Practice Guidelines in Anesthesia-2

Indian College of Anaesthesiologists
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Practice Guidelines in ANESTHESIA-2

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Foreword

In the field of medicine, the various specialties and subspecialties of Anesthesiology, Critical care and Pain management are becoming vibrant features. In the patients undergoing surgical procedures, constant innovation and development is being made in improving the quality care. "Practice Guidelines in Anesthesia"–Vol. 2 is a vital and basic component that offers fundamental recommendations for practice of anesthesia. Last year, the Indian College of Anaesthesiologists (ICA) that is an academic branch of Indian Society of Anaesthesiologists (ISA) published "Practice Guidelines of Anesthesia"– Vol. 1 that was widely read and appreciated. Now the ICA has come out with Vol. 2 of the Practice Guidelines of Anesthesia. The various topics covered in the book deal with preoperative preparations, perioperative management of number of clinical problems. The chapters dealing with pain management and care of critical care patients have also been included. The eminent clinicians from India and abroad have authored the carefully selected topics. To undertake rational and adequate patient care, the guidelines provide the fundamental and basic outline. In individual situation, we must allow some quantity of flexibility to the anesthesiologists to implement their own clinical judgment and experience. However, each institute or hospital may amend these guidelines depending on individual infrastructure and resources available.

I appreciate the tremendous efforts of Indian College of Anaesthesiologists in taking this distinctive initiative of publishing the guidelines. I would like to congratulate the Editor Dr SK Malhotra, the editorial board members Dr VP Kumra, Dr B Radhakrishnan and Dr Jayashree Sood for their admirable job.

I am sure that the readers would find all the topics remarkable and valuable in day-to-day anesthetic practice and care of the critically ill.

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Preface

The practice guidelines in the specialty of Anesthesia are well recognized that form the basis of recommendations for practicing anesthesiologists. These include the current advances in techniques in anesthesia practice and training in this area. It was not practical to include all the topics in "Practice Guidelines in Anesthesia"–Vol. 1, therefore Indian College of Anaesthesiologists (ICA), an academic branch of Indian Society of Anaesthesiologists (ISA), has come out with Vol. 2 containing twenty six more topics. The topics cover the field of Anesthesiology, Pain management and Intensive care. It incorporates fundamental principles of providing anaesthetic services as well as those required in areas of sub- specializations of anesthesia. The guidelines would be evaluated from time to time and improved accordingly as per the development of anesthetic practice and technology.

In the field of preoperative preparation, various chapters that have been included are; preoperative assessment of traumatic brain injury, bariatric and ophthalmic patients. The guidelines for intra and perioperative problems include, difficult airway management, central venous excess, patients on pacemakers, obstetric pain relief and blood transfusion therapy. A topic of perioperative fluid therapy has been added keeping trauma patients in mind. A chapter on perioperative arrhythmias has also been included. In the field of pain management, management of low back pain, ultrasound guided nerve blocks and acute pain management have been highlighted. Management of septicemia and patients with obstructive sleep apnea has been discussed. A chapter on current practice in Cardiopulmonary Resuscitation has been included. A chapter each on organization of anesthesia department and ethical practice has also been added. Practice Guidelines must always be considered as the studies in their progress and growth. A balance should be kept between basic principles and extensive detail. The same should be considered between professional outlook and the evidence as well as preferred and minimum standard of practice. These guidelines must not be the replacement of individual clinical experience and judgment of the anesthesiologist in offering best possible services to the patient. Also, these guidelines may be altered as per the accessibility of equipment and infrastructure in a particular institute or hospital. The practice guidelines also do not assure any specific outcome in the patient. The ICA assumes no liability for any lapse arising out of the use of recommendations provided in these guidelines. I am sure that the present Vol. 2 on Practice Guidelines in Anesthesia would be useful to the practicing anesthesiologists. However, suggestions and opinions from readers are welcome so as to improve the subsequent edition.

We are highly grateful to all eminent authors who have contributed with their time and energy in making it possible to publish the second volume of Practice Guidelines in Anesthesia.

SK Malhotra MD FICA

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Postoperative Pain Management Guidelines

Anil Agarwal, Chetna Shamsherry

INTRODUCTION

In the year 1995 an initiative to consider pain as the 5th vital parameter was undertaken so as to continuously assess it for an overall improvement of patient's outcome.[1] It was also declared by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO Standard RI 1.2.8, 2000) that patient has the right to be pain free. Its role in increasing the morbidities after surgical procedures has been well-established and accepted all eighty percent throughout the world. 80% of the surgical patients complain of postoperative pain and this is ineffectively controlled in around 50% of them.[2] Postoperative pain management has become mandatory in developed nations in about 19–93% hospitals of the west have well-established acute pain services (APS).[3] A survey in 2015 reported a very bleak existence of the APS in India with only three hospitals which practice 24-hour round the clock APS.[4] This emphasizes the need to introspect the quality of health care that we deliver to our patients. This chapter focuses on various proven and recommended ways to control pain perioperatively so as to enhance patient's postoperative recovery and satisfaction. A basic structure of the APS organization is also being presented so that the pain services could be effectively delivered. It is important to understand that pain management should start much before the patient is taken into an operative suite, and ideally should be introduced during the visit of the patient for preanesthetic evaluation. Post operative pain management guidelines also emphasize upon the importance of protocolized plan for pain management and review of the services through internal auditing processes. All the health centers have different infrastructure and resources and hence it is important to identify what resources and facilities can be delivered to the patients in the safest ways.

Repercussions of Perioperative Pain

Pain causes increase in the perioperative morbidity and mortality[5] as a result of its negative effects on almost all the organ systems (Fig. 16.1), which eventually leads to compromised quality of life, increased hospital stay and economic burden on the patient.[6] Multiple studies have proved that an effective management of pain postoperatively could lead to a decrease in the incidences of various morbidities like paralytic ileus, thromboembolic complications, myocardial ischemia, respiratory complications and mortality (Table 16.1).[7,8] An untreated or undertreated

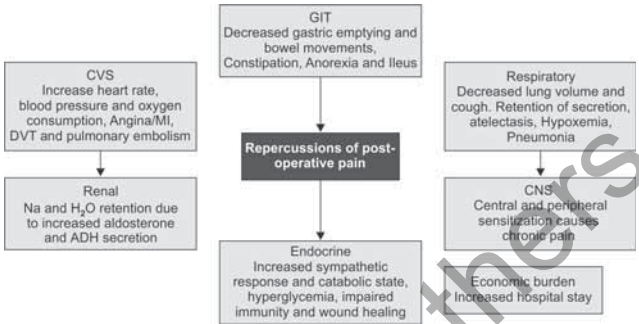

Fig. 16.1: Effects of pain on various organ systems of the body.

Table 16.1: Benefits of epidural and spinal analgesics in reducing perioperative complications.

Postoperative ileus	*2–4 days*
Intraoperative blood loss	30%
Pulmonary complications	40%
Thromboembolic complications	50%
Tachycardia	78%
Myocardial infarction	70%
Mortality	25%

Table 16.2: Surgeries commonly associated with development of chronic pain.

Type of operation	*Chronic pain incidence (%)*	*Severe chronic pain incidence (%)*
Amputation	30–85	5–10
Thoracotomy	5–65	10
Mastectomy	11–57	5–10
Inguinal hernia	5–63	2–4
Coronary bypass	30–50	5–10
Caesarean section	6–55	4
Cholecystectomy	3–50	Not estimated
Vasectomy	0–37	Not estimated

postoperative pain leads to neuronal changes in the central and peripheral nervous system resulting in the development of chronic pain. Incidence of chronic pain for various surgeries has been depicted in Table 16.2.[9]

Pain Physiology

Pain (algesia) as defined by International Association for the study of pain (IASP) is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage". Any trauma (which in the perioperative setup is the surgical stimulus) leads to release of multiple inflammatory markers, e.g. prostaglandins, 5HT, ATP, bradykinin etc. which are sensed by the nociceptors prostanoid receptors, 5HT3, P_2X3, BK2 respectively present at the nerve endings of the primary afferent A-delta and C neurons. The nerves depolarize to transmit the pain signals to the dorsal horn of the spinal cord and synapse with the second order neurons

in various lamina. The signals are transmitted across the synapse by release of presynaptic neurotransmitters facilitated by calcium ion channels (Tables 16.3 and 16.4). The second order neurons cross opposite and ascend through the anterolateral spinothalamic tract to reach the thalamus and synapse with the third order neurons which end in the cerebral cortex to perceive the sensation as pain. The dorsal horn of the spinal cord modulates pain sensitivity by an interplay between the primary neurons, secondary neurons, interneurons, projection neurons and descending inhibitory bulbospinal pathway. Sustained presence of inflammatory neurotransmitters sensitizes the nociceptors (peripheral sensitization) leading to an increased sensitivity to pain in the damaged area, this is known as *Primary Hyperalgesia*. If the neurons are stimulated for prolonged periods, their endings in the spinal cord themselves depolarize to generate an action potential which travel back towards periphery creating a reverberatory positive feedback loop, and also awaken the sleeping neurons in the adjacent area, a phenomenon known as *Wind-up*. This causes hypersensitivity to pain from the undamaged tissue surrounding the primary damaged site leading to *Secondary hyperalgesia*. These changes in the primary and secondary nerve synapse cause a decrease in the threshold of release of neurotransmitters at the level of spinal cord and an exaggerated pain response in brain known as central sensitization which converts acute into chronic pain (Fig. 16.2).[8]

Table 16.3: Neurotransmitters released by primary afferent neurons and their receptors in the dorsal horn of spinal cord.

Neurotransmitters	*Site of action is the dorsal horn of spinal cord*	*Receptors*
Peptides Growth factors	Substance P CGRP BDNF ATP	Neurokinin 1 CGRP 1 TRK B P_2X/ P_2Y
Excitatory amino acids neurotransmitters	Aspartate Glutamate	AMPA NMDA
Inhibitory neurotransmitters	Glycine GABA	GlyR GABA receptor

MULTIMODAL ANALGESIA

Pain can be modulated along its pathway from periphery to brain using various non-pharmacological or pharmacological means[10] (Table 16.5) either through oral or parenteral medications or drug instillation at local or central neuraxial site (Fig. 16.2). It has been proved and recommended that multiple medications should be used together through various routes for superior perioperative analgesia[11] thus emphasizing the importance of *Multimodal* analgesia (analgesia given through multiple modalities). This also helps in reducing the dose requirements of various drugs and their side effects. Analgesic

Table 16.4: Details of nerve fibers along with sensations carried by them.

Type of fiber	*Diameter (micrometer)*	*Velocity (m/s)*	*Sensation that it carries*
Alpha (myelinated)	13–20	80–120	Proprioception
Beta (myelinated)	6–12	35–90	Touch
Delta (myelinated)	1–5	5–40	Pain (mechanical and thermal)
C (unmyelinated)	0.2–1.5	0.5–2	Pain (mechanical, thermal and chemical)

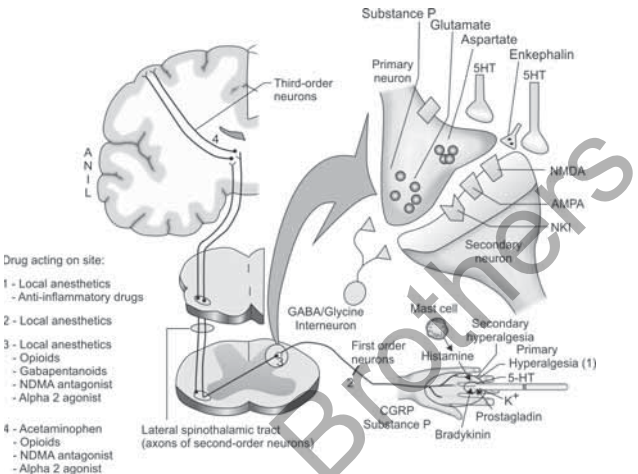

Fig. 16.2: Pain pathway along with the sites where various analgesic medications act.

modalities when feasible should be used according to the pain ladder that has been depicted in (Fig. 16.3); emphasizing the importance of regional and parenteral analgesia on postoperative day 1, and 2 when the patient is nil per oral and gradual transition to oral medications when the patient is allowed oral intake.

Acute Pain Services

The purpose of acute pain services (APS) is pain management in the perioperative setting, intended to reduce or eliminate postoperative pain (Fig. 16.4). APS should be established in the health care centers to deliver effective round the clock and safe analgesia services to the patients so as to maintain their functional abilities, physical and psychological well-being along with enhance the quality of life. All over the world it has been accepted that institutional protocols should be laid down for in-hospital perioperative management of pain and side-effects due to analgesic techniques based upon the algorithms,[12] resources and infrastructure suitable to a setup. It has been proved that a nurse-based anesthesiologist's supervized model of APS is more cost-effective and at the same time equally efficacious and safe in comparison to a doctor-based APS.[3] The most important pillar of APS is regular documentation and audit that helps to address the side-effects, complications and technical errors encountered during delivery of pain services.

GUIDELINES FOR PERIOPERATIVE PAIN CONTROL STRATEGIES

History Taking

Complete history related to substance abuse, psychiatric comorbidities, previous surgical

Table 16.5: Commonly administered drugs for postoperative pain relief.

Drug category	*Example*	*Moa*	*Site of action*	*Dose*	*Side effects*
Anti-inflammatory drugs					
NSAIDs nonspecific	Diclofenac Brufen Naproxen	Inhibits COX 1 and 2	Site of trauma with inflammation	75 mg TDS 200–800 mg QID 500 mg 1st dose then 250 mg QID	Gastric ulcer, NSAID induced bronchospasm, bleeding disorder, MI, renal failure. Naproxen has decreased incidence of MI.
NSAIDs: COX 2 inhibitors	Etoricoxib Celecoxib	Inhibits COX 2	Site of trauma	90/120 mg OD 200 mg BD	MI, mild gastric and renal failure. Celecoxib cause less MI
Acetaminophen Analgesic+ antipyretic+ anti-inflammatory	Paracetamol	Inhibits COX 3 peripherally +/- centrally	CNS + Site of trauma	500 mg–1 gm QID (max) 4 gm/day (adults)	PCM hepatotoxicity (rare)
Nerve blocking agents					
Local anesthetics	Lignocaine 2% Bupivacaine 0.5% Ropivacaine 0.75%, 0.5%, 0.25%	Inhibits Na channels for nerve conduction	Site of trauma + peripheral nerve + central neuraxis	3 mg/kg (max) 2 mg/kg (max) 3 mg/kg (max)	Cardiotoxic, euphoria, restlessness, respiratory depression
Opioids	Fentanyl Morphine Nalbuphine	Mu, kappa, delta receptors	Spinal and supraspinal analgesia	1–3 mcg/kg (I/V) 100 mcg/kg (I/V) 50 mcg/kg (epidural) 100–200 mcg (spinal)	Sedation, respiratory depression, nausea, vomiting
Gabapentanoids	Pregabalin Gabapentin	Acts to inhibit alpha-2 delta calcium channels	Dorsal horn of spinal cord	75–300 mg BD 300–1200 mg TDS	Sedation, constipation, weight gain
Ketamine		NMDA receptor antagonist	Spinal cord and brain	0.25–0.5 mg/kg bolus + 1–2 mcg/kg/min infusion postoperatively for 12–48 hrs	CNS affects, e.g. Hallucinations, delirium, inebriation etc. nausea/ vomiting.

(MI: Myocardial infarction).

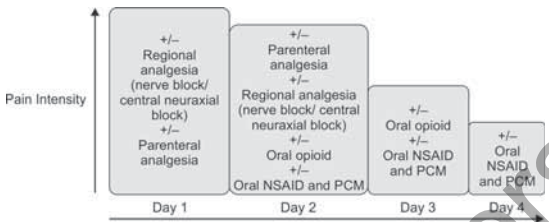

Fig. 16.3: The postoperative analgesic ladder emphasizing the use of regional +/- parenteral analgesia on immediate postoperative days.

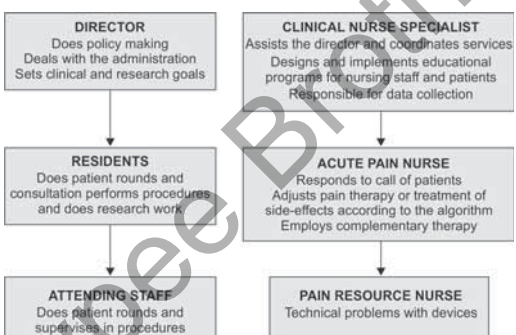

Fig 16.4: Responsibilities of members of APS team.

and analgesic experiences, drug allergies to specific analgesic medications should be specifically questioned. On long-term follow-up it has been studied that chronic pain is more likely to develop in patients who are anxious preoperatively.

Counseling

Recommendations suggest that the counseling for pain management should initiate from the time a patient visits the preanesthesia clinic for preoperative evaluation, so as to allay anxieties and fear related to surgically induced pain. The modes of analgesia offered depends on the kind of surgery or the surgical extent and the patient's sensitivity towards pain. This should be communicated not just to the patient but also the attending caregivers of the patient.[11,12]

Pain Assessment

Validated pain scores should be used depending upon the age, clinical condition and emotional condition of the patient. Visual

analogue scale (VAS), numerical rating scale (NRS), faces pain scale, FLACC (for children) are some well-accepted assessment tools for pain. Regular periodic assessment and documentation of rest pain, dynamic pain, and functional status of the patient should be carried out. Treating rest pain is necessary for comfort of the patient, but treating the dynamic component of pain which is pain during deep breathing, coughing, movements etc. fastens the mobilization of a patient after surgery, hence reducing the cardiopulmonary and thromboembolic complications and improving the immediate and long-term outcomes after surgery.[13] Dynamic pain management requires stronger analgesics compared to rest pain and parenteral analgesics are usually insufficient to cater it. This is why the postoperative pain management ladder advises to give regional blocks for analgesia for the first two days postsurgically supplemented by parenteral analgesics.

Nonpharmacological Interventions

TENS, acupuncture, hypnosis, massage, music, cognitive behavioral therapy, etc. could be used for better postoperative outcomes and so can be incorporated as and when the facilities are available.[14]

Pre-emptive or Preventive Analgesia

Any pain management/intervention performed before the surgical incision is known as pre-emptive analgesia. Preventive analgesia on the other hand does not correlate to the time of administration. The aim of both preventive and pre-emptive is to prevent the dorsal horn changes at spinal cord and central sensitization of pain so as to avoid the conversion of acute pain to chronic postsurgical pain. This in case of preventive analgesia is defined as an increase in the duration of analgesia of a drug by more than 5.5 times its half life. A pre-emptive analgesia could very well have preventive analgesic effects as well. The evidence of pre-emptive vs preventive analgesia are conflicting to prove supremacy of one over the other,[15] but it is the preventive analgesia which is more desirable. Meta-analysis have proven definite advantages of pre-emptive epidural analgesia on the reduction of opioid requirements of the patients perioperatively. Local anesthetic infiltration pre or post surgically shows equivocal effects on analgesia. Acetaminophen +/- NSAIDs + pregabalin should be given perieoperatively to enhance analgesia, although evidence for the timing of drug administration is not very strong.[16] Some studies support advocating acetaminophen and NSAID pre-emptively and pregabalin up to a week before operative procedures but still requires further meta-analytical evidence. Drug doses have been mentioned in Table 16.5.

Regional Analgesia

Meta-analysis have proved that regional nerve block whether peripheral or central analgesia provides superior pain relief than intravenous patient controlled analgesia.[17]

a. *Preprocedure preparation:* The insertion of the epidural catheter should be performed using aseptic precautions. The performer should scrub properly, and cover oneself using gown, face mask, cap and gloves. Use of chlorhexidine with alcohol gives rapid, stronger and prolonged broad spectrum bactericidal action over povidone iodine or chlorhexidine without alcohol for skin preparation.[18] The skin for central neuraxial or peripheral blocks should be prepared using chlorhexidine 0.5% with 70% alcohol[19,20] unlike 2% chlorhexidine used for central venous line cannulation. Case reports of chronic adhesive

arachnoiditis leading to paraplegia in patients have been reported after accidental insertion of chlorhexidine 2% with alcohol in measurable quantity (>0.1 mL).[21] Although no experimental evidence for neurotoxic potential of 2% chlorhexidine contaminated needles exists in humans or animals the neurotoxicity can also be attributed to the significant concentration of alcohol. So 0.5% is considered more safe for central neuraxial procedures. Care must be taken to allow sufficient time for the chlorhexidine to dry properly before skin palpation or needle prick and avoid using it in infants of less than 2 months.

b. Regional blocks should be preferred using USG as it would decrease procedure and drug related complications.[22] ASRA guidelines should be followed for any regional block procedures.
c. Whenever feasible more than one drug should be used in combination or as an additive in regional blocks, so as to decrease the total dose of one drug and provide the patient with superior analgesia due to additive effects of other medications.[23] Drugs to be used through epidural or regional nerve block routes have been depicted in Tables 16.6 to 16.8.
d. *Monitoring:* Regional nerve blocks whether central neuraxial or peripheral can lead to hemodynamic variations, sensory-motor weakness, local anesthesia overdose, etc. hence it is always advised that either of them should be used when there is a constant watch over the patient's vitals and there are set protocols and backup management guidelines to deal with any adverse effects.
e. Local anesthesia infiltrations at the trocar site for laparoscopic surgery/surgical sites provides superior pain relief compared to placebo/saline infiltration. Pre-incision and post-incisional bupivacaine infiltration provides equivocal effects.

Regional analgesic techniques for different surgeries has been shown in Table 16.9.

Table 16.6: Local anaesthetic medications for regional analgesia.

Local anesthetic	*Enantiomer*	*Start of action*	*DOA*	*MLAC for analgesia*	*Remarks*
Bupivacaine (0.1–0.125%)	R + S	Slow	2–8 hrs	0.6 of ropivacaine	Drug concentration can be decreased with an additive for all LA
Levobupivacaine (0.1–0.125%)	S	Moderate	2–5 hrs	0.52–0.59 of ropivacaine	Motor block and cardiotoxicity: bupivacaine > levobupivacaine > ropivacaine Analgesic efficacy at low concentration is ropivacaine = bupivacaine = levobupivacaine
Ropivacaine 0.2–0.75%	S	Moderate	2–6 hrs	1	Motor block is least. No advantage with adrenaline as additive
Lignocaine 0.1%		Fast	1–2 hrs		Nerve block infusion for >24 hrs results in motor block without analgesia. Causes TNS after intrathecal administration

(MLAC: Minimum local anesthetic concentration; TNS: Transient neurological symptoms; LA: Local anesthetic).

Table 16.7: Drugs used as additives for performing blocks.

Drug	*Spinal*	*Epidural*	*Epidural infusion*	*Start of action*	*DOA*
Morphine	100–200 mcg	40 mcg/kg	0.1–1 mg/hr	30–60 mins	12–24 hrs
Fentanyl	10–25 mcg	1–2 mcg/kg as bolus 1–4 mcg/mL as infusion	10–50 mcg/hr	5–10 mins	2–4 hrs
Clonidine	30–60 mcg	1–2 mcg/kg		20 mins	6–8 hrs
Adrenaline	0.2 mg	5 mcg/mL (<0.25 mg)			Prolongs lignocaine DOA

(DOA: Duration of action, mcg: Micrograms).

Table 16.8: Drugs with recommendations as additive for epidural anesthesia/analgesia.

Fentanyl	Efficacy with LA> LA/fentanyl alone (I)	Efficacy = Morphine epidurally	Preferred for high TEA	
Morphine	Least lipid soluble Slow onset and offset	Ceiling dose at 2.5–3.75 mg epidurally	Caution for high TEA	Risk factors for respiratory depression: >300 mcg given intrathecally, increasing age, obesity, systemic opioids
Clonidine	LA+/- morphine+ clonidine results in decrease use of systemic opioids (II)	Recommended with LA for caudal block (I)		Intensifies and prolongs analgesia (III)
Dexmedetomidine	LA + dexem is superior to LA + fentanyl epidurally			Intensifies and prolongs regional analgesia (I)
Dexamethasone	Nonparticulate steroid		Caution mandated through epidural route	Prolongs analgesia when added to LA/systemic administration for peripheral nerve blocks

(I,II,III: Levels of recommendation. I: Strong recommendation by multiple RCTs; II: Recommendation as proved by 1 RCT, III: Recommendation as proved in cohort studies).
(LA: Local anesthetic; TEA: Thoracic epidural anesthesia).

Parenteral Analgesia

a. *Routes of administration:* Routes which have a predictable absorption and bioavailability are preferred, hence intramuscular, subcutaneous, transmucosal routes should be avoided. Transdermal patches are also not advisable for immediate acute postoperative analgesia as

Table 16.9: Showing different regional analgesic techniques for various surgeries.

Type of surgery	*Regional analgesic technique*	*Remarks*
Truncal and Abdominal Procedures		
Breast surgeries	Paravertebral block Epidural block	Efficacy of both the blocks is similar but paravertebral block has less side-effects
Thoracic procedures	Thoracic epidural T4-6 Paravertebral block at the level of surgery + 2 levels above and below.	Use lipophilic opioids as additives for high TEA Paravertebral block has less side effects
Laparoscopic abdominal surgery	Transversus abdominal plane block Local anesthetic infiltration at trocar site	
Caesarean section	Transversus abdominal plane block	
Open abdominal surgeries: Above umbilicus Below umbilicus	 Thoracic epidural above T7 Thoracic epidural below T7	
Upper Limb Procedure		
Shoulder procedures	Inter scalene brachial plexus block	Continuous catheter preferred over single shot block
Arm or forearm procedures	Supraclavicular block Infraclavicular block Axillary block	Continuous catheter preferred over single shot block
Lower Limb Procedures		
Knee replacement	Femoral nerve block Adductor canal block Lumbar epidural L3-4	Adductor canal block results in lesser motor weakness of quadriceps
Hip replacement	Femoral nerve block Lumbar plexus block Lumbar epidural L3-4	
Other lower limb procedures Foot surgery	Lumbar epidural Sciatic block Femoral block Popliteal sciatic + saphenous nerve block	

there is a lag period for their action. Intravenous patient control analgesia (IVPCA) gives superior analgesia and patient satisfaction compared with intermittent I.V parenteral doses given by the health care providers.

b. *IV-PCA:* Institutions should protocolize their regime for IV-PCA devices in terms of drug dose to be filled, bolus dose, lockout interval and maximum number of bolus doses. A continuous background infusion of opioids leads to greater respiratory

Table 16.10: Drugs used for IV PCA.

Intravenous medication	*Concentration*	*Dose I/V*	*Remarks*
Morphine (opioid agonist)	1 mg/mL	PCA Bolus: 1–2 mL, Lockout: 5–10 min (usually 6–8 min)	Oral route is preferred over parenteral administration
Fentanyl (opioid agonist)	10 mcg/mL	0.5 mcg/kg bolus, lockout: 5–10 mins, max 2 mcg/kg/hr	Short acting hence titration is easier
Meperidine	10 mg/mL	Bolus:1–2 mL, lock out interval: 6 mins, max dose 10 mL	

depression, overuse of medication, hyperalgesia, increased hospital stay, cost and readmission, hence intermittent bolus should be preferred. If overdose of opioids occur, sedation is followed by respiratory depression which leads to a decrease in the respiratory rate and ventilation. Measuring capnography/the level of end tidal CO_2 can reveal ventilation compromises which are likely to precede any derangement of the oxygenation. Naloxone should be made available in the hospital for antagonizing any undesired side-effects of opioids. Drugs used in IV PCA device with its dose schedule has been shown in Table 16.10.

c. *NSAIDs:* Unless contraindicated, patients should receive an around-the-clock regimen of COXIBs or NSAIDs. Early use of anti-inflammatory drugs prevent continuous nociceptor firing and development of secondary hyperalgesia by inhibiting the wind up phenomenon. COX-2 selective inhibitors cause less renal injury, NSAID induced bronchospasm and perioperative bleeding as compared to nonselective NSAIDs. Celecoxib and naproxen have been found to have decreased incidence of MI. Care must be taken when prescribing NSAIDs for colorectal surgery as they may cause anastomotic leaks or impaired bone healing during orthopedic surgery.[15] Commonly used NSAIDs have been described in Table 16.5.

d. *Paracetamol:* This medication should be given round the clock during the perioperative period starting 1–2 hrs before surgery. NSAIDs and paracetamol given together provide superior analgesia and should be added together if not contraindicated. Paracetamol induced hepatotoxicity is a rare phenomenon.

e. *Alpha2 delta ligands:* Pregabalin and gabapentin act on the dorsal horn of the spinal cord to inhibit the alpha-2 delta calcium channels. These help to inhibit the presynaptic release of excitatory neurotransmitters and transmission progress in the second order neurons. Their use is strongly recommended for perioperative use to limit acute postoperative pain and reduce opioid consumption. Although postoperative sedation is to be watched for. Dose of pregabalin and gabapentin is shown in Table 16.5. These medications should be continued for at least 2 weeks postoperative period.

f. *Ketamine:* Ketamine is a NMDA antagonist hence acts centrally to prevent anterograde and retrograde transmission of pain thus preventing the wind-up phenomenon which leads to the development of chronic pain. Perioperative intravenous ketamine infusion decreases the incidence of chronic postsurgical pain, postoperative nausea, vomiting, has opioid sparing effects, and is recommended for use as preventive analgesic modality for thoracic surgeries. Addition of ketamine with opioids in the IV-PCA has been found to decrease the opioid requirements. Parenteral or regional analgesia should be tapered as soon as the patient starts accepting orally. This is to be decided based on the requirements of the individual patient. Dose of ketamine infusion has been mentioned in Table 16.5.

g. *Intravenous lidocaine:* According to the cochrane review intravenous lidocaine infusions have positive effects on pain relief, decrease opioid requirements, nausea, vomiting, ileus and hospital stay.[24] Lignocaine infusion has a preventive analgesic effect of 5.5 times the half-life or for >8 hrs duration after cessation of certain abdominal surgeries, e.g. Laparoscopic cholecystectomy, colorectal surgeries etc. Lidocaine infusion is contraindicated in patients with history of unstable coronary disease, recent MI, heart failure, heart block, electrolyte imbalance, cardiac arrhythmias or seizures. The intraoperative bolus dose is 1.5 mg/kg followed by 2 mg/kg/hr infusion. The postoperative infusion can be maintained between 1 and 2 mg/kg/min infusion depending upon the weight and safe dose limit of lignocaine.

CONCLUSION

Institution-based protocols should be made and followed to cover pain perioperatively.

Preoperative assessment, history taking and counseling of the patient should be emphasized before formulating plan to counter pain perioperatively.

Whenever possible, anesthesiologists should use multimodal pain management therapy using pharmacological and nonpharmacological modalities.

Preventive analgesia should be used to prevent postsurgical pain syndrome.

Unless contraindicated, patients should receive an around-the-clock regimen of COX-IBs, NSAIDs, or acetaminophen.

Analgesic modalities when feasible should be used according to the pain ladder which emphasizes the importance of regional and parenteral analgesia on postoperative day 1 and 2 when the patient is nil per oral and gradual transition to oral medications when the patient is allowed oral intake.

Oral medications are always preferable to parenteral analgesia.

Regular postoperative pain and functional status assessments using validated tools should be documented and audited.

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