

## Lidocaine infusion as a rescue analgesic in the perioperative setting

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In the present case series, three patients for whom regional anesthesia may have been the optimum technique for controlling postoperative pain are discussed. However, due to prevailing circumstances, regional anesthesia could not be provided. An intravenous infusion of lidocaine at 4 mg/min was administered perioperatively as an alternative 'rescue' analgesic technique. This infusion rate, based on previous extensive pharmacokinetic studies, is widely considered to be safe. Postoperative pain was lower than expected for the type of surgery. Anecdotal experience suggests that hospital length of stay may also be reduced, with both patient and economic benefits.

**Key Words:** *Analgesia; Lidocaine; Postoperative pain*

The responsibility of the anesthesiologist includes the provision of adequate pain relief following surgery. A current trend is the move away from opioids as the mainstay of postoperative analgesia and the move toward a multimodal approach. This stems from an appreciation of the multiple pain pathways involved in the genesis of postoperative pain and a desire to reduce opioid-related side effects.

In the present case series, we discuss three patients for whom the optimum technique for controlling postoperative pain may have been regional anesthesia. However, due to prevailing circumstances, regional anesthesia could not be provided. Lidocaine infusion was administered perioperatively as an alternative 'rescue' analgesic technique.

### CASE PRESENTATIONS

#### Case 1

A 46-year-old man presented for elective humeral head replacement and resurfacing arthroplasty for capsuloarthropathy. An interscalene block was offered to the patient as an adjunct to general anesthesia and for postoperative pain relief, but this was refused due to anxiety. Because the patient was a known alcoholic, the decision to perform a midazolam-based induction was made.

The patient was preoxygenated, and anesthesia was induced with intravenous ketamine 25 mg, lidocaine 100 mg, fentanyl 300 µg and midazolam 35 mg in titrated doses to effect. Paralysis was attained with rocuronium 45 mg. The

### Perfusion de lidocaïne comme analgésique de dernier ressort dans un contexte périopératoire

Avec la présente série de cas, on décrit trois patients pour qui l'anesthésie régionale aurait pu être la technique optimale de soulagement de la douleur post-opératoire. Or, en raison des circonstances, l'anesthésie régionale n'a pas pu leur être offerte. En dernier ressort, une perfusion intraveineuse de lidocaïne leur a été administrée à raison de 4 mg/min comme solution de rechange en période périopératoire. Ce débit de perfusion, établi selon des études pharmacocinétiques antérieures approfondies, est largement considéré sécuritaire. La douleur post-opératoire a été moins intense que prévu compte tenu du type de chirurgie. L'expérience anecdotique donne à penser que le séjour hospitalier peut également être abrégé, ce qui est intéressant pour le patient et économiquement avantageux.

patient also received ondansetron 4 mg and dexamethasone 8 mg for prevention of postoperative nausea and vomiting (PONV).

Following intubation with a size 8.0 endotracheal tube, the patient received a lidocaine infusion of 4 mg/min; sevoflurane was used for maintenance of anesthesia with a target minimal alveolar concentration (MAC) of 0.7. The patient also received intermittent boluses of fentanyl throughout the case, totalling another 200 µg in addition to the initial 300 µg. No local anesthetic was infiltrated into the wound at the end of surgery. The surgery and anesthesia progressed uneventfully and the patient was extubated without difficulty.

The patient was taken to the postanesthesia recovery unit (PACU) where he had an average visual analogue scale (VAS) pain score of 1 at rest and 2 with activity, on a scale of 0 to 10. During his 2 h stay in the PACU, he received a total of 3 mg of morphine and did not have any nausea or vomiting.

The patient was sent to the orthopedic inpatient unit with a patient-controlled anesthesia (PCA) pump programmed to deliver 1 mg morphine boluses with a 5 min lockout time. The patient used an average of only 2 mg/h until the next morning, at which time the PCA was discontinued and the patient was given oral analgesics. While using the PCA, the patient reported his VAS score to be 2 at rest and 5 to 6 with activity; this continued while he was on oral medications.

The patient was discharged 24 h after completion of surgery.

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### Case 2

A 39-year-old man presented for right proximal humerus reduction and internal fixation following a fall from a ladder. An interscalene block was offered to the patient as an adjunct to general anesthesia and for postoperative pain relief, but it was refused due to fear of the potential for nerve injury.

The patient was preoxygenated, and anesthesia was induced with intravenous ketamine 25 mg, lidocaine 120 mg, fentanyl 300 µg and thiopental 350 mg. Paralysis was attained with rocuronium 50 mg. The patient also received ondansetron 4 mg and dexamethasone 8 mg for prevention of PONV.

Following intubation with a size 8.0 endotracheal tube, the patient received a lidocaine infusion of 4 mg/min. Sevoflurane was used for maintenance of anesthesia, with a target MAC of 0.7 throughout the surgery. The patient also received intermittent boluses of fentanyl throughout the procedure, totalling 150 µg in addition to the initial 300 µg. The surgery and anesthesia progressed uneventfully and the patient was extubated without difficulty. No local anesthetic was infiltrated into the wound at the end of surgery.

The patient was taken to the PACU, where he had an average VAS score of 2 at rest and 5 with activity. During his 2.25 h stay in PACU, he received a total of 7 mg morphine and did not have any nausea or vomiting.

The patient was sent to the orthopedic inpatient unit with a PCA pump programmed to deliver 1 mg morphine boluses with a 5 min lockout time. The patient used an average of 1 mg/h until the next morning, at which time the PCA was discontinued and the patient was given oral analgesics. While using the PCA, the patient reported his VAS score to be 1 at rest and 3 with activity. His VAS score while on oral medication was 2 at rest and 4 with activity. The patient was discharged by the orthopedic service 24 h after completion of surgery. The patient was discharged 26 h after completion of surgery.

### Case 3

A 58-year-old woman presented for elective laparoscopic cholecystectomy for recurrent cholelithiasis. The patient was preoxygenated, and anesthesia was induced with intravenous ketamine 25 mg, lidocaine 40 mg, fentanyl 200 µg and propofol 180 mg. Paralysis was attained with rocuronium 50 mg. The patient also received droperidol 1.25 mg and dexamethasone 8 mg for prevention of PONV.

Following intubation with a size 7.0 endotracheal tube, desflurane was used for maintenance of anesthesia, with a target MAC of 1.1. Thirty-five minutes into the procedure, it was determined by the surgery team that they would have to abort the laparoscopic approach and perform a laparotomy due to the multiple adhesions encasing the gall bladder. At this point, lidocaine 120 mg was given intravenously and an infusion of 4 mg/min was started. The desflurane was adjusted to achieve a target MAC of 0.7; it remained at this level throughout the procedure. The remainder of the surgery and anesthesia progressed uneventfully and the patient was extubated without difficulty. No local anesthetic infiltration in the skin was used because of doubts regarding its efficacy.

The patient was taken to the PACU, where she had an average VAS score of 2 at rest and 4 with activity. During her 2.4 h stay in the PACU, she received a total of 6 mg morphine and did not have any nausea or vomiting.

The patient was sent to the general surgery inpatient unit with a PCA pump programmed to deliver 1 mg morphine

boluses with a 5 min lockout time. The patient used an average of 2 mg/h for the next 24 h, at which time the PCA was discontinued and the patient was given oral analgesics. While on the PCA, the patient reported her VAS score to be 2 at rest and 4 with activity; this continued while she took oral medication.

The remainder of the patient's stay in hospital was uneventful. The patient was discharged by the general surgery service 34 h after completion of surgery.

## DISCUSSION

In the present case series, we described three different surgical patients for whom the optimal pain control would arguably be the use of a regional technique. Because of either patient refusal or the specific intraoperative situation, these techniques could not be used.

The first and second cases involved shoulder arthroplasty. Patients receiving shoulder arthroplasty without regional blockade at St Joseph's Health Care (London, Ontario) and other centres tend to have high opioid requirements (1) and generally have 48 h hospital stays. Optimal pain control and reduced time to discharge has been reported with the use of interscalene blocks in this surgical population (2). Because this population has a high incidence of postoperative pain, intravenous lidocaine was used with the hope that it would reduce its likelihood. Thus, the patients had surgery that was known to be painful but they recovered well, with lower than expected pain scores and opioid requirements, and were fit for discharge in less time than expected.

The potential for morbidity resulting from interscalene blocks is low, but present. Lidocaine infusions are now used in St Joseph's Health Care as a potential alternative. This may be worth considering, especially if an anesthesiologist does not feel confident performing an interscalene block, or the block end point cannot be found.

The third case presented a patient who was scheduled to have a cholecystectomy by the laparoscopic approach. Unfortunately, due to adhesions encasing the gall bladder, the procedure had to be converted to a laparotomy. It must be emphasized that unexpected conversion of laparoscopic cholecystectomy to an open procedure is associated with increased pain, a prolonged hospital stay and increased morbidity – in particular, pulmonary morbidity. However, this patient also did well postoperatively, with lower than expected pain scores and opioid consumption. The patient had early return of bowel function and was discharged earlier than normal.

St Joseph's Health Care does not archive historical information on PCA morphine consumption in patients, so we cannot prove that these patients had reduced pain and analgesia requirements compared with other patients undergoing similar surgery. Nor can we be sure that these patients were not just 'lucky' in either their fortitude or the degree of pain experienced. Nevertheless, it is our experience in these and other patients at St Joseph's Health Care that lidocaine infusions offer a major contribution to postoperative analgesia, especially in major orthopedic surgery.

The idea that intravenous lidocaine may be able to reduce postoperative pain was suggested as early as the 1960s (3). Further work in the 1980s showed that low-dose intraoperative intravenous lidocaine reduced postoperative pain scores (4). More recently, the use of lidocaine infusions was described in the field of chronic pain management, particularly in the area

of neuropathic pain (5). Recent studies have re-examined the role of lidocaine infusions perioperatively for intra-abdominal surgery at comparable doses. They demonstrated reduced postoperative pain, in addition to faster return of bowel function and a shortened hospital stay (6-8). The use of intravenous lidocaine infusions for other types of surgery has not been reported.

The systemic analgesic mechanism of action is still poorly understood and is unlikely to be explained solely on the basis of lidocaine's well-known Na<sup>+</sup> channel blockade effect. Suggested additional mechanisms include the ability of lidocaine to inhibit flare formation and hyperalgesia secondary to experimental incision-induced pain (9). Further research has suggested that the mechanism of action may in part be associated with N-methyl-D-aspartate receptor antagonism (10). Other basic science papers suggest the inhibition of G-protein-coupled receptors and the inflammatory response as possible contributors to the analgesia seen with lidocaine infusions (11). Lidocaine infusion may also reduce anesthetic requirements and MAC by 20% to 40% (12,13), with potential economic benefits.

Nevertheless, despite incomplete understanding of the mechanisms of action, the evidence supporting perioperative lidocaine infusions as part of a multimodal analgesic regimen for the management of postoperative pain is accumulating. Practical advantages of this technique include the relative lack of preparation needed and lack of requirement for equipment more specialized than a syringe pump. Clinical advantages may include fewer opioid-related side effects, if fewer opioids are required.

Short-term intravenous infusions of lidocaine are safe (14). The pharmacokinetics of lidocaine infusion have been

extensively investigated owing to its longstanding use as an antiarrhythmic agent. The manufacturers support an infusion rate of 4 mg/min (ie, the dose is not based on the patient's weight) for an antiarrhythmic dose. Studies confirm that blood levels of lidocaine at this rate of infusion, although significant, are well below predicted toxicity levels (15). Of course, infusion rates should be reduced in the elderly, and in patients with hepatic disease or cardiac failure. In addition, some practitioners at St Joseph's Health Care intuitively reduce the infusion rate to 3 mg/min for very long procedures (eg, in excess of 6 h). As a testament to the safety of lidocaine infusion, a reported accidental intraoperative overdose of 100 mg/min intravenously over 7 min to 8 min, to a total dose of 16 mg/kg, was followed by full recovery (16).

It is possible that the use of low-dose ketamine in these cases may have been a factor in provision of overall better analgesia. However, previous studies have shown that, although it improves postoperative analgesia, the use of low-dose ketamine is still associated with significant PCA opioid consumption (17).

## CONCLUSION

The present case series demonstrates that intraoperative lidocaine infusions may be used as a successful alternative to regional anesthesia for 'rescue' analgesia when a regional technique is either refused by the patient or cannot be used. This may be particularly useful in orthopedic patients, where regional techniques are considered to provide optimal analgesia. Our anecdotal experience also suggests that, consistent with randomized controlled trials, hospital length of stay may be reduced with both patient and economic benefits.

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