# Musculoskeletal Injection

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*On completion of this article, you should be able to (1) describe the general method for musculoskeletal joint injection; (2) describe the clinical presentation, indications, technique, and supporting evidence for musculoskeletal injection of the 3 most commonly encountered injectable problems; and (3) compare and contrast the available anesthetics and corticosteroids used in musculoskeletal injection.*

**Patients commonly present to primary care physicians with musculoskeletal symptoms. Clinicians certified in internal medicine must be knowledgeable about the diagnosis and management of musculoskeletal diseases, yet they often receive inadequate postgraduate training on this topic. The musculoskeletal problems most frequently encountered in our busy injection practice involve, in decreasing order, the knees, trochanteric bursae, and glenohumeral joints. This article reviews the clinical presentations of these problems. It also discusses musculoskeletal injections for these problems in terms of medications, indications, injection technique, and supporting evidence from the literature. Experience with joint injection and the pharmacological principles described in this article should allow primary care physicians to become comfortable and proficient with musculoskeletal injections.**

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**GIM = General Internal Medicine; NSAID = nonsteroidal anti-inflammatory drug**

Musculoskeletal diseases are commonly encountered in primary care practice,[1] and physicians typically manage problems that would benefit from joint and soft tissue injections. Although musculoskeletal injection is one of the most frequently performed procedures among practicing internists,[2] physicians receive inadequate training regarding musculoskeletal diseases and injection technique.[3-6] The Accreditation Council for Graduate Medical Education[7] and the American Board of Internal Medicine[8] require resident physicians to understand arthrocentesis, yet residency training programs have traditionally provided limited instruction on this topic. Consequently, some training programs have instituted special musculoskeletal curricula that have been shown to improve physicians' confidence and ability with joint injections.[3-5]

The Mayo Clinic Division of General Internal Medicine (GIM) has created a musculoskeletal injection clinic. Our physicians perform musculoskeletal injections on patients and teach injection technique to internal medicine residents. In 2008, 563 injections were performed in the Mayo Clinic GIM Musculoskeletal Injection Clinic. The 3 most commonly injected sites were the knee (208 injections, 37%), greater trochanteric bursa (197 injections, 35%), and glenohumeral joint (96 injections, 17%). Properly performed joint injections are straightforward procedures that can be practiced by many primary care physicians. This article reviews the joint problems most commonly encountered in our GIM practice and summarizes the injectable medications, indications, and technique for musculoskeletal injection.

## PHARMACOTHERAPY

Musculoskeletal injections typically involve a combination of local anesthetics, which provide immediate analgesia and confirmation of accurate injection placement, and corticosteroids, which provide prolonged analgesia. The main corticosteroids used in the United States for joint and soft tissue injection are betamethasone sodium phosphate/acetate (Celestone Soluspan, Schering-Plough, Kenilworth, NJ), methylprednisolone (Depo-Medrol, Upjohn, Kalamazoo, MI), triamcinolone acetonide (Kenalog, Bristol-Meyers Squibb, Princeton, NJ), and triamcinolone hexacetonide (Aristospan, Sandoz, Princeton, NJ).[9] Solubility description, corticosteroid equivalent dosage, and dosages based on joint size are listed in Table 1.[10-13]

Corticosteroid duration of action depends on the preparation. In general, the shortest-acting corticosteroid is triamcinolone acetonide and the longest-acting is triamcinolone hexacetonide. Longer-acting preparations have a slightly higher risk of complications, including tendon rupture and tissue atrophy, but these risks are nevertheless small.[14]

A national survey of joint injection practice showed that physicians' preferences for specific corticosteroids are linked to the regions in the United States where the practitioners have trained,[9] perhaps explaining why uniform guidelines for recommended corticosteroid preparations are lacking. We often use triamcinolone hexacetonide for injections in the large intra-articular joints and greater trochanteric bursa, and triamcinolone acetonide for small intra-articular and soft tissue injections. Notably, despite more than 20 years of

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TABLE 1. **Corticosteroids for Musculoskeletal Injections**

| Drug name | How supplied | Solubility description | Corticosteroid equivalent dosage (mg)[a] | Dosages based on joint size[b] |
|---|---|---|---|---|
| Betamethasone sodium phosphate/ betamethasone acetate[10] | 3 mg betamethasone sodium phosphate/3 mg betamethasone acetate per mL suspension | Sodium phosphate: soluble, prompt action; acetate: slightly soluble, sustained action | 0.75 | Large: 1-2 mL<br>Small: 0.25-0.5 mL |
| Methylprednisolone[11] | 20, 24, or 80 mg/mL suspension | Low solubility creates sustained action | 4 | Large: 20-80 mg<br>Small: 4-10 mg |
| Triamcinolone acetonide[12] | 10 or 40 mg/mL suspension | Not a sustained-release medication | 4 | Large: 5-15 mg<br>Small: 2.5-5 mg |
| Triamcinolone hexacetonide[13c] | 5 or 20 mg/mL suspension | Low solubility ester and micronized suspension create sustained action | 4 | Large: 10-40 mg<br>Small: 2-6 mg |

[a] Equivalent to 5 mg of prednisone.
[b] Medium joints, bursa, ganglia, and tendonitis dosages are generally somewhere between those for a large and small joint.
[c] Dilution with local anesthetics containing parabens can cause flocculation.

combined experience, we have observed no complications of tendon rupture or septic arthritis.

Local anesthetics frequently used for joint and soft tissue injections are bupivacaine (Hospira, Lake Forest, IL; Sensoricaine, AstraZeneca, Wilmington, DE) and lidocaine (Xylocaine, AstraZeneca, Wilmington, DE). Table 2 summarizes available concentrations, onset, duration, and dosages of these medications.[15,16] We typically use lidocaine for intra-articular and bursal injections and bupivacaine for trigger point injections.

Newer intra-articular pharmacotherapeutic options exist; however, these would generally not be used by primary care physicians. For example, hyaluronidate, which requires multiple injections, has been shown to decrease pain in patients with osteoarthritis.[17,18] Likewise, intra-articular immunomodulators, such as infliximab, are being studied for the treatment of refractory inflammatory arthritis[19]; however, these intra-articular immunomodulators have yet to become common treatments.

## GENERAL METHOD FOR MUSCULOSKELETAL INJECTION

Musculoskeletal injections are safe and comfortable with the use of proper technique. Adverse affects from the medications used in joint injection are rare. Intra-articular corticosteroid injections do not lead to the progression of osteoarthritis.[20] Postinjection inflammation is caused by intra-articular injection of corticosteroid crystals and can mimic septic arthritis[21]; however, septic arthritis usually occurs later than postinjection inflammation and the findings are more persistent. Notably, the risk of septic arthritis from intra-articular injections is less than 0.03%.[22] The risk of hyperglycemia in patients with diabetes is very small and transient,[23] even for longer-acting corticosteroid preparations. Adrenal suppression from intra-articular corticosteroids has been described but usually lasts less than 2 weeks when it occurs.[24] Other risks include skin hypopigmentation, fat atrophy, tendon rupture, and facial flushing.[21] A systematic review of the literature on corticosteroid injection for athletic injuries revealed the following complication rates: skin atrophy (2.4%), skin depigmentation (0.8%), localized erythema and warmth (0.7%), and facial flushing (0.6%).[14]

The intra-articular injection procedure is safe with experienced clinicians and appropriately selected patients. Risk of hemarthrosis is small even in those taking antiplatelet agents or warfarin,[25,26] although most clinicians would discontinue or reverse the effects of these agents before elective injections in anticoagulated patients. Precautions should also be taken to avoid the risk of septic

TABLE 2. **Local Anesthetics for Musculoskeletal Injections**

| Drug name | How supplied | Dosage | Notes |
|---|---|---|---|
| Bupivacaine[15] | 0.25%, 0.5%, and 0.75% | 0.25% and 0.5% solutions generally used for joint injection<br>1-2 mL mixed with corticosteroid | Significantly longer onset and duration of action than lidocaine |
| Lidocaine[16] | 0.5%, 1%, 1.5%, 2%, and 4% | 1% and 2% solutions generally used for joint injection<br>1-2 mL mixed with corticosteroid | Onset and duration are proportional to total dose given<br>Smallest total dose should be given to avoid systemic adverse effects |

arthritis. In particular, the injection of joints that contain prosthetic hardware should be avoided; patients with such prosthetic hardware should be referred to an orthopedic surgeon. Additionally, injection should be avoided across suspected cellulitis, in areas of infectious arthritis or bursitis, in patients with bacteremia, or in severely immunocompromised patients.

To reduce the risk of infection and improve patient comfort, we suggest some simple measures (Table 3). Joint injection models that provide auditory feedback for correct needle position provide effective training.[5] Physicians should take the time to place themselves and patients in comfortable positions before the procedure. Surface landmarks (described in Musculoskeletal Injection for Specific Anatomic Regions) should be clearly identified, and the injection site may be marked with a pen, either by drawing an "X" with ink or marking a circular impression with the tip of the pen. The injection site should be cleansed with an antiseptic solution such as chlorhexidine; we avoid iodine solutions given the relatively high incidence of sensitivity to these agents. The skin should be cleansed with 3 consecutive swabs, using spiral motions from the center outward. Although radiographic guidance with ultrasonography or fluoroscopy may improve accuracy,[27-29] it is expensive and is therefore not typically used by primary care physicians who are experienced with injections. However, if response to blind injection is suboptimal, it may be beneficial to use ultrasound guidance to ensure injection placement for subsequent injections.[29]

TABLE 3. **Steps for the No-Touch Injection Technique**

| |
|---|
| 1. Verify with patient his or her name and procedure to be done |
| 2. Obtain consent by going over risks and benefits |
| 3. Obtain supplies, including one 1.5-inch 18-gauge needle, one 1.5-inch 22-gauge needle, one 5-mL syringe, a pen, antiseptic swabs, adhesive bandage, gloves, 1 vial of corticosteroid, and 1 vial of anesthetic |
| 4. Swirl the corticosteroid vial to mix. Shaking can cause bubbles. Draw up the corticosteroid and then the anesthetic using the 18-gauge needle. Inspect the contents of the syringe to be sure the medications have not flocculated or separated. Drawing up the corticosteroid first reduces the chances of this. Replace the needle with a 22-gauge needle |
| 5. Position the patient on the examination table at a height comfortable for you. Use pillows to support the limb and to improve patient comfort |
| 6. Identify the anatomic landmarks and mark the site of injection with a pen. Also, using the tip of the pen, press gently to make an indentation at the injection point. This will be the guide if the pen mark is erased by the antiseptic |
| 7. Clean the site with the antiseptic. **This is a no-touch technique. Do not touch the disinfected area.** Gloves should be worn as a universal precaution. However, sterile gloves are unnecessary because this is a no-touch technique |
| 8. Perform a preprocedure pause. Stop and verify the correct patient, correct procedure, and correct site |
| 9. Insert the needle |
| 10. Pull back on the needle to determine if joint fluid is present and to be sure a blood vessel has not been cannulated |
| 11. Inject the contents of the syringe. If correctly positioned, the contents should flow freely with little resistance. All of the medication should be completely expelled from the syringe **before** removing the needle to help prevent skin atrophy |
| 12. Withdraw the needle and place it in a sharps container |
| 13. Cover the injected area with an adhesive bandage |
| 14. Discuss after care with the patient, including signs of complications and the duration of the anesthetic and corticosteroid medications, and counsel the patient to avoid overuse of the joint for 2 to 3 days and to avoid submerging the joint in water |

## MUSCULOSKELETAL INJECTION FOR SPECIFIC ANATOMIC REGIONS: CLINICAL PRESENTATION, INDICATIONS, TECHNIQUE, AND SUPPORTING EVIDENCE

### Knee Joint

Knee pain is a common presenting symptom in primary care practice. Main indications for intra-articular knee injection are osteoarthritis, Baker cyst, and pes anserine bursitis.

Osteoarthritis is a slow and progressive disease that is linked to obesity and most commonly affects the medial compartment and patellofemoral joint; however, patients often describe diffuse knee pain. Although patients may report morning stiffness, it lasts only minutes. Furthermore, the pain typically worsens with activity. Physical examination usually reveals pain with passive range of motion, crepitus, and possibly a cool effusion. Treatments include gentle aerobic activity, quadriceps strengthening, nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen, and injections of intra-articular hyaluronidate and corticosteroids. Of course, treatment-refractory patients are referred to orthopedic surgeons for consideration of joint replacement.

Baker cysts are synovial fluid collections originating from the knee joint. Patients typically describe knee pain and stiffness and occasionally fullness in the popliteal fossa. Physical examination shows posterior swelling at the medial aspect of the joint where the semimembranous and medial head of the gastrocnemius intersect. A Baker cyst can rupture and mimic thrombophlebitis, causing a physical finding called *phlegmasia cerulea dolens*; therefore, ultrasonography is sometimes required to differentiate between these 2 diagnoses. Treatment options include physical therapy, needle aspiration, and corticosteroid injection. Because many Baker cysts are continuous with the knee joint, intra-articular knee injection is often effective.

Pes anserine bursitis also improves with corticosteroid injection. Patients usually present with inferomedial knee pain localized over the pes anserine bursa. On physical examination, palpable tenderness can be noted at the

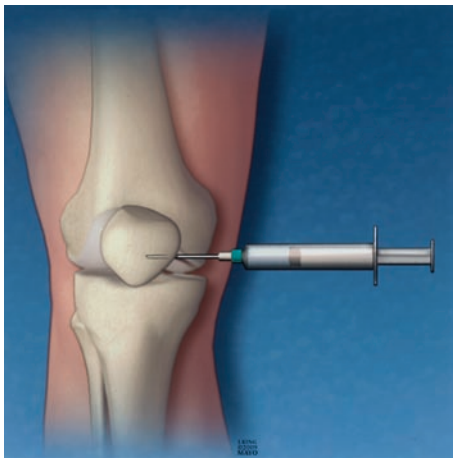

FIGURE 1. Anterior view of the right knee showing a medial approach intra-articular injection.

confluence of the sartorius, gracilis, and semitendinosus muscles. Moreover, pes anserine bursitis can be exacerbated by osteoarthritis of the knee. Treatments include hamstring stretching, quadriceps strengthening, and corticosteroid injection. Injections are placed directly into the bursa. Low-potency corticosteroids should be used to prevent tissue atrophy.

For intra-articular knee injections, we usually use 2 mL of triamcinolone hexacetonide (20 mg/mL) and 2 mL of lidocaine (2%). The technique for knee injection is described in Table 3. First, have the patient lie supine on the examination table with his/her head supported by a pillow. Place a rolled towel under the lower thigh to slightly angulate the knee and open the joint space. In our practice, a medial approach is most common (Figure 1). Palpate along the medial aspect of the patella, moving from superior to inferior in a clockwise motion. A small space or indentation will be felt at about the 3 o'clock position. Mark this point and insert the needle as described in Table 3. The angle of the needle should be parallel to the undersurface of the patella and aimed slightly superiorly to guide the needle toward the intercondylar notch, which decreases the risk of hitting the periosteum. Finish the injection using the steps outlined in Table 3.

The Cochrane Collaboration systematically reviewed the literature on intra-articular corticosteroid treatment of knee osteoarthritis in 2006.[30] Aggregate results from 28 trials (1973 combined participants) comparing intra-articular corticosteroids vs placebo, hyaluronidate, joint lavage, or other corticosteroids showed that intra-articular corticosteroids were more effective for pain reduction and patient global assessment at 1 week (number needed to treat, 3-4) and that pain reduction lasted for 2 to 3 weeks. However, evidence for functional improvement with corticosteroids was lacking, and at 4 to 24 weeks after injection, no evidence was found for improvement in pain or function. No differences were noted at 4 weeks in patients treated with corticosteroid vs hyaluronidate preparations. Finally, comparisons between types of corticosteroids showed that triamcinolone hexacetonide was superior to betamethasone.

### Greater Trochanteric Bursa

Greater trochanteric bursitis is a very common condition resulting in pain over the greater trochanter. Imaging studies indicate that the pain can be from gluteus minimus or medius injury or inflammation of the bursa itself.[31] Typical causes are running, local trauma, and gait disturbances, but it is often idiopathic. The pain can be severe, radiate to the buttock or anterior thigh, and be exacerbated by standing or sleeping on the affected side. Patients often describe "hip" pain; however, true intra-articular hip pain usually radiates to the groin. Trochanteric bursitis only rarely is caused by infection. On examination, palpation over the greater trochanter reproduces the pain. Three bursae (2 major and 1 minor) surround the greater trochanter. Major bursae are the subgluteus medius bursa (posterior and superior to the proximal edge of the greater trochanter) and the subgluteus maximus bursa (lateral to the greater trochanter). The minor bursa is the subgluteus minimus bursa (above and slightly anterior to the superior surface of the greater trochanter). Treatment options include NSAIDs, correction of gait abnormalities, postural and hip muscle strengthening, topical application of moist heat, ultrasonography, and corticosteroid injection.

For injecting trochanteric bursae, we typically use 2 mL of triamcinolone hexacetonide (20 mg/mL) and 2 mL of lidocaine (2%). The technique for injecting a greater trochanteric bursa is described in Table 3. First, have the patient lie on their asymptomatic side with the painful hip facing up. The patient's head should be supported with a pillow. Drape the patient with sheets to cover the genitals and expose only the area of the greater trochanter. Ask the patient to point with 1 finger to the area of greatest pain; mark this with a pen (Figure 2). Remember that up to 3 bursae, arranged around the greater trochanter in a triangular configuration, can be affected (Figure 2). The injection is distributed across all affected bursae that are localized by the patient. The injection is completed by using the steps outlined in Table 3.

Evidence supports the efficacy of corticosteroid injection therapy for trochanteric bursitis. Ege Rasmussen and Fanø[32] showed that corticosteroid injections gave excellent response in two-thirds of patients, with improvement in the remaining cases. Shbeeb et al[33] injected 75 patients with trochanteric bursitis with 6, 12, or 24 mg of betame-

thasone mixed with lidocaine, demonstrating responses in 77%, 69%, and 61% of patients at 1, 6, and 26 weeks, respectively. This study supported the observation that higher doses of betamethasone provide better pain relief.

### Glenohumeral Joint

Several etiologies of shoulder pain respond to a single intra-articular corticosteroid injection. The main indications for shoulder injection are rotator cuff arthropathy, adhesive capsulitis, and subacromial bursitis.

Rotator cuff tendinopathy and arthropathy usually occur from years of repetitive shoulder trauma. Patients often describe pain localized over the anterior shoulder. Pain can be exacerbated by moving the arm overhead (eg, external rotation with hair combing) or behind the back (eg, internal rotation with taking a wallet from the back pocket). Physical examination may show crepitus on passive range of motion and limited internal and external rotation with active range of motion. Pain with abduction between 60° and 120°, known as the painful arc, is often seen. With provocative maneuvers, physicians may also demonstrate signs of tendon impingement by eliciting positive responses (ie, pain). Specifically, examiners elicit the Neer sign by stabilizing the scapula and applying maximal passive forward flexion to the internally rotated shoulder. To elicit Hawkins sign, the patient is examined with his or her arm at 90% and elbow flexed in the horizontal position to 90%. While supporting the elbow, the examiner then applies maximal internal rotation.[34]

Adhesive capsulitis, also known as frozen shoulder, typically occurs after prolonged immobility of the arm. Patients describe shoulder pain and stiffness with the inability to abduct at the shoulder more than just a few degrees in any direction. Shoulder examination reveals diffuse pain with palpation and reduced active and passive range of motion in all planes. Remarkably, findings on radiography will often be normal.

Patients with subacromial bursitis typically describe their shoulder pain as being worse at night, awakening them when they roll over in bed. The onset may be abrupt and caused by overuse. The pain is exacerbated by abducting the arm greater than 90°. Physical examination may show a reduced range of shoulder motion because of pain. As in rotator cuff tendinitis, the most painful arc of motion will be between 60° and 120°. Pain may occur laterally over the subacromial bursa. Range of motion testing may also reveal pain on internal and external rotation.

For glenohumeral joint injections, we use 2 mL of triamcinolone hexacetonide (20 mg/mL) and 2 mL of lidocaine (2%). The method for shoulder injection involves the no-touch technique described in Table 3. Start with the patient sitting on the examination table at a height that is comfortable for you. We often use a posterior approach for shoulder injection. Specifically, palpate just the scapular spine and move laterally until you feel a space or indentation. Mark this spot (Figure 3). Next locate the coracoid process anteriorly. When inserting the needle, direct it toward the tip of the coracoid process. Complete the injection by using the no-touch technique described in Table 3. For subacromial injections, the same medications and basic technique are used. However, insert the needle in the space posterolateral to the acromion process. The needle should be inserted parallel to the ground and at a depth of approximately 3 cm.

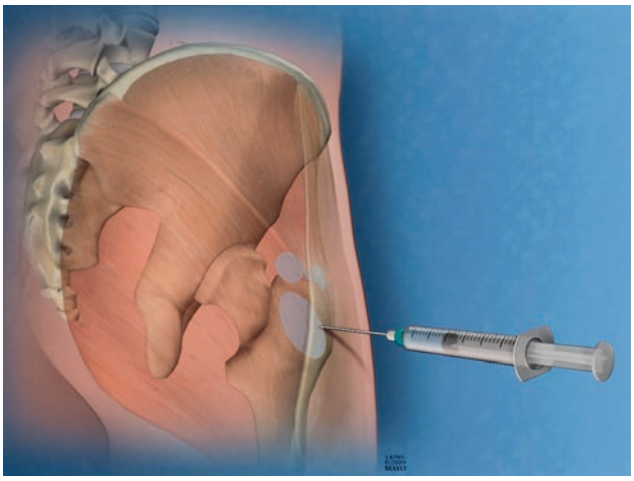

FIGURE 2. Posterolateral view of the right hip showing the 2 major (subgluteus medius and subgluteus maximus) and 1 minor (subgluteus minimus) trochanteric bursae. Injections should target the bursae that are most painful.

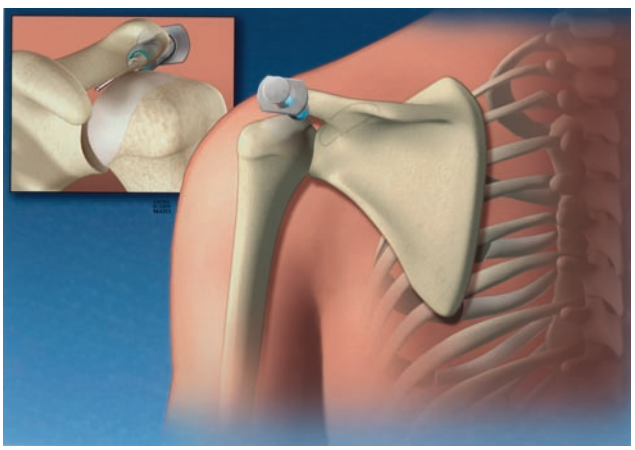

FIGURE 3. Posterior view of the left shoulder showing the needle directed toward the coracoid process anteriorly. The inset in the upper left corner shows the same joint from an anterior view. Notice the needle placement within the glenohumeral joint.

Regarding the effectiveness of shoulder injections, the Cochrane Collaboration systematically studied the literature on corticosteroid injection for shoulder pain in 2003,[35] reviewing 26 trials with a median of 52 participants, noting variability in number, site and dosage of injection, and methodology. For rotator cuff disease, subacromial corticosteroid injection showed a small benefit over placebo and no benefit over NSAID therapy. For adhesive capsulitis, 2 trials suggested a possible early benefit to intra-articular corticosteroid injection vs placebo, but data were insufficient to draw firm conclusions. Our usual practice is to first attempt conservative therapy. If NSAIDs are ineffective or contraindicated, then joint injection is offered.

## CONCLUSION

Musculoskeletal problems are common in primary care and often respond to injections containing both corticosteroids and short-acting anesthetics. Patients frequently present with symptoms involving the shoulder, trochanteric bursa, and knee. Evidence generally supports corticosteroid injection for these anatomic locations. The risks associated with joint injection are very low with proper injection technique and in appropriately selected patients. Experience with joint injection and the pharmacological principles described in this article should allow primary care physicians to become comfortable and proficient with musculoskeletal injections.

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## CME Questions About Musculoskeletal Injection

1. Which *one* of the following injectable corticosteroid preparations has the *longest* duration of action?
   a. Methylprednisolone
   b. Triamcinolone hexacetonide
   c. Betamethasone sodium phosphate/acetate
   d. Triamcinolone acetonide
   e. Bupivacaine

2. Toward which *one* of the following anatomic landmarks *should* the needle be directed when performing a glenohumeral joint injection?
   a. Coracoid process
   b. Acromion process
   c. Spine of the scapula
   d. Acromioclavicular joint
   e. Sternoclavicular joint

3. To prevent which *one* of the following is the corticosteroid drawn up before the local anesthetic when preparing the syringe for a joint injection?
   a. Clogging the needle
   b. Inactivation of the local anesthetic
   c. Contamination of the sterile corticosteroid preparation
   d. Inactivation of the corticosteroid
   e. Flocculation of the medications

4. Which *one* of the following conditions can Baker cysts *most closely* mimic when they rupture?
   a. Pes anserine bursitis
   b. Retropatellar pain syndrome
   c. Thrombophlebitis
   d. Osteoarthritis
   e. Adhesive capsulitis

5. Which *one* of the following symptoms is *frequently observed* in patients with greater trochanteric bursitis?
   a. Discomfort when moving through the painful arc
   b. Hip pain when sleeping on the affected side
   c. Hip pain that radiates to the groin
   d. Phlegmasia cerulea dolens
   e. Inferomedial knee pain

*This activity was designated for 1 AMA PRA Category 1 Credit(s).™*

Because the Concise Review for Clinicians contributions are now a CME activity, the answers to the questions will no longer be published in the print journal. For CME credit and the answers, see the link on our Web site at mayoclinicproceedings.com.