



Grand Rounds from HSS

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Perioperative Multimodal Anesthesia in High-Risk Patients

Edward C. Jones, MD, MA
Editor

Anesthesiologists at Hospital for Special Surgery carry on a long tradition of innovation in musculoskeletal care, clinical research, and practice standards that dramatically improves surgical outcomes. They have expanded the use of regional anesthesia and demonstrated the benefits of a multimodal approach to manage pain, reduce perioperative stress, and minimize postoperative complications. And they are leading efforts to address the opioid crisis. For instance, they have implemented strategies combining extended sensory nerve blocks and nonopioid pain medications that have significantly reduced the overuse of dependency-inducing drugs.

An anesthesiologist's clear understanding of the surgical procedure and thorough preoperative evaluation of the patient's general health are essential. Managing complex comorbidities is a crucial element in devising the best anesthesia plan for each patient. Along with administering optimal regional anesthesia, making use of a variety of multimodal approaches by anesthesia and pain-management specialists provides prolonged postoperative pain control and enables early mobilization. These techniques have resulted in minimizing postoperative opioid use and reducing the need for extended inpatient care, while improving patient satisfaction and surgical outcomes.

We present 3 cases involving patients with challenging comorbidities: hip fracture repair in a patient with Parkinson's disease, shoulder tendon surgery in a patient with myasthenia gravis, and total knee replacement in a patient with a history of alcohol use disorder. The authors—**Bradley Lee, MD**, and **David Kim, MD**, in Case 1; **Patricia Pang, MD**, and **Jonathan C. Beathe, MD**, in Case 2; and **Michael Singleton, MD**, and **Jiabin Liu, MD, PhD**, in Case 3—demonstrate that the most complex cases often require the greatest innovation in pain management. Special thanks to Dr. Beathe for his editorial oversight with the cases for this issue.

All volumes of Grand Rounds from HSS: Management of Complex Cases are available on hss.edu/complexcases, where you will find enlarged and additional images, references, and links to related articles. We hope you find these cases to be of interest and the principles presented informative. Comments are always welcome at complexcases@hss.edu.

Edward C. Jones, MD, MA

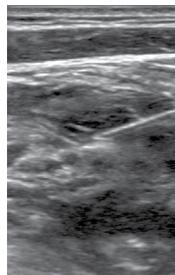
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Case 1

Case presented by Bradley H. Lee, MD, and David H. Kim, MD

Suprainguinal Fascia Iliaca Block as Postoperative Analgesia in Open Reduction and Internal Fixation to Treat Hip Fracture in a Woman with Parkinson's Disease

Case Report An 80-year-old woman with a history of Parkinson's disease and osteoarthritis, having sustained a left femoral-neck fracture after a fall at her home, was scheduled to undergo open reduction and internal fixation (ORIF). She weighed 55.8 kg (123 lb.), with a body mass index of 18.7. Her medications taken at home included amantadine and carbidopa—levodopa for Parkinson's disease. The patient had received morphine prior to hospital transfer, and during her preoperative assessment she was oriented to person and place but unable to identify the time of day or year. Her son noted that she had underlying dementia and became easily confused. Given concerns for postoperative delirium related to her age and Parkinson's, the goal of the anesthesia plan was to minimize postoperative opioid use while providing adequate analgesia.

The patient was taken to the operating room, where she underwent cannulated screw fixation for left hip intracapsular fracture. Spinal anesthesia (1.5% mepivacaine 4 mL) was administered, followed by placement of an epidural catheter for the surgery. She received sedation with fentanyl 100 µg and propofol infusion at 90 µg/kg/min. At the end of the procedure, a suprainguinal fascia iliaca (SIFI) block using 0.25% ropivacaine 30 mL was performed with ultrasound guidance, and a catheter was placed for postoperative analgesia (Fig. 1 and Fig. 2).

Postoperatively, a solution of 0.2% ropivacaine at 8 mL/hr was infused through the nerve catheter, which provided excellent analgesia. The catheter remained in place with continuous infusion for 43 hours, during which time she did not require opioids. The catheter was removed on postoperative day 2, and she was transitioned to acetaminophen 650 mg (every 6 hours scheduled) and tramadol 50 mg (every 4 hours as needed).

In spite of the avoidance of postoperative opioids, the patient experienced mild confusion starting in the morning on postoperative day 1. The patient's son noted that she had missed doses of her Parkinson's medications at home. With resumption of her

medication and frequent re-orientation, her cognitive status improved gradually during the hospitalization, with a return to baseline by the time of discharge.

Discussion As the population of elderly patients increases, so does the concern for postoperative delirium. It is well established that postoperative delirium is associated with increased hospital length of stay, morbidity, and long-term neurologic sequelae [1]. In particular, hip fractures are common among the elderly, and the use of psychotropic medications including opioids can predispose patients to postoperative delirium [2]. Therefore, strategies that provide effective analgesia while minimizing exposure to such medications are critical. Our case illustrates the use of SIFI block to provide prolonged analgesia and reduce opioid consumption after surgery for hip fracture.

The SIFI block has been demonstrated to provide effective analgesia for hip surgery [3]. The hip joint is innervated by various nerves including branches of the femoral and obturator nerves. The lateral femoral cutaneous nerve (LFCN) innervates the skin of the lateral thigh. The SIFI block involves injection of local anesthetic above the inguinal ligament and between the iliacus and fascia iliaca to anesthetize the femoral and obturator nerves, as well as the LFCN. This technique has been shown to reduce pain and opioid consumption after hip arthroplasty [3].

A single injection of local anesthetic used for SIFI block may last 24 hours [3]. The catheter provides continuous infusion and prolongs the analgesic effects beyond 24 hours. Our patient underwent ORIF of her femoral neck fracture and did not require postoperative opioids in the first 43 hours while the catheter infusion was used. Thereafter, she was given scheduled doses of acetaminophen, with tramadol as needed, for analgesia. The use of the SIFI block may provide effective analgesia for hip surgery and potentially minimize opioid use in elderly patients who are at increased risk for postoperative delirium. ■

[Images on the next page](#)

Case 1 References

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Figure 1



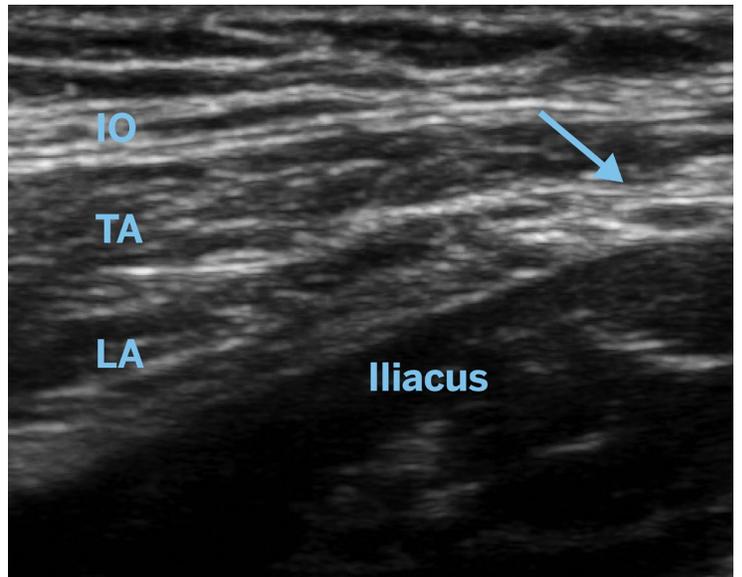
Identification of the inguinal ligament using landmarks—the anterior superior iliac spine to the pubis.

Figure 2



The suprainguinal fascia iliaca catheter.

Figure 2



Ultrasound image of the suprainguinal fascia iliaca block demonstrating spread of local anesthetic (LA) between the transversus abdominis (TA) and iliacus muscles. Also visualized are the internal oblique (IO) muscle and deep circumflex iliac artery (arrow).

Superior Trunk Block Regional Anesthesia for Shoulder Surgery in a Patient with Myasthenia Gravis

Case Report A 41-year-old woman with a diagnosis of biceps tendinitis was scheduled to undergo arthroscopic biceps tenodesis. She also had a 7-year history of myasthenia gravis and autoimmune-mediated asthma with frequent exacerbations.

Myasthenia gravis is an autoimmune disease characterized by skeletal muscle weakness and fatigability. Anesthetic goals of care for these patients include recognition of disease severity and cautious use of non-depolarizing neuromuscular blockers and anticholinesterases—medications typical of general anesthetics. Preoperative risk assessment for postoperative mechanical ventilation—particularly in the case of concomitant pulmonary disease—and expeditious extubation are important elements of care. Plans for multimodal analgesia focus on minimizing respiratory depression, often through the use of regional anesthetic techniques.

The patient's primary myasthenia gravis symptoms were ocular and respiratory in nature and worsened over the course of each day. Symptoms were managed with pyridostigmine, methotrexate, and prednisone, requiring increased steroid doses during asthma exacerbations, in addition to daily use of bronchodilators. Her medical history also included obesity, hypertension, and chronic kidney insufficiency.

This patient underwent arthroscopic biceps tenodesis under regional anesthesia supplemented with intravenous sedation. Before surgery, she received clearance from her rheumatologist and her pulmonologist, with recommendations to administer stress-dose steroids and continue the medications she took at home for myasthenia gravis and asthma perioperatively.

The shoulder joint and the rotator cuff are innervated by a confluence of nerves originating from the C5 and C6 nerve roots, in addition to skin innervation by the supraclavicular nerve from the superficial cervical plexus [3]. Therefore, the anesthesia plan was to (1) utilize a superior trunk block in conjunction with intravenous sedation intraoperatively and (2) rely on the superior trunk block and nonopioid medications for postoperative analgesia. The goal was to

minimize the patient's opioid requirements in the perioperative period, thereby decreasing risk of respiratory depression.

Standard monitors were applied. The patient was initially sedated with midazolam 5 mg and fentanyl 100 mcg, which were titrated intravenously over 10 minutes. Subsequently, an ultrasound-guided, superior trunk block was performed using a linear, high-frequency probe [4] and a Chiba 22 G × 2-3/8" block needle. Local anesthetic injection included a combination of 1.5% mepivacaine 10 mL and 0.5% bupivacaine 10 mL. Adequate anesthesia was achieved within 15 minutes, and no signs of respiratory depression were noted. The surgery proceeded without incident under conscious sedation with a propofol infusion at 58 mcg/kg/min.

The patient was discharged on the day of surgery without delay. She reported that analgesia from the block lasted for 18 hours, after which she managed her pain with nonopioid analgesics.

Discussion Although employing brachial plexus blocks has been favored for many patients undergoing shoulder arthroscopy, it can also benefit those with tenuous respiratory status. For a patient at high risk for respiratory depression associated with general anesthesia and opioid analgesia, a functioning brachial plexus block can significantly minimize the amount of opioids required intra- and postoperatively, a particularly important concern for ambulatory surgeries.

Traditionally, interscalene blocks have been favored for shoulder surgeries, as targeting the C5 and C6 nerve roots adequately anesthetizes the shoulder. Supraclavicular blocks are also reasonable, although the suprascapular nerve may not necessarily be anesthetized with lower volumes of local anesthetic deposited at that location. In such a situation, there would be inadequate anesthesia of the supraspinatus and infraspinatus muscles during surgical manipulation [3].

Selection of the appropriate peripheral nerve block requires consideration of the side-effect profiles of each block. Interscalene blocks provide adequate anesthesia and postoperative analgesia

for shoulder surgery, but they have the highest incidence of permanent neurologic complications of all peripheral nerve blocks [5] and 100% incidence of phrenic nerve paresis [6]. While supraclavicular blocks are performed at a more distal position of the brachial plexus, posing less risk for neurologic injury, at least 50% of patients still exhibit ipsilateral diaphragmatic paresis [7, 8]. The resultant respiratory compromise can have significant repercussions in patients with concomitant pulmonary disease or decreased functional reserve capacity. Careful consideration must therefore be given to the type of brachial plexus block selected and the volume of local anesthetic used in ensuring adequate anesthesia and analgesia, while minimizing spread to other structures.

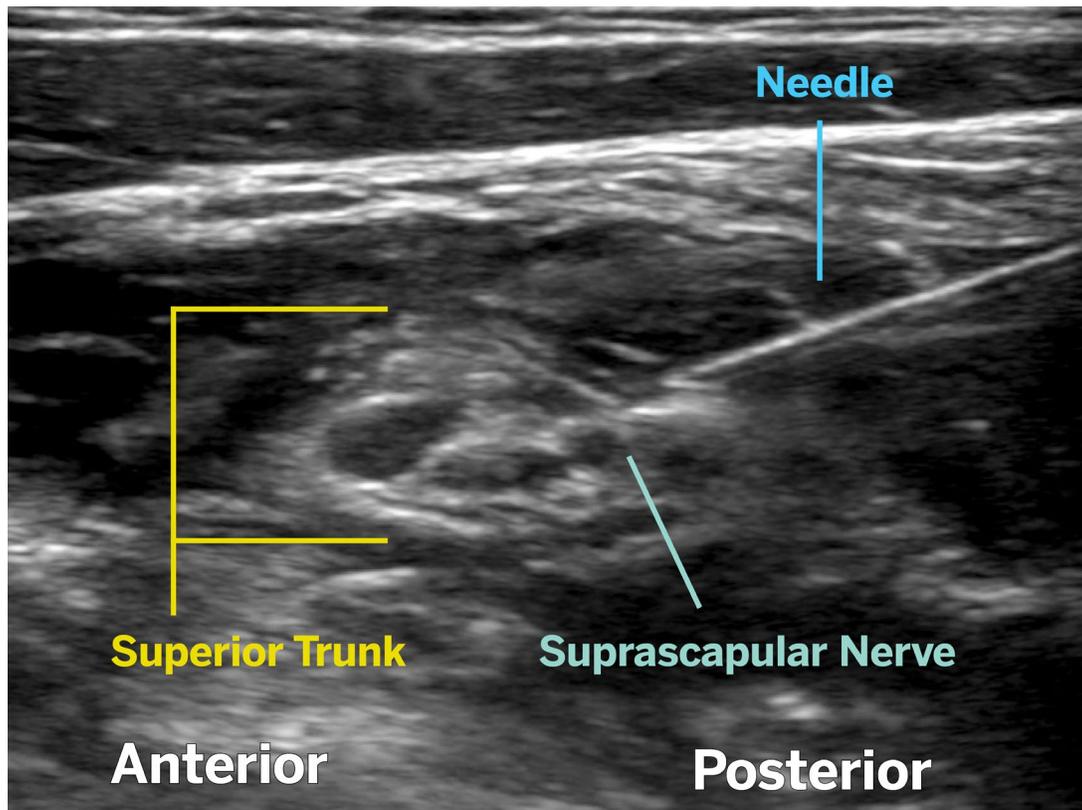
With these goals in mind, for this patient we relied on intravenous sedation in conjunction with an ultrasound-guided, long-acting, brachial plexus block, with a low volume of local anesthetic directed specifically at the superior trunk—distal to where the C5 and C6 nerve roots unite, but proximal to where the suprascapular nerve branches off (Fig. 1) [1, 2]. At this level, the phrenic nerve has diverged from the brachial plexus, potentially reducing the risk of its involvement when a low volume of injectate is used.

As this case illustrates, minimizing the risk of respiratory depression is a prime goal of anesthetic management of patients with respiratory compromise resulting from myasthenia gravis. Ultrasound-guided regional anesthesia has utility for these patients as part of a multimodal analgesic plan. The goals of care include optimizing respiratory mechanics and promoting early mobilization in order to facilitate quick return to baseline respiratory status and to reduce cardiopulmonary complications. A low-volume superior trunk block, as described here, can achieve these objectives, while potentially preserving diaphragm function.

Investigation currently under way at HSS will further elucidate phrenic nerve involvement with the superior trunk block. ■

[Image and references on the next page](#)

Figure 1



Ultrasound-guided superior trunk block anesthesia. The superior trunk (C5, C6) is isolated at the takeoff of the suprascapular nerve. The needle approaches the structures posterolaterally, with local anesthetic injection surrounding the structures.

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Minimizing Opioid Exposure After Total Knee Arthroplasty Using Peripheral Nerve Blocks in a Patient with a History of Alcohol Use Disorder

Case Report A 62-year-old woman with end-stage tricompartmental knee osteoarthritis presented for right total knee arthroplasty (TKA). She had a history of alcohol use disorder, with 4 years of sustained sobriety. She was also obese and had gout. She expressed a strong desire to avoid opioid analgesics post-operatively due to a concern for relapse into substance misuse.

In order to accommodate this wish while also providing adequate analgesia, we implemented spinal anesthesia and a strategy of multimodal analgesia, including peripheral nerve blocks to provide analgesia for both the front and back of the knee. The nerve blocks included an adductor canal block in combination with an infiltration of local anesthetic between the popliteal artery and capsule of the knee (IPACK) block, which together have been shown to reduce opioid use and enhance physical therapy performance after TKA [9].

Spinal anesthesia was performed using 1.5% mepivacaine 4 mL, along with moderate sedation with midazolam and propofol infusion titrated for effect. The IPACK and adductor canal blocks were performed under ultrasound guidance.

For the IPACK, a mixture of 0.25% bupivacaine 30 mL and preservative-free dexamethasone 3 mg was injected along the posterior aspect of the distal femur in order to block the sensory innervation provided by the medial and lateral genicular nerves.

The adductor canal block was achieved by initially injecting 0.5% bupivacaine 20 mL into the adductor canal, with assurance of good perivascular spread around the superficial femoral artery. The adductor canal catheter was then placed through the same needle (Fig. 1), and location was confirmed under ultrasound guidance with injection of 1–2 mL of air.

The TKA was completed uneventfully, and the adductor canal infusion catheter was left in place for 48 hours. The patient's postoperative pain regimen included

adductor canal catheter infusion of 0.2% ropivacaine at 8 mL per hour; acetaminophen 1000 mg IV every 6 hours for 24 hours, followed by 500 mg PO every 6 hours; and tramadol 50 mg as needed.

The patient ambulated on the day of surgery and advanced well with physical therapy, achieving good pain control with acetaminophen 500 mg every 6 hours. On postoperative day 1, the patient rated her pain on average 4/10 and elected not to take tramadol. The next day, she rated her pain 3/10 after taking a single dose of tramadol 50 mg. Her adductor canal catheter was removed on post-operative day 2, and she had a smooth transition to her oral pain regimen. She was discharged home on postoperative day 3 with prescriptions for acetaminophen and tramadol as needed.

At the patient's 6-week follow-up appointment, she had 0–100° range of knee motion and could walk up to one-fourth mile at a time; she was very pleased with acetaminophen as her sole analgesic and did not require tramadol at home. At her 3-month follow up, she continued to progress well, with range of motion now up to 105°, taking only acetaminophen as needed. Considering her satisfactory postoperative progress, the surgeon prescribed continued physical therapy and a routine follow-up evaluation at 12 months after surgery.

Discussion Long-term rates of relapse after remission from alcohol use disorders are estimated to be between 22 to 86%, depending on individual risk factors [6]. Increased stress response in the perioperative period can be devastating in elevating that risk [1, 7]. While the degree of this effect has not been determined, adequate analgesia may reduce the stress response to surgery and mitigate the risk of relapse.

Those with prior history of alcohol use disorders are at an elevated risk of developing other substance use disorders [8]. This risk is likely multifactorial, with

neurochemical, psychiatric, and genetic components [3]. Minimizing exposure to addictive medications perioperatively via a multimodal pain-management approach of regional anesthesia and nonopioid analgesics may be beneficial in reducing the risk of substance use disorders after surgery.

However, extending regional anesthetics for prolonged postoperative pain control, when patients likely require opioid analgesia, can be difficult. Our use of a combined adductor canal and IPACK block using dexamethasone is one of many techniques for extending analgesia after TKA [5]. Compared to traditional epidural-based analgesics, a postoperative peripheral nerve catheter infusion, such as the adductor canal block used in this case, may provide prolonged postoperative pain control.

An adductor canal block, when the catheter is properly inserted, blocks the saphenous nerve, distal branches of nerves to vastus medialis, and potentially branches of the obturator nerve [2]. It is less likely than a femoral nerve block to cause motor blockade of the quadriceps and thus facilitates early mobilization and physical therapy, especially when combined with an IPACK block, which blocks the sciatic contribution to knee sensation without causing hamstring weakness or foot drop [9, 10]. Much work has been done on different techniques involving various blocks, catheters, adjuvants, and extended-release formulations of local anesthetics; however, the optimal regimen for analgesia after TKA has yet to be agreed upon [4]. The current practice is largely institution dependent. ■

[Image and references on the next page](#)

Figure 1



Placement of an adductor canal catheter along the medial aspect of the mid-thigh, with sterile occlusive dressing (Tegaderm™).

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