Physiologic and antinociceptive effects following intramuscular administration of xylazine hydrochloride in combination with tiletamine-zolazepam in llamas

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Objective—To evaluate antinociceptive and selected effects associated with IM administration of xylazine hydrochloride in combination with tiletamine-zolazepam in llamas.

Animals—8 adult male llamas.

Procedures—Each llama received tiletamine-zolazepam (2 mg/kg) combined with either xylazine (0.1, 0.2, or 0.4 mg/kg) or saline (0.9% NaCl) solution IM (treatments designated as TZ-Xy0.1, TZ-Xy0.2, TZ-Xy0.4, and TZ-Sal, respectively) at 1-week intervals. Selected cardiorespiratory variables were assessed during lateral recumbency and anesthesia, and recovery characteristics were recorded. Duration of antinociception was evaluated by clamping a claw every 5 minutes.

Results—Interval between treatment administration and lateral recumbency for TZ-Xy0.4 was shorter than that for TZ-Xy0.1 or TZ-Sal. Mean ± SEM duration of antinociception was longer for TZ-Xy0.1 (8.1 ± 4.0 minutes), TZ-Sal (0.6 ± 0.6 minutes), Interval between treatment administration and standing was longer for TZ-Xy0.4 (112 ± 9 minutes) than it was for TZ-Xy0.2 (77 ± 9 minutes) or TZ-Sal (68 ± 9 minutes). Mean heart and respiratory rates during the first 30 minutes for TZ-Sal exceeded values for the other treatments. Administration of TZ-Xy0.2 and TZ-Xy0.4 resulted in \( P_{aO_2} < 60 \) mm Hg at 5 minutes after llamas attained lateral recumbency, and values differed from TZ-Sal findings at 5, 10, and 15 minutes; \( P_{aCO_2} \) was greater for TZ-Xy0.2 and TZ-Xy0.4 than for TZ-Sal at 5, 10, 15, and 20 minutes.

Conclusions and Clinical Relevance—Xylazine (0.2 and 0.4 mg/kg) increased the duration of antinociception in llamas anesthetized with tiletamine-zolazepam. (Am J Vet Res 2013;74:530–534)

Llamas (Lama glama) are New World camelids native to South America and are considered to be at an intermediate evolutionary stage between guanacos and alpacas. In South America, llamas reside at altitudes between 0 and 4,500 m. Llamas have become increasingly popular in North America, and many surgical procedures performed on these animals necessitate that anesthesia be induced. Because of the unique anatomic features of llamas, jugular venipuncture is difficult, especially in adult males that have thick skin over the jugular furrow. Therefore, in many circumstances, IM administration of anesthetic drugs is a more practical route for delivery. Combinations of xylazine hydrochloride and ketamine hydrochloride are typically used to anesthetize llamas, but at the doses that are commonly administered, such combinations provide anesthesia for only a short duration.¹

Received July 20, 2012.
Accepted October 5, 2012.

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ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>DAP</td>
<td>Diastolic arterial blood pressure</td>
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<tr>
<td>MAP</td>
<td>Mean arterial blood pressure</td>
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<tr>
<td>SpO₂</td>
<td>Oxygen saturation as measured by pulse oximetry</td>
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</table>

Tiletamine, a noncompetitive N-methyl-D-aspartate antagonist, and zolazepam, a benzodiazepine, are combined in an anesthetic preparation, which is available commercially as a 1:1 tiletamine-zolazepam formula that is used in many animal species. In llamas, administration of tiletamine-zolazepam (2 mg/kg, IM) induces only a brief period of antinociception; however, increasing the dose of tiletamine-zolazepam does not increase the duration of antinociception (authors’ unpublished observations) and has been associated with adverse effects. Concurrent administration of xylazine, an \( \alpha_2 \)-adrenergic receptor agonist that has sedative and analgesic properties, increases the antinociceptive effects of tiletamine-zolazepam in rats, and this combination has been used successfully to anesthetize wild and domesticated ruminants.
The purpose of the study reported here was to evaluate the antinociceptive and selected physiologic effects associated with IM administration of xylazine hydrochloride in combination with tiletamine-zolazepam in llamas. It was hypothesized that tiletamine-zolazepam would induce antinociception of short duration and that concurrent administration of xylazine would increase the duration of antinociception in a dose-dependent manner.

Materials and Methods

Animals—Eight sexually intact male llamas (body weight, 113 ± 30 kg; age, 1 to 2 years) were used in the study. The llamas were purchased from a commercial supplier and determined to be in good health on the basis of history and physical examination findings. Llamas were dewormed and vaccinated and were acclimated to their new premises for 14 days prior to study commencement. The study was approved by the University of Tennessee Institutional Animal Care and Use Committee.

Study design—Each llama was given each of 4 treatments IM in a randomized crossover design, with a 1-week washout period between treatments. The treatments consisted of tiletamine-zolazepam injectable formulation (2 mg/kg) combined in a syringe with either xylazine hydrochloride (0.1, 0.2, or 0.4 mg/kg) or saline (0.9% NaCl) solution and administered as 1 injection; treatments were designated as TZ-Xy0.1, TZ-Xy0.2, TZ-Xy0.4, and TZ-Sal, respectively. The tiletamine-zolazepam dose is reported as the sum of tiletamine and zolazepam doses.

Anesthesia—Before each experiment, food was withheld for 18 hours and water was withheld for 12 hours from each llama. Each llama was brought into a quiet room approximately 1 hour before the start of the experiment. The doses of tiletamine-zolazepam and xylazine were prepared separately and combined in a syringe immediately before administration. A 6-mL injection vial was achieved by addition of saline solution, and the dose was injected into a semitendinosus or semimembranosus muscle. When the llama assumed sternal recumbency with its neck resting on the floor, it was rolled into right lateral recumbency on a padded surface.

Recording and monitoring—During each experiment, recording of selected cardiorespiratory data began after the llama was rolled into lateral recumbency and was continued until the procedures were no longer tolerated. Heart rate was monitored continuously with base-apex ECG leads. Systolic arterial blood pressure, DAP, and MAP were measured with an oscillometric device and recorded at 5-minute intervals. A pressure cuff of appropriate size (width approx 40% of the limb circumference [neonatal No. 4 or 5]) was placed over the metacarpal artery of the nondependent forelimb, and the limb was positioned with the cuff approximately at the level of the base of the heart. Respiratory rate was assessed every 5 minutes on the basis of the number of observed thoracic excursions during a 1-minute period.

A sample of arterial blood (1 mL) for blood gas analysis was collected percutaneously from a femoral artery at 5, 10, 15, and 20 minutes after attainment of lateral recumbency. Each sample was collected anaerobically into a 1-mL syringe containing heparin and analyzed immediately with a handheld analyzer. Hemoglobin SpO2 was estimated by a pulse oximetry probe placed on the tongue. Rectal temperature was measured with a digital thermometer.

The following characteristics of anesthesia and recovery from anesthesia were recorded: time from drug administration to sternal recumbency, time from drug administration to lateral recumbency, duration of antinociception, duration of lateral recumbency, time from drug administration to standing, and quality of recovery. Antinociception was assessed every 5 minutes after the llama was placed in lateral recumbency by clamping a claw with a 10-inch Vulsellum forceps. The forceps was closed tightly to the first or second ratchet, depending on claw size, for 60 seconds but was released sooner when motor movement was observed. Motor movement was defined as any movement, either reflexive or purposeful, of the limbs or head. Absence of motor movement in response to clamping a claw was considered indicative of antinociception. The order in which claws were clamped was randomized, and no claw was clamped more than 2 occasions. Claw clamping was performed by the same investigator (RS) after the cardiorespiratory data were recorded at each time point. The quality of recovery from anesthesia was subjectively evaluated by the same investigator (RS) using a 3-point scale as follows: 1 = minimal struggling or paddling and standing on the first or second attempt; 2 = mild to moderate struggling and 3 attempts to stand, and 3 = moderate to excessive struggling or paddling during recovery and standing after ≥ 4 attempts.

Statistical analysis—A mixed-model ANOVA was used to examine the effect of treatment on physical and blood gas values with a commercial program. Cardiorespiratory data collected during the first 30 minutes were analyzed, and the findings were reported. The independent variables (llama and treatment) were evaluated for their effect on the dependent variables (rectal temperature; heart and respiratory rates; and systolic arterial pressure, DAP, and MAP). The independent variables (llama, treatment, time, and interaction between treatment and time) were evaluated for their effect on the dependent variables (PaO2 and PaCO2). A second mixed-model ANOVA was used to evaluate the effect of treatments on anesthetic and antinociceptive effects. The independent variables llama and treatment were evaluated for their effect on the following dependent variables: time from drug administration to sternal recumbency, time from drug administration to lateral recumbency, duration of antinociception, duration of lateral recumbency, and time from drug administration to standing. When a significant main effect was detected, a protected least significant difference mean separation method was used to compare differences. By use of the W statistic of Shapiro-Wilk and observation of stem leaf diagrams, distributions of residuals from the models were used to ensure that data were normally distributed. Results are expressed as least squares means ± SEM. For final analyses, a value of $P \leq 0.05$ was considered significant.
Results

After administration of TZ-Xy0.1, 2 llamas failed to become sterneally recumbent and another llama was not sufficiently sedated to be rolled into lateral recumbency; thus, a complete data set could not be collected. The duration of antinociception was longer (P ≤ 0.05) after llamas received TZ-Xy0.4 (least squares mean ± SEM, 51.3 ± 7.0 minutes) than after they received TZ-Xy0.2 (31.9 ± 6.0 minutes), TZ-Xy0.1 (8.1 ± 4.0 minutes), or TZ-Sal (0.6 ± 0.6 minutes; Table 1). After TZ-Sal, antinociception in response to claw clamping was evident in 7 llamas; however, there was no difference (P > 0.05) in the duration of antinociception for TZ-Xy0.1 and TZ-Sal. The duration of lateral recumbency was longer (P ≤ 0.05) for TZ-Xy0.4 than for all other treatments, but there was no difference (P > 0.05) in durations for TZ-Xy0.1 and TZ-Sal. The time from drug administration to standing was longer (P ≤ 0.05) for TZ-Xy0.4 (112 ± 9 minutes) than for TZ-Xy0.2 (77 ± 9 minutes) or TZ-Sal (68 ± 9 minutes), but there was no difference in those times among TZ-Xy0.1, TZ-Xy0.2, and TZ-Sal. Recovery from anesthesia was considered smooth on all occasions (score, 1), except for one llama given TZ-Xy0.1 (score, 2) and another given TZ-Sal (score, 2).

Cardiorespiratory data collected during the first 30 minutes in lateral recumbency are reported (Table 2). The heart rate was greater (P ≤ 0.05) when llamas received TZ-Sal, compared with findings for each of the 3 treatments involving xylazine, but did not differ (P > 0.05) when llamas received TZ-Xy0.2 or TZ-Xy0.4. The respiratory rate was greater (P ≤ 0.05) for TZ-Sal, compared with findings for each of the 3 treatments involving xylazine; however, there was no difference (P > 0.05) in respiratory rate between TZ-Xy 0.2 and TZ-Xy0.4 or between TZ-Xy0.1 and TZ-Xy0.4. At 5, 10, and 15 minutes after being rolled into lateral recumbency, PaO₂ for llamas given TZ-Xy0.2 or TZ-Xy0.4 was

Table 1—Effect of IM treatment with tiletamine-zolazepam (2 mg/kg) in combination with xylazine hydrochloride (0.1, 0.2, or 0.4 mg/kg) or saline (0.9% NaCl) solution (designated as TZ-Xy0.1, TZ-Xy0.2, TZ-Xy0.4, and TZ-Sal treatments, respectively) on times from drug administration to lateral recumbency, cardiac and respiratory variables in 8 adult male llamas.

<table>
<thead>
<tr>
<th>Variable</th>
<th>TZ-Xy0.1</th>
<th>TZ-Xy0.2</th>
<th>TZ-Xy0.4</th>
<th>TZ-Sal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to sternal recumbency (min)</td>
<td>6.0 ± 1.2 (6)</td>
<td>5.1 ± 1.0 (8)</td>
<td>3.5 ± 1.0 (8)</td>
<td>5.4 ± 1.0 (8)</td>
</tr>
<tr>
<td>Time to lateral recumbency (min)</td>
<td>9.6 ± 1.4 (5)</td>
<td>7.6 ± 1.1 (8)</td>
<td>5.3 ± 1.1 (8)</td>
<td>9.3 ± 1.1 (8)</td>
</tr>
<tr>
<td>Duration of lateral recumbency (min)</td>
<td>67 ± 10 (5)</td>
<td>62 ± 9 (8)</td>
<td>56 ± 9 (8)</td>
<td>60 ± 9 (8)</td>
</tr>
<tr>
<td>Time to standing (min)</td>
<td>88 ± 12 (6)</td>
<td>77 ± 9 (8)</td>
<td>112 ± 9 (8)</td>
<td>68 ± 9 (8)</td>
</tr>
<tr>
<td>Duration of antinociception (min)</td>
<td>8.1 ± 4.0 (5)</td>
<td>31.9 ± 6.0 (8)</td>
<td>51.3 ± 7.0 (8)</td>
<td>0.6 (1)</td>
</tr>
</tbody>
</table>

Data are reported as least squares mean ± SEM (value only where n = 1). Each number in parentheses represents the number of llamas from which data could be collected to derive the mean value.

*Within a row, values with different superscript letters are significantly (P < 0.05) different.

Table 2—Effect of IM treatment with tiletamine-zolazepam (2 mg/kg) in combination with xylazine hydrochloride (0.1, 0.2, or 0.4 mg/kg) or saline solution (designated as TZ-Xy0.1, TZ-Xy0.2, TZ-Xy0.4, and TZ-Sal treatments, respectively) on cardiovascular and respiratory variables in 8 adult male llamas determined for a 30-minute period or at 5, 10, 15, and 20 minutes after animals were rolled from drug-induced sternal recumbency into lateral recumbency.

<table>
<thead>
<tr>
<th>Variable</th>
<th>TZ-Xy0.1</th>
<th>TZ-Xy0.2</th>
<th>TZ-Xy0.4</th>
<th>TZ-Sal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate (beats/min)</td>
<td>48 ± 2 (5)</td>
<td>41 ± 1 (8)</td>
<td>41 ± 1 (8)</td>
<td>55 ± 2 (8)</td>
</tr>
<tr>
<td>Respiratory rate (breaths/min)</td>
<td>17 ± 1 (5)</td>
<td>20 ± 1 (8)</td>
<td>18 ± 1* (8)</td>
<td>27 ± 1 (8)</td>
</tr>
<tr>
<td>SAP (mm Hg)</td>
<td>145 ± 8 (5)</td>
<td>141 ± 6 (8)</td>
<td>154 ± 8 (8)</td>
<td>151 ± 7 (8)</td>
</tr>
<tr>
<td>DAP (mm Hg)</td>
<td>91 ± 9 (5)</td>
<td>98 ± 7 (8)</td>
<td>109 ± 7 (8)</td>
<td>104 ± 8 (8)</td>
</tr>
<tr>
<td>MAP (mm Hg)</td>
<td>111 ± 8 (5)</td>
<td>115 ± 7 (8)</td>
<td>126 ± 7 (8)</td>
<td>122 ± 7 (8)</td>
</tr>
<tr>
<td>SpO₂ (%): 5 min</td>
<td>93 ± 3* (5)</td>
<td>88 ± 2* (8)</td>
<td>86 ± 2* (8)</td>
<td>94 ± 2* (8)</td>
</tr>
<tr>
<td>10 min</td>
<td>94 ± 3* (6)</td>
<td>88 ± 2* (8)</td>
<td>83 ± 2* (7)</td>
<td>90 ± 2* (6)</td>
</tr>
<tr>
<td>15 min</td>
<td>96 ± 3* (6)</td>
<td>92 ± 2* (8)</td>
<td>89 ± 2* (7)</td>
<td>94 ± 3* (5)</td>
</tr>
<tr>
<td>20 min</td>
<td>96 ± 3* (5)</td>
<td>95 ± 2* (8)</td>
<td>93 ± 2* (7)</td>
<td>95 ± 3* (4)</td>
</tr>
<tr>
<td>PaO₂ (mm Hg): 5 min</td>
<td>62 ± 8† (5)</td>
<td>47 ± 7* (8)</td>
<td>41 ± 7* (8)</td>
<td>75 ± 7* (8)</td>
</tr>
<tr>
<td>10 min</td>
<td>67 ± 9† (4)</td>
<td>54 ± 7* (8)</td>
<td>43 ± 7* (8)</td>
<td>79 ± 7* (7)</td>
</tr>
<tr>
<td>15 min</td>
<td>71 ± 8† (5)</td>
<td>61 ± 7* (8)</td>
<td>53 ± 7* (8)</td>
<td>89 ± 7* (3)</td>
</tr>
<tr>
<td>20 min</td>
<td>86 ± 9* (2)</td>
<td>71 ± 7* (8)</td>
<td>63 ± 7* (8)</td>
<td>91 ± 10* (2)</td>
</tr>
</tbody>
</table>

*Within a column, values with different symbols are significantly (P < 0.05) different.

SAP = Systolic arterial pressure.

See Table 1 for remainder of key.
less (P \leq 0.05) than the values recorded for llamas given TZ-Sal. At 20 minutes after being rolled into lateral recumbency, PaO_2 for llamas given TX-Xy0.4 was less (P \leq 0.05) than the values recorded when llamas were given TZ-Sal. The SpO_2 for TZ-Sal was greater than values for TZ-Xy0.2 or TZ-Xy0.4 after 5 minutes of lateral recumbency and greater than the value for TZ-Xy0.4 after 10 minutes of lateral recumbency. At 5, 10, 15, and 20 minutes after being rolled into lateral recumbency when llamas received TZ-Xy0.2 or TZ-Xy0.4, PaCO_2 was greater (P \leq 0.05) than the value recorded when llamas received TZ-Sal. Blood pressure did not differ (P > 0.05) among treatments. There was no difference (P > 0.05) in rectal temperature among treatments.

**Discussion**

In the present study, the administration of tiletamine-zolazepam (2 mg/kg) IM without the addition of xylazine resulted in only a brief period of antinociception; thus, tiletamine-zolazepam at this dose is unsuitable for surgical procedures in llamas. Concurrent IM administration of xylazine at doses of 0.2 or 0.4 mg/kg prolonged the duration of tiletamine-zolazepam–induced antinociception in a dose-dependent manner.

The tiletamine-zolazepam dose was chosen on the basis of the results of a study in which tiletamine-zolazepam (2 mg/kg) induced immobilization but only a short duration of antinociception in llamas. In the present study, antinociception was evident in only 1 TZ-Sal–treated llama and only at the 5-minute time point after being rolled into lateral recumbency. This finding is consistent with results of that previous study in llamas and data from a study of rats in which tiletamine-zolazepam doses that resulted in immobility, loss of consciousness, and loss of the righting reflex had only minimal effects on responses to a tail-flick test.

Concurrent administration of xylazine significantly increased the tail-flick latency of tiletamine-zolazepam in rats and significantly prolonged the duration of antinociception induced by tiletamine-zolazepam in sheep and pigs. A range of xylazine doses was used in the present study to evaluate whether a dose-response effect exists for the interaction of xylazine with tiletamine-zolazepam in llamas. On the basis of these results, administration of xylazine at a dose of 0.1 mg/kg, IM, along with tiletamine-zolazepam (2 mg/kg) is not adequate for induction of anesthesia in llamas, given that the combination failed to induce lateral recumbency in 3 of the 8 study llamas. Although the addition of 0.1 mg of xylazine/kg did not significantly increase the duration of tiletamine-zolazepam–induced antinociception in the 5 llamas that became laterally recumbent, the mean duration of antinociception for this drug combination was approximately 8 minutes, compared with a mean duration of < 1 minute for TZ-Sal; however, this could be a result of the small sample size and a type II error. Concurrent administration of xylazine at doses of 0.2 and 0.4 mg/kg increased the duration of tiletamine-zolazepam–induced antinociception, compared with that achieved with TZ-Sal, in a dose-dependent manner, which was consistent with the dose-dependent effect of xylazine in potentiating the anesthetic effects of tiletamine-zolazepam in pigs.

In the present study, antinociception was considered to be present when there was no motor movement in response to the noxious stimulus. Prolongation of the antinociceptive and anesthetic effects of tiletamine-zolazepam via concurrent administration of xylazine may be a result of the latter’s sedative or antinociceptive actions. Xylazine-induced antinociception is caused primarily by stimulation of presynaptic α_2-adrenergic receptors, which results in a central and peripheral decrease in norepinephrine release and a subsequent reduction in CNS sympathetic outflow and concentrations of circulating catecholamines. It has been reported that the duration of tiletamine-zolazepam–induced antinociception in llamas is increased by concurrent administration of acepromazine (a phenothiazine compound not considered to have clinically important analgesic properties) but not by the opioid butorphanol, although butorphanol potentiated the effect of tiletamine-zolazepam in the tail-flick test in rats.

For all 3 treatments that included xylazine in the present study, the llamas’ heart rate was less than the TZ-Sal value, and this effect was more profound with the 0.2 and 0.4 mg/kg doses. This decrease in heart rate was consistent with the reported effects of xylazine (0.4 mg/kg, IM) in combination with ketamine in llamas. α_2-Adrenoceptor agonist–induced bradycardia is primarily caused by a centrally mediated sympatholysis and inhibition of norepinephrine release from sympathetic nerve endings.

Blood pressure in the llamas of the present study when they received TZ-Sal was comparable to findings reported previously for tiletamine-zolazepam–anesthetized llamas, as determined with the same noninvasive oscillometric technique and method. There was no difference in arterial blood pressure among treatments. These results were similar to the effect of xylazine (0.4 mg/kg, IM) on blood pressure in llamas when it was administered in conjunction with ketamine (4 mg/kg); however, xylazine (0.25 mg/kg) caused an initial increase in direct arterial blood pressure when it was administered IV to llamas. The lack of change in blood pressure following xylazine administration in the present study was most likely attributable to the relatively small doses used and route of administration.

In the present study, the observed decrease in respiratory rate following xylazine administration was consistent with the reported effects of xylazine in llamas and may reflect the drug’s central respiratory depressant effect. It is also possible that the greater respiratory rate in llamas when they received TZ-Sal was simply a reflection of the fact that the llamas were less deeply anesthetized. Although PaCO_2 increased with TZ-Xy0.2 and TZ-Xy0.4 and the increase persisted for the 20 minutes during which blood gases were analyzed, the changes were moderate and indicated that minute ventilation was well maintained despite the decrease in respiratory rate.

The PaO_2 decreased with all treatments, but when the llamas received xylazine, most became hypoxemic (PaO_2 < 60 mm Hg) 5 minutes after being rolled into lateral recumbency. Low PaO_2 has been reported for llamas given tiletamine-zolazepam (2 mg/kg). Mechanisms responsible for the decreased PaO_2 during anes-
thecia and recumbency may include hypoventilation, ventilation-perfusion mismatching, and intrapulmonary shunting from perfusion of nonventilated areas of the lungs. Despite the relative low $P_{aO_2}$, $SpO_2$ remained relatively high following all treatments. Although the pulse oximeter used in the present study was not validated for use in llamas, the $SpO_2$ values were consistent with values reported for llamas in another study. Llamas are capable of maintaining hemoglobin saturation at a low $P_{aO_2}$ because of a greater affinity of that species' hemoglobin for oxygen, an adaptation that helps llamas cope with living at high altitude. Nevertheless, the $SpO_2$ recorded for the llamas after they received xylazine may have been decreased by pooling of deoxygenated blood in the tongue as a result of induction of peripheral vasoconstriction, as reported for other $\alpha_2$-adrenergic receptor agonists. When llamas received tiletamine-zolazepam with xylazine in the present study, all recoveries from anesthesia were considered to be smooth and uneventful, even though 2 llamas made more than 2 attempts to stand. These results are similar to the findings of a study in llamas in which tiletamine-zolazepam (2 mg/kg, IM) was used in conjunction with either acepromazine or butorphanol. Conversely, when tiletamine-zolazepam (4.4 mg/kg IM) was used as the sole anesthetic drug in 4 llamas, 1 developed muscle tremors, rigidity, and hyperthermia. Likewise, tiletamine-zolazepam (mean ± SD dose, 5.0 ± 1.1 mg/kg) administered IM to guanacos caused stumbling and disorientation during recovery from anesthesia. Therefore, it appears that the quality of recovery from tiletamine-zolazepam–induced anesthesia is influenced by the dose used and whether other drugs are administered concurrently. Nevertheless, a potential weakness of the recovery scoring performed in the present study was the lack of blinding of the assessor to the treatment groups.

The results of the present study indicated that, in adult male llamas, tiletamine-zolazepam alone (2 mg/kg, IM) is only suitable for immobilization for nonpainful procedures, and the anesthetic qualities are not enhanced by concurrent IM administration of xylazine at a dose of 0.1 mg/kg. Concurrent IM administration of xylazine at a dose of 0.2 or 0.4 mg/kg significantly increased the duration of antinociception induced by tiletamine-zolazepam, and there was a dose-dependent response for the antinociceptive effect of xylazine. Although transient hypoxemia was associated with xylazine administration, the authors do not consider this to be clinically important in healthy llamas.

References


3. AnaSed, 100 mg/ml, Alkorn, Decatur, Ill.
4. 1100 Patient Monitor, Criticare Systems, Waukesha, Wis.
5. Dinamap Veterinary Blood Pressure Monitor 8300, Critikon, Tampa, Fla.
6. I-STAT Portable clinical analyzer, Heska Corp, Loveland, Colo.