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CASE REPORT

Use of wound soaker catheters for the administration of local anesthetic for post-operative analgesia: 56 cases

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Abstract

Objective To describe the administration of local anesthetic through wound soaker catheters for post-operative veterinary patients and to characterize complications.

Study design Retrospective study of hospital records.

Animals Records of patients in which a wound soaker catheter was placed post-operatively between November 1, 2004 and July 1, 2006 at a veterinary teaching hospital. Records in which a limb amputation was performed between January 1, 2002 and August 1, 2007 and in which a wound soaker catheter was not placed were reviewed for historic control.

Results A total of 56 cases were identified in which a wound soaker catheter was placed post-operatively including 52 dogs, 2 cats, and 2 goats. Twenty canine cases were identified in which limb amputation was performed and no wound soaker catheter was placed. The majority of surgical procedures for which a wound soaker catheter was placed included thoracic limb amputation (46.4%) and pelvic limb amputation (35.7%). Wound soaker catheters remained in place for an average of 1.6 ± 0.5 days. Feline and caprine patients received intermittent bupivacaine boluses every 6 hours. Canine patients received continuous lidocaine infusions. Complications included disconnection of the catheter from the infusion (7.7%), one seroma, and one suspected lidocaine neurotoxicity. Incisional infections were noted in 3/56 (5.3%) limb amputations with wound soaker catheters placed which was not higher than the incisional infection rate found in the historic control cases 3/20 (15%).

Conclusion and clinical relevance Use of the wound soaker catheter was a viable means of providing local analgesia in post-operative veterinary patients. Studies are needed to evaluate efficacy of pain management, and to further investigate techniques for catheter placement and maintenance which may help to optimize the analgesia achieved using this technique.

Keywords analgesia, bupivicaine, lidocaine, local anesthetic.

Introduction

Post-surgical pain in humans has been associated with numerous complications including anxiety, delayed wound healing, decreased appetite, and chronic pain states (Rodgers et al. 2000; Beilin et al. 2003). Multi-modal analgesic regimens that incorporate local anesthetics are becoming increasingly popular as a means of decreasing pain in the peri-operative period. Local anesthetics work by blocking the influx of sodium into the nerve axon and inhibiting the action potential which disrupts the generation and transmission of nerve impulses.

A variety of different techniques for the administration of local anesthetics have been described for use in veterinary patients, including topical, systemic, local, epidural, intra-cavitary, and intra-articular administration (Pascoe & Dyson 1993; Franquelo et al. 1995; Quandt & Eawlings 1996; Sammarco et al. 1996; Lemke & Dawson 2000; Lamont et al. 2000; Duke 2000; Smith et al. 2004; Carpenter et al. 2004; Wenger et al. 2005; Bernard et al. 2006; Steagall et al. 2006). Although local anesthetics provide excellent analgesia, their duration of action is relatively short, limiting their efficacy in the post-operative period.

In humans, the placement of soaker catheters is a relatively new technique for providing peri-operative pain relief. These are flexible indwelling catheters that are imbedded near or in surgical sites that can be used to deliver continuous infusions of local anesthetics. Advantages of the soaker catheter over more traditional analgesic regimens are that it provides local pain relief and theoretically reduces the risk of systemic side effects, and it is a mobile unit that can be used on an outpatient basis. Clinical investigations of this technique in human medicine have demonstrated an improved pain control and decreased opioid requirement following a variety of surgical procedures (Savoie et al. 2000; Park et al. 2002; Lau et al. 2003; White et al. 2003; Gottschalk et al. 2003; Su et al. 2005; Wheatley et al. 2005).

To date, two studies have been published in veterinary medicine pertaining to the use of soaker catheters for peripheral local anesthetic administration; both of which examined the use following total ear canal ablation in canine patients. These studies found that the infusions had few complications and permitted decreased opioid administration in the post-operative period. (Radlinsky et al. 2005; Wolfe et al. 2006).

The purpose of this paper is to expand the veterinary literature on soaker catheters and describe their use following a variety of surgical procedures with emphasis on documenting any complications associated with catheter placement or continuous local anesthetic administration.

Materials and methods

The study group included all animals in which wound soaker catheters were placed between November 1, 2004 and July 1, 2006 at the Cumming's School of Veterinary Medicine at Tufts University. Patients were identified retrospectively by searching a hospital computerized database for key words.

The general protocol in place for dogs during this study was to run lidocaine for 24 hours at 2 mg kg^{-1} $hour^{-1}$, then to halve the fluid rate for the next 12 hours and then to discontinue the infusion and ensure that the animal was still comfortable before removing the catheter. The following data were retrieved from the medical records: Details of reason for soaker catheter placement, type of soaker catheter placed, species, breed, age, sex, weight, number of hours that wound soaker catheter was in place, dose of local anesthetic, total amount of local anesthetic delivered, and any complications encountered including whether a post-operative infection occurred. Post-operative infection was defined as documentation at recheck appointment of drainage from the incision for which a doctor prescribed an antibiotic therapy. Data were compiled into a spreadsheet and mean, median, and standard deviation were calculated.

At the completion of the study, a second database search was performed to identify all canine patients who had undergone surgical limb amputation at the Small Animal Hospital between January 1, 2002 and August 1, 2007 in which a wound soaker catheter was not placed post-operatively. The following data were retrieved from the medical records: Location of leg amputated, underlying disease process, and whether a post-operative infection occurred. Post-operative infection was defined as documentation at recheck appointment of drainage from the incision for which a doctor prescribed an antibiotic therapy.

Results

Wound soaker catheter patient signalment

A total of 56 cases were identified in which a post-surgical soaker catheter was placed. Of these, complete data were compiled for 48 patients. Eight out of 56 patients' complete records could not be located and only signalment, surgical procedures, and whether an infection was present at recheck examination were documented for these cases. All eight cases were canine patients.

Of 56 patients that received a wound soaker catheter, 52 were dogs, 2 were cats, and 2 were goats. The average age of the dogs was 7.2 ± 3.8 years (range 1–17 years). The cats were

14 and 16 years of age and the goats were 14 and 15 years of age. The majority of patients were spayed or neutered. Twenty-eight of 56 (50%) dogs were females and four of these were intact. The remaining 28 dogs (50%) were male and five of these were intact.

The average weight of 44 dogs was identified and ranged from 6 to 61 kg with a mean of 31.5 ± 13.5 kg; the weight of the eight other dogs was not available because the hospital files were unable to be located. The two cats weighed 3 and 4.4 kg. The two goats weighed 58 and 48 kg.

The most common surgical procedure for which a wound soaker catheter was placed was limb amputation, comprising 46 of 56 cases (82%). The remainder of the surgical procedures are summarized in Table 1. Osteosarcoma was the most common underlying disease process for which a wound soaker catheter was placed, occurring in 21 of 56 cases (37.5%). Other disease processes are summarized in Table 2.

Wound soaker catheters remained in place for an average of 1.6 ± 0.5 days (range; 0.5–3 days). Local anesthetic administered through the wound soaker catheters included 0.5% bupivacaine (Bupivacaine HCl 5% Injection; Hospira Inc., Lake Forest IL, USA) and 2% lidocaine (Lidocaine HCl 2% Injection; Hospira Inc.). Bupivacaine was administered in intermittent boluses whereas lidocaine was administered using an infusion pump as a continuous infusion. One cat received intermittent boluses of bupivacaine (1 mg kg^{-1}) every 6 hours and one received 1.5 mg kg^{-1} boluses of bupivacaine every 6 hours. Goats received intermittent bupivacaine boluses (1 mg kg^{-1}) every 6 hours. The concentration and rate of local anesthetic administration for canine patients was based on achieving an average dose of 2 mg kg^{-1} $hour^{-1}$ of lidocaine infused at 5 mL $hour^{-1}$.

All dogs received a continuous lidocaine infusion through the wound soaker catheter. The average dose of lidocaine administered was 1.96 ± 0.55 mg kg^{-1} $hour^{-1}$ (range, 0.21–3 mg kg^{-1} $hour^{-1}$). Infusion rates ranged from 3.5 to 6 mL $hour^{-1}$ with a suggested target rate of 5 mL $hour^{-1}$. The rate and concentration was ultimately decided by the attending clinician who determined the volume of local anesthetic needed to bathe the wound bed. Concentrations of lidocaine delivered included 10, 15 and 20 mg mL^{-1}.

Twelve patients received soaker catheters that were created through the conversion of a 5 French red rubber catheter (Tyco Healthcare, Mansfield, MA, USA) into a soaker catheter. This was performed under sterile conditions by melting the tip of a red rubber catheter and then creating small holes along the sides of the catheter with a 20-gauge needle. Forty-four patients received commercially available veterinary diffusion catheters ranging in length from 2 to 9 inches (Diffusion/Wound catheter, MILA International Inc. Erlanger, KY, USA).

Complications were only identified in canine patients. The most common complication was disconnection of the catheter from the continuous infusion [4/52 (7.7%)]. Three of the four (75%) disconnections occurred in red rubber soaker catheters. Three out of 56 cases (5.3%) developed

Table 1 Summary of surgical procedures for which a wound soaker catheter was placed post-operatively

Surgical procedure	Number of cases	Total (%)
Thoracic limb amputation	26	46.4
Pelvic limb amputation	20	35.7
Mass removal	2	3.6
Mastectomy	2	3.6
Median sternotomy	2	3.6
Chest wall resection	1	1.8
Lateral thoracomtomy	1	1.8
Hemipelvectomy	1	1.8
Mid-femoral amputation	1	1.8

Table 2 Summary of underlying disease processes for which a wound soaker catheter was placed post-operatively

Disease process	Number of cases	Cases (%)
Osteosarcoma	21	37.5
Other appendicular neoplasia	14	25
Fracture	11	19.6
Mastitis	2	3.5
Congenital	2	3.5
Lipoma	1	1.8
Lung lobe torsion	1	1.8
Rib chondrosarcoma	1	1.8
Infection	1	1.8
Chylothorax	1	1.8
Quill removal	1	1.8

incisional infections involving four different bacterias. Cultures of the infections included *Staphylococcus – coagulase positive, Staphylococcus aureus, Morganella morgani* and *Escherichia coli*. Two infections resolved with systemic antibiotics and one case required surgical debridement of the incision. One other dog developed possible systemic lidocaine neurotoxicity. Symptoms included tremors and ataxia that resolved with the discontinuation of the lidocaine infusion. One animal developed a seroma that resolved without further treatment after catheter removal.

Leg amputee patients without wound soaker catheters

A total of 20 canine amputees were identified in which wound soaker catheters were not placed post-operatively. Twelve cases (60%) were thoracic limb amputations and 8 cases (40%) were pelvic limb amputations. Underlying disease processes resulting in limb amputation included osteosarcoma [14/20 (70%)], other appendicular neoplasia [5/20 (25%)], and fracture [1/20 (5%)]. Of these, three cases (15%) developed post-operative incisional infections. All infections resolved with systemic antibiotic administration. One case had a culture performed which yielded *E. coli*.

Discussion

In this study, the most common use for placement of a wound soaker catheter post-operatively was leg amputation. This finding is because of the fact that at our hospital, it is a standard protocol to place wound soaker catheters in amputee patients. We use wound soaker catheters in these patients because the brachial and pelvic nerves can be easily visualized and the catheters placed in close proximity to the nerves. This placement maximizes the effects of the local anesthetic and facilitates blocking somatic sensation of the incision and surrounding muscle beds. Additionally, our impression is that amputees receiving peripheral administration of local anesthetic require less systemic opioids, which in turn leads to decreased sedation and a more rapid post-operative return to walking, eating, and urination, which reduces hospitalization time and facilitates hospital discharge.

Neoplasia was the underlying disease process in 53.5% (30/56) of our population, which is not surprising, given that appendicular tumors are the most common reason limb amputation is performed. Osteosarcoma was the most common underlying disease process noted. Overall, post-operative complications were low. Disconnection of the catheter from the infusion was the most common complication reported; disconnection can result from the patient moving or unsecured connection of the infusion line to the soaker catheter. The disconnection rate seemed to decrease with a change from red rubber soaker catheters to pre-fabricated MILA catheters.

Incisional infections were identified in 5.3% (3/56) of cases receiving a post-operative wound soaker catheter. All cases of infection were in canine patients who had undergone leg amputation. Veterinary studies investigating post-operative wound infection have cited infection rates ranging from 4.8% to 5.9% depending on the classification of the surgical wound (Beal et al. 2000; Nicholson et al. 2002). There have been no reported increases in infection rates in patients receiving wound soaker catheters in studies conducted in people (DeWeese et al. 2001; Radlinsky et al. 2005; Wolfe et al. 2006). In those studies, infusions were delivered through closed system ambulatory elastomeric bulbs that required minimal handling. In our hospital, patients receive infusions via syringe pumps so they are disconnected and reconnected from their infusions when they are taken on walks, which increases the potential for contamination. There was no increase in infection rate noted in patients who had been found disconnected from their infusion.

To examine further whether wound soaker catheters might increase post-operative infection rates, a second database search was performed to identify canine patients in which a wound soaker catheter was not placed, so that the infection rates among these two groups could be compared. As it is currently standard procedure to place wound soaker catheters in our limb amputation patients, a 5-year time frame was selected arbitrarily to try to increase the number of control cases identified. Based on the comparison of the infection rate of the animals with the soaker catheter to that of the amputees that did not receive wound soaker catheters (5.3% *versus* 15%) as well as surgical infection rates from the veterinary literature (4.8% to 5.9%), we conclude that the placement of a wound soaker catheter did not appear to significantly increase the rate of infection. Limitations of

our study include the fact that it is a retrospective study and that the controls were, by necessity, historic. More definitive support for this conclusion would be provided by a prospective case control study.

Only one patient exhibited signs consistent with systemic lidocaine toxicity. The patient underwent a thoracic limb amputation for removal of a lytic bone lesion. Pre-operative blood work was within normal limits. The patient was on no medications pre-operatively and did not have a history of neurologic disease. Toward the end of surgery, a red rubber soaker catheter was inserted near the brachial plexus and the surgical site was closed. The patient was placed on a rate of 1.78 mg kg^{-1} $hour^{-1}$of lidocaine for post-operative analgesia. Approximately 5 hours after the infusion was started, it was noted that the patient was having facial twitching and generalized muscle tremors. Although we cannot conclude with certainty that these effects were the result of lidocaine toxicity, the symptoms resolved shortly after the infusion was discontinued. The low incidence of clinical toxicity in our study is likely because of the dose of lidocaine that we used and the relatively short duration of administration (1–2 days). Acute CNS toxicity is reported to occur with intravenous (IV) doses of lidocaine of 16 mg kg^{-1} in dogs (Feldman et al. 1989). Bupivacaine is reported to be toxic with IV administration of 4 mg kg^{-1} in dogs (Feldman et al. 1989). IV lidocaine is routinely administered at a rate of 4 mg kg^{-1} $hour^{-1}$ in canine patients for its anti-arrhythmic and analgesic effects, and rarely results in signs of systemic toxicity, even when administered at this rate for several days to unstable patients. While we do not know the plasma concentrations of local anesthetic in our patients, 2 mg kg^{-1} $hour^{-1}$ of lidocaine and 1–1.5 mg kg^{-1} of bupivacaine are at or below recommended doses for systemic administration. We saw signs of toxicity in one dog, so while these doses were safe for most of our patients, there is still a possibility that toxic effects may occur.

Based on evidence provided by this study, use of a wound soaker catheter may be a viable means of providing analgesia in selected post-operative veterinary patients. Further study is required to evaluate efficacy of pain management, degree of systemic lidocaine absorption, and investigation into placement and catheter maintenance which may be helpful to optimize the analgesia achieved using this technique.

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