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# Anesthesia Protocol: Peripheral Nerve Blocks for the MIS 2-Incision Hip Procedure

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## Executive Summary

The performance of major orthopaedic surgery as an outpatient procedure requires both appropriate minimally invasive surgical technique and specific anesthetic and acute pain protocols. To optimize recovery and outcome, it is important to:

- Provide the patients with effective postoperative pain control allowing active physical therapy within 2-3 hours following surgery
- Avoid postoperative nausea and vomiting (PONV)
- Maintain core temperature and hemodynamic stability

To provide effective postoperative analgesia with minimal motor block, an initial lumbar plexus is performed with 0.2% ropivacaine 15-17ml followed by the placement of a lumbar plexus catheter combined with a single sciatic nerve block 0.2% ropivacaine 5-7ml. Postoperatively, the lumbar plexus catheter is infused with 0.2% ropivacaine using a patient controlled regional analgesia (PCRA) with 5ml/hr bolus 5ml with a 60 minute lock period.

Surgery is performed under either a mini-dose spinal (9mg bupivacaine plus 10 microgram fentanyl) or general anesthesia.

A multimodal approach to postoperative pain management that also includes the use of ketamine and dexmethorphan, NMDA inhibitors, celecoxib, a COX-2 inhibitor, and avoids opioids is currently believed to represent the most effective approach.

In brief, this protocol outlines in greater detail the following:

- Celecoxib 200mg bid 2-3 days prior to surgery and for at least 5 days after surgery
- Celecoxib 400mg on the morning of surgery
- A lumbar plexus block prior to surgery, followed after surgery by a continuous lumbar infusion for 48 hours
- A single sciatic block performed prior to surgery
- Ketamine 0.15mg/kg IV
- Oxycodone 5-10mg only used for break-through pain
- Dexamethorphan 60mg PO for 48 hours postoperatively

*This anesthesia protocol is based on the experience of the authors. All patient care decisions remain the responsibility of the treating physicians. It is recommended that this protocol be reviewed within the treating institution to assess compatibility with the institution's practices, procedures, and treatment philosophy. The information and recommendations in this protocol have been reviewed by the authors and reflect their current practice as of the date this protocol is published.*

## Introduction

In the United States alone, over 200,000 patients annually undergo a total hip replacement (THR). The average length of acute care hospitalization following THR is 3.5-4 days followed typically by transfer to a rehabilitation center where patient care is continued and physical therapy maintained in order to further functional recovery. The classical surgical technique of THR requires a skin incision of 25-30cm and is associated with significant muscle and hip capsule trauma. In the past few years, consideration has been given to minimizing the size of the incision as well as the associated surgical trauma, postulating that such changes might result in shorter hospitalization, quicker functional recovery, and a reduced need for rehabilitation services. Reaping the benefits of these surgical innovations has, in part, been made possible by improvements in orthopaedic anesthesia, and especially by advances in postoperative analgesic techniques and experience gained in the past few years by home infusion of local anesthetics, especially related to the use of ropivacaine.

In the drive to "minimize" the surgical trauma of hip replacement, several minimally invasive techniques have been developed. Among them, it is possible to distinguish between two primary types: transmuscular and intermuscular. Transmuscular techniques refer to the use of incisions that cut across muscle in a more traditional approach. Intermuscular techniques use dissection designed to be performed between muscles. The concomitant use of appropriate specific anesthesia and postoperative analgesia protocols in patients undergoing minimally invasive techniques can allow faster functional recovery and reduce the need for transfers to a rehabilitation center. These advantages represent a potential for significant health care economic advantage. Although the long-term outcome of these innovations is not yet established, it is important to recognize that many patients undergoing minimally invasive total hip replacement are being discharged from the hospital either on the day of surgery or within 24 hours of surgery and that most of them have not required admission to a rehabilitation center.

## General Considerations

Anesthesia for ambulatory surgery, irrespective of the type of surgery, has some specific requirements.

### *Surgical*

Ambulatory surgery is usually performed in relatively healthy patients having surgery of relatively limited duration (less than 3 hours). Blood loss is usually minimal and the perioperative need for autologous and/or heterogenous blood transfusion usually represents a contraindication to the immediate discharge of the patient. In the absence of major complications, the patients can leave the ambulatory center either within a few hours or remain in an observation unit up to 24 hours.

### *Anesthesia*

Irrespective of the anesthesia technique, patients undergoing ambulatory procedures need to recover rapidly from anesthesia and the potential hemodynamic and other systemic lateration associated with the surgical procedure. Early discharge requires that the patient remain hemodynamically stable during the perioperative period. Romain et al. demonstrated that the occurrence of intraoperative complications (e.g., arrhythmia, hypotension, etc.) represented important determinants in the patient's ability to recover postoperatively. Hypothermia also represents a condition that negatively impacts a patient's recovery and should be avoided. Casati et al. (1999) and Lenhardt et al. (1997) demonstrated that a one-degree deviation from normothermia was associated with a 40-minute difference in readiness for discharge from the recovery room in patients undergoing total hip replacement and abdominal surgery, respectively. Hypothermia increases anesthetic potency, delays drug metabolism, depresses cognitive function, and leads to immunosuppression. Kurz et al. (1996) reported that even mild hypothermia in the recovery room was associated with an increased rate of postoperative infection in patients undergoing colorectal surgery.

An appropriate fluid balance directly or indirectly also impacts recovery. Adequate hydration is critical to prompt recovery and early ambulation. Furthermore, all solutions should not be thought of as equivalent—particularly when substantial volumes are to be infused. Williams et al. (1999) demonstrated some important differences between hydration with Ringer's lactate versus saline. In that study, 18 healthy volunteers received 50ml/kg of either Ringer's lactate or saline on two separate occasions. The administration of saline was associated with hyperchloremic metabolic acidosis, lassitude, clouded mental function, abdominal cramping, and delayed urination; whereas, the lactated Ringer's had none of these ill effects.

### *Postoperative Period*

To be discharged from the ambulatory unit or hospital, the patient's vital signs should be stable; postoperative blood loss should be minimal; the patient should be able to void (except in younger patients who can be discharged even if they have not voided), and be able to transfer and to ambulate. In this

respect, several scales have been developed and are used to determine patient readiness for discharge. Furthermore, for a number of orthopaedic ambulatory procedures, patients often are required to start passive and/or active physical therapy immediately after recovering from surgery and anesthesia. It is important to recognize that the most important determinants of delayed patient discharge and the primary factors leading to unscheduled hospitalization after ambulatory surgery are postoperative pain and postoperative nausea and vomiting (PONV). Pain and PONV may be related. Pain appears to trigger neurohumoral mechanisms that provoke nausea and vomiting. It is also well established that nausea and vomiting are common side effects of the opioids used to treat pain, hence, the emphasis on multimodal analgesia employing local anesthetics and anti-inflammatory agents as a means to reduce the need for opiate analgesia. In addition, there are a number of factors, either particular to the patient (e.g., a history of motion sickness) or particular to the anesthetic (e.g., use of nitrous oxide or reversal of muscle relaxants) that predispose to PONV. Postoperatively, hypotension also represents an important factor leading to postoperative nausea and vomiting.

Although general anesthesia and regional anesthesia alone and/or in combination have been shown to be appropriate and equally safe and effective for ambulatory orthopaedic surgery, the use of peripheral nerve blocks for anesthesia has been demonstrated to reduce hospital stay by 30-45 minutes when compared to general anesthesia and neuroaxial blocks following ambulatory surgery and minor orthopaedic procedures. In contrast, Williams et al. (2002) demonstrated that the use of peripheral blocks were only beneficial in patients undergoing ambulatory complex knee procedures, suggesting that for patients scheduled to undergo knee arthroscopy, either general anesthesia or a regional technique was equally appropriate.

## Specifics of the MIS Hip Procedure as an Ambulatory Procedure

The postoperative pain associated with a total hip replacement is usually considered to be mild at rest and moderate to severe during physical therapy, and mostly lasts 36-48 hours. In the case of a minimally invasive hip replacement, the intensity of the pain is also reduced by the fact that the technique is based on minimum muscle trauma and dissection. However, the minimally invasive technique does not diminish the trauma inflicted on the bone, which may represent the most painful stimulus. In addition, a patient who undergoes a minimally invasive hip replacement is required to undertake partial weight-bearing physical therapy sessions within hours following surgery. To be discharged from the hospital he/she is required to be able to walk independently with crutches or a walker and to ascend and descend at least 3-5 steps. Appropriate perioperative pain control, therefore, must be provided to allow for a patient to reach these goals. This is best achieved using a multimodal approach based upon a combination of cyclooxygenase-2 (COX-2) inhibitor, celecoxib, and a regional anesthesia (local anesthetic nerve block) technique. Accordingly, patients are started on 200mg celecoxib BID for 2 days prior to surgery. Those groups who do not use

continuous nerve block techniques advocate instead, in combination with a COX-2, the use of a long-lasting opioid (e.g., oxycodone 10mg BID) prior to and after surgery.

### **Preoperative Period**

On the day of surgery, each of our patients is asked to take 400mg celecoxib PO before they leave for the hospital. Contraindications to celecoxib include an allergy to aspirin and other anti-inflammatory agents as well as to sulfonamides. The dose is reduced by half if the patient has borderline renal failure (creatinine > 1.5) and/or is over the age of 70. In the preoperative area, after appropriate preoperative assessment, a combination of a lumbar plexus block with placement of a perineural catheter and a single sciatic nerve block is performed. In the postoperative care unit (PACU), a solution of local anesthetic is connected to the lumbar plexus catheter and infused using a patient-controlled regional anesthesia technique (e.g. a basal rate of 5ml per hour plus 5ml bolus with a lock out period of 60 minutes). Because most patients go home within 24 hours, the lumbar plexus catheter is postoperatively connected to an ambulatory pump to infuse up to 400ml of 0.2% ropivacaine. The patient discharge orders include celecoxib 200mg BID plus oxycodone 5-10mg q 6 hours PRN and instructions on how to recognize local anesthetic toxicity, how to remove the lumbar plexus catheter after 48 hours or at the end of the infusion, whichever comes first, and how to contact the acute pain attending on call in case of related pain issues. If a patient is hospitalized for at least 48 hours, the lumbar plexus catheter is removed prior to discharge, after stopping the infusion of local anesthetic at least 2 hours prior to discharge. The patient is given oxycodone 5-10mg PO. It is verified that his/her pain can be managed effectively both at rest and during physical therapy.

### ***Performance of the Peripheral Nerve Blocks***

After appropriate placement of an intravenous access, a nasal cannula delivers 3l/min of oxygen. Automated monitoring of blood pressure and pulse oximetry is initiated. The patient is placed in the lateral decubitus position with the hip to be operated on up. Midazolam 1-3mg IV and fentanyl 50-150mcg IV are administered in fractionated doses for sedation.

### ***Lumbar Plexus Continuous Nerve Block (Winnie Approach)***

The iliac crest is palpated and marked. A vertical line is drawn from the tip of the iliac crest down to the perpendicular line connecting the lumbar spinous processes. Next, a line is drawn at the level of the spinal process of L5-L3. Finally, a line is drawn parallel to the spinous process line 5cm laterally. The intersection of this line with the vertical line represents the site of insertion of the needle. After appropriate antiseptic preparation of the region, 1% lidocaine is injected into the insertion site using a 25-gauge, 3.75cm needle. Under strict aseptic conditions, a 10cm, insulated, introducer Tuohy needle, connected to a nerve stimulator (set up to deliver 1.5mA,

0.1ms with a frequency of 2Hz) and mounted to a loss-of-resistance syringe, is introduced through the skin with the bevel oriented cephalad. The needle is introduced perpendicular to the skin. The transverse process of L4 is usually encountered at a depth of 5-7cm from the skin. On its way to the transverse process, the needle usually elicits a direct stimulation of the paravertebral muscles. Next, the needle is walked either cephalad or caudad off the transverse process to a further depth of no more than 2cm and until quadriceps contraction is elicited. A loss of resistance is also felt as the needle enters the psoas compartment. The position of the needle is slightly adjusted to produce a motor response with a current <0.5mA. Two ml of 0.2% ropivacaine is slowly injected after a negative aspiration. After negative aspiration of blood, and verification that the injection has not produced a bilateral block (indicative of unacceptable intrathecal placement of the needle), an additional 5ml of 0.2% ropivacaine is slowly injected. The same sequence is repeated until a total volume of 17ml is administered. Next, a 22-gauge catheter is introduced 3-5cm beyond the tip of the introducer Tuohy needle tip. After the removal of the introducer needle, the catheter is secured at the skin with wound closure tapes and covered with a clear, occlusive dressing.

### ***Sciatic Nerve Block***

With the patient maintained in the same lateral position, a parasacral block is performed.

### **Parasacral Approach**

The posterior superior iliac spine and the ischial tuberosity are identified and marked. A line is drawn between these two points. The site of introduction of the needle is on the line at a distance of 7cm (3 fingerbreadths) from the posterior superior iliac spine (Fig. 1). After proper local skin infiltration, a 10cm, insulated, beveled needle connected to a nerve stimulator (1.5mA, 2Hz, and 0.1ms) is introduced perpendicular to the skin. Within the same distance required to produce a stimulation of the lumbar plexus, a sciatic mediated motor response is elicited.

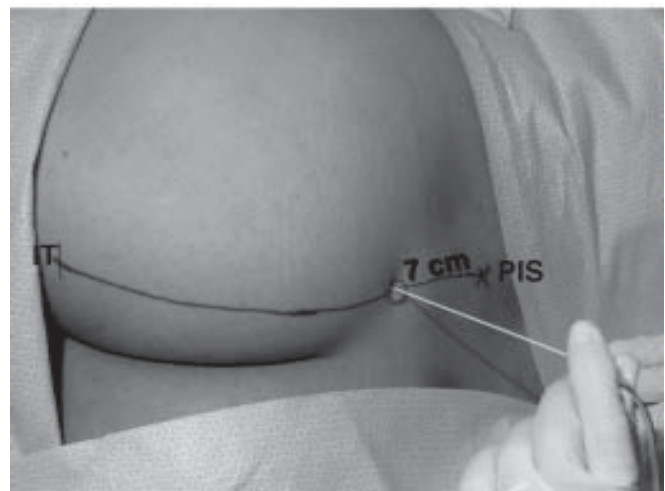


Fig. 1

After a sciatic mediated motor response has been elicited at the level of the foot and toes, the position of the needle is adjusted to maintain the same motor response with a current <0.5mA. A common peroneal stimulation elicits a dorsiflexion of the foot and extension of the toes or eversion of the foot while a tibial stimulation elicits a plantar flexion of the foot, and/or inversion of the foot. After negative aspiration for blood, the 5-7ml of 0.2% ropivacaine is injected slowly.

It is important to recognize that these blocks are performed for postoperative analgesia and also to minimize the use of opioids. It is also essential that postoperative motor function remains intact since the patient needs to have active physical therapy within 2-3 hours following surgery.

### **Surgical Period**

Irrespective of the anesthesia technique, the optimal recovery of the patient can be achieved by minimizing the amount of anesthetics administered. A processed EEG monitor (Bispectral Index; BIS) allows some titration of the level of anesthesia or sedation. Although our preferred intraoperative technique is spinal anesthesia, there are several acceptable anesthetic techniques. Any of them are acceptable as long as the patient will be ready to be actively mobilized within several hours following surgery. Regardless of the technique, ketamine 0.15mg/kg IV is injected prior to the start of surgery. The anesthetic requirements are also reduced because of the blocks performed preoperatively. In our practice, a foley catheter is not routinely placed. Instead, the patient is catheterized only once at the end of surgery before the transfer to the recovery room.

### *General Anesthesia*

General anesthesia has long been shown to be a reasonable option for ambulatory surgery. Propofol used for both the induction and maintenance of anesthesia hastens the patient's recovery and reduces the risk of PONV. In addition, the administration of opioids is minimized and the use of reversal agents is avoided, since these drugs increase the risk of PONV.

### *Regional Anesthesia*

Spinal and epidural anesthesia represent alternatives. Spinal anesthesia is especially appropriate in a patient who would benefit from the use of a continuous lumbar plexus block. In this context, the use of a mini-dose spinal (Ben-David et al. 2000) provides appropriate surgical anesthesia for the expected duration of the procedure. Our protocol includes the use of 7.5-9mg of bupivacaine (1-1.2ml of 0.75% bupivacaine), 10 micrograms of Fentanyl (0.2ml) and 0.8-1ml of 10% dextrose. The 27-gauge spinal needle is placed at the level of L2-L3.

The choice of the anesthesia technique is based upon the patient condition, his/her choice, the associated post-analgesia technique, the surgeon's preference, and the reliability of the surgical time. Thus, general anesthesia represents the technique of choice at the initial portion of the learning curve. When the surgical time becomes consistent, the use of a mini-dose spinal represents an interesting alternative.

### *Positioning*

Proper positioning of the patient is vitally important to the success of minimally invasive hip surgery. The patient is positioned supine with an inflatable pillow under the buttock of the operated side. A surgical table that allows independent mobilization of the legs is preferred in our institution (Fig. 2).



Fig. 2

The arm on the operative side is suspended over the patient's chest or face such that it does not obstruct surgical access to the hip and the long axis of the femur.

### *The Surgery*

The first incision, 4-6cm, is used to remove the femoral head and to prepare the acetabulum for the insertion of the cup. This anterior incision is made directly over the intertrochanteric region of the femur. The site of the incision is determined with fluoroscopy. After incising the skin, the dissection takes place between the tensor fascia lata laterally and the sartorius medially. The plane between the tensor fascia lata laterally and the rectus femoris medially is divided to expose the underlying hip capsule. After ligation of the circumflex femoral vessels, the hip capsule is opened longitudinally and retracted, allowing for the removal of the neck and head of the femur and the acetabular preparation. The cup is inserted and aligned with fluoroscopic guidance. Next, the operative leg is lowered and placed in a "figure-of-four" position. A posterior incision of 3-4cm is made to allow access to the femoral canal. After incising the skin and the underlying gluteal fascia, a tunnel is made through the gluteus maximus muscle and the underlying posterior hip capsule. The posterior incision, thereby, provides a tunnel for the insertion of a lateralizing reamer and rasps that are used to prepare the proximal femoral canal. An appropriate size femoral stem is inserted. Then, through the anterior incision, a trial femoral head of an appropriate neck length is applied to the trunnion on the stem. The hip is reduced to

assess its stability and the equality of limb length. When the optimal trial head has been determined, a comparable definitive head of the same neck length is impacted upon the stem. The final reduction of the hip is undertaken and hard copy image views are obtained. The incisions are closed in layers in conventional fashion.

#### *Prevention of Postoperative Nausea and Vomiting*

To minimize the risk of postoperative nausea and vomiting and to optimize the potential for a rapid functional recovery, it is important to (1) minimize the use of opioids during surgery; (2) avoid, if possible, the use of neuromuscular blockade reversal agents; (3) apply a careful choice of, and dosing of, anesthetic agents, and (4) avoid hypotension by providing the patient with appropriate fluid replacement. During the intraoperative period, it is our practice to routinely administer prophylactic antiemetic medications. These agents include 5HT<sub>3</sub> blockers, either ondansetron 4mg IV or granisetron 0.5mg IV. These drugs can be used alone, but are even more effective in combination with dexamethasone 4-8mg IV administered after the induction of anesthesia.

It is also important to recognize that the administration of solid food during the immediate recovery period should be avoided.

#### *Prevention of Hypothermia*

To prevent hypothermia, it is necessary to avoid excessive cooling of the OR. It is also important to include the systematic use of a forced air warming unit over the patient and to warm intravenous fluids through the use of one of the dedicated commercial units.

#### *Fluid replacement*

An appropriate volume of fluid is essential to facilitate the recovery of the patient and to minimize the possibility of orthostatic hypotension. The total volume needs to take into consideration the demographic of the patient, the blood loss associated with the surgery, and some estimate of any postoperative bleeding. Intraoperative fluid administration typically includes at least 2500-3000ml of lactated Ringer's combined with 500ml of colloid.

## **Postoperative Period**

Irrespective of the postoperative analgesia approach, patients who undergo minimally invasive hip surgery benefit most from a multimodal approach to pain started preoperatively.

In the PACU, the lumbar plexus catheter is infused using a patient-controlled regional anesthesia technique. The infusion is initiated with a basal rate of 5ml per hour plus 5ml bolus with a lockout period of 60 minutes. If the patient is scheduled to remain in the hospital for at least 48 hours, an infusion pump is indicated. If the patient is expected to be discharged within the first 24 hours, an ambulatory, or disposable, infusion pump is indicated. Prior to the connection, the catheter is aspirated to confirm negative aspiration for blood or cerebrospinal fluid.

Proper hydration is important during the recovery period and can be administered both intravenously (including 500ml of colloid) and orally in the form of coffee and/or juice and soft drink. In the absence of a wound drain or a foley catheter, it is difficult to estimate the postoperative blood loss. However, hemodynamic stability at rest and during physical therapy, repeat blood count testing, and the use of an ultrasonic bladder scan represent useful indicators. Also, the patient may be given electrolyte balance liquids such as sports drinks.

After appropriate recovery, the patient is transferred to the same-day observation unit and undergoes at least two physical therapy sessions. Usually, the first occurs 2-4 hours after the surgery and the second occurs within 5-7 hours. Dexamethorphan syrup 60mg PO is administered every 12 hours until discharge.

The patient also receives celecoxib 200mg BID started on the next day for at least 5 days postoperatively.

The most frequent side effect in a patient undergoing an *MIS 2-Incision* hip replacement procedure at our institution is orthostatic hypotension. The prevention of orthostatic hypotension episodes is most likely multifactorial. In the absence of routine systematic transfusion of 2 units of blood, relative anemia and/or hypovolemia represents an important contributing factor.

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