CASE STUDY

Chapter 6: Pharmacology of Local Anesthetics

A 70 kg otherwise healthy male patient is undergoing bilateral inguinal herniorrhaphy under local anesthesia administered by the surgeon and intravenous sedation you are giving. The surgeon is planning to infiltrate the skin with lidocaine prior to skin incision.

The patient reports a history of an “allergic reaction” to Novocain (procaine) which she received during a dental procedure. Is it safe to administer the planned local anesthetics?

Most dental reactions are not true allergies, but either unpleasant sensations from the intended local anesthetic effect (numb tongue and lips that feel swollen), or tachycardia from absorbed epinephrine. Even if the patient were truly allergic to procaine, it is exceedingly unlikely that he would also be allergic to lidocaine or bupivacaine, which are amide type local anesthetics, whereas procaine is an ester type drug.

The surgeon is planning to use 2% lidocaine with epinephrine for initial infiltration, followed by bupivacaine, 0.5% for longer lasting analgesia. How can she enhance the onset of the block?

Lidocaine with epinephrine is prepared with very low pH in order to stabilize the local anesthetic and the epinephrine, which is unstable at neutral or basic pH. At pH 4-5, that of commercial epinephrine containing local anesthetic solutions, only a tiny fraction will be in the uncharged, base form, which can permeate nerve cell membranes. The addition of bicarbonate, 1 mL per 10 mL of local anesthetic solution, will raise the pH and the unionized fraction, speeding the onset. This treatment also significantly reduces the pain of injection, an additional benefit.

After infiltration with lidocaine, the surgeon is prepared to infiltrate further with bupivacaine and perform some deep nerve blocks to enhance analgesia. She asks you how much of a 0.5% solution she can safely use. How will you respond?

The limit for a single subcutaneous infiltration is approximately 2.5 mg/kg. A 0.5% solution of bupivacaine contains 5 mg/mL, so the surgeon can use 175 mg, or 35 mL. This is an estimate based on average rates of absorption, and in practice actual toxicity often does not occur even at doses higher than this. Conversely, this limit assumes no drug is injected intravascularly.

The surgeon begins infiltration with bupivacaine. After about 15 mL have been injected, the patient complains of lightheadedness and then his eyes roll back and he loses consciousness. The patient develops tonic-clonic movements of his extremities. How will you respond?
Seizures associated with local anesthetic toxicity are treated symptomatically. Tell the surgeon to immediately stop injecting to limit further toxicity. You should administer supplemental oxygen and maintain the airway. If the patient is not breathing, you should administer positive pressure ventilation by mask. Intubation is not always necessary, as seizures associated with local anesthetic are often short lived. A small dose of midazolam (a benzodiazepine) or thiopental will help terminate the seizure.

Despite your initial efforts, the patient remains unresponsive. The electrocardiogram shows ventricular tachycardia. You cannot palpate a pulse. How will you proceed?

Your patient has developed a much more severe form of toxicity, cardiovascular compromise. This syndrome is associated with potent lipophilic anesthetics such as bupivacaine (had the surgeon only been using lidocaine, this complication would have been less likely). Immediate treatment is supportive: administer CPR and begin ACLS treatment for ventricular fibrillation (epinephrine or vasopressin, defibrillation). Unfortunately, bupivacaine-associated cardiovascular toxicity is often very difficult to reverse. Supportive treatment may require cardiopulmonary bypass until the local anesthetic can be cleared. A still experimental but very promising treatment is infusion of a lipid emulsion solution like that used in total parenteral nutrition (Intralipid). Current recommendation is to use 1.5-2 mL/kg of a 20% solution given as IV bolus, followed by an infusion if successful. In animals and a few human case reports, this treatment has proven dramatically successful. Importantly, even though propofol is packaged in a lipid emulsion, it should not be substituted because the vasodilation and cardiac depression associated with a large dose of propofol may counteract the effects of the lipid.