Postoperative Pain Management in Orthopedic Surgery

An Essay

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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Candidate

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List of Abbreviations

Abbr.	Full-term
AP7	: 2-amino-7-phosphonoheptanoic acid
CPPene	: 3-[(R)-2-carboxypiperazin-4-yl]-prop-2-enyl-1-phosphonic acid)
AP5	: APV, R-2-amino-5-phosphonopentanoate
ADHD	: Attention deficit hyperactivity disorder
cGMP	: Cyclic guanosine monophosphate
COX	: Cyclooxygenase
DVT	: Deep venous thrombosis
PCEA	: Epidural analgesia
GABA	: Glycine and γ-amino butyric acid
IASP	: International Association for the Study of Pain
IVPCA	: Intravenous analgesia
LI	: Lockout interval
mA	: Milliampere
MAOIs	: Monoamine oxidase inhibitors
NO	: Nitric oxide
NOS	: Nitric oxide synthase
NMDA	: N-Methyl D-Aspartate
NSAIDs	: Nonsteroidal anti-inflammatory drugs
NRM	: Nucleus raphe magnus
PCA	: Patient-controlled analgesia
PCTS	: Patient-controlled transdermal system
PONV	: Postoperative nausea and vomiting
PGE2	: Prostaglandin E2

PCRA : Regional analgesia
SC : Subcutaneous
Sp : Substance P
aPTT : Thromboplastin time
THA : Total hip arthroplasty
PCTA : Transdermal analgesia
VR-1 : Vanilloid receptor-1
WDR : Wide dynamic range neurons

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Abstract

Background: Postoperative pain remains poorly treated in many patients. One reason is the inadequate use of nonopioid analgesics ***(Pogatzki-Zahn et al., 2014).*** Managing postoperative pain is important to ensure a good quality of life and fast recovery after surgery ***(Mikami et al., 2015).*** Postoperative pain management is critical for optimal care of orthopedic surgery patients. Orthopedic procedures can cause severe intra-operative and post-operative pain. It is important to achieve optimal post-operative pain control since this will facilitate more rapid achievement of functional outcomes ***(Vadivelu et al., 2010)***.

Conclusion: Multimodal analgesia which is achieved by combining different analgesics that act by different mechanisms and at different sites in the nervous system, resulting in additive or synergistic analgesia with lowered adverse effects of sole administration of individual analgesics, is needed for acute postoperative pain management due to adverse effects of opioid analgesics, which can impede recovery; Yet, the literature on multimodal analgesia often shows variable degrees of success, even with studies utilizing the same adjuvant medication.

Key words: nonopioid, pain, analgesics, surgery, quality of life, post-operative pain

Introduction

Postoperative pain management is critical for optimal care of orthopedic surgery patients. Orthopedic procedures can cause severe intra-operative and post-operative pain. It is important to achieve optimal post-operative pain control since this will facilitate more rapid achievement of functional outcomes ***(Vadivelu et al., 2010)***.

Opioids, administered intramuscularly, as epidurals, or IV as patient-controlled analgesia, are effective for severe pain. Adjunctive therapy and preemptive analgesia such as nerve blocks, and methods of delivery such as infusion pumps, may be used after total knee arthroplasty and anterior cruciate ligament (ACL) reconstruction ***(Bourne, 2004)***.

Oral opioids are effective for moderate to severe pain, and tramadol, with efficacy comparable to morphine but with fewer severe side effects, is selected for moderate to moderately severe pain. Opioid-sparing NSAIDs, such as ketorolac, and COX-2-specific NSAIDS have been used in pain management of hip, knee, and ACL procedures. An individualized regimen of appropriate analgesics, combined with nonpharmacologic treatments such as physical therapy or cryotherapy and patient education, can aid orthopedic surgery patients' recovery ***(Bourne, 2004).***

Intrathecal (IT) narcotics can offer effective postoperative analgesia. These agents bind with opioid receptor sites in the dorsal horn of the spinal cord, resulting in modulation of pain signals at the spinal cord level. IT narcotics can be administered as an adjunct to general anesthesia (eg, for scoliosis surgery), or they can be mixed with local anesthetics and administered during spinal anesthesia (eg, for total hip arthroplasty) ***(Gaber and Kraay, 2015).***

The advantages of IT analgesia, especially if spinal anesthesia is already planned, include its simplicity, lack of need for catheter care or pumps, low cost, and easy supplementation with low-dose patient-controlled analgesia (PCA) narcotics as needed ***(Horlocker et al., 2009).***

Epidural analgesia is accomplished by means of epidural narcotics, local anesthetics, or their combination. Narcotics can be administered by bolus or infusion. Epidural local anesthetics, typically diluted solutions of bupivacaine or ropivacaine, are administered by infusion. Adverse effects of epidural local anesthetics include urinary retention, motor block, and a sympathectomy-induced decrease in blood pressure. Epidural local anesthetics and narcotics are frequently combined in lower dosages to decrease the risk of each drug's associated adverse effects ***(Viscusi et al., 2005).***

Peripheral nerve blocks can provide significant pain relief. Nerve blocks can either be combined with general

anesthesia or used as the sole anesthetic ***(Honarmand et al., 2015).***

Long-acting local anesthetics, such as bupivacaine or ropivacaine, provide nerve-block duration of approximately 12-18 hours. Certain additives may prolong this duration; for example, the addition of dexamethasone or methylprednisolone may provide an additional 6-10 hours of analgesia. However, longer duration can best be reliably achieved by the perineural placement of catheters, which are then infused continuously, or bolused as needed ***(Cummings et al., 2011).***

Peripheral nerve blocks have the advantages of no sympathectomy-induced decrease in blood pressure and no narcotic-related adverse effects such as urinary retention, nausea, or itching. However, some degree of motor block is observed with the sensory block. This result may limit the usefulness of some peripheral blocks in certain situations. For example, prolonged femoral blocks are a good choice for pain control in anterior cruciate ligament (ACL) reconstructions, but they are not a good choice in knee arthroscopy because the quadriceps motor block would prevent safe ambulation.

Successful use of nerve blocks depends not only on clinical knowledge of the site of incision innervation but also on knowledge of the innervation for the underlying bone and muscular tissue.

Aim of the Work

Orthopedic surgery is one of the surgical branches that is characterized by severe post operative pain which prevent the patient from early mobilization and expose him to life threatening complications of prolonged bed recumbency.

Therefore, adequate combined anesthesia is required for this type of surgery especially in major hip and knee surgeries to improve the early Movement.

So, the aim of this study is to discuss different modalities of pain control after major orthopedic surgery.

Chapter (1):
Physiology of Pain

1.1. Definition

Pain is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" ***(Loeser et al., 2008).***

Thus pain has objective, physiologic sensory aspects as well as subjective emotional and psychological components ***(Chaplan and Sorkin, 1997).***

The term "nociception" (Latin – noci = harm or injury) is used only to describe the neural response to traumatic or noxious stimuli ***(Merskey and Bogduk, 1994).***

Pain transmitted centrally and peripherally.

Peripheral transmission of pain consists of production of electrical signals at the pain nerve endings (Transduction) followed by propagation of those signals through the peripheral nervous system (Transmission) ***(Merskey and Bogduk, 1994).***

The primary sensory structure that accomplishes transduction is the nociceptor. Most nociceptors are free nerve endings that sense heat, mechanical and chemical tissue damage. Several types are described:

1) Mechanoreceptors, respond to pinch and pinprick,
2) Silent nociceptors, which respond only in the presence of inflammation.
3) polymodal mechanoheat nociceptors. The last are most prevalent and respond to excessive pressure, extremes of temperatures (>42 ^{o}C and < 18 ^{o}C), and algogens (pain producing substances) ***(Merskey and Bogduk, 1994).***

Polymodal nociceptors are slow to adapt to strong pressure and display heat sensitization ***(Raja et al., 1997).***

Recently, vanilloid receptor-1 (VR-1) was isolated from the sensory neurons. Vanillins are a group of compounds, including capsaicins that cause pain. The VR1 receptors not only respond to pain but also to protons and to temperatures >43 ^{o}C ***(Carl, 2002).***

Another receptor, VRL-1, which responds to temperatures above 50 ^{o}C but not to capsaicin, has been isolated from C fibers ***(Carl, 2002).***

Then Pain impulses are transmitted by two fiber systems.

The presence of two pain pathways explains the existence of two components of pain:

A) Fast, sharp and well localized sensation (*first pain*) which is conducted by Aδ fibers ***(Fields, 1987).***

b) A duller slower onset and often poorly localized sensation (*second pain*) which is conducted by C fibers ***(Cross, 1994).***