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Sedation and Pain killers in the Interventional Radiology

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Abstract

Introduction: Decisions regarding the use of sedatives and analgesics during interventional radiology (IR) procedures were primarily determined by habits and philosophies of the institution and that neither patient anxiety and pain scores nor physician decisions affected drug utilization. This review highlighted the articles that focused on the use of sedation or analgesic procedure during interventional radiology.

Methods: A systematic MEDLINE/PubMed literature search was performed with different combinations of search terms. The eligibility criteria included addressing pre- or post-operative pain control during interventional radiology. The full-text of the eligible articles were retrieved and two independent reviewers extract the information concerning sedation and pain killers from the eligible studies. Further exclusion of irrelevant articles were made based on the in-depth reading. The findings were discussed in a narrative data synthesis in the following section.

Results: Interventional radiology encompasses a wide range of procedures and the degree of associated pain depends predominantly on the procedure being undertaken. Procedures may be painful during but not after the procedure, relatively painless during but painful after the procedure, or relatively painless during and after the procedure. However, there is a lack of good quality publications in interventional radiology that specifically address the subject of peri- and postprocedural pain management. Weight-based protocols for procedural sedation have demonstrable benefit, protocols for postprocedural pain relief after major procedures have not been sufficiently rigorously evaluated.

Conclusions: Protocols for postprocedural pain relief after more invasive procedures such as UAE have not been rigorously evaluated. However, a regimen comprised of an opioid PCA combined with a regular oral NSAID and an antiemetic is sufficient for the majority of patients.

Keywords: Sedation, Analgesics, Radiology, Intervention, Diagnostic Osteoporosis

Introduction

Analgesia is defined as relief of pain without intentional production of an altered mental state such as sedation. A pharmacologic strategy should be planned before the procedure starts to minimize anxiety and pain, which are strongly related to the target of drug administration. Pain agitation and anxiety are potential side effects. Agitation can be paradoxical or due to pain, and sometimes it can be worsened by further sedative administration [1].

Decisions regarding the use of sedatives and analgesics during interventional radiology (IR) procedures were primarily determined by habits and philosophies of the institution and that neither patient anxiety and pain scores nor physician decisions affected drug utilization [2]. Analgesia is defined as relief of pain without intentional production of an altered mental state such as sedation. Pain signals are received, but medication prevents the perception of pain. Moreover, some preclinical studies have demonstrated the possibility of the sedative hypnotic drugs to increase pain perception, or its intensity, requiring thus analgesia. However, sedation can have an analgesic effect as pain is the result of an integrated sensory, affective, motivational system that modulates nociceptive input [3, 4].

Interventional radiologists may use a combination of drugs before, during and after the procedure to decrease pain and anxiety, thus allowing the procedure to be performed often on an outpatient basis. Nitrous oxide (NO) analgesia is safe and effective for use in IR in a wide variety of situations requiring pain and anxiety management [5]. NO has been used in radiology to control pain and distress in pediatric population. It has been suggested that pain and auditory pathways inhibit each other. Brain mechanisms underlying the modulation of pain perception under hypnotic conditions involve cortical as well as subcortical areas including anterior in the cingulate and prefrontal cortices, basal ganglia and thalami [6].

It has been shown to be effective in alleviating the perception of pain, anxiety and general discomfort in adults and children. The neurophysiological mechanisms of Virtual Reality (VR) efficacy on pain perception are not clearly understood [7]. Although evidence of the effectiveness of VR distraction to reduce pain and anxiety builds up , the analgesic efficacy of this technique is still poorly studied in medical procedures as well as in IR . It would worth to study as immersion in a hypnotic experiment induced by the VR of a patient having to undergo a procedure in IR could saturate his sensoriality, thus reducing the nociceptive perceptions and anxiety correlated with this procedure. Preliminary results from several studies demonstrated the feasibility, the efficacy and the safety of several sedative techniques in IR [8]. Beyond pharmacological sedation or hypnosis, digital sedation could reduce the anxiety and pain associated with IR procedures and may provide to the patient the adequate tools to optimize their ability to cope with painful and anxiety-provoking situations, in addition to improving post-procedural outcomes.

The principle of these techniques is based on verbal suggestions, particularly on sensory elements, made by the professional, which creates a modified state of consciousness, leading the patient to a dissociative state, thus modifying the perceptions of the pain. Multiple factors, such as the increased co-morbidities of patients referred to IR, cost containment, increasing numbers and complexity of IR procedures along with higher expectations among patients, have greatly increased the demand for sedation facilities [8, 9]. As general principles, the choice of sedation technique performed will depend on several factors, including type and duration of the procedure itself, anesthesiologists' availability. In the USA PSA can be provided by personnel authorized by the ASA, which has created a training course that allows the providers

to deliver only mild to moderate sedation to ASA physical status I and II patients [10]. Self-hypnosis is defined as a state of heightened and focused concentration during which patients use their own abilities to gain control over anxiety and the perception of pain. Self-hypnosis is a specific coping mechanism that patients can use to handle pain better and to reduce the effects of stress [11]. However, it has been shown that lay persons and radiology personnel can be trained effectively in facilitating self-hypnosis, and that even poorly hypnotizable patients may benefit from such interventions. This review highlighted the articles that focused on the use of sedation or analgesic procedure during interventional radiology.

Methods

A systematic MEDLINE/PubMed literature search was performed with different combinations of terms as "analgesia", "anxiety", "digital sedation", "clinical hypnosis", "interventional radiology", "local anesthesia", "pain", "sedation", "virtual reality". The eligibility criteria included addressing pre- or post-operative pain control during interventional radiology. The full-text of the eligible articles were retrieved and two independent reviewers extract the information concerning sedation and pain killers from the eligible studies. Further exclusion of irrelevant articles were made based on the in-depth reading. The findings were discussed in a narrative data synthesis in the following section.

Results and discussion

Interventional radiology is increasingly being offered to high-risk patients and as an alternative to surgery. An early case series of 62 patients reported that postembolization pain was a significant complication of hepatic artery embolization . Andreano and colleagues conducted a prospective evaluation of postprocedural pain in 50 patients undergoing elective MW ablation of hepatic tumors under general anesthesia. It has been suggested that the choice and conduct of IR technique may influence the amount of pain that patients experience. Furthermore, in a comparison of chemical ablation with chemoembolization for unresectable hepatic tumors, a randomized clinical trial of 90 patients in a parallel group study found no difference in pain between the two treatments . During interventional radiological procedures, the objective of intraprocedural sedation and analgesia should be to allow patients to tolerate unpleasant procedures and to expedite the conduct of procedures that are not particularly comfortable but that require that the patient does not move. Nagao and colleagues reported that thoracic epidural analgesia successfully managed periprocedural pain in a series of patients who had undergone UAE. Local anesthetic combined with morphine sulfate was administered through an epidural catheter inserted at T 10-11 [12]. In a study assessing 34 consecutive patients undergoing arteriography with nurse-controlled TV conscious sedation, most drugs were given when pain and anxiety scores were low. Patients with low pain and anxiety at the onset tended to do well (raising the question of whether medication was necessary). Although hypnosis was administered on the procedure table, total room times were significantly shorter for patients receiving adjunct hypnosis (61 min; C1 55-66 min) than those receiving only IV conscious sedation (78 min; C1 70-86 min). Invasive diagnostic and therapeutic procedures performed in the interventional radiology (IR) suite can be painful and anxiety provoking, rendering patients unable to follow breathing and movement instructions and potentially increasing the risk of cardiovascular complications [13].

Moderate sedation/analgesia is a depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation. Deep sedation/analgesia is a depression of consciousness during which patients cannot be easily aroused but respond purposefully after repeated or painful stimulation. Patients with chronic obstructive pulmonary disease are at substantial risk of respiratory adverse events resulting from the administration of sedation and analgesia. Patients with severe chronic obstructive pulmonary disease already have a blunted ventilatory response to CO 2 , and excessive sedatives and opiates will further compromise this response, predisposing patients to severe respiratory depression with excessive sedation. Inadequate sedation can increase the risk of an acute cardiac event in these

patients as a result of increased cardiac demand. Hemodynamic instability resulting from sedation is occasionally encountered in deeply sedated patients, particularly in patients with limited cardiopulmonary reserve. A review of patients who underwent endoscopy after sedation with BZDs and supplemental narcotics reported the incidence of serious cardiopulmonary complications and death as 5.4 and 0.3 per 1,000, respectively, and a study of deaths associated with dental procedures estimated the fatality rate as one per 152,000 [5]. Most medications (or their metabolites) used for sedation and analgesia are secreted renally, and patients with chronic renal failure receiving these medications will be predisposed to overdose or to prolonged effect.

In contrast, a double-blind randomized study of 19 patients reported that remifentanil PCA provided comparable pain relief to morphine PCA after UAE . However, adding ketamine to morphine PCA did not reduce morphine requirements during the first 24 h after UAE in another randomized clinical trial (RCT) of 56 patients. Nevertheless a variety of more or less complex pain medication protocols for UAE, varying from standard analgesia in all patients, to extensive regimens with opioid PCA combined with nonsteroidal anti-inflammatory drugs, to regional anesthesia-based protocols, have been developed with varying results [14]. However, there is wide variation in pain experienced between procedures and between patients. Andreano used a post-procedure analgesic protocol consisting of regular ketoprofen, paracetamol and tramadol, continued for 2-3 days with boluses of intravenous morphine for breakthrough pain in 54 consecutive patients undergoing hepatic tumor ablation. In addition, patients receive an anxiolytic (diazepam) immediately before the procedure as well as an acid suppressing drug (omeprazole), an antiemetic (metoclopramide or droperidol) and an analgesic (tramadol) before and after the procedure. In addition to conventional conscious sedation and SHNB, patients were prescribed either short-acting oral morphine tablets and indomethacin rectal suppositories or regular long-acting oral morphine tablets and naproxen rectal suppositories plus short-acting oral morphine tablets as required for breakthrough pain. Another study of 150 patients undergoing nonarterial interventional radiology procedures evaluated pain before and at regular intervals for 24 h after the procedure [15]. They asked 145 patients who had undergone an ablation under conscious sedation with intravenous pethidine to recall the maximum level of pain during the procedure on a scale of 0-10. Minimal post-procedure pain was recorded in a study of 46 patients undergoing elective RF ablation of hepatocellular tumors. They interviewed 99 patients who had received the sedation protocol for less invasive procedures and compared them with historical data. In a study of 91 patients undergoing minor abdominal interventional procedures, 25% of patients reported intraprocedural pain scores >4/10 despite using a systematic protocol for sedation and analgesia. A study of 63 patients undergoing a variety of abdominal drainage procedures using a stepwise protocol for sedation and analgesia found that only 5.6% of patients reported a pain score >4/10 [16].

A study of 53 patients with chronic kidney disease undergoing minor dialysis-related procedures (arteriovenous graft fistulogram/declotting, port insertion and tunnelled dialysis catheter placements) found that 13 and 6% of patients, respectively, reported pain scores >4/10 during and after the procedure. In contrast, a survey of Italian centers, which included data from 2320 patients who had undergone percutaneous RF ablation of focal liver tumors, reported that periprocedural pain was common but postprocedural pain was rare [17]. Pain developing >3 days after the procedure occurred in only 1.5% of patients. They found that 70% of patients recorded an intraprocedural pain score >4/10 and 25% of patients recorded an intraprocedural pain score ≥8/10. In a study of 23 patients undergoing ablation of hepatic tumors with local anesthetic infiltration but no sedation, the median intraprocedural pain score was 8/10 for those patients with lesions adjacent to the liver capsule or portal vein. However, 26% of patients reported pain ≥4/10 at 24 h.

In a study of fentanyl given as a bolus or as a continuous infusion for sedation during RF ablation of hepatic secondaries in 83 patients, the median visual analog scale (VAS) pain scores were 4/10 and 3.4/10, respectively, 3 h after the procedure [18]. Only 19% of patients reported any, mostly mild, post-procedure pain. An early observational study of 81 patients who

had undergone UAE of fibroids reported that after the procedure, most patients experienced several hours of moderate to severe pain that was controlled with morphine PCA started at the conclusion of the procedure in the angiography suite and ketorolac. A subsequent multicenter prospective single-arm clinical treatment trial involving 555 patients undergoing UAE for fibroids found that intraprocedural pain was reported by 30% of women [19]. Postprocedural pain was the commonest indication for prolonged hospital stay, return to hospital (10% of patients) and readmission (3% of patients) . Similarly, inadequate pain relief requiring additional hospital treatment (2.4% of patients) was the commonest adverse event post-discharge recorded by the Fibroid Registry.

In an observational study of 99 patients, these authors found that following UAE, the mean peak pain score in first 24 h was 3.03/10, while the mean peak pain score in first week was 4.99/10. An early observational study of 53 patients suggested that after UAE the extent of embolized tissue correlates with pain , while in a subsequent observational study of 81 patients, no correlations were detected concerning embolization technique, embolization material size and type (spherical or non-spherical particles) or size and/or localization of uterine fibroids. The EMMY trial, a multicenter randomized clinical trial of 81 patients demonstrated a clear and significant relation between pain and amount of embolization material utilized .
Thus in a prospective trial of 113 consecutive patients who were asked to recall their level of pain during transcatheter arterial chemoembolization, the mean VAS score of the 37 control group patients was 3.1/10 [20]. A randomized clinical trial of 58 patients that compared bilateral laparoscopic occlusion of the uterine artery with UAE found that patients who had undergone a laparoscopic procedure had less postoperative pain [21]. Mean pain scores after embolization and at discharge were 3.0/10 and 0.97/10, respectively in electroacupuncture treated patients compared with 4.49/10 and 2.11/10 in the control group. The mean maximum intraprocedural pain score of 91 patients undergoing minor abdominal interventional procedures was 3.4/10, with 75% of patients reporting a pain score ≤4/10. All patients perceived minimal intraprocedural pain. This contradicted the findings of an unpublished questionnaire survey involving 47 lung biopsy patients conducted at the same institution, which found that 38.3% of patients experienced moderate to severe pain. Thus despite opioid analgesics being administered to two-third of patients after UAE in the EMMY trial Hehenkamp felt unable to recommend a fixed pain medication protocol. Klein and Schwartz used a very similar protocol for 35 patients undergoing UAE as an outpatient procedure but did not report pain outcomes [22]. They found that 26% of patients reported pain ≥4/10 at 24 h. In the first 24 h after the procedure, the mean pain score was 3.03/10, with 11 patients experiencing an in-hospital pain score >7/10. The mean peak score in the first week after embolization was 4.89/10 with 19 patients experiencing a pain score >7/10 on any of the first 7 days after discharge.

At the time of discharge, 6 h after the procedure, all patients reported mild pain or no pain. The mean peak pain score in the first 5 days after the procedure for all patients was 4.8/10, but not surprisingly there was a significant difference in favor of regular long-acting oral morphine plus short-acting oral morphine for breakthrough pain over regular short-acting oral morphine only; 2.7/10 versus 5.7/10 ($p < 0.01$). Furthermore, over 90% of patients undergoing UAE experience postprocedural pain with a mean pain score between 5/10 and 7/10. To put this in context, a survey of over 70,764 patients in German hospitals reported that on the first postoperative day, 50% of surgical patients had a pain score >4/10 and 18% of patients had a pain score ≥8/10 [23].

Conclusions

Interventional radiology encompasses a wide range of procedures and the degree of associated pain depends predominantly on the procedure being undertaken. Procedures may be painful during but not after the procedure, relatively painless during but painful after the procedure, or relatively painless during and after the procedure. However, there is a lack of good quality publications in interventional radiology that specifically address the subject of peri- and postprocedural pain management. Nevertheless, a variety of more or less complex protocols exist for intraprocedural sedation and for peri- and

postprocedural analgesia. While weight-based protocols for procedural sedation have demonstrable benefit, protocols for postprocedural pain relief after major procedures have not been sufficiently rigorously evaluated.

Conflict of interests

The authors declared no conflict of interests.

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