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Evaluating the effects of continuous intravenous infusions of tramadol and tramadol-lidocaine on sevoflurane minimum alveolar concentration (MAC) and entropy values in dogs

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ABSTRACT. The sparing effects of tramadol and tramadol-lidocaine infusion on the minimum alveolar concentration (MAC) of sevoflurane in dogs as well as the entropy indices were investigated. Anesthesia was induced in eight young, healthy German shepherds weighing 27.6 ± 3.2 kg (mean ± SD) and maintained with sevoflurane. A standard tail-clamp technique was used to determine sevoflurane MAC during infusion with: sevoflurane alone to measure baseline MAC (MAC_B); tramadol (intravenous loading dose of 1.5 mg/kg and constant rate infusion [CRI] of 2.6 mg/kg/hr; MAC_T); and tramadol-lidocaine (tramadol CRI of 2.6 mg/kg/hr; and lidocaine intravenous loading dose of 1.0 mg/kg and CRI of 6 mg/kg/hr; MAC_{TL}). The state entropy (SE), response entropy (RE), and RE-SE difference were recorded 5 min prior to and during tail clamping. MAC_B was 2.4 ± 0.2%. Tramadol and tramadol-lidocaine CRI decreased MAC to 2.2 ± 0.3% and 1.7 ± 0.3%, respectively. The MAC-sparing effect of tramadol-lidocaine was greater than that of tramadol alone (8.2 ± 8.9% vs. 30.1 ± 10.7%; $P<0.01$). SE and RE in all subjects, and RE-SE difference in most subjects, were increased (all $P<0.05$) when they responded purposefully to noxious stimulation. A tramadol-lidocaine combination infusion can reduce anesthetic requirements to a higher degree than tramadol alone. Furthermore, MACentropy, MAC required to prevent increased entropy in response to a painful stimulation, and MAC of sevoflurane were similar in dogs.

KEY WORDS: tate and response entropy, lidocaine, minimum alveolar concentration, sevoflurane, tramadol

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Pre-emptive analgesia helps lower the amount of anesthetic required, keeps patients under general anesthesia, and diminishes complications associated with anesthesia and surgery [37]. Continuous rate infusion (CRI) with opioids [28] and other classes of analgesics [9, 38] has been employed to reduce the amounts of inhalational agents required, as shown by reduction in the minimum alveolar concentration (MAC) of volatile anesthetics [9, 25, 38, 45]. Moreover, CRI assures a constant level of analgesia, avoiding intermittent peak plasma concentration associated with intermittent administration, and enables the use of smaller doses, leading to a reduction in side effects [19].

Systemic administration of lidocaine, a local anesthetic, is commonly used in dogs for the management of cardiac arrhythmias [40]. Studies have found that the intraoperative administration of lidocaine can significantly reduce the MAC of volatile anesthetic in rabbits, cats, and dogs [1], as well as in horses [13]. In addition, CRI of lidocaine alone [9], in combination with morphine [20], or in combination with ketamine and dexmedetomidine [21] has been shown to improve post-operative pain control in dogs.

Tramadol, a synthetic racemic mixture of the 4-phenylpiperidine analogue of codeine [52], has recently received widespread acceptance in veterinary medicine. In addition to a weak affinity to the μ-opioid receptor of tramadol, studies have identified an additional mechanism that is different from the pure μ-opioid agonist. Tramadol inhibits norepinephrine and serotonin reuptake in the central nervous system [22, 43], and administering it can lead to a reduction in the MAC of volatile anesthetics [45]. A study in a recent study demonstrated that tramadol can improve lidocaine efficacy when used in combination for pain management in patients undergoing a transrectal ultrasound-guided prostate biopsy [46]. Although tramadol is identified as a weak opioid agonist, it has been shown that a tramadol-morphine infusion has a synergistic effect on sevoflurane anesthesia [28]. Previous research has shown that

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