In recent years, peripheral nerve block has become more widely used in Europe and the United States. Although single blocks are very effective for management of postoperative pain, their effectiveness is limited by their duration of effect, which does not exceed 14-18 hours. This is a major limitation as most upper and lower extremity procedures require more than 24 hours of postoperative pain control.

The first continuous nerve block was described in 1946 by Paul Ansbro [1] who performed repeated supraclavicular injections of the brachial plexus to prolong the duration of anesthesia in patients undergoing upper extremity surgery.

More than 30 years later Selander et al. [2] published a study on 137 patients, in whom an axillary catheter was placed for hand surgery. Tuominen et al. in 1987 [3] first reported on the use of continuous interscalene infusion with 0.25% bupivacaine at a rate of 0.25 mg/kg/hr for 24 hours for postoperative pain management after shoulder surgery. Although this technique was more effective than a single injection of 1.25 mg/kg of 0.5% bupivacaine, it was also associated with local anesthetic accumulation (plasma levels that increased from 0.7 ug/ml to 1.1 ug/ml) and symptoms of local anesthetic toxicity such as dizziness and confusion. The same group also evaluated the effects of a continuous interscalene block on the ventilatory function demonstrating paresis of the ipsilateral hemidiaphragm [4]. In 1997, Borgeat et al. [5] introduced patient controlled interscalene analgesia with 0.15% bupivacaine using a basal infusion rate of 5 ml/hr and bolus of 3 to 4 ml with a lock-out period of 20 min. This technique has proven to be safe and effective without symptoms of toxicity and superior to PCA morphine.

With the development of new technologies, the use of patient controlled infusion pumps has now become the gold standard, being associated with similarly effective analgesia as with a continuous infusion and much less requirement of local anesthetics both for upper and lower extremity blocks [6,7,8].

Probably because of the extensive use of spinal and epidural techniques for lower extremity anesthesia and analgesia, it was not until 1978 that Brands and Callanan [9] reported on the first lumbar plexus placement of an “epidural” catheter. In the following years several authors reported on the safe and effective use of continuous peripheral nerve blocks of the femoral [10,11], sciatic [12,13] and lumbar plexus [14] for knee, hip and foot procedures in both elective and trauma patients.

Singelyn et al. [10] compared the effects of continuous femoral infusions to PCA morphine and epidural analgesia for acute postoperative pain management in patients who underwent total knee replacement, and demonstrated that the use of continuous femoral infusions of a mixture of 0.25% bupivacaine, sufentanil and clonidine for 48 hours resulted in a 60% reduction of postoperative morphine consumption, and better immediate functional recovery as indicated by a greater range of passive motion using a continuous passive motion machine.

In 1999 Capdevila et al. [15] studied the postoperative outcome using either a continuous femoral block, epidural analgesia or morphine PCA after major knee surgery. The first two techniques were performed using a solution of 1% lidocaine, 0.03 mg/ml morphine and 2 microg/ml clonidine administered at 0.1 ml x kg^{-1} x h^{-1}. The continuous epidural infusion and continuous femoral block groups showed significantly lower VAS scores at rest and during continuous passive motion, better early postoperative knee mobilization and shorter durations of stay in the rehabilitation center compared with the PCA morphine group. Side effects were encountered less frequently in the continuous femoral block group.

In 2001, Chelly et al. [11] confirmed that continuous femoral infusions of 0.2% ropivacaine for 48 hours in patients undergoing total knee replacement provided better postoperative pain control than epidural analgesia or PCA morphine. They also confirmed that, using this technique, morphine requirement was greatly reduced and that immediate functional recovery was accelerated. Furthermore, they reported that the use of continuous femoral infusions was also associated with a 20% reduction of hospital length of stay and a 60% reduction of total postoperative blood loss as well as an 80% reduction of serious complications following surgery.
In 2001 Cuvillon et al. [16] studied the adverse events and the bacterial colonization of 208 femoral catheters. After 48 hours, each catheter was removed and semiquantitative bacteriological cultures were performed on each distal catheter tip. Positive cultures were seen in 120 catheters (57%) and staphylococcus epidermidis was the most frequent organism found. Three patients presented with increased temperatures and bacteremia - culture of the femoral catheter and blood were positive for Staphylococcus epidermidis. Bacteremia and fever disappeared without any antibiotic therapy when those three catheters were removed; none of the 120 colonized catheters had long-term infectious complications.

Capdevilla et al. [17] studied the location of continuous femoral nerve block catheters for postoperative pain treatment after lower limb orthopedic surgery. The tip of the catheter reached the lumbar plexus in 23%; in this group of patients, visual analog scale pain scores on movement were significantly lower. In 33 - 37% of the patients, the tip of the catheter was deep to the medial or lateral part of the fascia iliaca leading to a greater likelihood of block failure.

The main agent used for continuous peripheral nerve blocks reported in the literature is bupivacaine at different concentrations. In 2001, Borgeat et al. [18] demonstrated that the use of patient controlled continuous interscalene infusion of 0.2% ropivacaine produced selective sensory block in patients undergoing major shoulder surgery. They compared 0.2% ropivacaine and 0.15% bupivacaine (to account for the difference in potency between ropivacaine and bupivacaine) infused via an interscalene catheter on the relative intensity of sensory and motor block after major open shoulder surgery. Strength in the hand was measured using an hand grip device. With this study design the authors clearly demonstrated that bupivacaine and ropivacaine provided similar postoperative pain control, but 0.2% ropivacaine preserved motor function to greater extent. This is the strongest clinical evidence that ropivacaine is more suitable than bupivacaine for continuous perineural infusions of local anesthetics for postoperative pain management in orthopedics, because of the preferential sensory block that ropivacaine produces at the concentration studied. Indeed, in most cases the preferential sensory blocks may facilitate functional recovery of orthopedic patients by allowing immediate postoperative physical therapy.

Recently the pure left isomer of bupivacaine has been introduced as a new alternative of long-acting agents. We recently compared levobupivacaine with ropivacaine for continuous interscalene brachial plexus block after open shoulder surgery [19] and demonstrated that 30 ml of levobupivacaine 0.5% induces an interscalene brachial plexus anesthesia of similar onset and intensity as that produced by the same volume and concentration of ropivacaine. Postoperative interscalene analgesia with 0.125% levobupivacaine resulted in similar pain relief and recovery of motor function with a lesser volume of local anesthetic than with 0.2% ropivacaine.

Interestingly, while there is a move toward very short-acting agents in all branches of anaesthesia (such as propofol or remifentanil, continuously infused), physicians mostly prefer the use of long-acting agents, like bupivacaine, ropivacaine, or levobupivacaine, for acute postoperative pain management. Lidocaine has a shorter duration of action and is less toxic than long acting agents, potentially representing an interesting alternative. Capdevilla et al. [16] demonstrated adequate postoperative analgesia by using 1% lidocaine for continuous femoral nerve block. In a prospective, randomized, double-blinded study we recently compared postoperative analgesia and recovery of motor function during infusion of either 1% lidocaine or 0.2% ropivacaine for continuous interscalene nerve block [20]. The onset time for surgical anesthesia was much shorter with 1.5% lidocaine than with 0.5% ropivacaine. Postoperative pain intensity was greater with lidocaine for the first 8 hours of infusion, and the ratio between boluses given and asked to the PCA pump was 0.5 (0.13 – 0.7) with lidocaine and 0.7 (0.4 – 1.0) with ropivacaine (p = 0.005). Rescue IV tramadol was used more frequently with lidocaine (84%) than with ropivacaine (46%) (p = 0.05). Interestingly, after 16 and 24 hours of observation, a larger proportion of patients receiving ropivacaine had complete regression of motor block (70% and 95%) than those receiving lidocaine (50% and 55%) (p = 0.05 and p = 0.013, respectively), thus suggesting that, although 1% lidocaine can be effectively used for patient-controlled interscalene analgesia, 0.2% ropivacaine provides a better preservation of motor function.

Several authors reported about positive effects of using additives to the local anesthetic solution, such as clonidine, morphine or sufentanil. However, no randomized, double-blind studies have been reported on these points.
REFERENCES