

Multimodal Medicine: Pain Control Potential

Tyler James Ostlund

College of Nursing, Roseman University of Health Sciences

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Dr. Schwartz

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Pain is nothing new to the human condition. However, for as long as it has been part of human experience, it is still often misunderstood or under treated. The opioid epidemic that began in the 1990's is proof that pain management is still in need of study and improvement (Center for Disease Control [CDC], 2021). While it will likely never be a simple subject or treated by simple means, protocols can and have begun to be developed that can keep its treatment safer and more effective. While a variety of specialties and providers are more leading contributors to total opioid prescriptions, post operative pain management contributes to up to 60% of these and is an area of great potential for opioid risk reduction and increased efficacy of pain management protocols (Paulozzi & Jones, 2015).

One's risk of dying from an accidental opioid overdose is now greater than that of dying in a motor vehicle accident (Injury Facts, 2020). The opiate crisis in the United States has reached catastrophic levels in a relatively short amount of time. Since 1999, opiate deaths have increased sixfold, reported opiate overdose deaths have reached 218,000 of which 47,000 occurred in 2018 alone, and 2 out of 3 overdose deaths are opioid related (CDC, 2020). Some states in the US are up 400% for unintentional opiate overdose deaths and that for many, prescription opiates are where their addiction started (Use Only as Directed, 2021). "In 2010 enough prescription narcotics were prescribed to medicate every American adult every 4 hours for one month" (Hupp, 2016). A better job must be done. The problem is bad enough that it is now commonly referred to as an epidemic (CDC, 2021). The less unnecessary exposure patients have or excess use of opiate prescriptions there are, the better chance there is at curbing this crisis. If prescriptions opiates are a starting point for many, a way must be found to help reduce

that need for those prescriptions. According to the Young et al. (2021), “perioperative opioid prescribing has been associated with persistent opioid use after surgery” (p. 11).

Problem statement

Patients undergoing surgery expect their pain to be controlled but often have little to no knowledge of how that can or should be achieved. Cultural expectations of pain control vary but there is clearly a large population in the United States that now need or assume they need opiates to treat it. Misunderstandings about pain as well as less than ideal pain control has in part, led to the opiate crisis we are experiencing at the present time and the cost and death toll associated with it (Hupp, 2016). The crisis is complex and its solution is complex, however, according to a study in 2017, surgeons and or post-surgical prescriptions are key in preventing its growth. It argues that most interventions aimed at perioperative and postoperative safety and quality interventions completely overlook opiates while focusing on preventing thromboembolisms and infection. Although important, these postoperative complications are far from the only ones and prevention of postoperative opiate dependence should be of equal importance (Waljee et al., 2017). If pain control expectations and goals can be discussed early, and pain control methods can be discussed openly and honestly then it may be possible for patient and providers to follow effective combination therapy pain management interventions that will lead to reduced opioid prescriptions and higher quality pain control.

Although opiates have been the predominate form of pain control in surgical patients, multimodal pain management protocol focused on integration and a combination of a variety of different pain pathway medications and or therapies will lead to increased pain control, increased medication safety, and decreased opioid dependence in post operative surgical patients (Desai et

al., 2018). The aim of this MSN quality improvement project is to demonstrate a possible pain management protocol that will include evidence suggesting that multimodal pain management therapy can decrease opioid prescription use in adult post operative patients.

PICO Question

The question addressing the issue of pain management focuses on postoperative pain in adults. The PICO question for this MSN project asks: In adult postoperative surgical patients, does a multimodal pain management protocol as compared to current postoperative standard of care decrease the use of opiate pain medications?

Background and Significance

Post-operative pain management can be difficult to navigate both safely and effectively (Apfelbaum et al., 2003). The patient's pain control should be a priority but so should the patient's safety both during short-term and long-term recovery (Desai et al., 2018). Opioids, although a key piece of pain management, pose a significant risk to patient safety such as risk of dependence and risk of overdose (Hollman et al., 2019). To combat this, a goal of opioid prescription reduction strategies is warranted but must be balanced out by an additional goal of maintaining effective pain control.

Postoperative pain is simply put, pain that arises in direct relation to previous procedure or surgery. It is an expected adverse effect that comes from pursuing overall improvement in some function in the body or it's systems by procedural or surgical methods. Postoperative pain control is pivotal in determining a patient's return to normal function and controlling it efficiently and effectively reduces the net total negative physiological and psychological effects that arise simply from having the procedure or surgery done (Horn & Kramer, 2022). Though

procedures and surgeries have been done as far back as we have records, the best or most appropriate form of pain control has yet to be determined even though the scope or variety of pain control methods, medications, and therapies has only increased time and scientific discoveries. Poor management of post procedure pain is associated with reduced quality of life, higher costs, and increased opioid prescriptions (Apfelbaum et al., 2003). With so much at stake, implementing appropriate pain management protocol is key.

What is a multimodal pain management approach and why does it matter? According to the American Society of Anesthesiologists (ASA), “A multimodal approach is using two or more different methods or medications to manage pain rather than using opioids alone” (ASA, 2021, p. 2). Another way of describing this is combination of medications that act to reduce pain or different types of pain rather than just one kind (opiates), that are used to improve quality of care and offer safer pain control (ASA, 2021).

Goode et al. (2019), studied a multimodal pain control for hip and knee replacement patients using a prospective cohort study. Acetaminophen, NSAIDS, gabapentin, ketamine, etc. were compared to non-multimodal or strictly opiate pain control. The results demonstrated the power of a multimodal approach. The hip replacement group results showed an 18.5% decrease in opioid prescriptions after surgery, 19% fewer respiratory complications, 26% fewer gastrointestinal complications, and a 12% decrease in hospital length of stay, compared to patients receiving opioids alone.

Desai et al. (2018) conducted a retrospective study and reported a group of post-surgical participants prescribed opiates with the addition of scheduled acetaminophen led to a reduction in follow-up pain and as well as a reduction in hospital readmission risk. A second group was assigned an opioid and acetaminophen prescriptions but also received scheduled non-steroidal

anti-inflammatory which demonstrated an even further reduction in follow-up pain as well as readmission risk. The authors concluded that groups that utilized some form of multimodal pain management protocol, there was a 10-40% less daily opioid use as compared to groups that were only prescribed opioids alone.

Barriers to implementing the intervention in the population and or setting

There are potential barriers to implementing this kind of protocol. One reason that certain medications are not good options or carry heavy risks and are therefore not utilized in pain control is because they can have significant effects on a patient's kidney, liver, or other co-morbidities (Desai et al., 2018). NSAIDs for example can heavily impact the kidney and when surgery, anesthesia, and certain co-morbidities can cause a decrease in kidney function, an NSAID can further exacerbate either temporarily or permanently lead to kidney damage (Plantinga et al., 2011). The benefit in these cases must outweigh the harm which narcotic medications often don't cause or exacerbate (Plantinga et al., 2011). Acetaminophen likewise can have a significant impact on the liver. For those whose liver function is poor, acetaminophen can become toxic to the weakened liver and cause further liver dysfunction or even failure (Lee, 2020).

The reality and obstacle of overcoming previous decades of high dependency on opioids both potentially by providers in prescribing practices or by patients who have become largely dependent can be decreased compliance to a multimodal pain management focused treatment plan (Taylor & Stanbury, 2009).

Post-operative pain management poses as significant risk for opioid dependency. To decrease such a risk multimodal pain management protocol offers providers additional options

for the improved management of postoperative pain and decrease the use opioid prescriptions. Applying the use of theory as a foundation, using multimodal pain management theory and the theory of goal attainment, a provider can understand the benefits of such a protocol and apply new change to practice to reduce opioid prescriptions.

Theory

When patients and providers work together, they have significantly more power to influence overall health than either can do alone. The theory of goal attainment and multimodal pain management theory combined show that a patient must not only be very involved in their own health to manage conditions or symptoms effectively, but also that the symptom of pain in particular is multifactorial and must be treated as such if it is to be managed safely and successfully. What the patient and provider seek to achieve must be clear to both parties and can require a combination of pharmacological and non-pharmacological means to control. Both provider and patient must acknowledge this reality to maximize its healing potential. In terms of postoperative pain, these ideas are paramount and must be better utilized.

Theory of Goal Attainment

Imogene King's theory of goal attainment came from a career based on forwarding the progress and profession of nursing through practice and teaching (Petiprin, 2016). King's theory states that without clear, attainable goals, combined also with what King describes as access to special knowledge, communicated accurately and appropriately, the patient will not achieve satisfaction, growth, development, or improved health (Petiprin, 2016).

To King, the provider's perception of a patient must include the fact that they are social beings who, "have the ability to perceive, think, feel, choose, set goals, select means to achieve goals, and make decisions" (Petiprin, 2016, p. 3). The utilization of these abilities is what leads

to good health in any of its aspects. She described the culmination of nursing as, “a process of action, reaction and interaction” (Petiprin, 2016, p. 12). This entire process must be guided by the previously mentioned principles and its success can and must be measured by goal fulfillment. Both the patient and the provider must know in advance what their goals are and what it will take to achieve them.

Multimodal Pain Management Theory

Kehlet and Dahl were some of the first to introduce the major theory of multimodal pain management and its potential effect on pain control (Kehlet & Dahl, 1993). The core idea of this theory is that pain, due to a seemingly endless variety of types of pain, must be controlled with a variety medications, therapies, or methods (Kehlet & Dahl, 1993). They would argue that the objective of pain control must be to target the different sites or components that make up many pain pathways which may be acute, or chronic, inflammatory, or neuropathic, etc. (Cascella, 2019). As there are a numerous pain pathway types, each must be countered or treated with its corresponding styles of medications whether they be pharmacological, or non-pharmacological though nearly always, it is a combination of each of these that creates the potency of multimodal pain management theory (Cascella, 2019).

It is important to note that Multimodal Pain Management Theory does not seek to eliminate opioid use as a viable form of pain control but does state that at least two or more distinct drugs and or methods must be used to treat the pain rather than opioids alone (Cascella, 2019). The idea being that it is in the combination of medications, adjuvants, therapies, surgical methods, education, or behavioral approaches that provides maximum pain management with the least amount of side effects or risks for overdose or addiction (Cascella, 2019).

Theories Influence on Advanced Practice of Nursing

Through her theory, King's contribution to nursing and healthcare has been one of transformation (Petiprin, 2016). It is the transformation of what would otherwise be scientific yet unfortunately, a sometimes-robotic series of commands from knowledgeable and even good intentioned healthcare providers to their patients that essentially translates to do as I tell you orders (Petiprin, 2016). Without the application of theories like this, the patient-provider relationship would become cold, rigid, and relatively unindividualized even if that did make it simpler. Patient's and provider's goals would likely rarely match. Healthcare will never and perhaps should never be simple. The care of humans is complex, but with King's theory of goal achievement emphasizes the satisfaction, growth, and improvement of health the provider and patient desire (Petiprin, 2016). King's theory encourages a stronger, more active, and more responsive patient-provider relationship (Smith, 2002).

The Multimodal Pain Management Theory can be applied extremely broadly in healthcare but also has some of its greatest potency when it is applied directly or specifically to a single issue such as anxiety, depression, or pain. This model has begun to help revolutionize patient pain control and has "led to more cost effective and therapeutic pain management" (Gatchel, 2021, p. 6). It is this multifaceted approach focused on a balanced blend of pharmacological and non-pharmacological factors that produces increased benefit and better patient outcomes especially in relation to pain reduction in global healthcare (Gatchel, 2021). When combined with King's theory, pain can be managed with opioid sparing techniques while allowing the patient and the provider to focus on the goal of treatment and its efficacy.

Theoretical Framework Analysis

If goal attainment theory and multimodal pain management are utilized in tandem, achieving a reduction in opioid prescriptions and combating the opioid crisis is one possible

ramification. Meeting expectations and pain control goals while utilizing multimodal pain management protocol will produce safer post operative recovery results. An individualized, goal focused, multimodal approach, could also lead to a reduction in medical costs as pain becomes more controlled sooner or methods utilized to achieve that goal incorporate more inexpensive, safer, and more widely available medication regimens (Barker et al., 2020).

The theory of goal attainment and multimodal pain management combined, can have a significant impact on patient pain control. Providers and patients may find it difficult to meet expectations if goals and means to achieve them are not discussed early and often. Not doing this will make pain much more difficult to manage (Henry et al., 2017). It is not so much if these theories are used but more how and when they are used when dealing with current or potential future pain treatment. Goals are often determined for pain control based on a subjective number that sometimes even the patient and the provider don't discuss much nor how certain treatment methods are likely to help achieve it (Lalloo, 2021). This subjective number that is commonly used does incorporate King's theory reasonably but fails to do much to connect the pain to the variety of pathways that make it what it is or demonstrate what could be possible with multimodal approaches to its treatment. There is much more to pain than any single factor by itself and much more to pain control than opioid prescriptions (Traschel, 2021).

Theoretical Contribution to APRN Profession –

Like mental health, pain plays a part of every patient's life regardless of how healthy or unhealthy they are. The APRN profession feels the burden of the opioid crisis in some way, shape, or form in every clinic or specialty as the effects of the opioid crisis spill over. Whether it is increased healthcare costs, the trauma and heartache of opioid addiction or overdose, or perhaps most common, as any provider tries to help their patient manage pain without a clear

understanding of what can be achieved with minimal or no opioid prescriptions. Applying multimodal pain management protocols will help providers play their part in reducing opioid prescriptions thus lowering costs, providing increased patient safety, and simultaneously providing more effective pain relief.

Theories Implication to Guide Personal APRN Practice

The impact of multimodal pain management and goal attainment theory extends into each aspect of being a healthcare provider. There is no patient, treatment plan, or condition that cannot utilize the power behind these theories. However, with a focus on pain management, multimodal pain management and goal attainment theory will help improve patient pain control while leading to decreased health care costs and decreased opioid use. These theories will help create a foundation of understandable goals between the patient and the provider that will be individualized and incorporate the patient's unique pain pathway problems. With this foundation it will be possible to improve postoperative pain management outcomes, improve patient safety, and increase satisfaction both for the patient and the provider.

Pain management studies are plentiful, but the literature can be difficult to sort through or apply as there are many different manifestations of pain, types of pain, or reasons for pain to be present let alone styles of pain control methods. Therefore, a thorough literature search was conducted to provide evidence for the project aim, which is to demonstrate a possible pain management protocol that will include evidence suggesting that multimodal pain management therapy can decrease opioid prescription use in adult post operative patients.

Literature Search

To determine the potential of multimodal pain protocol on reducing opioid prescriptions a literature search was conducted. The search utilized the databases Cumulative Index to Nursing

and Allied Health Literature and PubMed. The first search terms used were post-operative OR post-surgical AND multimodal OR combined modality therapy AND pain management OR pain, post operative AND opioids OR Analgesics, opioid. This produced 144,862 results. A search was then conducted using the terms post-operative AND combined modality therapy AND opioids AND pain management. This produced 49 results. To narrow down these 49 results any source greater than 5 years old was removed. This narrowed the search to 23 total results. Any studies that focused solely on pain management with no mention of opioid prescription use was also removed. The results were also narrowed to free full text sources. The remaining 5 studies were used to analyze the possible effects of multimodal pain management protocols on prescription opioid use. The studies reviewed are one before-and-after cohort study (Girardot, 2020), one randomized, prospective, double-blind study (Savitah et al., 2017), two randomized, prospective, sham-controlled studies (Hamza et al., 2017; Xue et al., 2017) and one randomized controlled trial, double blind, parallel, placebo-controlled trial (Weisz et al., 2020).

Definitions

This project will use the following definitions:

1) Multimodal Pain Protocol/Opioid sparing protocol/Multimodal pain management

Utilizing two or more different methods or medications both pharmacological or not, to manage pain rather than using opioids alone (American Society of Anesthesiologists, 2022).

2) Postoperative

The period consisting of the patient's time in the post-anesthesia recovery room until the patient has fully recovered from surgery (Savitha et al., 2017).

3) Intraoperative

The period during which the patient is undergoing surgery in the operating room ending as the patient enters the post-anesthesia recovery room (Savitha et al., 2017).

4) Morphine equivalent

The amount of morphine in milligrams that is equivalent to the strength of another opioid dose being prescribed (Weisz et al., 2020).

Literature Review

The best methods to stem the tide of the opioid epidemic have been debated now for over two decades (Girardot et al., 2020). The role of pharmacological and non-pharmacological or multimodal methods to reduce opioid consumption has been increasingly studied though has yet to produce standardized, widely accepted, and widely utilized protocol. The **five** studies being analyzed help confirm not only the effectiveness of multimodal therapy as an appropriate and safe strategy but also demonstrate a reduction in opioid consumption in a variety of different populations as well as with a variety of methods.

Theme 1 - pharmacological multimodal approach

Savitha et al. (2017) randomized, prospective, double-blind study of 42 patients applied combination multimodal therapy consisting of diclofenac sodium injection, paracetamol, clonidine, and skin infiltration with bupivacain sodium to 21 male and female patients whose age ranged from 20-65 years old. These patients were all undergoing lumbar spine surgery. Savitha et al.'s study was designed to assess the effectiveness of these multimodal non-opioid medications on overall intraoperative morphine consumption to see if was reduced compared to the other 21 patients who received only paracetamol and skin infiltration with saline adrenaline as control group. The study concluded that there was a 3-fold reduction or total of 5mg less morphine needed in the study group than the control group. As an additional note in all studies

being analyzed, there were often other variables that could be accounted for and recorded that were not necessarily being studied though they are also of great importance in determining the potential of multimodal analgesia in opioid reduction. Examples include an increase or decrease in adverse effects medication effects like nausea, vomiting, sedation, respiratory depression, and constipation but these will not be covered in this review.

Though it demonstrates a reduction in intraoperative morphine consumption, is important to note a theme in Savitha et al.'s study and that is the lack of supporting evidence that these particular multimodal analgesics are more effective or the most effective of the myriad of options available. The fact that more than one multimodal medication is used makes the study's results more difficult to translate into widespread practice as it increases the possibility of medication interactions or co-morbidity interactions. This study also only accounted for a reduction in acute opioid use during the intraoperative period which although associated with later opioid use, does not verify that long term postoperative use of opioids is reduced such as months later. This is a consistent theme among the majority of literature and remains one of the areas of greatest debate (Weisz et al., 2017).

Weisz et al. (2017) took a more narrowed approach to determine the effectiveness of one single multimodal medication Caldolor (IV ibuprofen). Weisz et al's study consisted of a randomized, controlled, double-blind, placebo-controlled trial of 99 orthopedic trauma patients. Compared to the previous study, these patients shared somewhat similar age distribution 18-75 years old, though it was predominantly male at 74%. Significantly different however here was the reason for surgery. These patients had suffered from motor vehicle accidents (MVA) and received fractures to the ribs, face, pelvis, or extremities. It is important to note that none of these patients were being treated for spinal surgery like the previous study. Of the 99 patients, 53

received IV ibuprofen while the other 44 received placebo. The study focused on two outcomes, a decrease in pain intensity or score, and a reduction in opioid consumption or morphine equivalents. Only the latter being analyzed in this review, 2 results were worth noting. One, opioid consumption decreased in the study group by up to 22mg. Two, the time between the first request for an opioid medication on top of the ibuprofen was prolonged in the study group. It is important to identify here however, that opioids were still being requested in all but one patient in both groups, the study group as well as the control group. This demonstrates another key theme in both the studies being analyzed here, as well as the literature broadly and that is that opioids are still key and often irreplaceable in treating moderate to severe acute pain no matter what modalities are used (Girardot et al., 2020). **This is actually synthesizing the evidence:** Looking at the two studies analyzed to this point, the first study utilized a combination of 4 multimodal medications while the second utilized only one while participants in both studies still required opioids to manage their pain. It therefore may be considerably unrealistic to hope to eliminate or achieve a near-zero opioid consumption when treating pain. The goal must be to only reduce opioid use as much as is feasible given a specific population and underlying reason for treatment.

Knowing exactly how to adjust treatment or which multimodal form is best can become difficult as presenting pain level, age, BMI, and even chronic anticoagulation have been associated with higher opioid consumption and even if a “standard” multimodal protocol can be agreed upon, it may not be sufficient for a variety of individuals (Girardot et al., 2020).

Focused on assessing multimodal effectiveness outside the average population reviewed so far was Girardot et al.’s (2020) study. It focused on the geriatric mostly female population undergoing hip replacement surgery with an average patient age of 84 years old. It was a before-

and-after cohort study where retrospective chart review was done for preoperative and postoperative multimodal pain management order sets. In a group of 248 patients, 131 were given a preoperative multimodal order set consisting of 1 dose of 1000mg IV Tylenol with PRN opioids available while other 117 patients were given only a post operative 1000mg dose of Tylenol up to 3 times and PRN opioids as needed. The study confirmed a mean opioid medication use that was significantly lower in the post operative order set group by 22%. However, there are some potential confounding factors in this study that may have drastically changed the results such as the amount of time spent in a preoperative state of up to 2 days with only a single dose of Tylenol available other than opioids for pain control. Some patients in preoperative group received surgery within the first few hours of presentation while others may have waited the full two days and therefore may have needed significantly more opioids in that time. Also, of note in this study compared to the previous two studies is the citation of another study in 2013 of 400 geriatric patients who received a scheduled opioid tramadol and scheduled non opioid paracetamol after hip surgery and the results showed an overall increase in opioid consumption compared with those who did not have paracetamol which runs counter to most multimodal pain management literature available (chin et al., 2013). This may have been due to the “scheduled” nature of opioids when most studies utilize only PRN opioids for comparison however more studies are needed in order to understand this more fully.

In Girardot et al.’s (2020) study, it is also difficult to verify the full validity of the results due to the route of Tylenol being given changing from IV to oral depending on the patient’s appropriate diet being NPO or not at the time of administration. Studies have shown improved time of onset and peak plasma concentration to be much higher in IV Tylenol vs oral thus it further studies would need to be done to confirm the full efficacy of route of this multimodal

medication in comparison to each other and their actual potency in reducing opioid consumption (Bollinger et al., 2015). Other potential issues involved in Girardot et al.'s (2020) study include the fact that it is not randomized, has no placebo group, and also, its report that the ED physicians and the anesthesiologists who interacted with the subjects were not involved in the study and therefore gave whatever pain medications opioid or not that they deemed necessary at the time. It is also important to note that one major barrier and reason IV Tylenol is not as widely used for multimodal pain management as might otherwise be is cost as it is significantly more expensive than most other medication options.

Theme 2 - nonpharmacological multimodal approach

Xue et al.'s (2017) study is the first of the five to look at non-pharmacological options as multimodal pain management to try and reduce opioid consumption. This study took 316 patients in a multi-center randomized, placebo-controlled study, to assess the effect of electroacupuncture (EA) on opioid consumption in chronic pain opioid users ages 15-85 years balanced fairly evenly between males and females. Xue et al. does confirm a reduction in opioid medication consumption utilizing EA up to 39% in study group and 25% in placebo group but does introduce a variety of potentially confounding variables that would make translation to a widely used standard protocol more difficult. At the same time, it does also introduce the idea of another nonpharmacological option other than EA or in tandem with EA that can potentially reduce opioid consumption as well. This other non-pharmacological option is the use of a pain medication management medical doctor that was assigned to the groups to discuss each individual's current opioid regimens and the recommendations for how and when to reduce their medications as well as providing education on pain during the study. This is essentially utilizing combination multimodal therapy instead of just EA and therefore it will be impossible without

further study to determine which intervention led to what amount of opioid reduction. The study also does not account for history or cause leading to current opioid use. It also cannot produce a “true” placebo as EA utilizes electricity to produce its affect and the only way to use a placebo was to place the same type of equipment on the patient and have it all appeared to be functioning with lights and sounds but just did not deliver any actual stimulation which a patient would be able to perceive.

One strength this study has that previous literature about EA or acupuncture as a non-pharmacological means to manage pain and reduce opioid consumption does not reliably, is to produce a standardized protocol that could be followed (Xue et al., 2017). When it comes to acupuncture and EA, the exact locations needles are placed, frequency and intensity the device is run at, time of each session, time between sessions, as well as total number of sessions must all be determined and standardized, and they often are not. Further studies to determine the most ideal answers to these questions must be performed.

Hamza et al.’s (2017) study though unrelated to the previous study, strived to assess the effectiveness of transcutaneous electrical a nerve stimulation (TENS) on post operative opioid consumption. The study was a prospective, randomized, placebo-controlled trial. The subjects were 100 women who were involved in abdominal surgery by hysterectomy or myomectomy. In this study however, PRN opioids were not involved but rather a continuous PCA pump that was discontinued when the patient’s pain no longer required it. The goal of the study was to determine which frequency 2-Hz, 100-Hz, or mixed, or none, produced the best results in reduction of opioid consumption via PCA pump. The study concluded that all groups other than the control or no TENS unit group experienced an opioid-sparing effect, the mixed frequency produced the best results with up to a 23mg reduction in PCA opioid consumption. Again, the

problem with this study like the Xue et al. study is that it is impossible to have a “true” placebo group when dealing with electrical stimulation. However, the other significant difference that needs to be considered in this study and with future studies is that the vast majority of surgeries do not require or use PCA pumps to manage pain. This makes it difficult to provide a widely used and standardized protocol for this kind of multimodal pain management even though it is non-pharmacological when trying to reduce opioid consumption. The TENS units compared to EA and even compared to pharmacological methods has the added benefits of being completely non-invasive, cheap, safe, and simple as the location does not need to be precise like EA.

These five studies demonstrate the potential of multimodal pain management on reducing opioid consumption. Savitha et al. (2017) demonstrated the effectiveness of combination multimodal pain management in reducing opioid use intraoperatively. Weisz et al. (2020) added to the evidence by demonstrating that even mono-therapy multimodal medicine for pain management produces a significant opioid sparing effect in orthopedic trauma patients. Girardot et al. (2020) confirmed this result of monotherapy with a different pharmacological agent in a geriatric specific population that is often at increased risk for adverse effects of almost any medication and still produced a reduction opioid use. Xue et al. (2017) was able take multimodal pain management another step further by demonstrating reliable opioid sparing effects in a chronic opioid use population utilizing non-pharmacological and minimally invasive methods though it was not monotherapy. Finally, Hazma et al. (2017) proved that non-pharmacological and completely non-invasive, monotherapy could produce a reduction in opioid use with females in two kinds of abdominal surgery.

Further studies must be conducted to determine the answers to a variety of questions regarding multimodal pain management that are still not fully understood. Questions such as

which types of non-opioid medications are best or are the mostly equal? Is combination therapy more effective the monotherapy at producing greater opioid reduction? Are certain pharmacological or non-pharmacological therapies consistently better at producing opioid sparing effects with certain populations? As the debate continues as to the best or most appropriate way to stem the tide of the opioid epidemic, multimodal pain management can be a powerful tool in reducing the number of opioids needed to control pain thus possibly leading to less overdoses, less deaths, reduced health care costs related to adverse effects and shorter hospital stays.

Conclusion

The opioid epidemic as well as increased and sometimes overuse of opioids has caused addiction, death, increased health care costs, increased length of hospital stays, as well as a myriad of adverse effects that can complicate recovery and lead to chronic opioid use. Utilizing the theory of goal attainment, and multimodal pain management theory, protocols can be implemented that focus on opioid, non-opioid, and non-pharmacological combinations to reduce total opioid use. Patient and provider can work towards the common goal of pain control while adhering to the safest and effective methods possible. Studies have shown strong evidence that multimodal pain management protocol has been applied in various populations, utilizing monotherapy, combination therapy, and non-pharmacological methods to achieve significant reductions opioid consumption. Though there are still many gaps in the literature to determine the perfect or most appropriate method or combination of methods for every scenario, the basic principles of multimodal pain management have been proven effective again and again and can lead to a reduction in the seemingly never-ending negative consequences of the opioid epidemic.

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