PAIN MEDICINE
Volume 9 • Number S1 • 2008

Complications Related to Sedation and Anesthesia for Interventional Pain Therapies

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ABSTRACT

Aim. The use of sedation with invasive pain management procedures is increasingly prevalent. This paper discusses the inherent risks associated with sedation that is too deep as well as general anesthesia for these procedures.

Methods. This article provides numerous illustrations of the risks associated with sedation for invasive procedures and explains other disadvantages of sedation and general anesthesia in this context.

Conclusion. Sedation for invasive procedures cannot be considered benign and the risks of sedation should be discussed with the patient along with the risks of the procedure itself.

Key Words. Sedation; Epidural Injections; Spinal Cord Stimulation; Intrathecal Catheter; Complications; Complex Regional Pain Syndromes; Sympathetic Nerve Blocks

Introduction

In the last decade, there has been significant growth of interventional pain management. With this growth, the venue of procedures is evolving as more procedures are performed in free-standing ambulatory surgical facilities where anesthesiologists are available to provide services for pain management in addition to the surgical procedures they cover. Although the use of anesthesia is not usually needed for many simple procedures, sedation is more frequently utilized for pain procedures than in prior decades. Sedation can be used for pre-operative or pre-procedure medication, intra-operatively during regional or local anesthesia, and post-operatively. Anxiolysis, amnesia, and elevation of the local anesthetic seizure threshold may be desirable effects of sedation. Sedation can be provided orally, intravenously or less commonly, by other routes. A general principle in choosing the route of sedation is to provide as simple and uncomplicated means of sedation as possible, to provide a patient both comfort and safety. Oral medications appropriately timed can provide adequate anxiolysis in most cases.

Although intravenous sedation can be beneficial, inappropriately administered heavy sedation can reduce the patient's ability to provide feedback when vital structures are unintentionally reached with a needle. The lack of this feedback can eliminate one potential way to alert the interventionalist that a procedure has gone awry before a minor complication progresses to a catastrophe. The series of case reports presented in this article underscores the need to carefully consider whether heavy sedation or general anesthesia is necessary for many pain management procedures.

The dose of intravenous medications should be titrated appropriately; the end point of titration should be adequate sedation [1]. Benzodiazepines provide an excellent means of sedation. Propofol by continuous infusion can theoretically provide any readily titratable level of sedation and rapid recovery once the infusion is terminated, independent of the duration of the infusion [2]. However, propofol requires continued vigilance with a goal of maintaining a light level of sedation if it is to be considered for use with pain management procedures. It is important to note that although

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 1526-2375/08/$15.00/S121 S121–S127 doi:10.1111/j.1526-4637.2008.00448.x

Table 1 Uses and doses of propofol [1]

Clinical Use	Dose
Induction of general anesthesia	1–2.5 mg/kg IV; dose reduced in the elderly
Maintenance of general anesthesia	50–150 μg/kg/min IV combined with N_2O or an opiate
Sedation	25–75 μg/kg/min IV
Antiemetic	10–20 mg IV; can repeat q 5–10 min or start infusion of 10 μg/kg/min

propofol can be used as a sedative, that it can also be used for induction or maintenance of general anesthesia. See Table 1. For anxiolysis purposes only, doses on the low end (25 μg/kg/minute) should be considered.

In the last decade, with the growth of the field of interventional pain management, intravenous sedation is more frequently used with invasive procedures. The rationale for providing sedation for patients undergoing pain procedures is to avoid unnecessary anxiety and patient discomfort. A spectrum of effect between mild sedation and deeper levels of anesthesia can be provided by the same medications. However, by providing heavy sedation or general anesthesia, patients are rendered insensate and cannot provide the vital feedback needed to optimize treatment related to the procedure, or avoid complications from procedures. This feedback provides interventionalists with information that allows them to modify technique or abort the procedure, thereby preventing disasters such as spinal cord trauma and infarction resulting in paraplegia and quadriplegia.

Respiratory arrests have been reported because dural puncture was not recognized before local anesthetic was administered.

Cases

Several cases illustrate the danger of heavy sedation and anesthesia for spinal injections.

Case 1

A 44-year-old patient with persistent neck pain after anterior cervical fusion at C5/6 was referred to an anesthesiologist for interlaminar cervical epidural steroid injection. Prior to the procedure, the patient was sedated with midazolam (4.0 mg) fentanyl (total of 100 mcg) and propofol (incremental doses totaling 200 mg according to the record).

Fluoroscopy was employed but according to dictation, the fluoroscope was utilized only in the frontal plane initially and then only to identify midline and level of needle entry. The first image stored is the lateral view (Figure 1) demonstrating a large volume of contrast material vertically oriented in the central canal.

The image in Figure 2 demonstrates solution in the central canal spreading upward and below the needle. Based on the two images, this contrast material must be within the substance of the cord. There is no indication of any patient response to the injection in the procedure note or the records of the anesthesia and nursing staff.

When the patient recovered, she reported intense pain in the neck, in both upper and lower extremities, greater on the left than right. She was weak in all four extremities. Weakness was profound on the left. Emergent magnetic resonance imaging (MRI) (Figure 3) demonstrated bright signal within the substance of the cord, with a focal area of extremely dense contrast material and a larger area of intermediate-to-bright signal extending into the upper thoracic region. Axial images (Figures 4a and 4b) demonstrate this accumulation of bright signal to the left of midline corresponding with the left sided location of contrast material on the prone spot film. The MRI scan was obtained within 3 hours of the injection procedure. Bright signal within the substance of

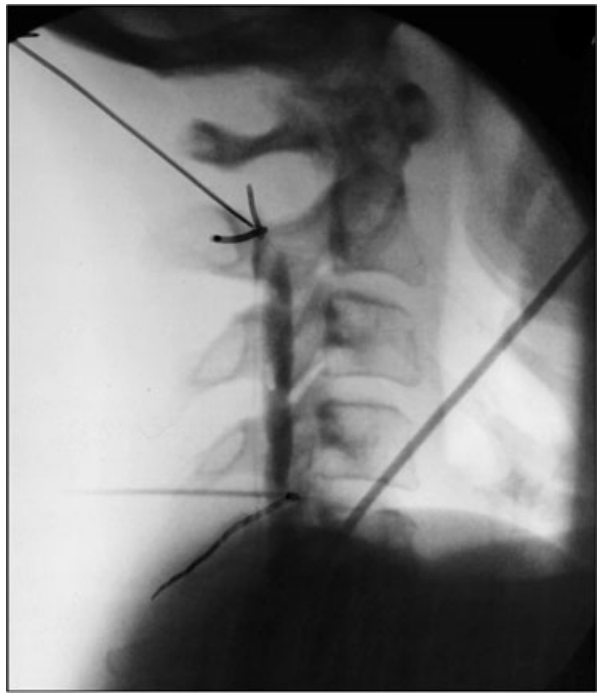

Figure 1 First image. Large needle in place, with the tip located deep in the central canal (open arrow). Large accumulation of contrast material in the central canal is confined.

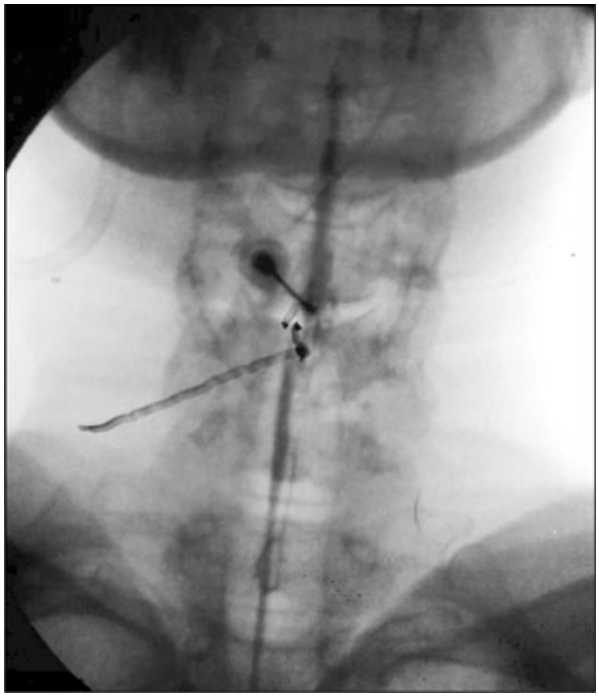

Figure 2 Prone view of procedure. Needle is in the midline. Vertically oriented contrast collection in the central canal extends above and below the needlepoint. The contrast material extending below the needle lies just to the left of midline. On the basis of the frontal and lateral views, the contrast material must be within the substance of the spinal cord.

the cord at this early time is consistent with injection of solution into the substance of the cord. Cord infarct does not appear as a zone of bright signal in less than 24–36 hours. Cord infarct is generally central. The rapid appearance of altered signal and its eccentric location are hallmark findings of direct injection into cord substance.

Case 2

A 25-year-old patient had a work-related injury resulting in left carpal tunnel syndrome and a left cubital tunnel syndrome. She eventually underwent implantation of a spinal cord stimulator system. She presented for revision of the pocket and addition of a new cervical lead. The procedure was performed under general anesthesia. A 14-gauge Tuohy needle was used to place the lead percutaneously through a translaminar approach at C7-T1. The patient woke from the procedure quadraparetic. The lead entered the spinal cord at C7-T1 and traversed rostrally to C2. Figure 5 demonstrates the lead in the body of the cord.

Case 3

A 46-year-old female with back surgery syndrome, status post implantation of a spinal stimulator system underwent implantation of intrathecal catheter and pump under general anesthesia. The catheter was placed percutaneously through a 15-gauge Tuohy needle under fluoroscopic guidance. The needle entered the subarachnoid space at T11–T12. Despite the use of fluoroscopic guidance, the neurosurgeon, who placed the catheter, believed it entered in the lumbar region. Multiple attempts were made to pass the needle utilizing only uniplanar fluoroscopic imaging. The patient woke from anesthesia paraparetic with severe neuropathic pain and compromise of bowel and bladder function. Figure 6 demonstrates entry of the catheter into the subarachnoid space.

Case 4

Slavin recently reported [3] implantation of an intrathecal catheter at T11–T12 under general

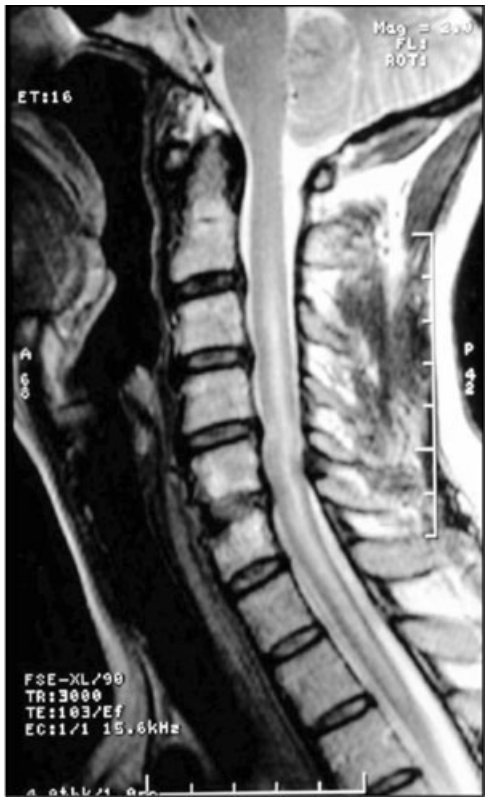

Figure 3 Sagittal MRI, spin echo T2 weighted image. Scan was obtained within three hours of the injection. Note the linear zone of bright signal within the substance of the spinal cord extending from about upper C3 level to mid-body of C6. Less bright signal extends some below the level of C6 down to the T2/3 junction. All of the bright signal represents fluid within the substance of the cord.

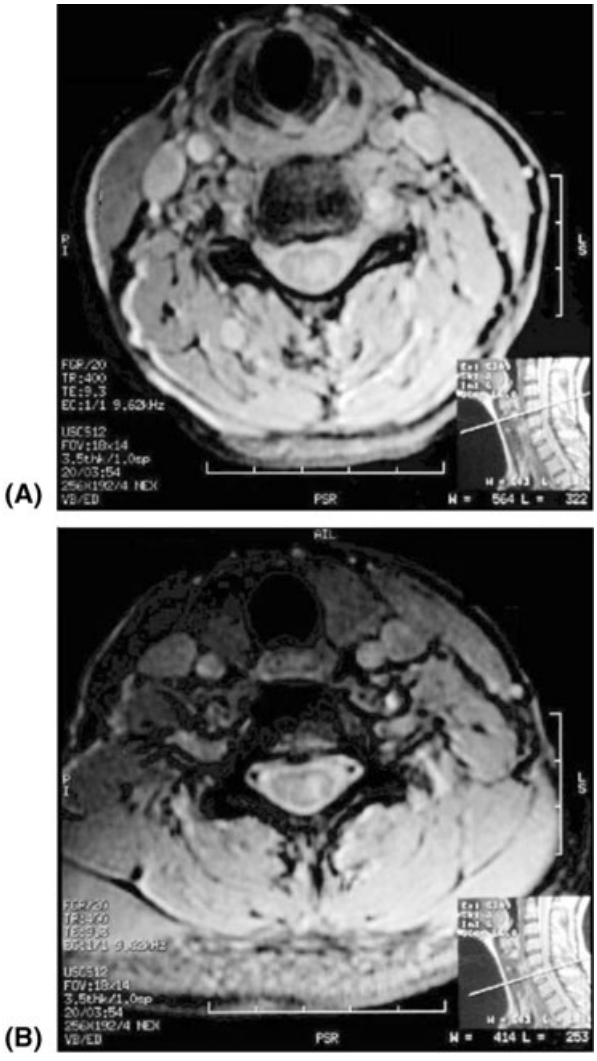

Figure 4 (A) Axial gradient echo image through lower C4. (B) Axial gradient echo image through upper C6 vertebra. Note bright signal within the substance of the cord. At the lower level, the signal is clearly to the left of midline.

anesthesia, the catheter advanced intramedullary to T7. The patient developed monoparesis. Figure 7 represents the CT scan of the catheter placement.

To draw attention to the dangerous consequences that can arise from sedating a patient before administering a cervical epidural steroid injection, Hodges et al. reported two cases of spinal cord damage occurring in patients who were heavily sedated. Hodge described these two cases of intrinsic spinal cord injury to "draw attention to the dangerous consequences that can arise from sedating a patient before administering a cervical epidural steroid injection" [4].

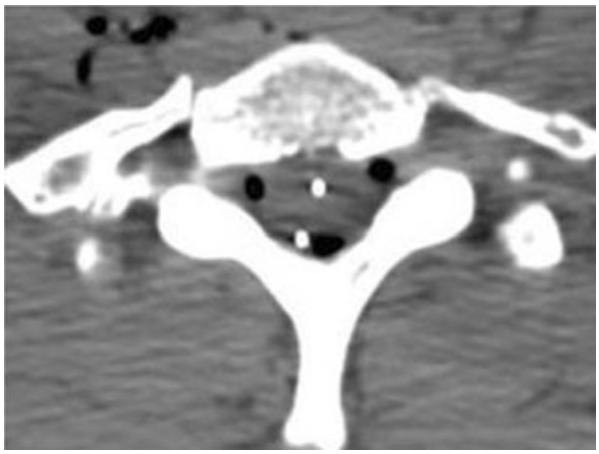

Figure 5 Computed tomography (CT) scan demonstrates two spinal cord stimulator leads in the cervical spine. The dorsal lead (the original implanted lead) is in the epidural space. The newly placed anterior lead is in the parenchyma of the cord.

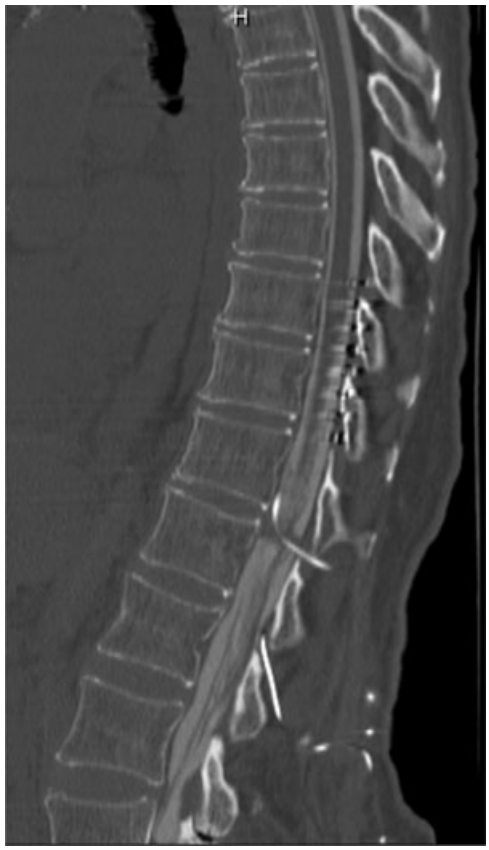

Figure 6 Saggital CT view demonstrating entry of intrathecal catheter, T11–T12. Previously implanted spinal cord stimulator lead can be seen entering the epidural space at T12-L1 with its tip at T8. Multiple needle punctures occurred at T11–T12, as evidenced by the entry of the catheter at that point.

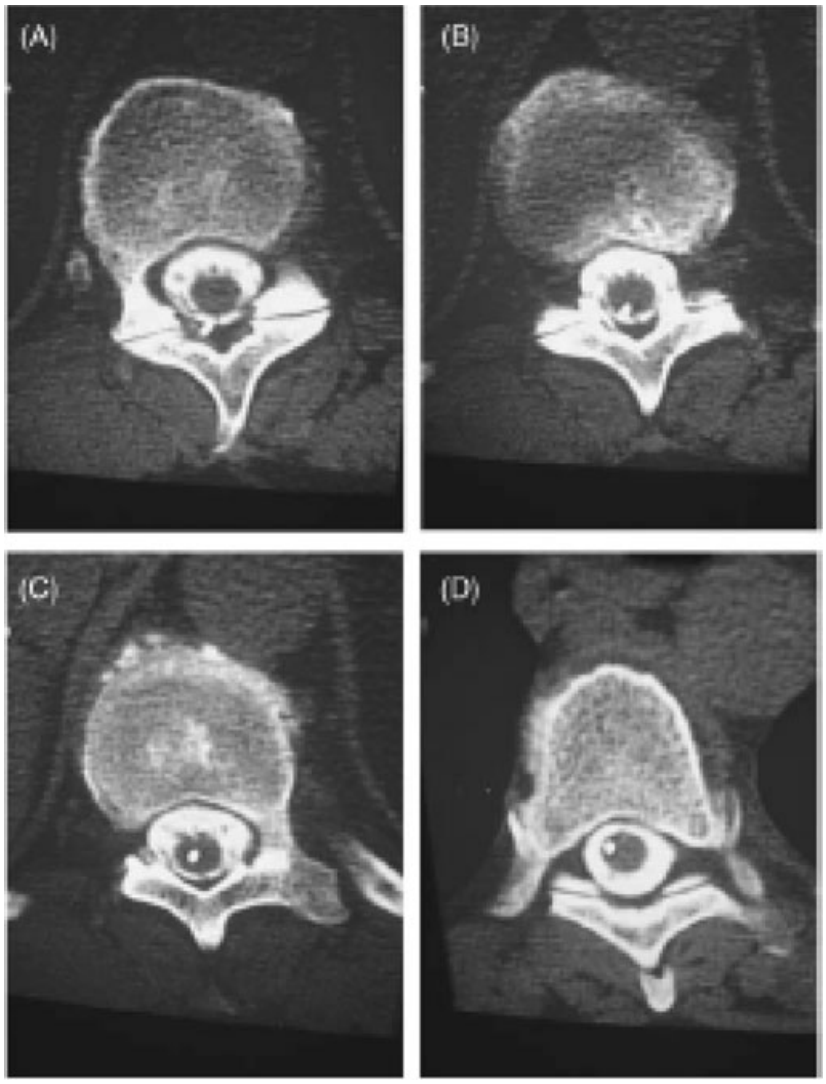

Figure 7 CT myelogram (A) demonstrates the entrance of the intrathecal catheter into the subarachnoid space. (B) The point penetrating into the cord. (C) The central intramedullary position of the catheter at the T11 level. (D) Catheter tip in the anterolateral quadrant of the spinal cord at the T7 level [3] (with permission).

Lofsky [5] reviewed malpractice claims from epidural injections and noted that four of the cases of spinal cord injury had received sedation usually consisting of midazolam and fentanyl with propofol added in two of them. Oswalt [6] and Bromage [7] reported paraplegia caused by thoracic epidural placement under general anesthesia. Johnson et al. [8] reported on 5334 cases of epidurography and therapeutic epidural injections and noted that in the skilled hands of physicians experienced in fluoroscopy, sedation was rarely necessary. In the entire series, only five patients required intravenous sedation. All of these patients requiring intravenous sedation had prior bad experiences with blind epidural injections. The authors conclude that epidurography in conjunction with epidural injections provides for safe conditions, and sedation after the therapeutic injection and is associated with an exceedingly high frequency of untoward sequelae.

They emphasize that the injections can be performed safely on outpatients and not require sedation or special monitoring. One of the main purposes of sedation is to relieve or prevent anxiety. Of course anxiety can be relieved with medication. However, physician communication with the patient both before and during the procedure can alleviate anxiety. It is incumbent upon the physician to explain the procedure in advance so that the patient knows what to expect. Real time communication with the patient during the procedure reduces the fear of the unexpected. Indeed, the comparability of physician communication to administration of medication is well established in the perioperative period [9].

Perspective

With the growth of interventional pain management, ambulatory surgery centres are increasingly used as sites for these procedures. Because other procedures performed in the same facilities require anesthesia, scheduling logistics often create pressure to utilize anesthesiology services. Surgery centres publicize the fact that procedures can be performed painlessly with the patient having no recollection of the procedure. Unfortunately, there is a fine line between sedation and the next deeper classic plane of anesthesia. In the second stage (delirium), the subject experiences excitement, unconsciousness, and a dream state with uninhibited activity. Ventilation is irregular and unpredictable [10]. If the sedation becomes too deep, delirium can occur, making injections untenable. The anesthesiologist then can either lighten the sedation (which requires waiting), or deepen the anesthetic to the point that the patient is non-responsive. Some consequences of performing interventional procedures on non-responsive patients are grimly detailed above.

Other Considerations

Many injections are performed for diagnostic as well as therapeutic purposes. Sympathetic blocks, for instance, can be performed to determine whether or not the patient has sympathetically mediated pain. Anxiolysis alone can decrease sympathetic tone, and thereby decrease sympathetically mediated pain. Clearly, sedation produces anxiolysis and therefore can confound the diagnostic goal. Similarly, selective nerve route blocks are performed to determine whether pain emanates from a specific nerve root. Sedation, including some analgesia, can confound the result. Table 2 lists procedures for which patient awareness provides an extra margin of safety.

In patients with complex regional pain syndrome (CRPS), unnecessary invasive procedures should be avoided. CRPS has been caused by venipuncture, donation of blood, and establishment of an intravenous line. One author (JP) has participated in the defense of several malpractice cases in which appropriately performed venous access has produced CRPS in asymptomatic patients. If CRPS can be caused by such simple procedures, then one must consider the effects of establishing an intravenous line in a patient who already carries a diagnosis of CRPS. This should not be construed to indicate that intravenous lines are contraindicated in CRPS patients, but rather that intravenous lines for the purpose of unneeded sedation can be avoided. When intravenous access is necessary for safety considerations, then intravenous access is imperative. When intravenous access is established solely for the purpose of sedation, the risk of exacerbated CRPS should be considered. A spinal cord stimulation trial requires precise patient feedback, so that a paresthesia can be produced which is concordant with the patient's pain. A heavily sedated patient cannot possibly provide the type of information needed to perform an adequate trial. A lightly sedated patient can be confused and not provide optimal information.

When considering the anxiety of a patient when making a decision regarding the possible use of intravenous sedation, oral preoperative medication should be considered. For instance, oral diazepam can be administered the night before the procedure as well as with a small sip of water on the morning of the procedure to provide anxiolysis. Explanation of the procedure with appropriate oral premedication can obviate the need for intravenous sedation.

Table 2 Interventional procedures in which patient feedback is valuable

Procedures
Epidural injections (especially cervical)
Selective nerve root blocks
Facet joint injections (especially cervical)
Intrathecal catheter placement
Spinal cord stimulator lead placement
Sympathetic blocks
Intra-discal ablations

Conclusion

There is little question that appropriate use of fluoroscopy has made invasive pain management much safer. Unfortunately, fluoroscopy can provide a false sense of security when not expertly employed. Sedation can eliminate the failsafe of patient feedback when fluoroscopic images are not properly interpreted. This article highlights the catastrophes that can occur when patients are provided excessive anesthesia for invasive pain procedures. General anesthesia should be avoided when needles are directed into the spine for the purpose of introducing catheters or leads. Sedation for invasive procedures cannot be considered benign and the risks of sedation should be discussed with the patient along with the risks of the procedure

itself. Interventionalists not specifically trained in anesthesiology should refrain from directing nurses to administer sedation while simultaneously performing invasive procedures. Anesthesiology training and standards are rigorous. To insure patient safety, intravenous administration of these medications requires appropriate supplemental training.

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