ORIGINAL RESEARCH

Assessment of pharmacologic pain management modalities for patients on hemodialysis

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ABSTRACT

Objective: The aim of this project was to assess the change in pain level for hospitalized patients on hemodialysis when using non-opioid medications alone compared to opioid medications alone to establish support for a clinical pain management model that would provide acute pain management guidance for patients on hemodialysis.
Methods: This was a non-interventional survey completed at an acute care hospital in Chicago, IL. Patients over the age of 18 on hemodialysis reporting acute pain completed the Short Form McGill Pain Questionnaire-2 on day one and day three of hospitalization to assess pain levels over a three-day period.
Results: The results demonstrate a decrease in total pain for patients using non-opioid medications and opioid medications; however, there is no statistically significant decrease in total pain scores between participants using non-opioid medications alone versus opioid medications alone ($p = .743$).
Conclusions: Patients in the non-opioid group perceived their pain management to improve between day one and day three; however, their pain management did not improve to the degree that opioid medications provided. Care should be taken when dosing opioid medications for patients on hemodialysis given the patients' decreased renal function.

Key Words: Hemodialysis, Pain Management, Non-Opioid Medication, Opioid medication, Short Form McGill Pain Questionnaire-2

1. INTRODUCTION

Pain is the most common symptom reported by approximately 47% of patients on hemodialysis, and 82% of those patients rate the pain as moderate to severe.[1] Approximately 75% of patients on hemodialysis report inadequate pain management.[2] Pain for patients on hemodialysis is multifactorial in etiology and can stem from comorbidities, complications of renal failure including but not limited to calciphylaxis and neuropathy, and procedures associated with the hemodialysis.[3] Opioid use for patients on hemodialysis varied between 5% and 36%.[3] In 2008, researchers reviewed the United States Renal Data System and found that 50% of patients on hemodialysis on the registry were prescribed at least one opioid, and there were 315,856 opioid prescriptions for those patients.[4,5] Opioid use in patients on hemodialysis is associated with increased risk of dialysis discontinuation, hospitalization, and death.[6] As of 2016, there were 18,147 patients with kidney failure on hemodialysis in Illinois.[7] In 2010, less than 19.9% of patients on hemodialysis in Illinois were using prescribed opioid medications.[5]

The World Health Organization's pain ladder can be used, with modifications, in pain management for patients on hemodialysis.[8–11] The major modifications to the pain ladder would entail using dose adjusted medications as well as

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stepping down pain management as pain resolves.[12] Much of the evidence for treating pain in patients on hemodialysis comes from expert advice as opposed to clinical studies.[13] A study of 45 patients on hemodialysis showed that the World Health Organization's pain ladder was effective in treating neuropathic and nociceptive pain for patients on hemodialysis.[13] Patients on hemodialysis can take non-opioid pain medications as the first step of the WHO pain ladder.[8] Patients on hemodialysis could take Acetaminophen with or without other adjuvant medications for pain.[5,10,14] The National Kidney Foundation also considers non-steroidal anti-inflammatory drug use for very short courses in pain management.[5] Non-steroidal anti-inflammatory drugs can be used for anuric patients on hemodialysis in short courses if the drugs will help reduce opioid use and treat the patient's pain.[10,15] Patients on hemodialysis can take Tramadol, dosed for kidney function, as the second step of the WHO pain ladder.[9,10,14,16] Other medications that can be used for step two in pain management are low dose oral oxycodone and low dose oral hydrocodone.[9] Patients on hemodialysis can take low dose hydromorphone as the third step of the WHO pain ladder.[1,9,15,17]

Using opioid medications for acute pain is associated with long-term opioid use and should only be prescribed in the lowest dose when necessary and for the shortest duration needed.[18] A higher initial dose of opioid is associated with an increased risk of long-term use and increased risk of overdose.[18] In a prospective cohort study analyzing 3939 patients with chronic renal insufficiency, it was found that opioid use had a stronger association with adverse events than non-steroidal anti-inflammatory drugs.[19] Cumulative opioid use, compared with nonuse, was associated with a 1.4-fold increased risk of a 50% reduction in glomerular filtration from baseline or kidney failure requiring kidney replacement therapy, 1.5-fold increased risk of pre-kidney failure death, and 1.7-fold increased risk for hospitalization.[19]

At the hospital site where the project was conducted, there were on average five to ten patients daily who required hemodialysis. Many of these patients were admitted for complaints of acute pain, which may be multifactorial in etiology. Medications ordered for the acute pain predominantly included Acetaminophen, non-steroidal anti-inflammatory medications, Tramadol, and IV Hydromorphone. Acetaminophen is thought to inhibit cyclooxygenase-mediated activation of prostaglandins primarily in the CNS, and it may act on the serotonergic inhibitory descending pathway and the endogenous opioid pathway.[20] Non-steroidal anti-inflammatory medications work through inhibition of cyclooxygenase which reduces the production of inflammatory mediators, including prostaglandins.[20] Tramadol works by inhibiting serotonin and norepinephrine reuptake, which enhances inhibitory effects on pain transmission in the spinal cord.[21] Opioid medications, such as Hydromorphone, Oxycodone, and Hydrocodone, work on the central nervous system by decreasing pre-synaptic release of excitatory neurotransmitters, decreasing post-synaptic neuronal excitability, and promoting descending inhibition.[20]

2. METHODS

The aim of the project was to assess the change in pain level for patients on hemodialysis when using non-opioid medications alone compared to using opioid medications alone which would establish support for proposing a clinical pain management model that, in addition to established guidelines, would provide acute pain management guidance for patients on hemodialysis. Acute pain is a time-limited unpleasant sensory and emotional experience associated with actual or potential tissue damage due to noxious stimuli which damage or threaten to damage normal tissues due to traumatic injury, in the context of an underlying medical condition or due to treatment.[22] The project was conducted at an acute care community hospital in Chicago, Illinois. Ethics approval was not required for this project. IRB exempt approval was obtained through the University of Alabama in Huntsville and shared with the acute care hospital in Chicago. Patients were provided with informed consent for this project. Patients were predominately Hispanic and African American, and the project was conducted on the medical/surgical and telemetry units.

The project design was a non-interventional survey. Patient charts were reviewed to determine if the patient met inclusion criteria. Inclusion criteria included patients age 18 and older, male or female, patients who are anuric, patients on chronic hemodialysis, patients reporting acute pain, and patients who have pain medication ordered by their attending physician. Exclusionary criteria included patients who are not anuric, patients on hemodialysis for acute kidney injury, patients who are not on hemodialysis, patients who are not on chronic hemodialysis, patients who are on peritoneal dialysis, patients who do not report pain, and patients who do not have pain medications ordered by their attending physician. Project staff did not order, prescribe, or modify any pain medications for participants.

Participant pain levels were collected on day one and again on day three of hospitalization using the Short-Form McGill Pain Questionnaire-2.[23,24] Consent to use the survey was obtained. The instrument is one page containing 22 qualities of pain and related symptoms on a zero to 10 Likert scale where zero indicated "none" while 10 indicated "worst possible".[23] The 22 qualities of pain are related to five

subtypes of pain: total pain, continuous pain, intermittent pain, neuropathic pain, and affective pain.[25] The instrument was selected for use due to its reliability and validity when assessing pain. Reliability, internal validity, convergent validity, and construct validity were established for the instrument.[24] The Cronbach's alpha for continuous pain was 0.77, intermittent pain was 0.82, neuropathic pain 0.80, affective predictors 0.84, and total pain 0.93.[24] For the instrument, total pain was calculated as the summation of the scores for the 22 pain qualities.[25]

Data collection was completed via telephone. Participant data was de-identified through use of participant ID numbers and recorded on a separate sheet to track patients and match patients with their surveys in case they opted out of the project. Participants were categorized into two groups based off the pain medication ordered by the patient's attending physician. Group A was patients who are administered non-opioid medications only on hospital day one for acute pain management and group B was patients who are administered opioid medications only on hospital day one for acute pain management. Responses from the survey were entered into Qualtrics. Qualtrics is a password protected online system to create and store survey data through the University of Alabama in Huntsville system.[26] The paper copies of the surveys were destroyed to protect participant responses. The data was then loaded into SPSS 24 for data analysis. Data analysis completed included total pain frequencies and non-parametric tests, including Wilcoxon Signed Rank test and Mann Whitney U test between day one and day three data. Non-parametric tests were selected due to small sample size.

3. Results

There were a total of 13 adult participants in group A. The mean age was 70 years old, there were four males and nine females, six Hispanic participants, and seven African Americans. There were a total of 12 adult participants in group B. The average age was 54 years old, there were two males and 10 females, one Caucasian participant, two Hispanic participants, and nine African American participants. The difference in total pain scores was calculated between day one and day three for group A and group B participants using the Wilcoxon Signed Rank test. For group A participants, the average total pain on day one was 1.696 with a standard deviation of 1.878. Total pain on day three was 1.325 with a standard deviation of 1.956. The mean decrease in total pain between day one and day three was 0.372 with a standard deviation of 0.306 (p = .002). For group B participants, total pain on day one was 1.985 with a standard deviation of 1.221. Total pain on day three was 1.43 with a standard deviation of 1.483. The mean decrease in total pain between day one and day three was 0.555 with a standard deviation of 0.659 (p = .005). The Mann Whitney U test for total pain scores between group A and group C on day one was performed. Day one mean rank for group A was 10.92 and mean rank for group C was 15.25 (p = .142). The Mann Whitney U test for total pain scores between group A and group C on day three was performed. Day three mean rank for group A was 12.42 and mean rank for group C was 13.63 (p = .683). The Mann Whitney U test for total pain scores between day one and day three data was performed between group A and group B. The total pain mean rank for group A was 12.54, and total pain mean rank for group B was 13.50 (p = .743). There is no statistically significant relationship between medication groups and day one pain scores (p = .142), day three pain scores (p = .683), or change in total pain from day one to day three (p = .743).

4. Discussion

This project reinforces the notion that the WHO pain ladder can be applied to patients on hemodialysis with acute pain.[12] Opioid medications do have a place in treating acute pain in patients on hemodialysis.[6] Patients in the non-opioid group perceived their pain management to improve between day one and day three; however, their pain management did not improve to the degree that opioid medications provided to group B participants. Care should be taken when dosing opioid medications for patients on HD given the patients' decreased renal function. Further studies are needed regarding the use of both opioids and non-opioid medications together in pain management for patients on HD. One limitation to this project was the small sample size due to the project being carried out during the Covid-19 pandemic. Clinical guidelines and evidence-based practices should be utilized in conjunction with patient response to pain medications when developing clinical pain management models for pain management.

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Authors Contributions

Dr. Rios was responsible for study design, data collection, drafting manuscript, and revising. Dr. Smith and Dr. Mead were responsible for study design and revising the manuscript. All authors read and approved the final manuscript.

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Conflicts of Interest Disclosure

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Informed consent

Obtained.

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Data sharing statement

No additional data are available.

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