Comparative Study Between Bupivacaine 0.5% Versus Bupivacaine 0.5% with Fentanyl in TAP Block for Post-Operative Analgesia After Appendectomy

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا

إلا ما علمتنا إنك أنت

العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

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List of Abbreviations

Abb.	Full term
AAG	Alpha1-acid glycoprotein
CNS	Center nerve system
ECG	Electrocardiography
HR	Heart rate
Hz	Hertz
IV	Intravenous
LA	Local anesthetics
NaHCO3	Sodium bicarbonate
NSAIDs	Non-steroidal anti-inflammatory drugs
OR	Operating rooms
PCA	Patient-controlled analgesia
SD	Standard deviation
TAP	Transversus abdominis plane
VAS	Visual analogue scale

INTRODUCTION

Peripheral nerve block has a significant role in modern anesthesia practice. This technique became very popular in ambulatory and inpatient anesthesia due to its safety and significant success rate for analgesia ***(Mukherjee et al., 2014).***

Ultrasound guidance is a reliable and safe technique in peripheral nerve block. Several benefits obtained using the ultrasound including accuracy, fast onset and decreasing the dose of local anesthetic drugs. Ultrasound guided needle placement decreases the risk of complications and increases the accuracy of the block ***(Hopkins, 2007).***

Despite improvements in perioperative care, major surgical operations are still followed by sequelae such as pain, organ dysfunction and prolonged convalescence. It has been assumed that adequate pain relief will improve the surgical outcome with reduced morbidity, need for hospitalization and convalescence, and there is a common consensus that optimal pain relief is a prerequisite for early postoperative recovery. However, in recent years it has been realized that several other factors in perioperative management are important in the control of postoperative recovery and rehabilitation, and that these factors must be considered and revised in order to achieve the advantageous effects of pain relief on outcome. Among the most commonly used pain-relieving techniques patient-controlled analgesia (PCA) with opioids, non-steroidal anti-inflammatory drugs (NSAIDs) and epidural analgesic techniques, there is evidence that the epidural local anesthetic or local anaesthetic–opioid techniques are the most effective on providing dynamic pain relief after most of surgical procedures ***(Kehlet & Holte, 2001).***

Aim of the Work

The aim of the study is to compare the effectiveness of US guided TAP block using 0.5% bupivacaine versus 0.5% bupivacaine with Fentanyl for postoperative analgesia in patients undergoing appendectomy.

Chapter 1

LOCAL ANESTHETICS

Introduction:

Local anesthetics (LA) are drugs that block conduction of electrical impulses in excitable tissues. These tissues include the nerve cells and myocytes (both cardiac and skeletal muscles). Analgesia and anesthesia occur as a result of the blockage of electrical impulses ***(Mumba et al., 2017).***

Pharmacology of local anesthetics:

Structure-activity relationship of local anesthetics:

Local anesthetics consist of a hydrophilic amine and a lipophilic aromatic ring connected by an intermediate chain. The structural bond in the intermediate chain determines whether the local anesthetic will be classified as an ester or an amide, (Fig 1). Furthermore, the bond in the intermediate chain determines the pathway of metabolism of the compound. Ester local anesthetics are metabolized by plasma pseudo-cholinesterase, whereas the amides are metabolized in the liver by the cytochrome family of enzymes ***(Mumba et al., 2017).***

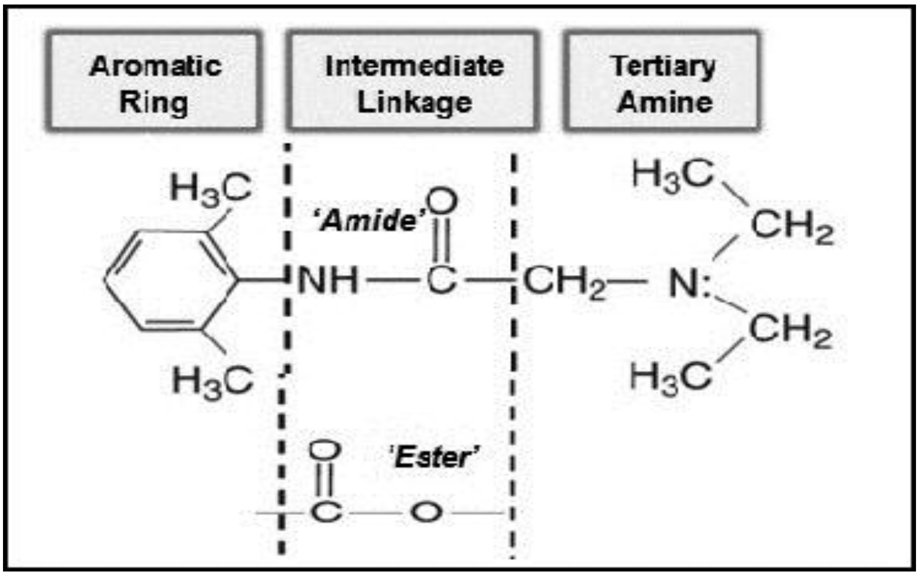

Figure (1): Structure of local anesthetics ***(Becker and Reed, 2012)***.

Mechanism of action of local anesthetics:

LA block the transmission of nerve impulses by reversibly blocking the fast voltage-gated Sodium channels, thereby inducing analgesia and anesthesia. Physico-chemically, LA are weak bases that are formulated in an acidic media, hence containing a larger proportion of the drug in the ionized state. However, it is the unionized fraction that is able to cross the lipid bilayer neuronal membrane and block the voltage-gated Sodium channels from the inside of the axo-plasm. This blockade renders the Sodium channel inactive, and hence, no further conduction of impulses occurs ***(Mumba et al., 2017)***.

Determinants of physiological activities of local anesthetics:

The activity of LA is influenced by a number of factors. These include the pH of the surrounding tissue, the lipid solubility of the LA, pKa, the bond in the intermediate chain and its length and the protein binding of the particular LA in question. Details of how each of these factors influence the activity of LA is discussed below:

1. pKa:

The pKa is the pH at which the number of ionized and unionized fractions of the drug is in equilibrium (the pH at which 50% of the drug is ionized and 50% is present as base). The pKa of the LA is related to pH and the concentrations of the cationic and base forms by the Henderson-Hasselbalch equation: pH = pKa + log ([base]/ [cation]) ***(Mumba et al., 2017)***.

The pKa generally correlates with the speed of onset of action of most amide LA drugs; The lower the pKa, the more the unionised fraction is present for any given pH and hence the faster the onset of action ***(Gadsden, 2013)***.

2. PH:

The lower the pH, the less the potency because in acidic conditions the ionised fraction predominates, there is less of the unionised fraction, and there is less of the LA available to cross the lipid bilayer and block the voltage gated Sodium channels. This explains why LA does not have much efficacy in reducing pain in infected tissues like abscesses in which the pH of such tissues is much lower than the physiological pH of 7.4 ***(Gadsden, 2013)***.

For this reason, sodium bicarbonate (NaHCO3) is often added to LA. This increases the amount of drug in the base form, which slightly shortens the onset time. Obviously, the limiting factor for pH adjustment is the solubility of the base form of the drug. Unfortunately, only small changes in pH can be achieved by the addition of bicarbonate because of the limited solubility of the base. As such, only small decreases in onset time are realized. For instance, with the alkalinisation of bupivacaine, an increase in the amount of base in solution is limited by the minimal solubility of free base in solution. For each LA, there is a pH at which the amount of base in solution is maximal (a saturated solution). Further increases in pH result in precipitation of the drug ***(Gadsden, 2013)***.

3. Lipid solubility:

The more lipid soluble the local anesthetic is, the higher the potency, the faster the onset of action and the longer the duration of action. This is because there are more drug molecules able to cross the lipid bilayer of the neuronal membrane and create a ‘depot’ of the drug from within the axoplasm ***(Mumba et al., 2017).***