CHAPTER **34**

POSTOPERATIVE PAIN MANAGEMENT

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Pain following a surgical procedure is expected, yet can be controlled through a combination of physiologic and pharmacologic means. The physician often looks to pharmacologic measures to control the patient's discomfort, overlooking the fact that through careful preoperative and intra-operative planning, the severity of pain can be lessened and better controlled. Pain is defined by the International Association for the Study of Pain as "an unpleasant experience which we primarily associate with actual or potential tissue damage or described in terms of such damage."[1] This experience of pain is an individual one, which must be appropriately evaluated and managed in each specific post-surgical patient. All patients expect to have pain postoperatively but Carr related that 80% underestimate the intensity.[2] Seventy-five percent of postoperative patients are noted to suffer with moderate to severe pain postoperatively, due to the caregiver's fear of addiction and respiratory depression.[1]

This paper will discuss a step-wise approach to postoperative pain management to enable the physician to sequentially evaluate and treat the patient in the peri-operative setting (Fig. 1). The effective control of pain in the acute setting will prevent the progression to chronic pain which can present itself as addiction. Addiction is a fear any time habit-forming medications are prescribed, and because of this fear, analgesic agents are often under-prescribed. While addiction is a reality, 99% of patients stop taking narcotics when the pain stops, and therefore surgical pain may be under-treated under the guise of preventing addiction.[1] The management of pain in the addicted or tolerant patient is often a difficult dilemma, and will also be discussed. The management of post-operative pain must be viewed as a continuum, with resolution achieved through various modalities initiated before the incision is made, up to the point of cessation of post-surgical pain.

PRE-EMPTIVE ANALGESIA

Addressing surgical pain in a pre-emptive manner, prior to any tissue damage, is the initial step in the management of post-surgical pain. The use of a local anesthetic block in a regional fashion or in combination with sedation administered by the anesthesiologist has been shown to decrease the hyperexcitability produced in the spinal cord following a noxious stimulus. Utilizing the same local anesthetic block in a post-incisional manner does not reduce the need for postoperative analgesia to the same extent. Ejlerson showed this relationship in hernia repairs, and cited that the hyperexcitability from direct stimulus continued beyond the acute injury, necessitating an increase in postoperative pharmacologic analgesics.[3]

Needoff applied this technique of pre-emptive local ankle blockade with first ray procedures. Significantly less pain was reported at the six-hour period, with pain relief normalizing at 24 hours after the initial incision.[4] This justifies that the use of a local anesthetic block preoperatively has a significant impact on a patient's post-surgical pain. Pre-emptive anesthesia does not eliminate the need for postoperative analgesia, but by decreasing the hyperexcitability, it allows for better postoperative analgesia via additional methods.

CONTROL OF EDEMA

Postoperative edema is a major antagonist to post-operative pain control, and therefore must be minimized intraoperatively and postoperatively. The increase in interstitial fluid secondary to vascular and lymphatic damage, combined with increased blood flow, causes swelling and pressure on the regional nerves. Pain is produced by the pressure on nerve endings, resulting in muscle spasm causing muscle hypoxia, and creating a pain spasm cycle. Edema is a natural result of tissue damage, and must be controlled in both the intra-operative and postoperative periods.

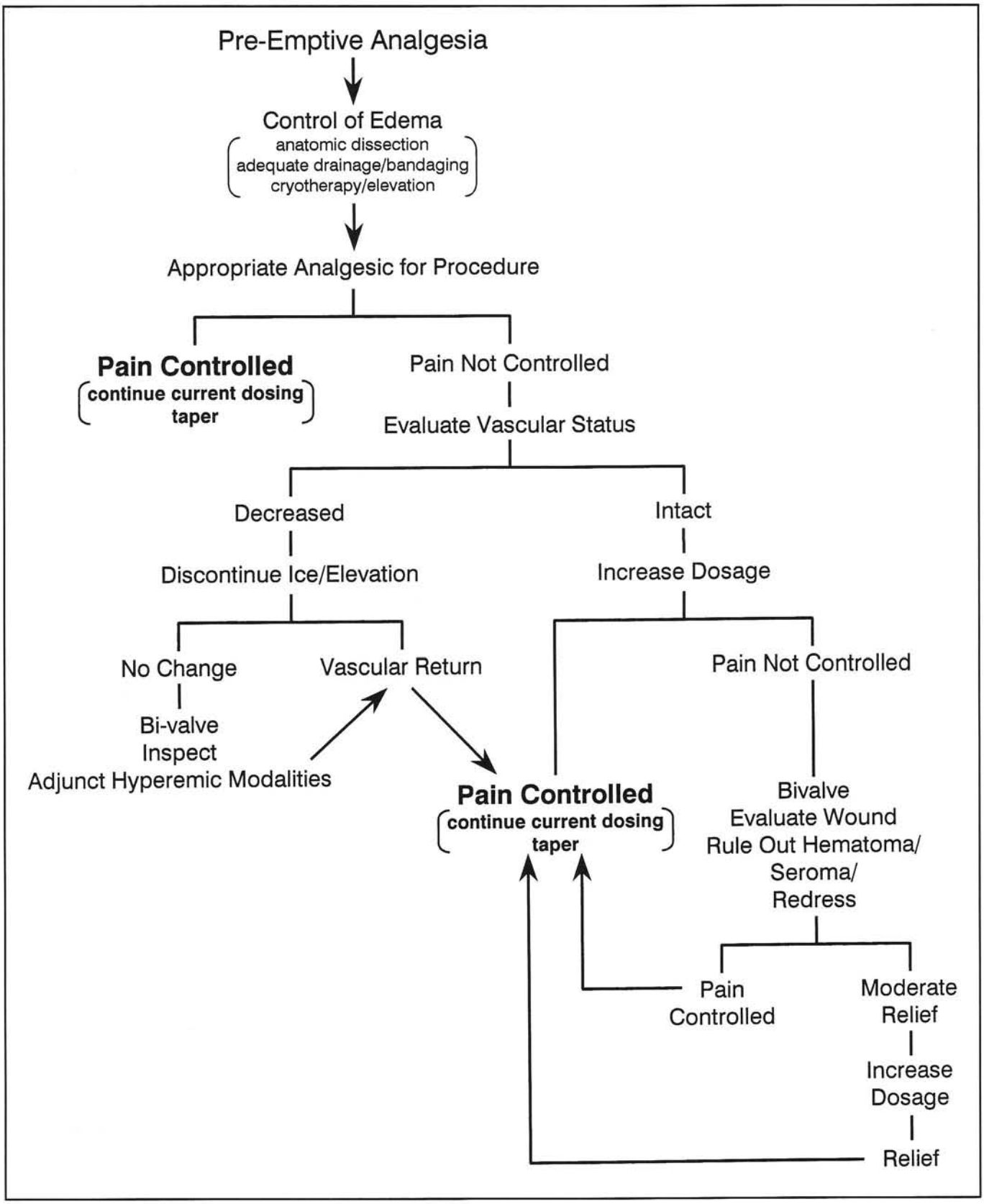

Figure 1: Algorithm for management of postoperative pain.

Intraoperative Measures

The control of edema in the intraoperative period is dependent on minimizing tissue injury through dissection and retraction techniques. Atraumatic dissection technique, and the ability to recognize and control vascular injury will result in less edema and fewer gaps in which fluid can accumulate. Appropriate drainage techniques and compressive bandaging, when necessary, will additionally control edema and minimize hematoma or seroma formation. The combination of these specific steps will decrease the pressure on local nerve endings, attenuating the stimulus response. The key to controlling pain is to intervene and limit the pain spasm cycle at the local level, decreasing the need for narcotics acting on the supraspinal level.

Postoperative Measures

The control of edema extends beyond dissection techniques into various postoperative modalities. Elevation and cryotherapy are very effective in controlling postoperative edema and pain. Cryotherapy has the additional effect of decreasing inflammation, decreasing hematoma formation and gives a direct postoperative analgesic effect. In the early postoperative period, cold therapy decreases cellular metabolism, decreasing the energy required for cellular functions. Vasoconstriction and increased blood viscosity occur, which decrease vascular permeability decreasing initial hemorrhage and edema. Cold therapy has an additional anesthetic effect by raising the pain threshold and interrupting the pain spasm cycle. The local anesthetic effect of direct application of ice after 5 to 12 minutes is due to this local effect, and causes a decrease in the release of vasospastic substance and histamine. Cold therapy is rarely applied in such a direct fashion, but a local effect is still created, minimizing these edema-enhancing modalities.

Care must be taken with cryotherapy to prevent cold injuries, and to discontinue use in vasospastic or cold-sensitive patients. Direct application of ice on the skin should be avoided. The use of circulating continuous cold therapy has been shown to have increased efficacy versus the commonly used bags of ice. Cold therapy can be applied continuously with a cast. With soft dressings, cold is applied approximately 20 to 25 minutes every hour for 2 hours, then every 2 to 3 hours for the initial 48 to 72 hour peri-operative period.[5]

PHARMACOLOGIC MANAGEMENT OF PAIN

The use of pharmacologic agents in the management of postoperative pain is a necessary and frequently used modality. The specific mechanism of action is not the purpose of this paper, but the following tables provide some of the commonly used medications for treating mild to severe pain (Tables 1-3). The use of narcotics carries with it the possibility of addiction and respiratory depression. These must always be kept in consideration, but are often the unnecessary causes of under-medication of patients by medical personnel. Less than 1% of patients prescribed narcotic medications eventually become addicted, while 75% of patients in moderate to severe pain suffer needlessly due to under treatment.[1] Although a rare occurrence, respiratory depression must be evaluated for and treated immediately when it does occur. It is important to acknowledge that these are genuine concerns that must be considered, but higher emphasis is often inappropriately placed on these concerns versus adequately controlling the patient's pain.

Various parameters have been studied regarding narcotic dosing including age, weight, body surface area, gender and personality types, with age having the most direct correlation.[6,7] As patients mature, less narcotic analgesics have been documented to be necessary to provide equal pain relief, therefore dosages can be adjusted accordingly.

The procedure performed must also be considered in regard to pharmacologic management. Increased dissection and bone violation will increase edema, and therefore increase the requirement for analgesia. The spasm reaction of the pain spasm cycle can be increased when surgical procedures place a direct or indirect strain on muscle, as tendon balancing is performed. Muscle relaxants may be considered when evaluating this patient population.

Narcotics can be administered in many forms, with the majority of forefoot procedures requiring oral analgesics. Rearfoot and other extensive procedures often require parenteral narcotics. Patient Controlled Analgesia (PCA) has proven to be an effective means to control postoperative pain. This method takes advantage of the patient's ability to determine the amount of narcotic necessary, while a constant blood level is

maintained through continuous infusion. Non-narcotic agents including NSAIDs/acetominophen also have pain relieving properties through analgesic and anti-inflammatory effects. The pharmacologic management of pain must consider appropriate dosing, procedures performed and the patient's post-surgical course.

ANALGESIA IN THE SUBSTANCE ABUSE PATIENT

The treatment of pain in the substance abuse patient can be a difficult dilemma, as most physicians are concerned regarding the addiction potential of narcotics. The initial concern in addressing postoperative or post-traumatic pain in this subset of patients is to control their pain, with detoxification to come once the acute pain is adequately controlled. Addiction is described as a "behavioral pattern characterized by overwhelming involvement with the use of a drug (compulsive use), the securing of its supply, and a high tendency toward relapse after withdrawal."[1] Withdrawal symptoms commonly associated with opiate abuse have a 2 to 12 hour onset after the last dose, and include diaphoresis, lacrimation, rhinorrhea and yawning. Patients may become physically dependent on a drug, in that they need periodic dosing to prevent withdrawal. This is an important factor in tapering dosages, and control of pain in the hospital setting. These patients often develop tolerance to a certain level of medication, therefore dosage or frequency must be increased. This occurs in substance abuse patients, requiring them to take increased amounts of narcotics to provide an analgesic effect, and to prevent withdrawal symptoms.

The control of pain in substance abuse patients is a dilemma, as increased dosages are necessary to control traumatic or surgical pain. A second opiod derivative is often used to replace the addiction substance and suppress the withdrawal symptoms, while attempting to detoxify the patient through gradual tapering of medication. Methadone has been shown to be an effective opiod analgesic for control of postoperative pain in the addicted patient. It has a long duration of action, and detoxification can occur by decreasing the dose 10% to 15% every three days. The drug is given orally. This decision-making process usually includes the treating physician as well as a pain management specialist to assist in the detoxification and recovery process.

The management of postoperative pain in the drug dependent patient is two-fold: initially the acute pain caused by trauma or surgery must be controlled, followed by encouragement and working with a drug rehabilitation program with a team approach to detoxify the patient. The plan must be discussed with the patient with an addictive personality to prevent the return to the addictive lifestyle. The preoperative knowledge that these patients require increased dosage allows for proper adjustment to adequate levels in the perioperative period. The patient with an addictive personality must also be observed and instructed regarding taper so that an abuse pattern does not develop. Following the proposed algorithm is beneficial in treating the addicted/tolerant patient, as it is important to remember that an inadequate level of narcotics is not the only source of postoperative pain complaints.

CONCLUSION

Following the proposed algorithm may necessitate increasing medication dosage and changing to a more potent narcotic (which is appropriate when approached in a systematic way). Ischemic pain, produced by spasm or compression, must be ruled out, because this will not be relieved by increased dosages of narcotic analgesics. The algorithm must be followed in the addictive personality as well, since the cause of ischemic or spasmodic pain still exists, but is obviously much more difficult to ascertain when the patient is tolerant to lower dosages. The sedative effect of the narcotic may increase, but the ineffectiveness of the narcotic is often due to a secondary factor that must initially be addressed. A systematic approach allows the cause of pain to be determined, evaluated and addressed appropriately allowing for the most efficient and least addictive treatment plan.

Table 1 ANALGESICS FOR MILD TO MODERATE PAIN

GENERIC	TRADE	RATIOS	CLASS	ORAL DOSE	COMMENTS
Propoxyphene	Darvon	65 with 389 aspirin and 32.4 caffeine	Opiate Agonist	1 q 4h NTE 390 mg qd	1/2-2/3 Codeine potency
Propoxyphene Napsylate	Darvocet N-50	50 with 325 acetominophen	Opiate Agonist	1-2 q 4 h NTE 12/24 h	2/3-equal Codeine potency <600 mg/day
	Darvocet N-100	100 with 650 acetominophen	Opiate Agonist	1 q 4 h NTE 6/24 h	
Acetominophen	Tylenol	325 mg		1-2 q 4-6 h NTE 12/24 h	<4 gm/day
	Tylenol ES	500 mg		1-2 q 4-6 h NTE 8/24 h	
	Tylenol Extended Relief	650 mg		1-2 q 4-6 h NTE 6/24 h	
NSAIDs			NSAID		

Table 2 ANALGESICS FOR MODERATE TO SEVERE PAIN

GENERIC	TRADE	RATIOS	CLASS	PARENTERAL	ORAL	COMMENTS
Oxycodone	Percodan	4.5mg with 325mg ASA	Opiate Agonist		1 q 6 h	
	Percocet	5mg with 325mg acetominophen	Opiate Agonist		1 q 6 h	
	Tylox	5mg with 500mg acetominophen	Opiate Agonist		1 q 6 h NTE 8/24 h	
Hydrocodone	Lortab 2.5	2.5mg with 500mg acetominophen	Opiate Agonist		1-2 q 4-6 h NTE 8/24 h	
	Lortab 5	5mg with 500mg acetominophen	Opiate Agonist		1-2 q 4-6 h NTE 8/24	
	Lortab 7.5	7.5mg with 500mg acetominophen	Opiate Agonist		1 q 4-6 h NTE 6/24 h	
	Lortab 10	10mg with 500mg acetominophen	Opiate Agonist		1 q 4-6 h NTE 6/24 h	
	Lorcet 10/650	10mg with 650mg acetominophen	Opiate Agonist		1 q 4-6 h NTE 6/24 h	
	Vicodin	5mg with 500mg acetominophen	Opiate Agonist		1-2 q 4-6 h NTE 8.24 h	
	Vicodin ES	7.5mg with 750mg acetominophen	Opiate Agonist		1 q 4-6 h NTE 5/24 h	
Codeine	Tylenol with Codeine #2	15mg with 300mg acetominophen	Opiate Agonist		1-2 q 4 h	<360mg Codeine/day
	Tylenol with Codeine #3	30mg with 300mg acetominophen	Opiate Agonist		1-2 q 4 h	
	Tylenol with Codeine #4	60mg with 300mg acetominophen	Opiate Agonist		1-2 q 4 h	
	Tylenol with Codeine Elixir	12mg with 120mg acetominophen with 7% alcohol/5ml	Opiate Agonist		adult 15 ml q 6 children .5 mg/kg	
Meperidine	Demerol		Opiate Agonist	50-150mg q 3-4 h	50-200 mg q 3-4 h children .5-.5 mg/lb q 3-4	< 3 gm q day due to normeperidine acculmulation (neruotoxicity, seizures)
	Mepergan Fortis	50mg with 25mgPhenergan	Opiate Agonist		1-2 q 4 h	
Morphine			Opiate Agonist	2.5-15mg IV q 4 h 5-20mg IM q 4 h	5-30mg q 4 h	
Butorphanol	Stadol		Opiod Ag/Antag	1-4mg IM q 3-4 h 1 mg IV q 3-4 h		5x morphine potency
Nalbuphrine	Nubain		Opiod Ag/Antag	10 mg/70 kg q 3-6 h		
Tramadol	Ultram		Opiate Agonist		50-100 q 6 h NTE 400mg	<400 mg/day
Ketrolac	Toradol		NSAID	30 mg IV/60 mg IM Loading dose, then 15-30 IV/IM q 6 h	10 mg q 4-6 h NTE 40 mg/day	Do not use > 5 days of combined therapy

Table 3 ANALGESICS FOR SEVERE PAIN

GENERIC	TRADE	CLASS	PARENTERAL DOSE	ORAL DOSE
Hydromorphone	Dilaudid	Opiod	1-4 mg q 4-6 h	2-4 q 4-6 h
Dolophine	Methadone	Opiod	2.5-10 q 3-4 h	2.5-10 q 3-4 h

REFERENCES

1. Tucker C: Acute pain and substance abuse in surgical patients. *J Neuroscience Nursing* 22(6):339-349, 1990.
2. Carr ECJ, Thomas VJ: Anticipating and experiencing post-operative pain: the patients perspective. *J Clinical Nursing* 6:191-201, 1997.
3. Ejlersen E, Andersen HB, Eliasen K, Mogensen T: A comparison between preincisional and postincisional lidocaine infiltration and postoperative pain. *Anesth Analg* 74:495-498, 1992.
4. Needoff M, Radford P, Costigan P: Local anesthesia for post-operative pain relief after foot surgery: a prospective clinical trial. *Foot and Ankle International* 16(1):11-13, 1995.
5. Taylor RP: Postoperative cryotherapy. In Vickers NS, Miller SJ, Mahan KT, Yu GV, Camasta CA, Ruch JA, eds. *Reconstructive Surgery of the Foot and Leg - Update 96*. Tucker, Ga: The Podiatry Institute; 1996:299-301.
6. Belleville JW, Forrest WH, Miller E, Brown BW: Influence of age on pain relief from analgesics: a study of postoperative patients. *JAMA* 217(13):1835-1841, 1971.
7. Burns JW, Hodsman NBA, McLintock TTC, Billies GWA, Kenny GNC, McArdle CS: The influence of patient characteristics on the requirements for postoperative analgesia : a reassessment using patient-controlled analgesia. *Anaesthesia* 44:2-6, 1989.

ADDITIONAL REFERENCES

Benzon HT: Postoperative pain and its management. *Resident and Staff Physician* 35(4):21-26, 1989.

Bradner B, Munro B, Bromley LM, Hetreed M: Evaluation of the contribution to postoperative analgesia by local cooling of the wound. *Anaesthesia* 51:1021-1025, 1996.

Caldarella DJ, Scholnick F: Postoperative pain management. In Camasta CA, Vickers NS, Ruch JA, eds. *Reconstructive Surgery of the Foot and Leg - Update 93*. Tucker, Ga: The Podiatry Institute: 1993: 327-331.

Cohn BT, Draeger RI, Jackson DW: The effects of cold therapy in the postoperative management of pain in patients undergoing anterior cruciate ligament reconstruction. *Am J Sports Med* 17(3):344-349, 1989.

Katz J: Pre-emptive analgesia: evidence, current status and future directions. *European J Anaesthesiology* 12(10): 8-13, 1995.

Stockle U, Hoffmann R, Schutz M, von Fournier C, Sudkamp NP: Fastest reduction of postoperative edema: continuous cryotherapy or intermittent impulse compression? *Foot Ankle Int* 18(7):432-438, 1997.

Walker RH, Morris BA, Angulo DL, Schneider J, Colwell CW: Postoperative use of continuous passive motion, transcutaneous electrical nerve stimulation, and continuous cooling pad following total knee arthroplasty. *J Arthroplasty* 6(2):151-156, 1991.