Chapter 13

Posterior Lumbar Plexus Block

- Applied Anatomy
- Continuous Lumbar Plexus Block (Psoas Compartment)

APPLIED ANATOMY

The lumbar plexus is formed from the anterior primary rami of the first four lumbar nerve roots, and lies within the substance of the psoas major muscle (1) (Fig. 13-1). The branches of the lumbar plexus (except the iliohypogastric and ilioinguinal nerves, which are the first lumbar segmental body-wall nerve and its collateral branch, respectively) supply the lower limb, but in their passage across the posterior abdominal wall they give off branches to the parietal peritoneum. Branches of the lumbar plexus include the iliohypogastric and ilioinguinal nerves (L1), genitofemoral nerve (L1 and L2), lateral cutaneous nerve of the thigh (posterior divisions of L2 and L3), femoral nerve (posterior divisions of L2, L3, and L4), and obturator nerve (anterior divisions of L2, L3, and L4) (1).

CONTINUOUS LUMBAR PLEXUS BLOCK (PSOAS COMPARTMENT)

Introduction

Because it is a relatively easy and successful block to perform, and anesthesiologists are used to placing needles at this level in the course of performing lumbar epidural blocks, the psoas compartment block is sometimes performed for improper or debatable indications (2). If the continuous femoral nerve block is performed with the catheter on the femoral nerve and deep to the fascia iliaca, and the lateral cutaneous nerve of the thigh and obturator nerve are included in the block (see Fig. 12-5), there are very few good indications left for the psoas compartment block (2,3).

Hip replacement surgery, for example, because of the surgical destruction of the joint capsule and consequent denervation of the joint, is remarkably pain free and therefore probably not a good indication for this block, although acetabular fracture may be an excellent indication. Lumbar epidural block may be a better choice for intraoperative and postoperative analgesia in primary total hip replacement because patients can become very uncomfortable in the decubitus intraoperative position if the "down" leg is not anesthetized and if the patient's torso is not blocked. Also, the epidural catheter may be removed the day after surgery because severe pain seldom persists after 24 hours and patients are often started on thromboprophylaxis; in addition, the hip joint gets its innervation from the entire lumbosacral plexus, which is not fully covered by a lumbar plexus block.

Similarly, for lower leg surgery, a more distal saphenous nerve block combined with a sciatic nerve block is almost always a better choice than a lumbar plexus block combined with a sciatic nerve block. Another common indication for lumbar plexus block that should be questioned is inguinal hernia repair (4). An iliohypogastric and ilioinguinal nerve block combined with a field block is probably a safer alternative than an L1-L2 lumbar paravertebral block (5), but this is outside the scope of this atlas.

Specific Anatomic Considerations

The psoas compartment is a relatively large and vascular compartment, and large volumes of local anesthetic agent are necessary to fill it (6). This brings the issue of local anesthetic toxicity into the equation—the more so because it is such a vascular compartment, which also predisposes to retroperitoneal hematoma formation in case of vascular trauma by the needle or catheter.

Large volumes of local anesthetic agent in the vicinity of the epidural space are also potentially problematic, and many cases of wide epidural spread have been reported (3).

Other problems, such as intra-abdominal placement of needles and catheters, kidney and ureter injury, and subarachnoid injection, have also been reported (3).

Because the nerve roots are covered with dura, sharp or thin needles should probably not be used for this block (see Chapter 3). Even 22-gauge B-bevel needles should probably not be used because of the danger of dural penetration or intra-root injection and subsequent large-volume subarachnoid block. As a general principle, large-bore Tuohy needles (16- to 18-gauge) are the best choice here because they are the least likely to penetrate the dura or nerve root (7).

Nerves

1. Subcostal nerve (T12)
2. Iliohypogastric nerve (L1)
3. Ilioinguinal nerve (L1)
4. Lateral femoral cutaneous nerve (L2,3)
5. Femoral branch of genitofemoral nerve (L1,2)
6. Genital branch of genitofemoral nerve (L1,2)
7. Femoral nerve (L2,3,4)
8. Sciatic nerve
   a. Common peroneal nerve (L4,5,S1,2)
   b. Tibial nerve (L4,5,S1,2,3)
9. Posterior femoral cutaneous nerve (S1,2,3)
10. Nerve to Sartorius muscle (L2,3,4)
11. Saphenous branch of the Femoral nerve
12. Obturator nerve (L2,3,4)
13. Pudendal nerve (S1,2,3)
14. Sympathetic trunk
15. Lumbosacral trunk

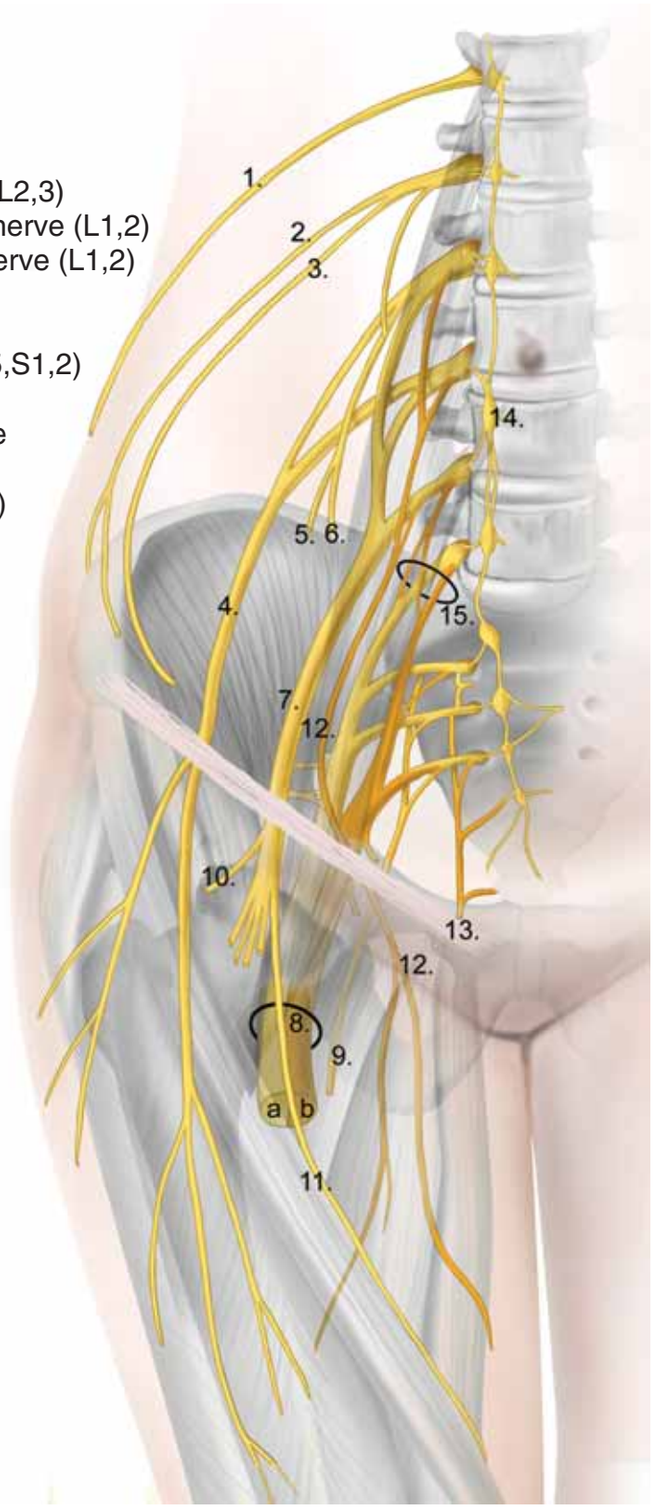

FIGURE 13-1 The lumbosacral plexus.

FIGURE 13-2 The patient is placed in the lateral decubitus position and the dorsal spines of the lumbar vertebrae are marked.

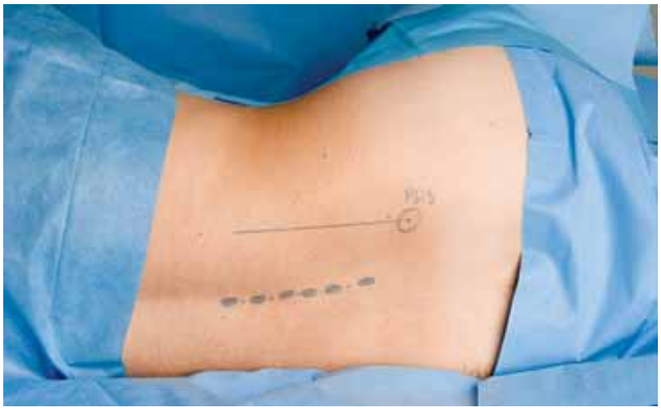

FIGURE 13-3 The posterior superior iliac spine is identified and a line drawn from it parallel to the dorsal spines.

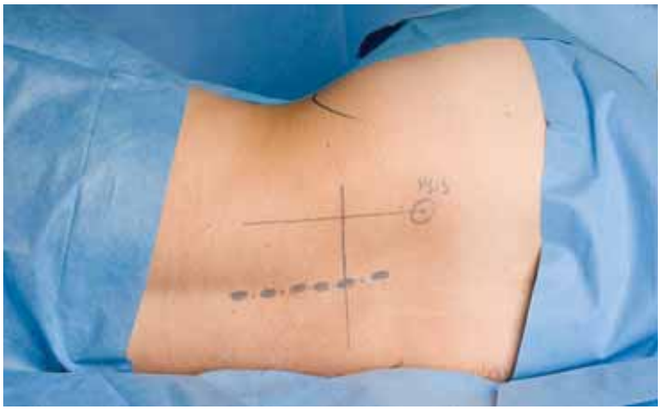

FIGURE 13-4 The intercristal line (Tuffier's line) is drawn.

Technique

With the patient in the lateral decubitus or sitting position and the lumbar spine flexed, a line is drawn marking the dorsal spines of the lumbar vertebrae in the midline (3) (Fig. 13-2).

The posterior superior iliac spine is palpated and marked, and a line drawn parallel to the midline from its midpoint (Fig. 13-3).

The intercristal line is now drawn, and the dorsal spine of the vertebra palpable on this line is the dorsal spine of the fourth lumbar vertebra (Fig. 13-4).

The distance between the two parallel lines is now measured, and this distance is divided into thirds. Needle entry is two thirds of the distance from the midline on the intercristal line, as indicated in Figure 13-5.

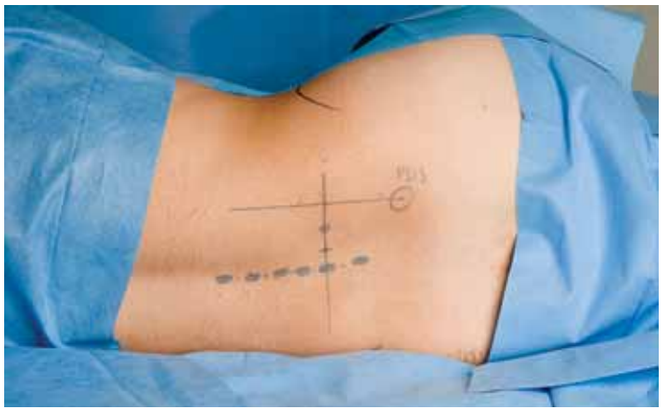

FIGURE 13-5 The distance between the two parallel lines is measured, and needle entry is two thirds of this distance from the midline.

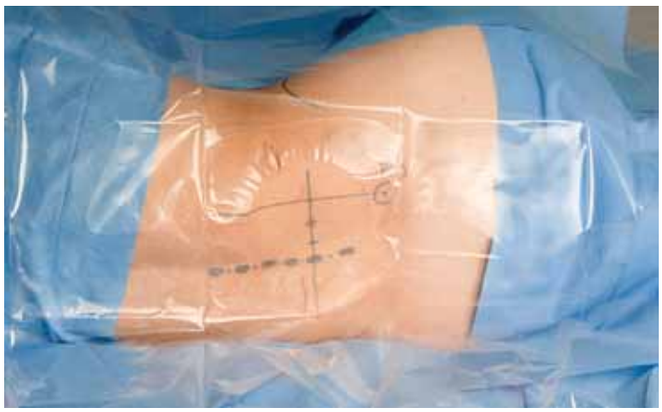

FIGURE 13-6 After skin preparation, a sterile, fenestrated drape is placed over the lumbar spine.

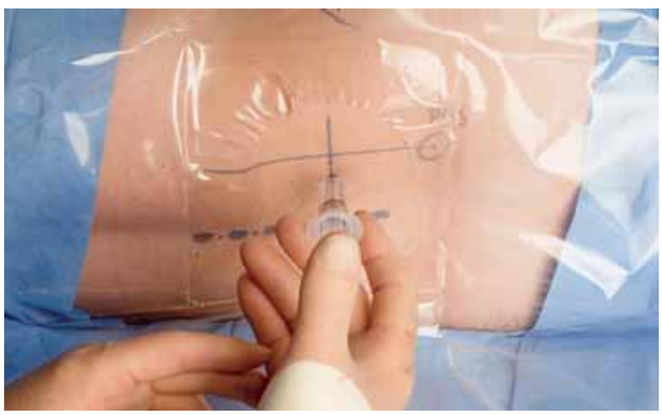

FIGURE 13-7 The skin and subcutaneous tissues are anesthetized thoroughly, all the way down to the transverse process or articular column of L4.

The skin is prepared with an appropriate antiseptic solution and the area covered with a transparent, fenestrated, sterile plastic drape (Fig. 13-6).

The skin and subcutaneous tissue are thoroughly anesthetized with a lidocaine and 1:200,000 epinephrine solution (Fig. 13-7). The anticipated path for tunneling the catheter is also anesthetized. Note the slight medial angulation of the needle, and that the tissue all the way down to the bony pars intervertebralis, articular column, or transverse process is anesthetized.

For some patients it may be necessary to use a longer needle to reach the bony parts. It is always handy to measure the depth to the bony

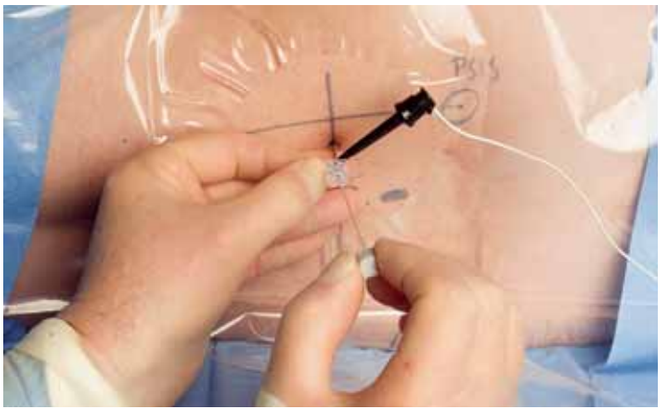

FIGURE 13-8 An insulated Tuohy needle connected to a nerve stimulator is advanced slightly mesiad, aiming for the anterior midline until contact with the transverse process or articular column is made.

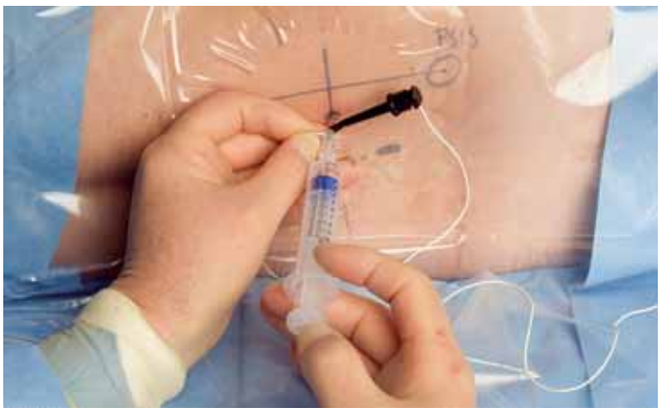

FIGURE 13-9 A loss–of–resistance-to-air syringe is attached to the needle and the needle is walked off the bony part in a caudal and lateral direction.

parts with ultrasonography before needle entry. It is, however, important to inject local anesthetic agent only after contact with the bone has been established. This is to minimize the theoretical but dangerous possibility of intrathecal injection of local anesthetic agent. Again, note the slightly medial angulation of the needle to ensure contact with the bony structures. (For all paravertebral blocks—cervical, thoracic, lumbar, and sacral—the needle is aimed at the anterior midline to ensure contact with the bony structures.)

The nerve stimulator, set to a current output of 1 to 1.5 mA, a pulse width of 200 to 300 μsec, and a frequency of 2 Hz, is clipped to the 100-mm insulated 17- or 18-gauge Tuohy needle (or a longer needle, if required), which enters the skin aiming slightly mesial toward the anterior midline (Fig. 13-8). The needle stylet is removed when contact with the bone is established.

A loss–of–resistance-to-air syringe is attached and the needle tip is walked off the bone in an inferolateral direction (obliquely lateral and caudal; Fig. 13-9).

The needle is advanced gently and, as with all types of paravertebral block, loss of resistance to air and the motor response—quadriceps muscle twitches in this instance—appear simultaneously. The nerve stimulator output is turned down and clear, brisk twitches should still be present at 0.3 to 0.5 mA.

It is important not to inject normal saline or local anesthetic agent through the needle at this stage because this will make stimulating catheter placement impossible or very difficult. The notion of "opening up the space" with saline for easier catheter passage is not based on scientific fact. In living tissue this practice causes edema, which makes further nerve stimulation through the catheter difficult or impossible. If the anesthesiologist believes that it is important to "open up the space," it should be done with 5% dextrose in water, which does not

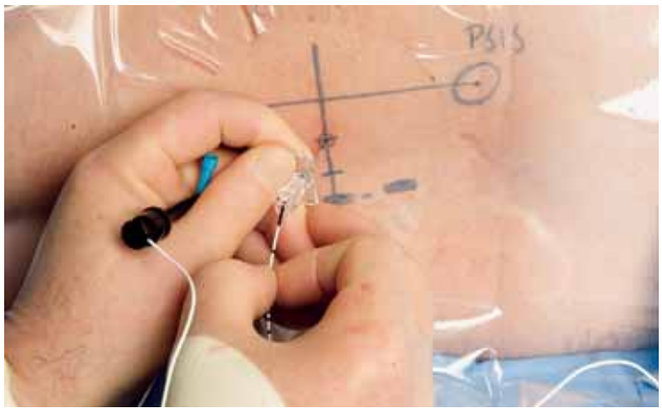

FIGURE 13-10 Once contact with the lumbar plexus is made, indicated by an ipsilateral quadriceps motor response, the nerve stimulator is attached to the proximal end of the stimulating catheter, which is advanced through the needle. If the motor response weakens or disappears during catheter advancement, the catheter is retracted carefully to within the needle shaft, the needle manipulated slightly—in this case turned 45 degrees counterclockwise—and the catheter advanced again.

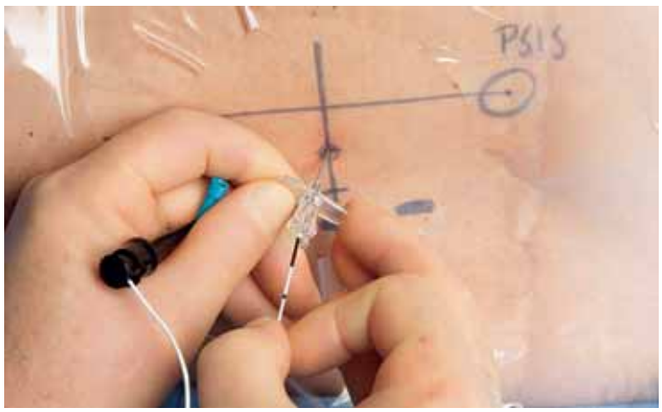

FIGURE 13-11 The special marking on the catheter indicates that the catheter has not yet protruded beyond the needle tip, and the needle can be manipulated safely.

conduct electricity and hence will not abolish the stimulated motor response.

The nerve stimulator is now attached to the proximal end of the stimulating catheter and the catheter tip placed in the needle shaft (Fig. 13-10). Notice the special mark on the catheter, which indicates that the tip of the catheter is now situated at the tip of the needle.The catheter is advanced beyond the tip of the needle and the motor response should remain unchanged during catheter advancement. If, however, the motor response changes or the twitches stop, it simply means that the catheter is advanced away from the nerves, possibly into the psoas muscle or even intra-abdominally.

Carefully withdraw the catheter tip to within the needle shaft, make a slight adjustment to the needle, such as turning it a quarter-turn clockwise or counterclockwise, or advancing or withdrawing it slightly, and advance the catheter again (Fig. 13-11). Repeat this maneuver until brisk motor twitches in the quadriceps muscles are observed during catheter advancement. The needle should never be manipulated if the broad black mark on the catheter is not completely visible, which indicates that the catheter is fully inside the needle shaft. Care should also be taken not to turn the bevel of the needle medially toward the epidural space; this may lead to epidural catheter placement.

Advance the catheter 3 to 5 cm (Fig. 13-12). The motor response should remain unchanged during catheter advancement.

The needle is now removed without disturbing the catheter (Fig. 13-13).

The catheter can be tunneled subcutaneously by using a dedicated tunneling device or by inserting the inner stylet of the needle 1 to 2 cm from the catheter exit site to the previously marked and anesthetized spot. This is not always necessary for a lumbar paravertebral block. The

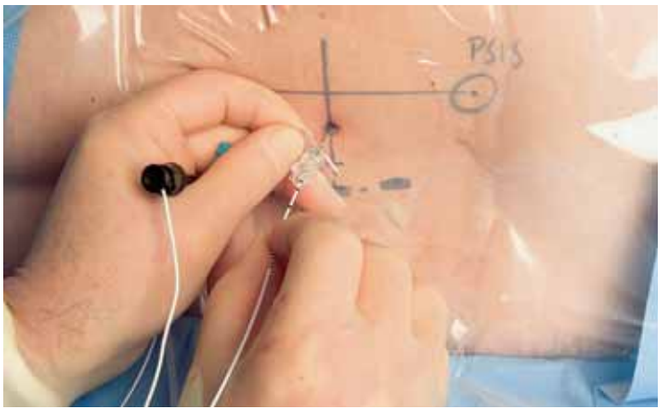

FIGURE 13-12 A continuous quadriceps motor response during catheter advancement indicates that the catheter is situated on the roots of the lumbar plexus. The catheter is advanced 3 to 5 cm.

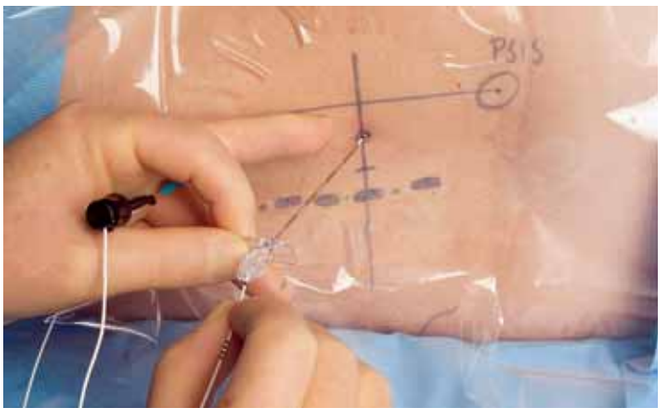

FIGURE 13-13 The needle is removed without disturbing the catheter.

tunneling technique is similar to that demonstrated previously (see Chapter 12).

Clip the Luer lock connecting device to the catheter and the nerve stimulator to the connecting device. Turn the nerve stimulator output up until a brisk motor response can just be seen.

With brisk quadriceps muscle twitching observed, inject a test dose of 2 mL lidocaine 2% in 1/200,000 epinephrine through the catheter. Notice that the motor response stops immediately on injection of the normal saline. This constitutes a positive Raj test, which gives final assurance that the primary and secondary block will be successful. Bilateral numbness in the legs or buttocks indicates intrathecal catheter placement, and tachycardia indicates intravascular injection.

The catheter and connecting device are attached to the fixation device, which is applied to a convenient position on the patient's flank or other convenient place. The catheter and exit wounds are covered with a transparent dressing to facilitate daily inspection of the site.

The catheter is removed when the patient no longer needs the continuous nerve block and full motor and sensory function has returned to the limb (see Chapter 12).

Local Anesthetic Agent Choice

Almost all local anesthetic agents in various concentrations, volumes, and combinations have been used successfully for this block. The author's choice is to use 20 to 40 mL of ropivacaine 0.5% to 0.75% as an initial bolus. This is followed by a continuous infusion of 5 to 10 mL/hour of ropivacaine 0.2% and patient-controlled regional anesthesia boluses of 5 to 10 mL of ropivacaine 0.2%. Relatively large volumes of local anesthetic agent are usually required for psoas compartment block. It is likely that use of a stimulating catheter placed next to the

lumbar plexus roots may permit injection of smaller volumes, but this notion has not yet been substantiated by research.

(See continuous lumbar paravertebral block movie on DVD.)

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