Continuous peripheral nerve block in combat casualties receiving low-molecular weight heparin


Army Regional Anesthesia and Pain Management Initiative, Anesthesia and Operative Service, Walter Reed Army Medical Center, Washington, DC, USA

*Corresponding author: Walter Reed Army Medical Center, Building 2, Ward 44, Room 4418, 6900 Georgia Avenue, NW, Washington, DC 20307-5001, USA. E-mail: chester.buckenmaier@na.amedd.army.mil

Background. Continuous peripheral nerve block (CPNB) is an important therapeutic tool in the anaesthetic and analgesic management of combat casualties at Walter Reed Army Medical Center (WRAMC). We describe our experience using CPNB techniques in combat trauma patients treated with low-molecular weight heparin (LMWH). Guidelines used at our institution for managing CPNB catheters in patients being treated with LMWH are introduced.

Methods. From March 2003 to April 2005, 187 combat casualties treated by the WRAMC regional anaesthesia/acute pain section using CPNB were evaluated retrospectively by electronic chart review. Patient characteristic data, CPNB type, duration of CPNB, indication for LMWH [enoxaparin sodium injection (Lovenox®–Sanofi Aventis, Bridgewater, NJ, USA)], enoxaparin dose (mg) before and after catheter insertion and removal, time from CPNB placement and removal to enoxaparin dose, and complications were recorded.

Results. Median enoxaparin dose and time given before catheter insertion were 30 mg and 21 h, respectively. Median enoxaparin dose was also 30 mg given a median of 12 h after peripheral nerve catheter placement. Catheters remained in situ for a median of 8 days (range 1–33 days). Catheter specific complications were infrequent and identified in 7 (3.7%) patients (two catheter malfunction-kinking, catheter tip dislodgement in situ, two superficial catheter site infections and two catheter dislocations). There were no catheter-related bleeding complications evident in this study.

Conclusions. Information regarding the safety of CPNB in patients treated with LMWH for perioperative venous thromboembolism prevention is scarce. Our initial experience with CPNB and concurrent LMWH has not been complicated by catheter-related bleeding.

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Continuous peripheral nerve block (CPNB) is an increasingly common anaesthetic technique used for surgical anaesthesia and for prolonging postoperative analgesia. Paralleling the development of CPNB has been the advancement in perioperative venous thromboembolism prevention recommendations. Most notably, the development of low-molecular-weight heparin (LMWH) which has improved bioavailability and extended plasma half-life compared with standard unfractionated heparin. Additionally, LMWH has a lower incidence of heparin-induced thrombocytopenia. For these reasons LMWH has become a standard therapy for the prevention of deep vein thrombosis (DVT) and pulmonary embolism. Unfortunately, with the introduction of the first LMWH in the USA (enoxaparin sodium or Lovenox®) in 1993 there was a significant increase in the incidence of spinal haematoma following epidural or spinal regional anaesthesia. In an effort to improve the safety of neuraxial regional anaesthesia in the anticoagulated patient, practice guidelines were published through the American Society of Regional Anesthesia and Pain Medicine (ASRA) Consensus Conference on Neuraxial Anaesthesia and Anticoagulation in 1998. These recommendations were updated in 2003 following a second conference.
The ASRA Consensus Conference provided useful clinical guidelines for the use of neuraxial techniques in patients receiving concomitant LMWH. Noting the lack of investigational data, the Conference statement provided little direction for plexus and peripheral regional anaesthesia techniques in anticoagulated patients. Therefore, the Conference suggested that using guidelines for neuraxial anaesthesia in peripheral block patients ‘may be more restrictive than necessary.’

From the beginning of the War in Iraq in March 2003, CPNB has been identified as a viable and important technique for anaesthesia and long-term analgesia on the battlefield, throughout the evacuation process, and during rehabilitation in the USA. Walter Reed Army Medical Center (WRAMC) is one of the major tertiary military medical centres caring for returning wounded. This study describes our experience with CPNB techniques in combat trauma patients treated with LMWH at WRAMC. Additionally, we have included our own guidelines that we are developing for our institution concerning LMWH and CPNB.

Materials and methods

Following WRAMC Institutional Review Board review and approval, 187 combat casualty patients from March 2003 to April 2005 who were treated at our institution were included in the retrospective study. All CPNB catheters were placed by resident anaesthesiologists under the supervision of regional anaesthesia section staff anaesthesiologists. Catheters were placed using a Stimuplex® HNS-11 peripheral nerve stimulator with Contiplex® CPNB needles (B. Braun Medical Inc., Bethlehem, PA, USA). All block techniques were performed with standard monitoring in a regional anaesthesia section outside of the operating room. All patients were managed by the acute pain service with at least one daily patient visit and 24 h access to an anaesthesiologist during catheter infusions.

Patient characteristic data and CPNB data were entered and maintained in a database. Information in the database was collected from electronic medical records kept in accordance with institutional policy and clinical improvement programs. For the purpose of this study, patient characteristic data, CPNB type, duration of CPNB, indication for enoxaparin, enoxaparin dose (mg) before and after catheter insertion and removal, time from CPNB placement and removal to enoxaparin dose, and complications were recorded. The arithmetic mean value is presented with standard deviation [mean (sd)] as well as the lowest and highest related values (range). The range is also reported with the associated median value.

Results

Of the 187 patients studied, 177 (94.7%) were male. Median patient age was 25 yr (range 19–58). The primary regional anaesthesia event was single CPNB in 111 and double CPNB in 76 patients, amounting to over 3000 catheter days (Table 1). For most patients (134, 71.7%) venous thromboembolism prophylaxis was the primary indication for enoxaparin administration around the time of peripheral nerve catheter insertion. Median enoxaparin dose and time given before catheter insertion were 30 mg and 21 h, respectively. Median enoxaparin dose was also 30 mg, given a median of 12 h after CPNB placement. Catheters remained in situ for a median of 8 days (range 1–33 days). Similar median dose (30 mg) and dosing interval (11.1 h) were observed before catheter removal. Enoxaparin was continued at the same median dose at a median 8 h after primary peripheral nerve catheter withdrawal.

Thirty patients went on to have second regional anaesthetics (22 single and 8 double CPNB) with median enoxaparin dose and time before and after catheter placement 30 mg and 19 h, and 30 mg and 11 h, respectively. Catheters remained in place for a median of 8 days (range 2–38) representing over 700 total catheter days. Corresponding enoxaparin dose and times before and after secondary catheter removal were 30 mg and 10 h, and 30 mg and 8 h, respectively. Four patients had third CPNB catheter events. Collectively, 305 CPNB catheters were placed in 187 patients amounting to 3082 catheter days. Mean and median patient follow-up after last catheter removal was 57 and 26 days, respectively. Catheter-specific complications were infrequent and identified in 7 (3.7%) patients (two catheter malfunction-kinking, catheter tip dislodgement in situ, two superficial catheter site infections and two catheter dislocations). There was no catheter-related bleeding complication evident in this study.
Discussion

To our knowledge, this study provides the first patient data concerning the complication rates of CPNB in trauma patients receiving LMWH during their hospital course. Our Regional Anesthesia Section has adopted the Second ASRA Consensus Conference on Neuraxial Anesthesia and Anticoagulation guidelines to manage neuraxial anesthesia and analgesia in anticoagulated patients.

To date, as stated by these guidelines, ‘There are no investigations that examine the frequency and severity of hemorrhagic complications following plexus or peripheral block in anticoagulated patients.’ We have reviewed the initial data from our early patient population to identify complications that have occurred in patients receiving both CPNB and LMWH therapy. Of particular interest is the relatively long duration [10.3 (SD 6.8) days] that the CPNB catheters remained in situ without any significant bleeding complications as well as the shortened time interval between catheter placement and first postop dose of LMWH (12 h vs the recommended 24 h for twice daily dosing after operation, regardless of anaesthetic technique).

While this practice is in conflict with the 2003 ASRA Consensus recommendations, the WRAMC surgical staff decided on dosing LMWH 12 h after surgical procedures in the combat casualty patient population as a result of concerns for heightened risk of thromboembolism in these polytrauma patients and their frequent repeated operating room visits. This practice reality at WRAMC was the impetus for our policy development on peripheral nerve block and CPNB with concurrent LMWH therapy. Additionally, contrary to the ASRA guidelines for epidural catheters, which recommend removal of catheters if LMWH dosing is used twice daily (the most common dosing at WRAMC), we did not remove CPNB catheters under these clinical conditions. As stated by the 2003 ASRA Consensus, ‘...the associated risk following plexus and peripheral technique remains undefined.’ By reviewing these data, our aim is to begin defining the relationships and risks between CPNB and LMWH.

Undoubtedly, the most conservative approach is to apply the consensus statement’s anticoagulation and neuraxial anaesthesia parameters to peripheral nerve anaesthesia. This would require waiting 24 h postop before initiating the first dose of LMWH. It would also preclude the use of indwelling catheters in patients receiving a twice daily dosing of LMWH. In our institution, the severity of injury and demand for effective pain management coupled with the high risk for DVT in trauma patients placed us in a position where we needed long-term peripheral nerve catheters in patients receiving prophylactic or therapeutic enoxaparin.

Because of these two conflicting interests, we elected to use a more liberal policy regarding LMWH and CPNBs (Appendix A). This clinical decision was based in part, on the existence of an Acute Pain Service at our institution that provides twice daily visits to all CPNB patients and 24 h access to an anaesthesiologist should any problems with the catheter arise. The remainder of the decision was based on the fact that these catheters are not neuraxial, thus decreasing the potential for a catastrophic outcome from spinal or epidural haematoma.

Of note, lumbar plexus CPNB was performed 88 times despite concomitant use of LMWH with no apparent clinical consequences. All of the cases noted in the ASRA Consensus Conference related to major bleeding following a peripheral nerve block were associated with the psoas compartment or lumbar sympathetic block. Multiple case reports describe the delayed development of retroperitoneal haematoma following lumbar plexus single injection or CPNB when enoxaparin is used for postoperative thromboprophylaxis. For this reason, the lumbar plexus CPNB is managed more conservatively at our institution, as noted in Appendix A.

There are important limitations of these data cohort that should be emphasized. The study population was made up primarily of young, healthy male soldiers who had sustained battlefield multi-system trauma with attendant high risk for venous thromboembolism. These results may not necessarily translate to non-combat injured, those with less severe trauma, or a significantly older patient population with multiple co-morbidities that could influence the safety of CPNB and LMWH used in parallel. Furthermore, only 187 patients were included in this study. It has been estimated that the prevalence of spinal haematoma with LMWH use was 1 in 3000 continuous epidural anaesthetics though this is likely an underestimation. To avoid a Type II error, a considerably larger patient population would be needed to determine the true incidence of bleeding complications related to LMWH use with CPNB. Finally, it is apparent from Table 1 that our own institutional guidelines were violated, albeit infrequently, because of error or miscommunication. While these errors did not result in clinically significant consequences this should not be construed as a suggestion to shorten the time intervals for catheter placement and removal outlined in Appendix A.

Our experience with CPNB and concurrent LMWH used in multitrauma combat casualties has led us to develop guidelines for our institution’s Regional Anesthesia Section. We realize that our patient base is small, but we hope to continue collecting data in an effort to define true safety guidelines for peripheral nerve anaesthesia and anticoagulation therapy. Although we have yet to experience any bleeding complications, we remain concerned of the possibility and therefore monitor our patients closely. We look forward to the next ASRA Consensus which perhaps may offer separate guidelines for neuraxial vs peripheral regional techniques.
Appendix A
Enoxaparin (Lovenox®) anticoagulation guidelines for single injection peripheral nerve block and CPNB at WRAMC.

- Definitions:
  - Prophylactic enoxaparin: 30 mg twice daily or 40 mg once daily.
  - Therapeutic enoxaparin: 1 mg kg⁻¹ twice daily or 1.5 mg kg⁻¹ once daily.
  - CPNB: continuous peripheral nerve block (catheter).
  - Single injection peripheral nerve block (no catheter).

- Prophylactic enoxaparin:
  - Wait 10–12 h to place/pull catheter or administer single injection block.

- Therapeutic enoxaparin:
  - Do not place CPNB catheters until 24 h after last enoxaparin dose. Do not place lumbar plexus catheters if therapeutic enoxaparin will continue.
  - Single injection peripheral nerve blocks are administered at the discretion of the staff anaesthesiologist 12–24 h after the last enoxaparin dose.

- CPNB catheter is in place, enoxaparin increased from prophylactic to therapeutic dose:
  - Lumbar plexus catheter: recommend removal of the catheter 24 h after last enoxaparin dose.
  - Other catheters [including thoracic paravertebral CPNB (The thoracic paravertebral spaces are relatively avascular.): recommend continuation of CPNB therapy.
  - Consider adding neurological checks (motor function) to daily anaesthesia note for patients with catheter(s) on therapeutic enoxaparin.

- Catheter removal guidelines:
  - Prophylactic enoxaparin: remove the catheter 10–12 h after the last enoxaparin dose.
  - Therapeutic enoxaparin: remove the catheter ≥24 h after the last enoxaparin dose.
  - Hold the next enoxaparin dose until ≥2 h after pulling a CPNB catheter.

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