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The occasional Bier block (intravenous regional anesthesia)

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ABier block is a simple anesthetic technique for surgery of the arms and legs and for fracture reduction. It avoids the need for a general anesthetic or heavy sedation and is specially useful in patients who have a full stomach. It can be done safely even if done infrequently as long as the proper steps are followed.

Under an occluding tourniquet, local anesthetic is injected into a vein distal to the site of the surgery or fracture. The local anesthetic will diffuse from the vein into the tissue surrounding the peripheral nerves and will produce surgical anesthesia in about 10 minutes. The following is the technique that I use.

- Step 1. Insert an intravenous (IV) catheter in the unaffected arm to provide for emergency IV access. Apply a blood pressure cuff, saturation monitor and cardiac monitor (Fig. 1).



Fig. 1

- Step 2. Insert a 22-gauge IV catheter into the affected extremity, as distally as possible, and cap it with a heplock. Flush with saline.
- Step 3. Apply a few layers of cast padding and then apply a pneumatic tourniquet proximally on the limb, but do not inflate it. Check distal pulses.
- Step 4. Elevate the arm and exsanguinate it with an elastic (Esmarch) bandage. Inflate the

tourniquet to 300 mm Hg or 2.5 times the systolic blood pressure. Recheck pulses to ensure that they are absent (Fig. 2).



Fig. 2

- Step 5. Inject local anesthetic over a period of 90 seconds. More rapid injection may cause IV pressure to exceed cuff pressure. The limb will discolour and develop a mottled appearance, and the patient may complain of burning sensation or "pins and needles." Surgical anesthesia is usually achieved about 10 minutes later, but test for anesthesia before beginning any procedure. Keep the tourniquet inflated for the duration of the surgical procedure since the duration of anesthesia is minimal after tourniquet release (Fig. 3).



Fig. 3

- Step 6 (after the procedure). After injecting the anesthetic, keep the tourniquet on for a minimum of 20 minutes. Once 40 minutes has passed all the local anesthetic is fixed in the tissue and the tourniquet can be released. However, between 20 and 40 minutes a significant amount of local anesthetic is still unbound. Therefore, I release the cuff in graduated steps. Deflate the cuff for 10 seconds and then reinflate for 1 minute. Repeat this two more times. If the patient complains of numbness of the tongue, lightheadness, visual disturbance or a roaring sound in the ears (all signs of local anesthetic toxicity), inflate the tourniquet until the symptoms resolve and then repeat these steps again.

Pneumatic tourniquets are available as either single or double cuffs. A tourniquet can become uncomfortable after about 30 minutes. The advantage of the double cuff is to avoid this tourniquet pain. Test both cuffs before starting (Fig. 4). Then inflate the proximal cuff to allow the anesthetic to infiltrate under the distal cuff. If there is tourniquet pain, inflate the distal cuff and then release the proximal cuff. (It is important to follow these steps as you need one cuff inflated at all times to prevent the release of local anesthetic into the systemic circulation.) A single cuff can be used as well. It is wider than the individual cuffs of the double tourniquet, therefore it reduces the risk of the anesthetic agent leaking. It should be used only for short procedures because of tourniquet pain.

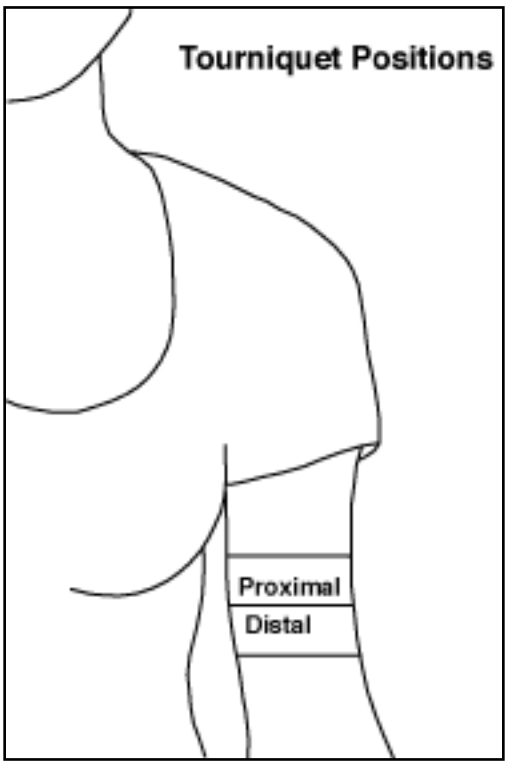


Fig. 4

If you are unfortunate enough to have a cuff failure or leakage of a large amount of lidocaine into the systemic circulation, it is important to know what to do to treat the toxic side effects. Treatment of seizures can usually be accomplished with oxygen, and Valium or Versed. Succinylcholine may be needed if the patient requires intubation. For more severe toxic reactions leading to cardiovascular collapse, epinephrine should be used for hypotension, atropine for a decreased heart rate and defibrillation for ventricular arrhythmias. If the arrhythmia recurs then the use of bretylium as an antiarrhythmic agent should be considered.

The only type of local anesthetic agent that I use is preservative-free lidocaine. I favour use the 2% (20 mg/mL) solution that is used for epidural anesthetics (Fig. 5), but any preservative-free solution of lidocaine is appropriate. The toxic effects of lidocaine range from numbness of the tongue, lightheadedness, auditory disturbance and muscle twitching at lower doses to convulsions, coma, respiratory arrest and cardiovascular collapse at progressively higher blood concentrations. The cardiovascular collapse can be difficult to reverse, but it is possible with lidocaine. Another common local anesthetic, Marcaine (bupivacaine), is much more cardiotoxic and should not be used for IV regional anesthesia.


Fig. 5

When I mix up my lidocaine solution, I aim for a total dose of 3 to 4 mg/kg. This is diluted to a total volume of 30 to 50 mL for an upper extremity and 80 to 100 mL for a lower extremity. I believe a better block is obtained by maintaining a minimum concentration of 0.5% for arms. However, due to the large volume necessary for legs, concentrations may be as low as 0.25%. No vasoconstrictors should be used. For my 2% lidocaine solution in a patient weighing 80 kg this solution would be mixed as follows: total dose (80 kg * 3 mg/kg) = 240 mg or 12 mL of the 2% (20 mg/mL) solution. Dilute to 40 mL with normal saline intravenous solution (i.e., approximate concentration 0.6%).

If the Bier block is being done on the lower extremity, dilute to 100 mL to give an approximate concentration of 0.24%.

Most of you will be using this technique for distal fractures of the extremities. I apply the same technique, including exsanguination of the arm, with an elastic bandage. This can be somewhat uncomfortable over the fracture site and often I will give a little intravenous narcotic and wrap less tightly over the fracture site. Exsanguination is an important part of this technique so that the local anesthetic solution is not diluted further, making it less effective. In patients with hairy arms, I will often put a pillow case over the arm before exsanguinating as the elastic bandage can be quite uncomfortable when it pulls on hair.

Using a careful step-by-step technique, a Bier block can be an effective and safe method of providing limb anesthesia in the Emergency Department.

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