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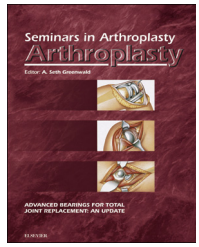

Multi-modal pain management for total knee replacement

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ABSTRACT

Multi-modal pain management is probably the most important method adopted in past 10 years to improve post-operative recovery of total knee replacement patients. The goal is to provide sufficient pain relief to perform rehabilitation, while minimizing side effects from the treatment. A reduction in narcotic use will lessen side effects such as sedation, nausea, vomiting, ileus, urinary retention, and respiratory depression. Medications, nerve blocks, and peri-articular injections are directed toward the brain, dorsal root ganglia, and peripheral nerves. Improved post-operative recovery can be achieved lessening hospital stays and facilitate outpatient surgery. The author's current method of multi-modal pain management is described.

1. Introduction

Older pain management techniques had inadequate pain relief and adverse side effects. Patient-controlled intravenous narcotics (PCA) are associated with sedation, nausea and vomiting, respiratory depression, ileus, and urinary retention. Femoral nerve blocks are associated with quadriceps weakness. Continuous epidural catheter infusions may have technical problems with the catheter, pruritus, and rebound pain. The key to successful pain management is to provide sufficient pain relief to perform rehabilitation, while minimizing side effects from the treatment. Successful pain management starts with alleviating the patient's fear of post-operative pain with pre-operative counseling. Pre-emptive analgesia should be started prior to onset of painful stimuli to prevent the establishment of central sensitization which can amplify post-operative pain. Use of parenteral narcotics should be minimized to lessen narcotic-related side effects such as nausea and vomiting, respiratory depression, ileus, and urinary retention.

Multi-modal pain management is probably the most important method adopted in past 10 years to improve post-operative recovery after total knee and hip replacement surgery. This has been more influential in improving short term outcomes than minimally invasive surgical approaches, computer-assisted surgery, robotics, patient-specific instrumentation, and new implant designs. This pain management involves a multi-level attack. Opioids, alpha 2 agonists, and tricyclic antidepressants are used to affect the brain. Local anesthetics, alpha 2 agonists, N-methyl-D-aspartate receptor antagonists, anticonvulsants, and tricyclic antidepressants will attack at the level of the dorsal root ganglia. Peripheral nerves and nociceptors are affected with local anesthetics, anticonvulsants, and anti-inflammatory drugs.

2. Multi-modal pain management programs

This concept started as part of a rapid recovery program for minimally invasive total hip replacement popularized by

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Berger et al. [1] in 2004. He recommended avoidance of intravenous and epidural narcotics, and use of non-steroidal anti-inflammatory medications and sustained release oral narcotics pre- and post-operatively. Skinner and Sintani [2] in 2004 introduced the concept of "stacked-modality" program for total hip and knee patients using "around the clock" acetaminophen, rofecoxib, tramadol, dexamethasone, bupivacaine pain pumps, and patient-controlled analgesia with morphine. They reported on 23 total knee patients on their multi-modal protocol compared to 27 patients receiving conventional pain control. The multi-modal pain managed patients had less narcotic use and shorter hospital stays. Dorr [3] and Pagnano et al [4] in 2006, and Ranawat and Ranawat [5] in 2007 also expanded on Berger's and Skinner's protocols with additional medications such as lansoprazole, ketorolac, clonidine patch, peripheral nerve blocks, and the use of peri-articular injections. Maheshwari et al. [3] reported that by using Dr. Dorr's program, only 15% of patients needed parenteral narcotics post-operatively and only 6.4% of patients used parenteral narcotics post-operative day one [3]. Pain scores were 3/10 on all post-operative days. By avoiding narcotics, the incidence of nausea and vomiting were 20% and 3.6% respectively. Overall, 98.6% were able to be discharged to home at a mean 2.7 days post-operatively. Pagnano introduced the use of femoral and sciatic nerve blocks [4]. Ranawat and Ranawat [5] introduced the concept of a peri-articular injection cocktail. The deep soft tissue injection was composed of 24 ml of 0.5% bupivacaine, 8 mg (0.8 ml) of morphine sulphate, 0.3 ml of 1:1000 epinephrine, 1 ml (40 mg) of methylprednisolone acetate except in diabetics, 750 mg (10 ml) of cefuroxime, and 22 ml of 0.9% sodium chloride. The superficial soft tissue injection was 20 ml of 0.5% bupivacaine hydrochloride diluted with 20 ml of 0.9% of sodium chloride. In this peri-articular pain cocktail, the morphine will stimulate the opiate receptors, the epinephrine prolongs the action of the local anesthetic, and the steroid decreases local tissue inflammation. Ranawat's multi-modal protocol also included use of celecoxib, sustained release oxycodone, and pantoprazole. Post-operatively, patients are provided a clonidine transdermal patch, Ketorolac intravenously or intramuscularly, acetaminophen, and pantoprazole.

As the use of multi-modal pain management protocols gained popularity, numerous studies were performed comparing various optional modalities within the protocols. Ranawat reported on randomized control study of this peri-articular injection protocol versus a patient-controlled analgesic pump and a femoral nerve block [6]. All patients also were given the other medications which are part of his multi-modal protocol. The peri-articular cocktail group had slightly better, but non-statistically significant improved pain scores. The peri-articular injected group was able to perform better active straight leg raise on post-operative day one than the control group (63% versus 21%).

Spangehl et al. [7] reported a randomized clinical trial of 160 patients comparing continuous femoral nerve block plus a single shot sciatic nerve block versus a peri-articular injection at post-operative day one. The peri-articular injection included ropivacaine, epinephrine, ketorolac, and morphine. All patients had a general anesthetic and received narcotics as needed. The pain scale numbers were equal. The peri-articular injection patients required greater than 2.5 times more narcotics on day of surgery, but an equal amount on post-operative day number one. This study implied that peri-articular injections were inferior to peripheral nerve blocks. However, 12% of peripheral nerve block patients had dysesthesias at 6 weeks.

Recently, sustained release liposomal bupivacaine was introduced to improve the efficacy and duration of peri-articular injections in the hope of eliminating use of peripheral nerve blocks. Barrington reported very positive results in a case–control study of 1124 hip and knee replacements with a multi-modal pain protocol including sustained release liposomal bupivacaine compared to 1124 hip and knee replacement patients utilizing a multi-modal pain protocol before the sustained release bupivacaine was introduced [8]. They noted improved pain scores on and after post-operative day one.

Berend reported excellent results with use of a combined adductor canal block with 0.5% ropivacaine and a pericapsular injection with a sustained release liposomal bupivacaine plus 25 ml of 0.5% bupivacaine hydrochloride with epinephrine [9]. Additional multi-modal medications were utilized including decadron, hydrocodone, and intravenous acetaminophen. This pain management protocol facilitated outpatient unicompartmental, patellofemoral, and total knee replacements. There was no comparison with use of plain bupivacaine in the pericapsular injections.

Surdam et al. [10] reported on a randomized prospective comparison study of a femoral nerve block versus use of a peri-articular injection protocol including a sustained release liposomal bupivacaine. On the day of surgery, the peri-articular injection patients had less pain relief and used more narcotic medication. Over next 3 days, there was no statistical difference between the two groups with respect to pain and narcotic consumption. However, the femoral nerve block patients had more difficulty with ambulation.

Bagsby et al. [11] reported on a study comparing ropivacaine to sustained release liposomal bupivacaine peri-articular injections. The ropivacaine cohort used 400 mg of ropivacaine, 0.4 mg of epinephrine and 5 mg of morphine in 100 ml of saline. The liposomal bupivacaine cohort used one syringe of 20 ml of liposomal bupivacaine with 30 ml of saline and a separate syringe of 30 ml of 0.5% non-sustained release bupivacaine hydrochloride. Both cohorts had additional multi-modal medications such as acetaminophen, celecoxib, sustained release oxycodone, and pregabalin. They found that pain relief was similar in first 24 h. However after 24 h, the patients who received liposomal bupivacaine had worse pain relief, implying that a sustained effect of the liposomal bupivacaine was not occurring.

3. My technique

In the pre-operative holding area, the patient is given celecoxib 200 mg or meloxicam 15 mg orally if they are allergic to sulfa. Oral sustained release oxycodone of 10 mg is given if the patient is not already taking narcotics, has a BMI less than 24.9, or is over the age of 70. Furthermore, 20 mg is given