Local anesthetics block nerve impulses caused by painful stimuli, which makes them effective analgesics. Regional and peripheral blocks are versatile and can be applied to most surgical and dental procedures. The objective of this article is to provide practical details that allow a clinician to implement these blocks immediately after assembling the necessary supplies.

DISTAL EXTREMITY BLOCKS
Indications for local anesthesia of the distal limb are listed in Table 1.

Common distal extremity blocks include:
1. Intravenous regional anesthesia (IVRA)
2. Metacarpal/metatarsal ring block
3. Brachial plexus block

This article discusses IVRA and ring blocks; see Table 2 for a comparison of their benefits. Although with practice RUMM blocks become easy, the latter 2 blocks—brachial plexus and proximal RUMM blocks—are used with greater success if a peripheral nerve locator is used. They require advanced technical skills, and are best learned in a wet laboratory setting before being applied in practice; instruction regarding their use is beyond the scope of this article.

TABLE 1. Indications for Local Anesthesia of the Distal Limb

| Biopsy | Mass removal |
| Carpal and tarsal arthrodesis | Onychectomy (amputation of distal phalanx) |
| Foreign-body removal | Ostectomy/osteotomy of distal radius/ulna |
| Fracture repair | Toe amputation |

TABLE 2. Comparison of Benefits: IVRA & Ring Blocks

| Efficacy | IVRA | Ring Blocks |
| More effective than ring block for major procedures | Less effective than IVRA for major procedures |
| Location | Ideal for forelimb, distal to elbow | Forelimb, distal to carpus |
| Hindlimb, distal to tarsus |
| Medication | Lidocaine | Bupivacaine, lidocaine, or mepivacaine |
| Duration | Analgesia persists approximately 20 min after tourniquet release | Dependent on duration of action of local anesthetic administered |
| Limitations | Restricted to procedures < 90 min due to tourniquet use | |
| Additional benefits | Reduced blood at surgical site | Minimal supplies |
| Quick to perform |

INTRAVENTOUS REGIONAL ANESTHESIA
IVRA is a locoregional analgesic technique, which some may know as the Bier block, named for the physician who first described this technique nearly a century ago.

Description
IVRA provides reliable, effective regional analgesia to facilitate fracture repair, toe amputation, and foreign body or mass removal, all under conditions of minimal blood loss. In my experience, it is most easily applied to the forelimb; however, this technique can be used in both forelimbs and hindlimbs of dogs and cats.
**Technique Overview**
IVRA is a relatively simple, elegant technique that involves using the patient’s venous system to distribute local anesthetic medication. Essentially, the technique involves:
- Compressing the blood out of the distal limb
- Occluding arterial in-flow with a tourniquet
- Filling the venous system with an appropriate dose and volume of lidocaine.

The tourniquet allows the local anesthetic to remain in situ, with diffusion into the superficial and deep tissues and minimal leakage into systemic circulation.

**Sedation/Anesthesia**
IVRA is typically combined with general anesthesia and reduces inhalant requirements. For minor procedures, such as pad biopsy and foreign body removal, it may be possible to use this technique in sedated animals.

**Step-by-Step Approach to IVRA**
This patient has a malignancy affecting digit V, which requires toe amputation.

1. **Clip hair as indicated for catheter and surgery. Using sterile technique, place a small-gauge IV catheter in the most distal vessel possible.**
   - Cap the catheter and secure with tape. Some advocate directing the catheter tip distally, but I place catheters for IVRA using standard proximal tip orientation.

2. **Identify an arterial pulse distal to anticipated tourniquet location (eg, palmar artery). Later (Step 5, page 68), absence of a pulse will help verify that the tourniquet is occluding arterial and venous blood as intended.**

3. **Exsanguinate the distal limb by tightly wrapping self-adhesive elastic bandage material from the toes (distal) toward the elbow/tarsus (proximal), covering the catheter as you go (A). For large dogs, it may be helpful to wrap the leg a second time, starting again at the toes and wrapping proximally (B).**

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**IVRA: Materials & Medications**

**MATERIALS**
- Small (20 or 22) gauge catheter and cap
- Self-adhesive elastic bandage material
- Tourniquet: pneumatic (preferred) or nonpneumatic

**MEDICATIONS**
- Lidocaine
  - Dose, 3 mg/kg max, for dogs/cats
  - Volume of 0.5% lidocaine: 0.6 mL/kg
  - Do not use bupivacaine

**Notes**
- A pneumatic tourniquet is a blood pressure cuff that can be inflated with a sphygmomanometer, allowing pressure to be maintained.
- **Important:** Lidocaine solution must be labeled for IV administration and contain no additives; lidocaine in multidose vials designed for SC infiltration may contain a preservative and should never be injected IV.
- Dilute 2% lidocaine 1:4 with isotonic crystalloid fluids to create 0.5% lidocaine solution (eg, 1 mL 2% lidocaine plus 3 mL of 0.9% NaCl)
- If the tourniquet is released rapidly or prematurely, a bolus of more cardiotoxic bupivacaine may enter the systemic bloodstream.
Apply a tourniquet just proximal to the top of the bandage, and note time of tourniquet application.

- **Pneumatic tourniquet (recommended):** Inflate cuff pressure to 50 to 100 mm Hg higher than the patient’s systolic arterial pressure; do *not* exceed 400 mm Hg.
- **Nonpneumatic (elastic band) tourniquet:** Consider placing a protective layer between the skin and band of tourniquet.

Once the tourniquet is applied, remove the bandage and verify that the peripheral pulse is *absent*; do *not* proceed if an arterial pulse is present. If pulsatile blood is detected distal to the tourniquet, repeat steps 3 and 4. In the figure, the palmar artery is being used to verify absence of an arterial pulse.

**Surgical Insight:** Pneumatic tourniquets are recommended because (1) the pressure is distributed over the wide surface of the cuff and (2) tourniquet pressure can be monitored.

Inject lidocaine slowly over 1 to 3 minutes (see IVRA: Materials & Medications for details on lidocaine dose and preparation); then remove the catheter.

**Prep for and perform the procedure.**

- During the procedure, monitor and maintain tourniquet pressure. *Limit duration of tourniquet application to 90 minutes or less.*

Slowly and gradually release the tourniquet over a period of 2 to 4 minutes.
LOCAL ANESTHESIA FOR THE DISTAL EXTREMITY

Surgical Insight: The skin is often tightly adhered to the distal extremity, making injection challenging. Lift up the skin and slide the needle under it to help facilitate injection in this area.

RING BLOCKS: Medication Choices & Safety Measures

Choice of medication depends on desired duration of nerve blockade.
- For long duration analgesia, bupivacaine is recommended because lidocaine and mepivacaine are effective only for shorter periods of time.
- Onset and efficacy of blockade depend on (1) proximity to the nerves and (2) volume and concentration of medication (larger volume/higher concentration are associated with faster onset).
- Risk for inadvertent IV administration is minimal, particularly if the anesthetist aspirates before each injection; thus, the local anesthetics listed are appropriate for ring blocks in cats and dogs.

To ensure safe administration of medication:
- Calculate maximum total dose and label syringes, to prevent toxic adverse effects should inadvertent IV administration of the medication occur.
- Draw medications into syringes on the day of the procedure to prevent local anesthetics from adhering to plastic in the syringe.

Step-by-Step Approach to Ring Blocks

1. Perform SC injection of medication just proximal to the carpus in the forelimb (A) or at the level of the tarsus in the hindlimb (B). Before injecting, aspirate to avoid inadvertent IV administration. Inject as the needle is withdrawn to deposit a line of medication that is perpendicular to the long axis of the limb.

Ring Blocks: Materials & Medications

<table>
<thead>
<tr>
<th>MATERIALS</th>
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<td>• Small (25 or 27) gauge needles&lt;br&gt;• Syringes</td>
<td>Bupivacaine&lt;br&gt; Lidoceaine&lt;br&gt; Mepivacaine</td>
<td>Up to 2 mg/kg (dogs and cats)&lt;br&gt; Up to 8 mg/kg (dogs)&lt;br&gt; Up to 6 mg/kg (cats)&lt;br&gt; 5 mg/kg (dogs and cats)</td>
<td>4 to 12 H&lt;br&gt; 1 to 2 H&lt;br&gt; 2 to 4 H</td>
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Notes
- a. See Ring Blocks: Medication Choices & Safety Measures.
- b. Total dose is distributed SC between the multiple injection sites.
- c. Doses are not for use with the IVRA technique.

Sedation/Anesthesia
In sedated animals, consider adding sodium bicarbonate to the local anesthetic medication to minimize the sting associated with SC administration (1 part sodium bicarbonate to 9 parts local anesthetic). In patients under general anesthesia, I do not add bicarbonate to the blocks.

Technique Overview
To create a ring of anesthetic that blocks superficial nerves, local anesthetic is delivered via SC injection in lines over the dorsum and ventrum of the distal limb.
- On the forelimb, injection sites are just proximal to the carpus.
- On the hindlimb, injection sites are on the dorsal and plantar surfaces, at the level of the tarsometatarsal joint.

Description
For the forelimbs, the goal is desensitization of the dorsal and palmar branches of the ulnar nerve, the superficial branches of the radial nerve, and the median nerve. For the hindlimbs, the goal is desensitization of the superficial and deep peroneal nerve and the tibial nerve and/or lateral and plantar nerves.

Metacarpal/Metatarsal Ring Blocks
The ring block is another simple analgesic technique used for the paw and metacarpal/metatarsal region.

Step-by-Step Approach to Ring Blocks

1. Perform SC injection of medication just proximal to the carpus in the forelimb (A) or at the level of the tarsus in the hindlimb (B). Before injecting, aspirate to avoid inadvertent IV administration. Inject as the needle is withdrawn to deposit a line of medication that is perpendicular to the long axis of the limb.

Surgical Insight: The skin is often tightly adhered to the distal extremity, making injection challenging. Lift up the skin and slide the needle under it to help facilitate injection in this area.

Ring Blocks: Materials & Medications

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Notes
- a. See Ring Blocks: Medication Choices & Safety Measures.
- b. Total dose is distributed SC between the multiple injection sites.
- c. Doses are not for use with the IVRA technique.
Repeat SC needle insertion, aspiration of the syringe, and medication injection to create a circumferential ring of local anesthetic around the limb. The circumferential SC injections shown in the figures demonstrate local anesthetic blockade of superficial nerves in the forelimb and hindlimb of a cat.

**POSTOPERATIVE ANALGESIA**

Local anesthetic techniques, such as IVRA and ring blocks, should be incorporated as part of a multimodal approach to minimizing perioperative pain.

For IVRA, while lidocaine provides excellent in situ anesthesia and analgesia, once the tourniquet is released, the lidocaine’s effect diminishes after approximately 20 minutes. Therefore, plan to provide postoperative analgesia tailored to the patient’s anticipated pain.

Duration of local analgesia conferred by ring blocks is dependent upon the local anesthetic used (ie, bupivacaine confers longer duration analgesia). Additional postoperative analgesia benefits the patient, in anticipation of pain extending beyond the duration of the local block.

**COMPLICATIONS**

Visit tvpjournal.com/resources.asp#resources to find:

- **Table 3. Minimizing Risks Associated with IVRA and Ring Blocks**
- **Local Anesthetic Calculation Cheat Sheet**, which assists with calculating maximum doses of bupivacaine 0.5% solution.

### TABLE 3. Minimizing Risks Associated with IVRA & Ring Blocks

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<th>POTENTIAL ADVERSE EFFECT</th>
<th>IVRA</th>
<th>RING BLOCKS</th>
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| Tissue or nerve damage    | • Limit tourniquet duration to < 90 min  
• Monitor tourniquet pressure | • Ensure careful technique  
• Use new, small-gauge needles  
• Do not inject if resistance is met | |
| Local anesthetic overdose | • Use lidocaine  
• Do not use bupivacaine  
• Calculate max dose for each patient | • Calculate max dose for each patient  
• Use dose calculation cheat sheet  
• Always aspirate syringe before injection  
• Label syringes | |
| Inadequate analgesia during procedure | • Administer IV analgesic (eg, fentanyl, hydromorphone) | • Administer IV analgesic (eg, fentanyl, hydromorphone) |
| Venous engorgement        | • Ensure absence of peripheral arterial pulse following tourniquet application | n/a |
| Tourniquet-related pain   | • If patient shows signs of tourniquet pain—increased heart rate, respiratory rate, and blood pressure unresponsive to analgesic administration—place second tourniquet distal to initial tourniquet; then release proximal tourniquet after second is inflated. | n/a |

**IN SUMMARY**

Local anesthesia techniques are important analgesic “tools” because:

- Patients benefit from effective, preventive, site-specific analgesia
- Balanced anesthetic protocols allow reduced reliance on inhalants.

After reviewing the step-by-step instructions in this article, you should be able to incorporate IVRA and ring blocks into your anesthesia and pain management protocols with confidence.

**Suggested Reading**


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