration for gynecologic based on current best-practice guidelines. The data was retrieved utilizing the electronic medical record (EMR) for a retrospective chart review. After collection, a data analysis was performed. These data included analyzing if variables like age or procedure type influenced the provider to administer more or less fentanyl.

The second step of the project was to conduct an educational session to certified registered nurse anesthetists who will care for these patients and educate them on benefits of non-opioid analgesics. By potentially implementing this quality improvement initiative into their practice at Corewell Health East- Royal Oak, patients having these gynecologic procedures may have improved patient outcomes.

Project Setting

The setting for this DNP project is Corewell Health East- Royal Oak Campus. The retrospective chart review was conducted and final presentation will be delivered to nurse anesthetists at Corewell Health East- Royal Oak Campus.

Key Personnel and Stakeholders

The key personnel for this DNP project include: Kelsey Murphy, Principal Investigator; Paulina Franzen, Co-Principal Investigator; Lori Shannon DNAP, CRNA, Project Chair, and Kathleen Huston MD, Project Committee Member. Stakeholders for this project include other obstetric and gynecological surgeons at Corewell Health East- Royal Oak Campus and members of the anesthesia team, including nurse anesthetists and anesthesiologists.

Participants and Population

The participants for the project included currently practicing nurse anesthetists at Corewell Health East- Royal Oak campus, as well as the anesthesiologists. No nurse anesthetist or physician participants are excluded from this project. The patient population includes all female patients undergoing minimally invasive gynecological procedures, specifically dilatation and curettage and/or hysteroscopies, at Royal Oak hospital. All patients included were 18 years or age and older.

Recruitment Strategies

This is a retrospective chart review. Patients chosen for this study were Dr. Huston's patients who underwent a dilation and curettage and/or hysteroscopy procedure between the years of 2019 and 2022. Inclusion criteria consisted of Dr. Huston's patients and 18 years of age and older. Exclusion criteria consisted of patients who had a missed abortion or had a more invasive procedure, such as laparoscopy.

Projection Intervention Plan

This is a quality improvement initiative to educate anesthesia providers about evidence-based analgesic techniques for minimally invasive gynecological procedures. The presentation took place at Corewell Health East- Royal Oak, on Tuesday, June 6, 2023. The presentation was given over the span of 20 minutes, with 10 minutes left for questions from the audience.

Data Collection Strategies

Data mining was performed by Stacey Karwoski, Business Intelligence Analyst - Corewell Health, to find patients who fit the inclusion and exclusion criteria for this DNP project. Subsequently, patient encounter numbers were provided. Patient charts were accessed by using the electronic medical record system at Corewell Health East- Royal Oak. The data points that were collected include: patient age at the time of the procedure, the type of procedure that the patient underwent, the total dose of fentanyl administered, whether the fentanyl dose was given at induction or during another point in the case, and if any other analgesic adjuncts or non-opioid analgesic medications were administered.

The data was then analyzed by Dr. Kyle Moxley, a statistician with Oakland University. A statistical analysis was completed with the data collected from the charts. This analysis included total dose of fentanyl given, how much fentanyl was given between procedures, how much fentanyl was given to different age groups, and if there was a difference between the amount of fentanyl given at induction versus the rest of the case. These data points were used to present to the CRNAs at Corewell Health East- Royal Oak.

Procedures for Project Implementation

The dissemination of the DNP Project results was used to share research findings with the CRNAs at Corewell Health East- Royal Oak and demonstrate how patient care for this

population may be improved using non-opioid analgesia. An educational presentation was held on the current opioid administration practices to the CRNAs at Corewell Health East- Royal Oak, as well as information about non-opioid alternatives that are considered evidence-based best practice for the treatment of pain during dilatation and curettage and/or hysteroscopy procedures.

Potential Barriers to Implementation and Sustainability

Some of the potential barriers to implementation and sustainability include: provider resistance to change, education reaching all of the anesthesia providers, and drug availability. Magnesium sulfate is not stocked in all of the Omnicells throughout Corewell Health East- Royal Oak. Therefore, access to this analgesic adjunct may be limited. Intravenous acetaminophen is not readily available, since it requires a physician order and pharmacy approval in order to dispense. Oral acetaminophen would require a preoperative order per the surgeon or physician anesthesiologist.

Ethical Considerations and Risks

IRB approval was granted to proceed with the DNP project and data collection. The project presentation was written in full HIPAA compliance, without disclosing any personal information of the patients included in the study. Additionally, although the evidence-based research suggests that alternative analgesic measures are superior to opioid administration, rescue opioids are not ruled out and are based on individual patient analgesic requirements. Each patient will be evaluated on a case by case basis to determine whether opioids would be beneficial to administer to the patient.

Potential Benefits and Outcomes

There are a myriad of potential benefits for patients by reducing or eliminating opioids in minimally invasive gynecological procedures. One known benefit is a reduction in opioid exposure. A retrospective cohort study of 36,177 opioid-naive patients undergoing minor surgery (Hah et al., 2017) demonstrated new persistent opioid use in 5.9-6.5% of those patients. It is also important to note that post-surgical reduction in opioid prescribing does not affect patient satisfaction. Additionally, eliminating the harmful opioid side effects, such as constipation, nausea/vomiting, and respiratory depression would result in an improvement of patient outcomes.

Anticipated Resources, Budget and Funding Plan

There are no concerns about budget or funding plan since the DNP project is a retrospective chart review.

Evaluation Plan

The purpose of this DNP project is to evaluate the current analgesic practices in anesthesia, focusing on perioperative opioid administration, for minimally invasive gynecological procedures at Corewell Health East - Royal Oak.

One outcome measure of the DNP project focused on determining the current anesthesia medication administration practice for minimally invasive gynecological procedures. Current practice includes administration of ketorolac in 78% of cases and fentanyl administration in 64% of cases. Out of those cases, the average fentanyl dose was 45.34 micrograms. None of the patients received intravenous acetaminophen or magnesium sulfate. The analysis method for this objective was a retrospective chart review of 59 patient charts who underwent hysteroscopy and/or dilation and curettage. Data regarding patient age, type of procedure, dose of fentanyl, and

dose/type of other analgesic adjuncts were collected. Data was submitted to an Oakland University statistician, Dr. Kyle Moxley, and returned upon completion of statistical analysis.

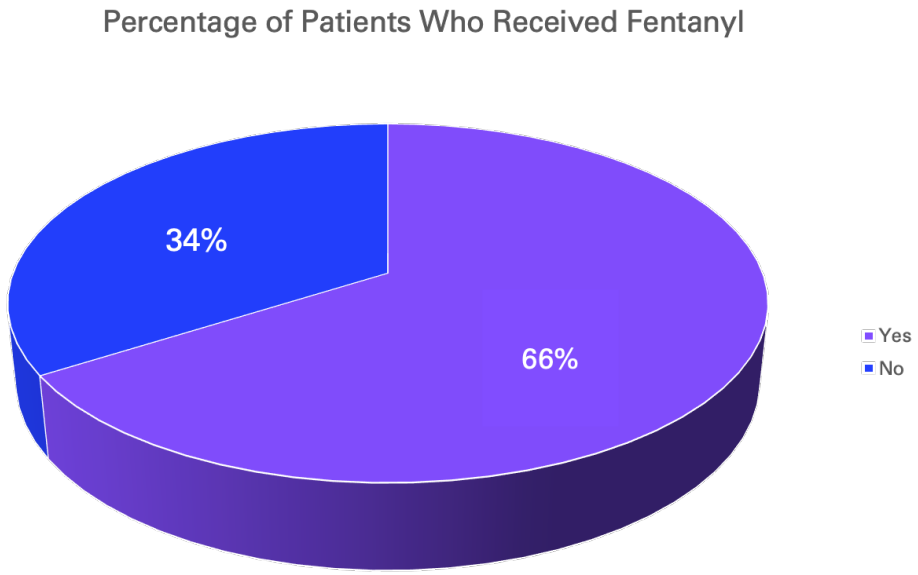
The second outcome measure was to determine which medications would provide adequate analgesia in the perioperative period and educate anesthesia providers in their use. This outcome measure was met by conducting an exhaustive literature search and review. The current literature states that best practice is to avoid opioids and use nonsteroidal anti-inflammatory drugs, such as ketorolac, as well as acetaminophen and magnesium sulfate. After a thorough literature review, a professional presentation was provided to educate Certified Registered Nurse Anesthetists at Corewell Health East- Royal Oak about the benefits of using nonsteroidal anti-inflammatory drugs, acetaminophen, and magnesium sulfate for this particular type of pain. Additionally, a discussion took place summarizing results of the chart review, focusing on current fentanyl administration practices and how it can be altered using non-opioid alternatives.

Results

A retrospective chart review was conducted on 59 patients who underwent a dilation and curettage, hysteroscopy, or both. The data points that were collected included the patient's age, type of procedure, the total dose of fentanyl the patient received, the induction dose of fentanyl, the amount of fentanyl that was given for the remainder of the case, and other pain medications and dose that the patient may have received. Specific points of interest included the average amount of fentanyl that was given to this patient population, whether one type of procedure receive more fentanyl than another, if there was a difference in the amount of fentanyl that was given during induction versus the remainder of the case, and if these patients received other analgesic adjuncts. A statistician performed the analysis of the data.

Average Fentanyl Use

The range of fentanyl that was given was between 0 and 100 micrograms. Twenty of the fifty-nine patients, or 34%, did not receive any fentanyl throughout the case. The maximum amount of fentanyl that a patient received was 100 micrograms. For the 66% of patients who received fentanyl, the average dose received was 45.34 micrograms (Table 1). The 95% confidence interval is 34.35 to 56.33 micrograms (Table 2).

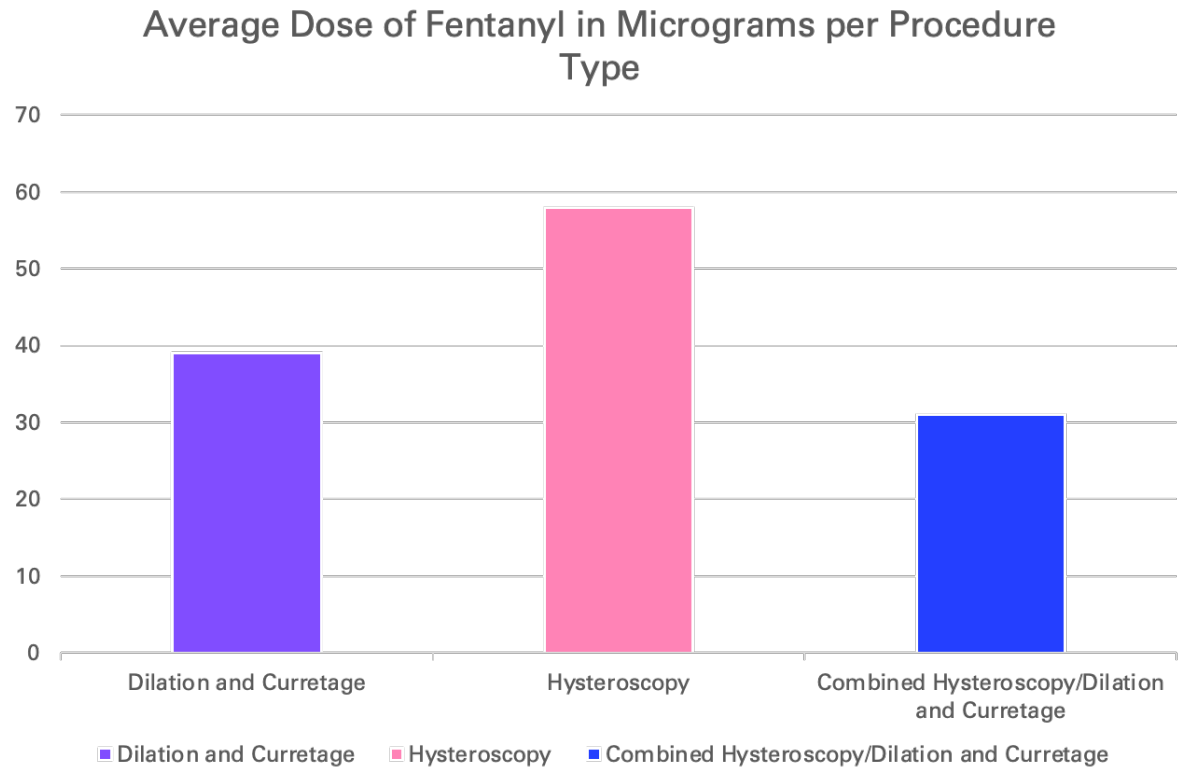


Fentanyl Use by Case

Another data point that was of interest to this DNP project was if a difference existed in the total amount of fentanyl given to a patient based on procedure type. The mean amount of fentanyl that was given for a dilation and curettage was 39.29 micrograms. The mean amount of fentanyl that was given for a hysteroscopy was 57.5 micrograms. The mean amount of fentanyl that was given for a hysteroscopy and dilation and curettage was 30.68 micrograms (Table 3).

When compared, the difference in the amount of fentanyl that was given between the different procedures was not statistically significant, when p= 0.068 (Table 4). However, to practitioners, it is worth noting that a hysteroscopy received about 17 micrograms more than a

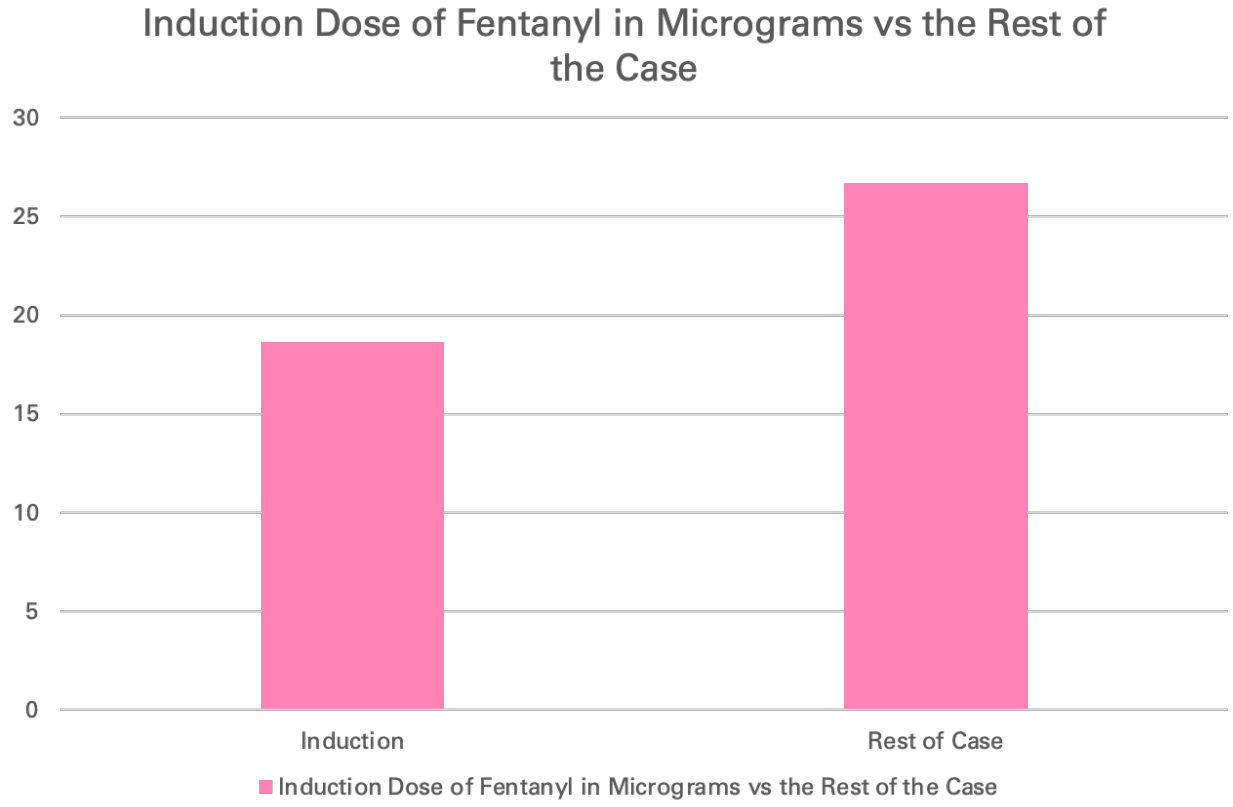
dilation and curettage. A hysteroscopy received almost 20 micrograms of fentanyl more than when the procedure was both a hysteroscopy and dilation and curettage. The procedure that received the least amount of fentanyl were the cases that were a combined hysteroscopy and dilation and curettage.



Induction Dose of Fentanyl versus the Rest of the Case

A specific data point that was of interest for this DNP project was if there was a statistically significant difference in the amount of fentanyl that was given during the induction period of anesthesia versus the rest of the case. The rest of the case is defined as any time period that did not include induction. This includes fentanyl that was given in the preoperative unit, during maintenance, emergence/extubation, or given by an anesthesia provider in the post-anesthesia care unit (PACU).

A Wilcoxon matched-pairs signed rank test was conducted to determine whether there was a difference in fentanyl given at two operative time periods: induction (Mean= 18.64, SD= 25.25) and the rest of the case (Mean= 26.69, SD= 33.43) (Table 5). Results of that analysis indicated that there was no significant difference, when z = -1.36, p=.181 (Table 6). These results indicate that there was no statistically significant difference in how much fentanyl the patient received between induction and the rest of the case.

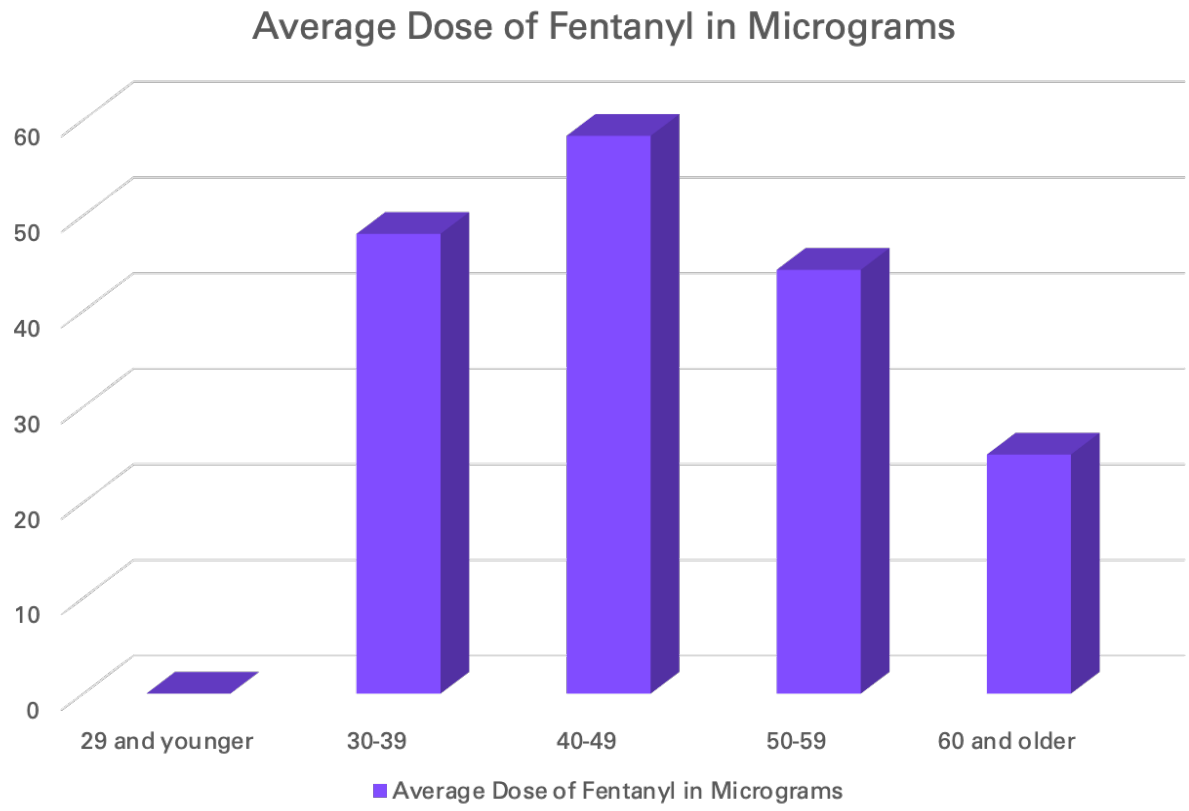


Amount of Fentanyl by Age

The amount of fentanyl that was administered was compared between different age groups. Age groups were divided into the following categories: 29 years of age and under, 30-39, 40-49, 50-59, and 60 and older. There was only one patient in the 29 and under age group and this patient did not receive any fentanyl for the procedure. The mean amount of fentanyl given for the 30-39 age group was 48.08 micrograms. The mean amount of fentanyl given for the 40-

49 age group was 58.33 micrograms. The mean amount of fentanyl given for the 50-59 age group was 44.32 micrograms. The mean amount of fentanyl given for the 60 and above age group was 25.00 micrograms (Table 7).

When comparing the age groups to each other, there was not a statistically significant difference in the amount of fentanyl that was administered, p= 0.348 (Table 8). The 29 year and under age group consisted of one patient. Therefore, it is difficult to compare this age group to the other age group. The rest of the age groups were all within 20 micrograms of fentanyl given.

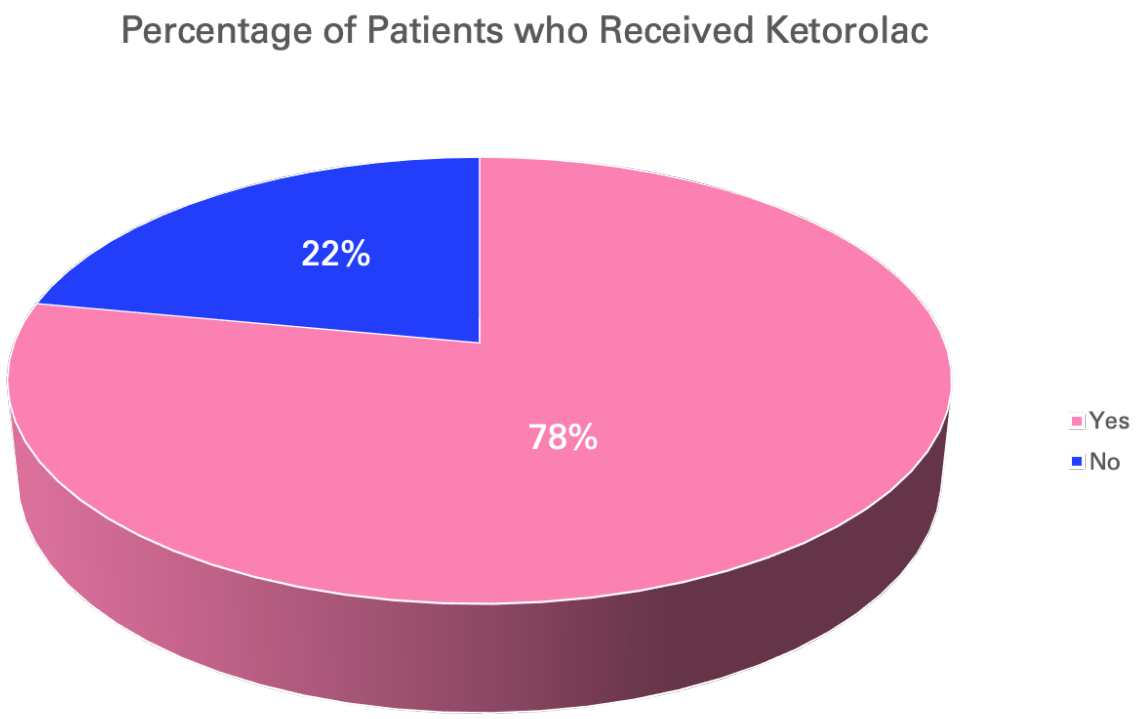


Discussion

Analysis of Findings

According to research findings, the average fentanyl use in hysteroscopies and/or dilatation and curettage procedures was 45.34 micrograms. There is no statistically significant difference in opioid administration between the induction phase of anesthesia and the rest of the

perioperative period. There is also no statistically significant difference in the dosage of fentanyl between different age groups or between procedures (dilatation and curettage versus hysteroscopy versus both). The retrospective chart review showed 78% of patients received ketorolac. Within the chart review, of the 22% of patients who did not receive ketorolac, there was no evidence of allergies to nonsteroidal anti-inflammatory drugs or contraindications to ketorolac, such as previous bariatric surgery, peptic ulcer disease, previous gastrointestinal bleeding, or renal dysfunction. It was unclear during the chart review whether the anesthesia provider or surgeon decided if a patient did or did not receive ketorolac. No patients received magnesium sulfate or acetaminophen, which literature reviews support their use as beneficial analgesic adjuncts.



Discussion of Facilitators and Barriers

One of the barriers encountered in this study is a limited sample size of 59 patients. Additionally, one surgeon participated in the study and one healthcare facility was involved. Anesthesia practices of individuals within one anesthesia group were involved, which may not be representative of all anesthesia providers. Additionally, physician anesthesiologists induce anesthesia at this facility and they may influence what medications are administered. For that reason, the timing of opioid administration was considered and evaluated. Another barrier to this DNP project is the lack of literature on the subject of opioid-free or opioid sparing minimally invasive gynecologic procedures.

Unintended Consequences

There were no unintended negative consequences due to the retrospective nature of this project. However, there would be positive consequences to patient outcomes if anesthetic practices change and providers use fewer or no opioids.

Recommendation for Sustaining Intervention

Current literature supports the use of nonopioid adjuncts for the treatment of pain related to dilation and curettage and/or hysteroscopy procedures. Analgesic adjuncts such as ketorolac, acetaminophen, and magnesium sulfate have been proven to reduce pain scores and enhance patient comfort, thus reducing or eliminating intraoperative opioid requirements.

Application in Other Settings and Populations

Opioid-free and opioid sparing procedures can be applied to other minimally invasive procedures. At Corewell Health East- Royal Oak, opioid-free protocols exist for thyroid and parathyroid surgeries. According to the research conducted within this DNP study, opioid sparing techniques are already being utilized in hysteroscopies and dilatation and curettage

procedures, as well as more invasive surgeries such as vaginal pelvic reconstructive surgery and hysterectomies.

Limitations of Project Findings

Limitations of the DNP project include the limited number of charts examined, a single facility, and only one provider's patients. Access to only 60 patient charts was granted for the retrospective chart review, and one chart had to be eliminated due to the unexpected invasiveness of the procedure. The total number of charts reviewed was 59. The DNP project was conducted within a single facility, Corewell Health East- Royal Oak. Due to the above listed limitations, the study may not be representative of the anesthesia profession across the United States.

Implications for Practice and Career Development

This DNP project will benefit continuing education for anesthesia providers and provide information regarding evidence-based anesthesia practice protocols. The research regarding benefits of nonsteroidal anti-inflammatory drugs, acetaminophen, and magnesium sulfate can be used for not only minimally invasive gynecologic procedures, but other surgical procedures. Evidence-based practice is always evolving and it is important to continue to learn as a provider.

Contribution of Project in Achieving DNP Essentials and Personal Goals

The following DNP Essentials were achieved by completing this project:

- DNP Essential I was met by researching non-opioid alternatives to pain management in minimally invasive gynecologic procedures and its implications on current anesthesia practice. Current practice was evaluated to compare to evidence-based best practice.
- DNP Essential II was met by evaluating current care delivery approaches and developing this quality improvement initiative. The current practice of the system (Corewell Health East- Royal Oak) was evaluated as well.

- DNP Essential III was met by reviewing current literature on the topic of opioid-free anesthesia for minimally invasive gynecological procedures and included comprehensive information regarding non-opioid alternatives. Findings of the current evidence-based practice were used to support the quality improvement initiative. The literature that was evaluated was from research articles and clinical trials.
- DNP Essential IV was met by conducting a literature search, a retrospective chart review, and a data analysis. Multiple databases were searched to gather the literature that was to be used for the project. A retrospective chart review was then conducted and relevant data was collected from these charts. A data analysis was completed with data collected.
- DNP Essential V will be met by educating anesthesia staff on current analgesic practices, and informing them on evidence-based research to support opioid alternatives in minimally invasive gynecological procedures. We will help to lead this initiative in best practice for minimally invasive gynecological procedures. We will advocate for a change in practice to provide better outcomes to our patients.
- DNP Essential VI was met by discussing and educating the other members of the anesthesia care team about the current practice at Corewell Health East- Royal Oak. Anesthesia members were invited to collaborate about implementing evidence-based best practice going forward and how to provide our patients with the best care.
- DNP Essential VII was met by researching epidemiological data on the opioid epidemic. This was discussed with regards to how reducing opioids can help to reduce the opioid epidemic.
- DNP Essential VIII was met by using advanced communication skills to develop partnerships with CRNAs and to educate them on best-practice guidelines and improve

patient outcomes. Therapeutic nursing interventions are also discussed like heat and ice to reduce pain in the postoperative period. Evidence-based care will be used to improve patient care.

Appendix A - IRB Approval Letter

Beaumont HEALTH

Nursing EBP, Quality and Research Council

Nursing Research/EBP/QI Application Review
Date: 12.12.22
To: Paulina Franzen, RN, BSN, SRNA and Kelsey Murphy, RN, BSN, SRNA

Re: Best Practice Analgesic Management for Minimally Invasive Gynecological Procedures at Royal Oak Beaumont Hospital

Dear Paulina and Kelsey,

Your EBP Project application was reviewed by the Beaumont Health Nursing Evidence Based Practice, Quality Improvement and Research Council. This council consists of site representatives from all of our sites – including Directors of Education and Research, CNO's, Research Institute Managers, and various leaders from Beaumont Health System as well as members of the faculty at Oakland University.

Thank you for addressing the few questions/concerns were identified by the Council and for forwarding your Data Attestation Form. Thank you for sharing your dissemination plan. **Please also provide a summary of your final results to our Council!**

Your project is approved by the Council.

Please reach out with any questions or concerns.

On behalf of the Beaumont Nursing EBP, Quality and Research Council, thank you for your application.

Andrea Carr and Caroline Medcoff

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Appendix B - Copy of Data Collection Tool

Patient Number	Age	Procedure (H, D&C, or Both	Total Dose of Fentanyl (mcg)	Induction Dose (mcg)	Rest of Case (mcg)	Other Meds and Dose
1	51	D&C	50	50	0	Ketorolac 30 mg
2	56	Hysteroscopy	25	0	25	Ketorolac 30 mg
3	61	D&C	25	25	0	Ketorolac 30 mg
4	62	Both	0	0	0	None
5	47	D&C	0	0	0	Ketorolac 30 mg
6	52	Both	0	0	0	Ketorolac 30 mg
7	55	Both	0	0	0	Ketorolac 30 mg
8	38	Both	100	50	50	Ketorolac 30 mg
9	52	Both	0	0	0	Ketorolac 30 mg
10	47	Hysteroscopy	100	0	100	Ketorolac 30 mg
11	70	Both	50	50	0	Ketorolac 15 mg
12	38	Hysteroscopy	25	25	0	Ketorolac 30 mg
13	47	Hysteroscopy	75	25	50	Ketorolac 30 mg
14	35	Hysteroscopy	50	50	0	Ketorolac 30 mg
15	50	Both	50	0	50	Ketorolac 30 mg
16	51	Both	0	0	0	Ketamine 50 mg
17	37	Hysteroscopy	50	50	0	Ketorolac 30 mg
18	58	D&C	100	25	75	None
19	41	Both	25	25	0	Ketorolac 30 mg
20	45	Hysteroscopy	50	50	0	Ketorolac 30 mg
21	29	Both	0	0	0	Ketorolac 30 mg
22	46	Hysteroscopy	0	0	0	Ketorolac 30 mg
23	46	Hysteroscopy	100	25	75	None
24	64	Both	0	0	0	None
25	50	Hysteroscopy	100	25	75	None
26	44	Hysteroscopy	100	0	100	Ketorolac 30 mg
27	52	Hysteroscopy	100	50	50	Ketorolac 30 mg
28	38	Hysteroscopy	0	0	0	Ketorolac 30 mg
29	32	Both	50	0	50	Ketorolac 30 mg
30	57	Both	25	25	0	Ketorolac 30 mg
31	36	Hysteroscopy	100	50	50	Ketorolac 30 mg
32	51	D&C	100	50	50	None
33	37	Hysteroscopy	100	50	50	None
34	CANNOT	USE	LAP	SURGERY		
35	52	Hysteroscopy	100	25	75	Ketorolac 30 mg
36	32	Hysteroscopy	0	0	0	Ketorolac 30 mg
37	46	Hysteroscopy	100	0	100	None
38	53	Hysteroscopy	0	0	0	Ketorolac 15 mg
39	33	D&C	0	0	0	Ketorolac 15 mg
40	47	Both	25	0	25	Ketorolac 15 mg
41	41	Hysteroscopy	100	75	25	Ketorolac 30 mg
42	54	Both	0	0	0	Ketorolac 30 mg
43	54	Hysteroscopy	100	0	100	Ketorolac 30 mg
44	66	Both	50	0	50	Ketorolac 15 mg
45	44	Both	100	100	0	None
46	47	Hysteroscopy	0	0	0	Ketorolac 30 mg
47	79	Hysteroscopy	25	0	25	Ketorolac 15 mg
48	58	Both	25	25	0	Ketorolac 15 mg
49	55	Hysteroscopy	0	0	0	Ketorolac 30 mg
50	56	Both	0	0	0	Ketorolac 30 mg, Ketamine 50 mg
51	31	D&C	0	0	0	Ketorolac 30 mg
52	50	Hysteroscopy	0	0	0	Ketorolac 30 mg
53	41	Both	100	75	25	Ketorolac 30 mg
54	52	Hysteroscopy	100	50	50	Ketorolac 30 mg
55	32	Both	50	0	50	Ketorolac 30 mg
56	39	Hysteroscopy	100	0	100	Ketorolac 30 mg
57	46	Hysteroscopy	0	0	0	Ketorolac 15 mg
58	53	Hysteroscopy	100	50	50	Ketorolac 30 mg
59	74	Hysteroscopy	25	0	25	None
60	65	Both	25	0	25	None

Appendix C- Data Tables

Table 1:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Total Dose of Fentanyl (mcg)	59	0	100	45.34	42.160
Valid N (listwise)	59				

Table 2:

Descriptives

			Statistic	Std. Error
Total Dose of Fentanyl (mcg)	Mean		45.34	5.489
	95% Confidence Interval for Mean	Lower Bound	34.35	
		Upper Bound	56.33	
	5% Trimmed Mean		44.82	
	Median		25.00	
	Variance		1777.469	
	Std. Deviation		42.160	
	Minimum		0	
	Maximum		100	
	Range		100	
	Interquartile Range		100	
	Skewness		.281	.311
	Kurtosis		-1.609	.613

Table 3:

Descriptive Statistics

Dependent Variable: Total Dose of Fentanyl (mcg)

Type		Statistic	Bootstrap[a] Bias	Std. Error	95% Confidence Interval Lower	Upper
both	Mean	30.68	-.23	7.49	16.39	45.99
	Std. Deviation	34.444	-1.527	5.225	21.321	41.882
	N	22	0	4	15	29
d&c	Mean	39.29	-.11[b]	16.91[b]	6.25[b]	72.22[b]
	Std. Deviation	45.316	-4.845[c]	10.931[c]	11.180[c]	54.772[c]
	N	7	0[b]	2[b]	3[b]	12[b]
Hyst	Mean	57.50	.16	8.03	42.86	74.32
	Std. Deviation	44.115	-.950	2.567	37.176	47.420
	N	30	0	4	23	37
Total	Mean	45.34	.00	5.59	34.33	56.78
	Std. Deviation	42.160	-.492	1.932	37.254	45.025
	N	59	0	0	59	59

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

b. Based on 999 samples

c. Based on 993 samples

Table 4:

Tests of Between-Subjects Effects

Dependent Variable: Total Dose of Fentanyl (mcg)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9419.519[a]	2	4709.760	2.816	.068	.091
Intercept	73306.279	1	73306.279	43.824	<.001	.439
Type	9419.519	2	4709.760	2.816	.068	.091
Error	93673.701	56	1672.745			
Total	224375.000	59				
Corrected Total	103093.220	58				

a. R Squared = .091 (Adjusted R Squared = .059)

Table 5:

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Induction Dose (mcg)	59	18.64	25.254	0	100
Rest of Case (mcg)	59	26.69	33.433	0	100

Table 6:

Test Statistics[a]

	Rest of Case (mcg) - Induction Dose (mcg)
Z	-1.361[b]
Asymp. Sig. (2-tailed)	.173
Exact Sig. (2-tailed)	.181
Exact Sig. (1-tailed)	.091
Point Probability	.004

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Table 7:

Descriptive Statistics

Dependent Variable: Total Dose of Fentanyl (mcg)

Age_re		Statistic	Bootstrap[a] Bias	Std. Error	95% Confidence Interval Lower	Upper
1.00	Mean	.00	.00[b]	.00[b]	.00[b]	.00[b]
	Std. Deviation	.	1.798E+308[d]	.000[d]	.000[d]	.000[d]
	N	1	1[b]	1[b]	1[b]	3[b]
2.00	Mean	48.08	.47	11.50	26.93	71.43
	Std. Deviation	41.409	-1.815	5.198	27.047	48.611
	N	13	0	3	7	20
3.00	Mean	58.33	.98	11.76	34.63	81.25
	Std. Deviation	44.987	-2.032	4.236	33.256	50.069
	N	15	0	3	8	22
4.00	Mean	44.32	.05	9.64	26.14	64.77
	Std. Deviation	45.599	-1.165	3.043	37.171	49.212
	N	22	0	4	15	30
5.00	Mean	25.00	.00[c]	6.64[c]	12.50[c]	37.50[c]
	Std. Deviation	18.898	-2.147[e]	4.564[e]	7.517[e]	24.406[e]
	N	8	0[c]	3[c]	4[c]	13[c]
Total	Mean	45.34	.28	5.48	35.17	56.36
	Std. Deviation	42.160	-.373	1.876	37.705	45.127
	N	59	0	0	59	59

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

b. Based on 633 samples

c. Based on 998 samples

d. Based on 268 samples

e. Based on 997 samples

Table 8:

Tests of Between-Subjects Effects

Dependent Variable: Total Dose of Fentanyl (mcg)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8018.191[a]	4	2004.548	1.139	.348	.078
Intercept	23500.337	1	23500.337	13.348	<.001	.198
Age_recode	8018.191	4	2004.548	1.139	.348	.078
Error	95075.029	54	1760.649			
Total	224375.000	59				
Corrected Total	103093.220	58				

a. R Squared = .078 (Adjusted R Squared = .009)

References

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