Indian Journal of Clinical Anaesthesia 2023;10(3):290–294

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Indian Journal of Clinical Anaesthesia

Journal homepage: www.ijca.in

Case Series

Multimodal analgesia regime for open spine fixation surgery: A case series

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ARTICLE INFO

Article history:
Received 29-06-2023
Accepted 15-07-2023
Available online 07-09-2023

Keywords:
Multimodal analgesia regime
Fixation surgery
Post- operative pain

ABSTRACT

Postoperative pain is a common and significant problem that affects millions of patients worldwide. Inadequate pain control can lead to a range of negative outcomes, including prolonged hospital stays, delayed recovery, increased healthcare costs, and decreased patient satisfaction. Therefore, effective management of postoperative pain is essential for improving patient outcomes and reducing healthcare utilization. While progress has been made in improving postoperative pain management, there are still significant gaps in our understanding of the mechanisms underlying postoperative pain and the most effective interventions for its management. Further research is needed to optimize pain management strategies and reduce the burden of postoperative pain on patients and healthcare systems.

Multimodal analgesia is an approach to pain management that uses a combination of medications and other interventions to effectively manage pain while minimizing side effects. The goal is to target pain at different points in the pain pathway, using different mechanisms of action, to achieve better pain control than could be achieved with a single medication alone. By using multiple medications that work through different mechanisms, a lower dose of each medication can be used, reducing the risk of side effects. The approach is often tailored to the individual patient, taking into account their medical history, the type of surgery or injury, and their level of pain. Overall, multimodal analgesia aims to improve pain control and patient outcomes while reducing the risk of adverse effects.

1. Introduction

Multimodal analgesia relates to an approach for pain management which involves simultaneous use of multiple analgesic techniques or medications with different mechanisms of action. Aim of multimodal analgesia is to provide more effective pain relief by targeting pain through various pathways, while reducing the reliance on any single analgesic agent.[1] By combining different types of medications and/or non-pharmacological interventions, multimodal analgesia aims to optimize pain control, minimize side effects, and improve patient outcomes. The motive behind multimodal analgesia lies in the understanding that pain perception involves complex mechanisms and pathways within the body. By targeting multiple points in these pathways, multimodal analgesia can address pain from various angles, enhancing the overall pain relief. This approach can be particularly useful in managing acute pain following surgery or trauma, as well as chronic pain conditions.

The components of multimodal analgesia can vary depending on the specific clinical scenario and patient needs. It often involves the use of non-opioid analgesics such as non-steroidal anti-inflammatory drugs (NSAIDs) and acetaminophen. Adjuvant medications such as anticonvulsants or antidepressants may also be included to provide additional pain relief or target specific pain mechanisms. Regional analgesia techniques, such as nerve

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https://doi.org/10.18231/j.ijca.2023.058

blocks or epidurals, can be employed to provide targeted pain control in specific areas of the body.[2] Additionally, non-pharmacological interventions like physical therapy, cognitive-behavioural interventions, acupuncture, and other complementary therapies may be integrated into the multimodal analgesia approach. The specific combination and timing of these interventions may vary depending on the patient, the type and duration of pain, and the clinical setting.

The aim is to create an individualized treatment plan that maximizes pain relief while minimizing side effects and risks associated with high doses of a single medication, such as opioids. Multimodal analgesia has gained increasing recognition and acceptance in clinical practice due to its potential to improve pain management outcomes. By utilizing multiple approaches to target pain, it offers the opportunity to reduce opioid consumption, enhance pain control, promote faster recovery, and improve patient satisfaction.

To achieve the above-mentioned goal, current anaesthesia practice made multimodal analgesic regime a part of patient management protocols. Multimodal analgesic modality has not only shown improved outcomes in terms of early ambulation, reduce hospital stay, readmission, cost to patient but have also decreased opioids consumption in perioperative period. After critical appraisal of literature and understanding many recommendations, we used multimodal analgesic modality for our five-patient posted for lumbar fixation surgery and observed them in the post-operative period for pain score and total opioid consumption.

2. Materials and Methods

In our case series, we included five patients posted for lumbar spine fixation surgery belonging to ASA physical status I to II. Pre-anaesthesia check-up was done for all the patient after admission for the procedure. All patients were kept fasting after 12mignight day prior to surgery, they were administered Tab. gabapentin 100mg at 10pm, night before the surgery and 300mg in the morning at 6am on the day of surgery with sips of water.

On the day of surgery, patients were shifted in the operating room, standard monitoring was attached, baseline parameters were recorded, and anaesthesia was administered with standard anaesthetic regime. Inj. fentanyl 100mcg and Inj. midazolam 2mg was given as pre-medication before induction of anaesthesia, for induction, Inj. propofol, 2mg/kg, was given and Inj. succinycholine, 2mg/kg, was administered for facilitation of endotracheal intubation with appropriate sized tube and anaesthesia was maintained with mixture of O_2 with Air (40:60) along with inhalation agent, sevoflurane and vecuronium bromide used as muscle relaxant.

After induction of anaesthesia, patients were given prone position on silicone gel boosters, all pressure points, head to toe, were checked and padded with cotton. Following positioning, each patient was administered Inj. $MgSo_4$, 8mmol, over one hour in 500ml normal saline, 0.9%. Surgical incision was marked using C-arm and length of surgical incision was noted, subsequently to marking the skin incision, surgical draping was done. Later to draping, surgical site was infiltrated with Inj. xylocaine (2%) with adrenaline (1:2,00,000), 20ml. After surgical time-out and before giving the skin incision, every patient received Inj. ketamine, 0.25mg/kg, as loading dose. Intraoperatively, depth of anaesthesia was maintained with sevoflurane maintained at 1MAC. Inj. ketamine was used to provide intra-operative analgesia given at hourly interval calculated since administration of the loading dose till the spine fixation was complete and surgical wound closure was started. After starting of wound closure, patients were given Inj. paracetamol, 1gm, and before final layer of skin closure, Inj. ropivacaine, 0.2%, 40ml, was infiltrated over entire surgical incision. All patients were reversed and extubated after giving supine position following completion of the surgery and shifted to recovery for post-operative management and observation.

Post-operatively, patient was administered Inj. diclofenac, 75mg, 12^{th} hourly, for 48hours along with Inj. paracetamol, 1gm, 6^{th} hourly for 24 hours and Tab. gabapentin, 100mg, orally, at 8hour interval, was started once patient were allowed to take orally liquids followed by soft diet. For prevention of nausea and vomiting after the surgery, Inj. ondansetron, 4mg, 8^{th} hourly was advised and continued for 24hour.

In recovery unit, all patients were assessed for post-operative pain using Wong-Baker FACES pain rating scale (Happy Face{0}, Smiling face {2}, Neutral face {4}, Frowing face {6}, Crying face {8}, Crying face with eyes closed {10}) and agitation sedation score (Unarousable {-5}, Deep sedation {-4}, Moderate sedation {-3}, Light sedation{-2}, Drowsy {-1}, Alert and calm {0}, Restless {+1}, Agitated {+2}, Very agitated {+3}, Combative {+4}) were recorded along with total amount of opioid consumption and any complications for 24 hours. Observations were documented every 2hours for first 6 hours followed by every 4hours for 24hours. If patient complaint of any pain in the recovery unit, Inj. fentanyl, 0.5mcg/kg, was used as rescue analgesic and minimum interval of 30minutes was kept between two doses. On second post-operative day, patient assessment for pain, total opioid consumption and complications, if any were recorded at 12^{th} hourly interval.

3. Discussion

We conducted five case open spine fixation surgery using our multi modal analgesia regime, average age of patient

Table 1: Wong-baker faces pain rating scale

Time (hours)	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
0	2	2	2	2	2
2	2	2	2	2	2
4	2	4	2	2	2
6	2	6	2	2	2
10	2	4	2	2	2
14	2	4	2	4	2
18	4	4	4	4	4
22	4	4	4	4	4
34	2	4	2	2	2
46	2	2	2	2	2

Table 2: Agitation sedation score

Time (hours)	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
0	-2	-3	-2	-2	-2
2	-2	-2	-2	-1	-2
4	-1	-2	-2	0	-1
6	0	-1	-1	0	0
10	0	0	0	0	0
14	0	0	0	0	0
18	0	0	0	0	0
22	0	0	0	0	0

Table 3: Pain-specific multimodal analgesia regime used for spine fixation surgery

Preoperative	
Night before surgery	Gabapentin 100mg, PO
Morning of surgery	Gabapentin 300mg, PO
Pre-incision	
$MgSo_4$	8mmol, IV
Ketamine (bolus)	0.25mg/kg, IV
Local anesthetic	Xylocaine (2%) with adrenaline (1:2,00,000), 20ml
During surgery	
Ketamine	5mg, hourly, IV
Before skin closure	
Paracetamol	1gm, IV
Local anesthetic	Ropivacaine (0.2%), 40ml
Postoperative	
Paracetamol	1mg, 6^{th} hourly for 24hours, IV
Diclofenac	75mg, 12^{th} hourly for 48 hours, IV
Gabapentin	100mg, 8^{th} hourly, PO

Abbreviations; PO, Per oral; IV, Intravenous

was 64 years, with M:F ratio 3:2. Out of five cases, 2 were single level spine surgery, 2 were two level and 1 was three level fixation surgery. All the patients were comfortable in the post operative period and only one patient required fentanyl in post-operative period for pain relief.

Excellent pain relief postoperatively assist in speedy recovery, less complications and enhance patient satisfaction. Opioid medication customarily was the first choice to provide pain relief to patient in the post-operative period which led to opioid epidemic along with rise in morbidity and mortality because of opioids. To overcome the side effects of opioid overuse multimodal analgesia regime which included, nonopioid adjuvant medication and regional anaesthesia, became integral part of perioperative strategy. Later, with the development of ERAS recommendations for perioperative care, multimodal analgesia regime became one of the standardized approaches for better patient care.

Multimodal analgesia plays a crucial role in anesthesia practice as it provides, enhanced pain relief, reduced reliance on opioids, balanced analgesia, prevention of hyperalgesia and chronic pain, reduced opioid related adverse events, faster recover and improved outcomes and post operative pain relief plan tailored made as per the patient needs.

Mark FK et al, published review article about the role of multimodal analgesia in spine surgery stating that, "A growing body of evidence supports multimodal analgesia in spine surgery. Methods include the use of pre-emptive analgesia, NSAIDs, the neuromodulatory agent's gabapentin and pregabalin, acetaminophen, and extended-action local anesthesia".[3] In our patients, we used, gabapentin, $MgSo_4$, ketamine, paracetamol, diclofenac along with local anaesthetic, ropivacaine, as a part of multimodal analgesia regime.

All patients were given gabapentin, 100mg, orally night before surgery, 300mg in the morning on day of surgery and was continued in postoperative period, 100mg, 8^{th} hourly. Peng et al, in their meta-analyses concluded, that the use of gabapentin in perioperative significantly reduces opioid requirements in postoperative period.[4] Zeng et al, in their control randomized trial, gave gabapentin (600mg) in patient undergoing craniotomy, night before the surgery and 2hours before induction of anaesthesia. They concluded that, Preoperative gabapentin significantly alleviated acute postoperative pain and decreased the incidence of vomiting in patients undergoing suboccipital or subtemporal craniotomy.[5]

Sang-Hawn Do, in his review article mentioned the versatile nature of magnesium and how by blocking the N-methyl-D-aspartate receptor and calcium channel reduces the intraoperative use of analgesic and provides muscle relaxants in surgical patients.[6] In another, systemic review by, Guo et al, a quantitative meta-analysis was

performed to evaluate the analgesic efficacy and safety of systemic magnesium on post-operative pain. In their conclusion, suggested that systemic magnesium during general anaesthesia significantly decreases post-operative pain scores without increasing adverse events.[7] For our cases, we administered, $MgSo_4$, 8mmol, over one hour mixed in, 0.9% normal saline (500ml) and assessed patients for any hemodynamic changes and analgesic requirements. None of the case, had significant change in the intraoperative hemodynamic and no additional opioids were given to any patients intraoperatively, suggesting, magnesium can be used as an adjuvant medication in multimodal analgesic regime.

Ketamine is an N-methyl-D-aspartate (NMDA) receptor antagonist that has been shown to be useful in the reduction of acute postoperative pain and analgesic consumption in a variety of surgical interventions with variable routes of administration.[8] Chakravarthy et al, in their ERAS protocol used ketamine bolus (0.25mg/kg) pre-incision and infusion during surgery (5mcg/kg/min).[9] For our patients, we gave ketamine bolus (0.25mg/kg) before the skin incision and 5mg, hourly after the first dose till the instrumentation of spine was over. The average bolus dose when calculated for five cases was 16.6gm and average total consumption was 31.6mg. None of the patient received additional dose of fentanyl intraoperatively, suggesting that ketamine provided adequate analgesia to the patients during the surgery.

For pain relief in the postoperative period, we gave paracetamol, 1gm, and diclofenac sodium, 75mg, at the time of surgical wound closure. Paracetamol, 1gm, was started at the time of skin closure and was continued in the postoperative period at 6^{th} hourly interval for 24 hours and diclofenac, 75mg, given at 12hour interval for 48hours. In the recovery period, only one patient was given additional dose of fentanyl as rescue analgesic and no postsurgical complication was noted in any of the patient. Zhang et al, who did a meta-analysis of randomized control trials where patients received NSAIDs for pain relief in lumbar spine surgery. From eight studies, 408 cases were included in their study. And they concluded, NSAIDs are effective in postoperative analgesia after lumbar spine surgery. The NSAID dose, different surgery types, and analgesic type might influence the efficacy of NSAIDs.[10] In another, prospective randomized controlled trial, Rajkiran et al, compared the analgesic effect of paracetamol, diclofenac and studied the effect on coagulation profile using a sonoclot analyser and incidence of hematoma formation in patients undergoing supratentorial craniotomy. After analysis the data of 110 patients, they opined 'compared with paracetamol, diclofenac sodium provided more effective postoperative analgesia at 24 hours with no evidence of adverse effects on coagulation profiles in patients undergoing craniotomy for supratentorial tumors.[11]

In our cases, along with systemic analgesics we used local anaesthesia technique in which the entire surgical wound was infiltrated using local anaesthetic, ropivacaine, 0.2%, 40ml. Ropivacaine is a long-acting, amide-type local anaesthetic with both anaesthetic and analgesic effects. According to, consensus statement for perioperative care in lumbar spinal fusion: Enhanced Recovery After Surgery (ERAS) Society recommendations published in The Spine Journal, 2021, the quality of evidence for wound infiltration with local anaesthetic was high with a strong recommendation for its use for improving post-operative pain management.[12]

4. Conclusion

For improved recovery and greater patient satisfaction pain management is very important in perioperative and post-operative period. We used multimodal analgesia pathway using gabapentin, diclofenac, paracetamol and intraoperatively, ketamine, $MgSo_4$and local anaesthetic. This amalgamation of analgesics benefited our patient undergoing spinal fixation surgery by providing good pain relief, early recovery and function at same time decrease use of opioids.

5. Source of Funding

None.

6. Conflict of Interest

None declared.

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Cite this article: Yadav A, Swarnkar N. Multimodal analgesia regime for open spine fixation surgery: A case series. *Indian J Clin Anaesth* 2023;10(3):290-294.