Assessment and Management of Postoperative Pain Associated with Sleep Apnea Surgery

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KEYWORDS

• OSA • Surgery • Postoperative • Pain • Opioids

KEY POINTS

- Given the risks of opioid use by patients with obstructive sleep apnea (OSA), special attention to opioid risk reduction and avoidance is warranted.
- There is a growing body of evidence that supports the safe and effective use of nonopioids and nonpharmacologic management of postoperative pain following OSA surgery.
- Strategies for managing postoperative pain should include the use of local anesthetic infiltration, nonsteroidal antiinflammatory drugs, acetaminophen, topical analgesics, surgical wound cooling, and when necessary, safer opioid medications, such as tramadol and intranasal butorphanol.

INTRODUCTION

Obstructive sleep apnea (OSA) is a highly prevalent disorder in which individuals experience periodic repetitive episodes of complete or partial obstruction of the upper airway during sleep. In the United States, OSA affects at least 10% of men and 3% of women older than 30 years.[1] OSA is associated with cardiovascular disease, stroke, diabetes, and cognitive dysfunction, contributing to decreased work productivity and quality of life, as well as increased risk of workplace disability and car accidents.[2–4] Consequently, OSA results in a socioeconomic cost comparable to that of smoking.[5]

The gold-standard treatment of OSA is continuous positive airway pressure (CPAP), which attempts to maintain airway patency by blowing a stream of air through the nose or mouth. Although effective, CPAP is difficult to tolerate for many, resulting in poor

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Otolaryngol Clin N Am 53 (2020) 765–777
https://doi.org/10.1016/j.otc.2020.05.006
oto.theclinics.com

long-term adherence.[6] For patients who fail CPAP, surgery may be offered. OSA surgery aims to restore airway patency by removing or displacing obstructing tissue at one or more levels along the upper airway or by increasing the size of the airway via reconstructive techniques. The recognition that obstruction may occur at more than one anatomic level led to multilevel surgical approaches in which multiple surgical procedures are performed at the nasal, soft-palate, oropharyngeal, and/or hypopharyngeal levels.[7]

Surgery for OSA can be extremely painful postoperatively. In a study of adult patients with OSA who underwent nasal, pharyngeal, or combination surgery, the most common adverse outcome was emergency room visit for pain-related diagnoses.[8] Postoperative pain may also be a significant reason why patients avoid surgery.[9] When OSA surgery is performed, postoperative pain is commonly treated with opioids analgesics. In a recent survey of prescribing patterns among otolaryngologists, tonsillectomy and uvulopalatopharyngoplasty (UPPP) had the highest average number of tablets of pain medication prescribed of all surgical procedures assessed.[10] Given the present epidemic of opioid addiction in the US, opioid stewardship is a particularly important issue for otolaryngologists who perform sleep surgery.[11] In addition, the use of opioids by OSA patients deserves special attention, as OSA may be a risk factor for opioid-induced respiratory depression.[12] Moreover, OSA patients may experience increased postoperative pain intensity and decreased pain tolerance.[13] The mechanisms that underlie these associations are poorly understood, and the effect of OSA surgery on pain sensing has not been well studied.

The aim of this work is to review and synthesize the literature encompassing the assessment and management of postoperative pain in adults following OSA surgery, with an emphasis on opioid risk-reduction and avoidance.

ASSESSMENT OF POSTOPERATIVE PAIN

Uvulopalatopharyngoplasty, Modifications, and Variations

UPPP, the most common surgical procedure for OSA, was first reported as a surgical correction of anatomic abnormalities in OSA by Fujita and colleagues[14] in 1981. Although high success rates were initially reported, subsequent studies demonstrated poor outcomes for UPPP in isolation when used to treat OSA in all but a select group of patients.[15] Consequently, variations of UPPP, as well as palatopharyngeal reconstructive procedures, have been introduced.

Early variations to conventional UPPP include coblation- and laser-assisted uvulopalatoplasty (LAUP), which may be staged procedures, and may take place in an outpatient setting. In studies evaluating LAUP, postoperative pain visual analogue scale (VAS) scores were in the moderate to severe range.[16–23] Pain associated with LAUP may be significantly less than traditional UPPP[17,19,22,23] but worse compared with coblation and radiofrequency (RF) palate surgery.[16,18,22,23] LAUP may also require a shorter duration of pain medication use than UPPP but a longer duration compared with RF palate surgery. In these studies, patients received a nonsteroidal antiinflammatory drug (NSAID) and/or acetaminophen, and/or narcotic pain medications, and/or corticosteroids for pain control.

In a study that described a modified UPPP using a microdebrider, postoperative VAS pain scores were in the low to moderate range, much less than those associated with traditional UPPP.[24] Patients received acetaminophen with codeine.

Several palatal reconstructive procedures have been proposed for lateral pharyngeal wall collapse. Lateral pharyngoplasty was the first such procedure. Postoperative pain after LP is reported as moderate and not significantly different than UPPP.[25–27] In

studies, pain medications used for LP include NSAIDs, tramadol patient-controlled analgesia (PCA), and pethidine.

Expansion sphincter pharyngoplasty (ESP) was introduced to address lateral pharyngeal wall collapse while minimizing the relatively high rates of dysphagia reported after lateral pharyngoplasty. A randomized controlled trial (RCT) that compared ESP with UPPP using NSAIDs for pain relief showed no significant difference in the use of analgesics postoperatively.[28] A recent prospective study evaluating a modified ESP technique in patients who received acetaminophen, NSAIDs, tramadol, and steroids reported significant postoperative pain in more than half of patients.[29]

In a prospective study evaluating soft palatal webbing flap palatopharyngoplasty, a procedure designed to simultaneously address both lateral pharyngeal wall and soft palatal collapse, patients who received acetaminophen for pain control reported moderate VAS pain scores in the first week that subsided by the end of the second week after surgery.[30]

Anterior palatoplasty (AP) was introduced as a modification to a palatal stiffening procedure using electrocautery designed to create a palatal scar and fibrosis, resulting in an increase in the anteroposterior distance of the velopharynx.[31] Postoperative VAS pain scores for AP are in the moderate to high range with or without tonsillectomy.[27,31–36] With NSAIDs and possibly narcotic pain medication, pain reportedly resolves by 2 weeks following surgery. One study comparing AP with LP found no significant difference in postoperative pain when patients received tramadol PCA and pethidine.[27] A retrospective study that looked at combined AP and ESP reported pain medication use that lasted about 5 days on average.[37]

The uvulopalatal flap (UPF) technique is a reversible technique that was designed to achieve the same anatomic results of the UPPP while reducing the risks of velopharyngeal insufficiency.[38] UPF results in moderate postoperative pain.[17,34–36,39] Compared with UPPP, UPF results in less intense pain of shorter duration among patients who received an NSAID.[17] Three RCTs that compared UPF with AP found that UPF resulted in significantly more postoperative pain.[34–36] Patients received acetaminophen in 2 of the studies and IV tramadol and acetaminophen in the third.

Z-palatoplasty (ZPP) is a modified UPPP designed to create a scar contracture that ensures widening of the anteroposterior and lateral oropharynx at the level of the palate, particularly in individuals without tonsils. Compared with UPPP, ZPP results in a significantly shorter duration of pain medication use among patients taking acetaminophen with codeine.[40]

Other palatal reconstructive techniques have been devised to reposition or displace the palatopharyngeus muscle in a more lateral and anterior position to enlarge the retropalatal space, including relocation pharyngoplasty (RP),[41] barbed reposition pharyngoplasty (BRP),[42] barbed palatoplasty (BP),[37] the velo-uvulo-pharyngeal lift,[43] barbed Roman blinds technique,[44] and the Alianza technique.[45] Studies describing these techniques report postoperative pain in the moderate range that decreased to mild by postoperative day 7. In a retrospective study comparing BP with combined AP and ESP, patients who underwent BP used pain medications for a significantly shorter duration than for combined AP and ESP.

Radiofrequency/Coblation Tongue Base Reduction

The tongue base is a common site of obstruction in patients with OSA. Traditional midline glossectomy and open procedures are rarely, if ever, performed due to significant morbidity. Alternatively, minimally invasive techniques were developed to address tongue base obstruction, including submucosal minimally invasive lingual

excision (SMILE), RF tongue base reduction (RFTBR), and robot-assisted tongue base resection procedures.

Postoperative pain VAS scores for RFTBR range from mild to moderate, and durations of pain medication use range from 2 to 4 days.[46–51] Reported pain regimens include NSAIDs only, NSAIDs and steroids, and narcotics and NSAIDs. One study that compared RFTBR with SMILE reported no significant difference in postoperative pain.[51] Another study found that RFTBR resulted in significantly less postoperative pain than SMILE.[50]

In a study examining postoperative outcomes of multilevel surgery involving RFTBR, patients also underwent nasal surgery when appropriate, palatal stiffening implants, and partial uvulectomy.[52] The number of postoperative days that narcotic pain medication was used ranged from 0 to 4. Another study that involved RFTBR as well as RF ablation of the inferior turbinates, soft palate, genioglossus, and tonsils demonstrated very low overall postoperative VAS scores.[53]

Hyoid Suspension

Hyoid suspension and its variants involve repositioning the hyoid bone using fascia, sutures, or wires to expand the retrolingual airway. With the use of an NSAID, postoperative pain following hyoid surgery is low to moderate and decreases to mild by postoperative day 5 to 7.[54–56]

Transoral Robotic Surgery

Transoral robotic surgery (TORS) for OSA was introduced to provide a minimally invasive technique with better access, exposure, and visualization of oropharyngeal and supraglottic structures. Studies that evaluated TORS in combination with ESP report low postoperative pain that is not significantly different than TORS plus UPPP or TORS plus BRP.[57,58] Another study retrospectively compared TORS with ZPP with RFTBR with ZPP and SMILE with ZPP.[59] Postoperative day 1 pain was in the severe range for all 3 procedures.

Hypoglossal Nerve Stimulation

Direct stimulation of the hypoglossal nerve to protrude the tongue and expand the pharyngeal airway during sleep is a relatively new and promising surgical approach to the treatment of OSA. Because the procedure involves only small incisions over the neck and chest with minimal dissection, low postoperative pain is expected. In several studies, mild pain was reported in 14% to 26% of patients, whereas moderate to severe pain was reported in 2% to 4% of patients.[60–62] A recent systematic review of hypoglossal nerve stimulation (HNS) for OSA found that only 6.2% of patients reported postoperative pain.[63]

NONOPIOID TREATMENT OF POSTOPERATIVE PAIN

Vitamin C

One RCT demonstrated improved pain scores and reduced opioid analgesic utilization after preoperative vitamin C. It is unclear if this effect lasted more than 24 hours postoperatively.[64]

Local Anesthetics

Local infiltration with anesthetic agents has significant potential for decreasing immediate postoperative pain and can potentially decrease overall narcotic use. One prospective analysis found that bupivacaine infiltration resulted in significant improvement in postoperative pain during swallow and at rest. Similarly, lidocaine

infiltration was found to be superior to placebo.[65] Another RCT demonstrated the advantageous effects of ropivacaine infiltration at rest and during swallowing, including decreased morphine PCA consumption.[66]

Local glossopharyngeal nerve blocks, however, do not seem to confer similar benefits.[63] A novel technique for continuous lesser palatine nerve local anesthesia infiltration using a tunneled catheter after UPPP provided some benefit but is challenging to perform and complications are unclear.[67]

Corticosteroids

Corticosteroids are known for their antiinflammatory and antiemetic effects. One prospective study tested the analgesic effects of unilateral local wound infiltration with triamcinolone in UPPP patients and found lower VAS scores on the test side.[68] One the other hand, systemic corticosteroids have not proved as efficacious in UPPP patients.[69]

Sucralfate

Sucralfate has been used for decades in the treatment of peptic ulcer disease. It is thought to provide a protective coating by binding exposed protein of damaged cells. It also promotes local production of prostaglandin E2, which increases blood flow, mucous production, and surface migration of cells and accelerates healing. Two RCTs found that sucralfate improved postoperative pain outcomes, decreased analgesic requirement, accelerated mucosal healing, and resulted in early return to regular daily activities.[70,71]

Dexmedetomidine

Dexmedetomidine is an alpha-2-adrenergic agonist with sedative and analgesic properties. Its use for intraoperative anesthesia during upper airway surgery for OSA has been shown to be safe, with a stable hemodynamic profile; however, its opioid-sparing properties have not been shown to decrease narcotic use intraoperatively.[72] Conversely, postoperative infusion of dexmedetomidine is associated with improved VAS scores, decreased morphine utilization, longer time to first analgesic request, and less side effects in UPPP patients.[73] Moreover, use of dexmedetomidine may result in significantly lower incidence of oxyhemoglobin desaturation and bradypnea.

Nonsteroidal Antiinflammatory Drugs

NSAIDs are effective analgesics because of their ability to inhibit inflammatory prostaglandins via inhibition of the cyclooxygenase-2 (COX2) enzyme. However, their use in upper airway surgery has traditionally been guarded due to a presumed increased risk of postoperative hemorrhage.

Ketoprofen is a phenylpropionic acid-derivative NSAID that has been in clinical use since 1973. It seems to take effect rapidly and is believed to decrease the respiratory depressive effects of opioids. It is also less likely to disturb hemostatic function compared with several other NSAIDs. Its use with UPPP has been examined in several studies. One study found ketoprofen to provide sufficient analgesia in 90% of patients after UPPP for up to 2 weeks postoperatively.[74] However, this effect was not long-lasting, as its half-life is only 2 hours. An increased risk of postoperative bleeding has not been found.[75] An RCT that examined the effects of ketorolac versus ketoprofen after UPPP found that ketorolac resulted in lower VAS pain scores and less opioid use than ketoprofen without a difference in the rate of complications.[76] No increased risk of postoperative hemorrhage was found with ketorolac. Similar findings were confirmed when ketorolac was compared with mefenamic acid.[77]

Parecoxib and celecoxib belong to a subclass of NSAIDs that selectively bind and inhibit COX2. Celecoxib in combination with pregabalin was shown to decrease VAS pain scores and postoperative opioid consumption when given preemptively 1 hour preoperatively before maxillomandibular advancement with or without concomitant genioglossus advancement.[78] Another study examined the role of parecoxib after UPPP in patients with OSA and found significantly improved VAS pain scores at rest and during swallowing, without an increase in adverse reactions.[79]

Lastly, the use of diclofenac after UPPP was associated with less rescue analgesic consumption and significantly lower VAS pain scores compared with placebo.[80] There was no increase in side effect profile or bleeding time associated with diclofenac.

OPIOID TREATMENT OF POSTOPERATIVE PAIN

Intranasal Butorphanol

Butorphanol, a synthetic opioid agonist-antagonist, is a potent narcotic. Its analgesic potency is 15 to 23 times greater than that of meperidine. It does not appear to cause dose-related respiratory depression and seldom causes physical dependence. Intranasal (IN) butorphanol is easy to administer, especially in patients experiencing severe oral pain, and is rapidly absorbed.

Several studies have examined the impact of IN butorphanol on postoperative pain in UPPP. In a study that compared IN butorphanol, IV butorphanol, and IN fentanyl, those treated with IN butorphanol experienced less nausea and vomiting, less postoperative pain, and less postoperative cognitive dysfunction.[81] Another RCT found that IN butorphanol was equivalent to mefenamic acid and intramuscular meperidine in terms of postoperative pain control and pain-associated morbidities.[82] Finally, a prospective cohort study examined the use of IN butorphanol, ibuprofen, and magic mouthwash in patients who underwent LAUP and nasal turbinate coblation.[83] The intervention was found to cause a 50% reduction in pain within an average of 48 minutes, with 30% of patients requiring no additional interventions.

Fentanyl

In one study that examined the use of fentanyl to treat OSA surgery postoperative pain, patients who underwent either UPPP or tonsillectomy received loading and continuous doses of ketoprofen in addition to fentanyl PCA.[84] There were no reported adverse side effects that warranted drug discontinuation. In addition, there were no reported episodes of increased respiratory depression or significant sedation.

Hydrocodone and Oxycodone

There is a paucity of research examining the use of oxycodone and hydrocodone in OSA surgery patients. One retrospective analysis comparing narcotic use alone versus use in addition to ketorolac or gabapentin reported no differences in pain-related phone or clinic encounters or in complication rates.

NONPHARMACOLOGIC TREATMENT OF POSTOPERATIVE PAIN

Autologous Platelet-Rich Fibrin

Platelet-rich fibrin (PRF) is an immune and platelet concentrate in a single-fibrin membrane, which is believed to contain up to 60 different biologically active substances. Topical application of PRF theoretically mimics and supports physiologic wound healing. Its use has been studied in numerous clinical settings.[85] In a study of patients undergoing RP who received PRF, there was a significant reduction in VAS pain scores, time required to return to a normal diet, and rate of wound dehiscence.[86]

Cooling Techniques

Cooling is one of the oldest methods of pain control. Immediate cooling of thermal injuries reduces pain, decreases injury to tissues, and promotes quicker healing. In an RCT evaluating surgical wound cooling after UPPP and tonsillectomy, 5 minutes of cooling was associated with a significant reduction in the average daily and overall pain VAS scores.

DISCUSSION

OSA is a highly prevalent disorder with significant comorbidities that often requires painful surgical treatment in individuals who are unable to tolerate treatment with CPAP. Postoperative pain has traditionally been managed with opioid pain medications. However, there is a growing body of evidence that supports a detrimental impact of opioids on patients with OSA. In particular, people with OSA are at increased risk of opioid-induced respiratory depression or central apnea and may have increased pain sensitivity and decreased pain tolerance. Therefore, the issue of postoperative pain management is a particularly important aspect of safe and quality care for patients with OSA. In 2014, the American Society of Anesthesiologists published a set of evidence-based practice guidelines for perioperative management of patients with OSA that offers some guidance on general postoperative pain management for patients with OSA.[87] Among their recommendations, the investigators advocate for the reduction or elimination of opioid medications via the use of regional analgesic techniques, NSAIDs, and other modalities, such as ice or transcutaneous electrical nerve stimulation. However, there is presently no widespread consensus specifically regarding the management of pain after OSA surgery.

A review of the literature revealed widely varying postoperative pain levels depending on the type of surgery. In general, procedures that are limited to mucosa and do not include tonsillectomy produce less postoperative pain. A diversity of pain medications and pain management approaches used to treat postoperative pain after OSA surgery was also observed. Because of significant heterogeneity and incomplete reporting, it is difficult to systematically compare postoperative pain and pain relief across studies. Moreover, it is unclear whether reports of pain reflect analgesic suppressed pain levels or pain that subsequently required analgesia. Nonetheless, numerous studies of a variety of types of OSA surgery report that postoperative pain scores for patients who received narcotic pain medications are similar to postoperative pain scores of patients who used nonnarcotic medications. This suggests that postoperative pain for many patients might be effectively managed with nonopioids, even for the most painful surgeries, such as UPPP and tongue base resection.

Numerous studies have assessed postoperative pain outcomes using nonopioid medications, including NSAIDs (ibuprofen, diclofenac, naproxen, and celecoxib), acetaminophen, and corticosteroids and collectively suggest a minimal detrimental impact on postoperative complications.[17–19,25,30,31,34,35,49,51,54,56,88] In several studies, patients were given tramadol in addition to other nonopioid medications.[27,29,36]

Evidence for nonopioid postoperative pain control is provided by numerous studies that demonstrate improved postoperative pain and decreased opioid use with NSAIDs, including ketorolac,[76,77] diclofenac,[80] and COX2 inhibitors.[78,79] The use of NSAIDs does not seem to significantly increase the risk of postoperative bleeding.

Several other analgesic adjuncts with opioid-sparing properties, including sucralfate, pregabalin, and dexmedetomidine, may also provide significant pain relief. High-level evidence supports the use of topical sucralfate to reduce analgesic requirements following UPPP and LAUP.[70,71] One RCT showed that a one-time preoperative

oral dose of pregabalin and celecoxib before maxillomandibular advancement surgery decreased postoperative pain and reduced postoperative narcotic used.[78] Another study reported that dexmedetomidine resulted in lower postoperative pain and decreased opioid consumption.[73] It also significantly lowered the incidence of oxyhemoglobin desaturation and bradypnea, a particularly important finding given the increased risk of opioid-induced respiratory depression in patients with OSA. In addition, novel nonpharmacologic approaches have shown promising results, such as topical PRF[86] and IV vitamin C[64]; however, further study is required.

Several studies support the use of intraoperative local infiltration of bupivacaine or ropivacaine to help alleviate postoperative pain and reduce opioid use after OSA surgery.[65,66] Local wound infiltration with triamcinolone acetonide may also help to reduce surgical pain.[68] In addition, one RCT showed that simple intraoperative ice pack administration results in significantly reduced pain following UPPP.[89]

Because patients with a history of OSA may experience pain more intensely and have a lower pain tolerance than the general population, the use of opioid pain medications may be necessary for some individuals. Butorphanol, a potent narcotic that does not seem to cause dose-related respiratory depression and seldom causes physical dependence has gained interest in the management of postoperative pain for patients with OSA. Several studies have demonstrated equivalent or better pain control after OSA surgery compared with other narcotic pain medications.[81–83]

This review demonstrates the existence of a body of evidence that supports the use of nonopioid analgesics and nonpharmacologic approaches to the management of postoperative pain following surgery for OSA. The risks of opioids for people with OSA are significant, and in light of the growing epidemic of opioid misuse and abuse, special attention to opioid risk-reduction and avoidance is warranted in this population.

SUMMARY

Strategies for managing postoperative pain should emphasize the use of multimodal analgesic therapy, including long-acting local anesthetic infiltration, NSAIDs, acetaminophen, topical analgesics, and surgical wound cooling. In cases where necessary, opioid medications may be used; however, safer medications such as tramadol and IN butorphanol should be considered.

DISCLOSURE

The authors report no financial or other relationships that may lead to a conflict of interest.

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