PECTORAL PLANE BLOCK IN CARDIAC DEVICE IMPLANTATION: CLINICAL AND PHARMACOKINETIC STUDIES

Perioperative pain remains one of the primary challenges in managing patients undergoing surgical interventions, which directly impacts quality of life, length of hospitalization, and long-term prognosis. Despite being considered a minimally invasive procedure, cardiac device implantation is associated with significant perioperative discomfort. Therefore, optimizing analgesic strategies is crucial for reducing complications and enhancing patient recovery. Recent studies suggest that the pectoral plane block (PECS) offers superior pain control compared to local lidocaine infiltration or systemic opioid-based analgesia.

This thesis explores the use of the PECS block to optimize postoperative analgesia in patients undergoing cardiac device implantation, with a focus on the pharmacokinetics of ropivacaine, a widely used local anesthetic. The study incorporates data from four investigations: validation of a bioanalytical method for ropivacaine quantification, a comparative clinical study on PECS block efficacy, an analysis of ropivacaine pharmacokinetics in plasma, and its tissue distribution in an animal model.

The first part of the thesis provides a theoretical framework on the mechanisms of perioperative pain, current analgesic strategies, and the evolution of regional anesthesia techniques. Ropivacaine is a preferred anesthetic for regional blocks due to its favorable safety and efficacy profile. This amide-type local anesthetic exhibits lower cardiotoxicity compared to bupivacaine, making it preferable for patients with cardiovascular conditions. Pharmacokinetic studies have demonstrated its optimal duration of action, and its administration via the PECS block ensures effective analgesia, reducing postoperative opioid requirements. Beyond its mechanisms of action, this study examines ropivacaine's impact on patient recovery, length of hospitalization, and overall quality of life post-procedure. It has been demonstrated that regional anesthesia positively impacts perioperative morbidity, reducing the incidence of respiratory and cardiovascular complications. Additionally, the PECS block helps mitigate the physiological stress response, promoting a faster and less traumatic recovery.

The first study presented in this thesis focused on the development and validation of a precise and efficient method for quantifying ropivacaine and its main metabolite, 3-OH-ropivacaine, using high-performance liquid chromatography coupled with mass spectrometry (LC-MS/MS).

The second study was a comparative clinical trial evaluating the efficacy of the PECS block versus local lidocaine infiltration in patients undergoing cardiac device implantation. Patients were divided into an experimental group (receiving the PECS block with ropivacaine) and a control group (receiving conventional analgesia). Postoperative assessments indicated a significant reduction in pain scores in the PECS group, as well as decreased opioid consumption. Moreover, patients who benefited from the PECS block reported superior perioperative comfort.

The third study focused on the pharmacokinetic analysis of ropivacaine, evaluating its tissue distribution and elimination from the body. The study demonstrated that the PECS block enables controlled anesthetic release, maintaining prolonged analgesic effects without increasing the risk of systemic toxicity. These findings support the ultrasound-guided use of the PECS block for safer and more effective administration.

The final study assessed the tissue distribution of ropivacaine and its metabolite in an animal model, highlighting adequate absorption in the thoracic region. This detailed analysis allows for dose optimization to ensure a balance between clinical efficacy and safety.

Through these contributions, this research supports the adoption of innovative strategies in perioperative pain management, contributing to the development of personalized and safe protocols for patients undergoing cardiac device implantation. Widespread implementation of the PECS block in clinical practice could mark a significant advancement in regional anesthesia, reinforcing its role in postoperative pain

management. Furthermore, this technique could be extended to other types of minimally invasive surgical interventions, holding significant potential in reducing opioid consumption and improving patient recovery.

In conclusion, ultrasound-guided PECS block utilization in cardiac device implantation represents a viable and effective strategy for perioperative pain control. The findings of the studies included in this thesis provide compelling evidence regarding the benefits of this type of regional anesthesia, supporting its integration into clinical practice guidelines. Future directions include refining administration techniques, optimizing local anesthetic combinations, and advancing ultrasound-guided approaches to improve the precision and safety of the PECS block.