CHEMICAL RESTRAINT OF CAMELIDS – KETAMINE STUN TECHNIQUE
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Key Points
- Adding a small dose of ketamine to injectable chemical restraint cocktails (Ketamine Stun) can dramatically improve patient cooperation and systemic analgesia.
- Dosing must be more conservative if patient must remain standing. This limits the level of systemic analgesia that can be achieved, but improvements in patient cooperation are evident.

The Ketamine Stun is simply the addition of a small dose of ketamine to any injectable chemical restraint technique. I initially developed the Ketamine Stun technique in the early 1990's to cover my limited cat handling abilities. My first exposure to camelid patients came when I left equine practice to teach at Ohio State. The recalcitrant behavior they frequently exhibited quickly led to experimentation with low dose ketamine protocols to improve the level of patient cooperation during diagnostic and therapeutic procedures. Success was immediately evident and the technique became wildly popular with the food animal clinicians, residents, and students charged with the care of these patients (1).

I named this technique the Ketamine Stun (aka Ket Stun) because of the stunned effect it produced in patients when administered at doses that produce recumbency. These patients appear to be awake, but seem oblivious to surroundings and procedure being performed. The intravenous effect is quite brief (approximately 15 minutes) and patients typically stand and appear fairly normal at that time. I initially referred to this state as semianesthetized, but perhaps chemical hypnosis is more appropriate. Because of the success in camelid patients the Ketamine Stun technique was adjusted for use in ruminants (less xylazine) and proved to be just as useful (2, 3). Equine applications have proven more challenging. Dramatic improvement in cooperation evident a minute or two after the IV bolus of ketamine is administered in patients that were totally uncooperative under the prior detomidine-morphine sedation suggests the potential of this technique. Unfortunately, the effective sedation-ketamine levels are not far removed from those that produce instability.

Alpha2-adrenergic agonists possess potent sedative and analgesic effects. Opioids are typically thought of as analgesic drugs, but they possess central nervous system effects that when combined with a tranquilizer or sedative produces a greater level of mental depression. Ketamine is a N-methyl-D-aspartate (NMDA) receptor antagonist that possesses potent analgesic effects at subanesthetic doses. Ketamine was initially included in the stun technique for its analgesic properties, but likely contributes to the mental aspects of the enhanced cooperation exhibited by patients under the influence of the Ketamine Stun technique. By combining drugs one is able to use smaller doses of the individual components while still achieving the desired level of patient control. Dosing must be more conservative when using the ketamine stun technique in standing patients. This limits the degree of systemic analgesia relative to what can be achieved in recumbent patients, but still provides improved patient cooperation when compared with more traditional methods of standing chemical restraint.

In ruminants and camelid patients I typically use a combination of xylazine, butorphanol, and ketamine. In equine patients I generally use detomidine, morphine, and ketamine. Morphine is used to provide analgesic relief in food animal patients and is much cheaper than butorphanol.
I have used morphine (0.05–0.06 mg/kg) in ruminant stuns. In standing adult cattle stuns, a similar level of cooperation is achieved with either opioid, but patients appear less obtunded when morphine is used. Some practitioners may find the obtunded appearance useful because it allows them to follow the decay over time in the level of chemical restraint. Deterioration in the level of patient cooperation also can be used to determine when supplemental drug administration may be required.

Ketamine Stun techniques can be divided into two broad categories: standing and recumbent. The standing Ketamine Stun is used primarily in large ruminants and horses. The recumbent Ketamine Stun is used primarily in small ruminants, camelids, and foals. The level of effect achieved is determined by three variables (dose, route of administration, initial demeanor of the patient). The stun cocktail can be administered IV, IM, or SQ depending on the systemic analgesia, patient cooperation, and duration desired (Table 1).

(Table 1) Route of administration determines the relative impact of the ketamine stun technique.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Relative ranking</th>
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<tbody>
<tr>
<td>Intensity (analgesia/cooperation)</td>
<td>IV &gt;&gt; IM &gt; SQ</td>
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<tr>
<td>Onset</td>
<td>IV &gt;&gt; IM &gt; SQ</td>
</tr>
<tr>
<td>Duration of effect</td>
<td>SQ &gt; IM &gt;&gt; IV</td>
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Aggressive dosing increases the level of systemic analgesia and patient cooperation, but also increases the risk of instability, unintended recumbency, or the duration of intended recumbency. In patients that must remain standing balance between the alpha2-adrenergic agonist and ketamine is crucial. Greater levels of sedation require lower peak blood levels of ketamine to avoid producing a transient period of instability in equine patients and recumbency in ruminant and camelid patients. Obtaining maximum benefit from the Ketamine Stun technique requires pushing up against the limits of this balancing act. The rapid rise in blood levels produced by IV administration of ketamine presents the greatest challenge. Titrated administration of IV ketamine can be used to minimize risk of untoward responses.

An endless number of permutations are possible when using the Ketamine Stun. Many years of experimentation in many different species have provided a great deal of insight into the potential of this technique but have not produced a definitive combination for all situations in each species. Intravenous administration has been used more extensively, so intramuscular dosage recommendations are not as highly refined. Practitioners are encouraged to experiment and feedback is vital to further development.

The dosage protocols for the Ketamine Stun techniques are deliberately conservative. Results obtained over several years in camelid patients with "mid-range" behavior were used to develop the recommendations to ensure the most sensitive individuals are not overly affected. I generally use the upper end of the recommended dosage ranges in most normal healthy patients. Extremely anxious or unruly individuals may require somewhat more aggressive dosing or supplemental administration to achieve the desired effect. I find the lower end of the recommended dosage ranges useful for quick or less invasive procedures. The xylazine component of the Ketamine Stun technique is smaller than xylazine doses used to produce recumbent sedation in camelid patients, but it is large enough to pose a risk in severely compromised patients and should be reduced accordingly when using the intravenous Ketamine Stun technique in these patients.
Intravenous Ketamine Stun

The camelid intravenous Ketamine Stun technique is designed to provide a potent, but brief level of chemical restraint. It was designed for short procedures requiring a high level of patient cooperation and/or systemic analgesia. The enhanced degree of patient cooperation provided by the intravenous Ketamine Stun technique improves the quality of patient care that can be provided, which has made it very popular with practitioners that have tried it. The thick skin and fiber of the camelid neck can make jugular venopuncture somewhat challenging. The veins on the external surface of the ear are relatively large and accessible, providing a useful alternative site for intravenous administration in camelid patients. Most camelid patients require only modest head restraint when a 25-gauge needle and good technique are used. Percutaneous injections via the ear vein should be limited to small volumes.

A combination of xylazine, ketamine, and butorphanol is administered IV (Table 2). A graceful transition to recumbency occurs approximately 1 minute after intravenous administration of the Ketamine Stun combination. Patients continue to appear surprisingly "alert", but are typically oblivious to their surroundings and procedures being performed. Systemic analgesia peaks 1-2 minutes after intravenous Ketamine Stun administration and diminishes over time. The initial level of systemic analgesia is typically fairly profound. Patients typically are ready to stand and walk with minimal residual effect evident approximately 15 minutes after intravenous administration of the Ketamine Stun. One should plan ahead and work fast when using the intravenous Ketamine Stun.

Mild random head or limb motion is not unusual in stunned patients, but purposeful movement and/or vocalization are signs of an inadequate level of analgesia and additional drug should be administered. Administering one half of the initial ketamine dose IV is often effective when supplementation is required. Allow approximately 1 minute for onset to occur before deciding if additional drug administration is required. Should the initial half dose of ketamine fail to produce the desired level of patient cooperation and systemic analgesia an additional half dose of ketamine along with one half of the initial dose of xylazine should be administered IV. Supplemental doses of ketamine and xylazine can also be used to extend duration. Administering one half of the initial ketamine dose IV generally extends duration by approximately 5 minutes. Administering the initial ketamine dose IV or one half of the initial dose of xylazine and ketamine doses IV often extends duration 7-10 minutes. Onset time for ketamine is approximately one minute, so "educated anticipation" or a delay before proceeding is required when extending duration in this manner. Extending duration with boluses of intravenous ketamine or xylazine-ketamine should be limited to cases that require only a few supplemental doses or in emergency situations in which other options are not available. Double Drip or Ruminant Triple Drip provide a more stable plane of anesthesia than intermittent bolus administration.

A wide range of minor procedures (castrations, biopsies, flushing septic joints, casting fractures, etc.) has been accomplished using only the intravenous Ketamine Stun. Flank laparotomy procedures to correct uterine torsions and perform C-sections have been done using only the intravenous Ketamine Stun on several occasions. Surgical preparation was completed before the intravenous Ketamine Stun was administered. The surgical team was prepared to use local anesthetic blockade, but determined it was not required before proceeding. Surgery time was extremely short in these cases and a booster dose or two of ketamine was required to complete the procedures. Careful monitoring is required to ensure proper analgesic support with
this approach. The use of local anesthetic blockade decreases the likelihood of patient awareness and improves the level of analgesia in the immediate post-operative period. Having syringes preloaded with local anesthetic speeds the blockade process, which reduces its impact on the diminishing level of systemic analgesia. Patients were able to stand almost immediately upon completion of the flank laparotomy procedures. Mother and baby were amazingly alert and functional immediately following C-sections where the intravenous Ketamine Stun was used.

(Table 2) Ketamine Stun Doses*

<table>
<thead>
<tr>
<th></th>
<th>Xylazine</th>
<th>Ketamine</th>
<th>Butorphanol</th>
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<tr>
<td>IV Ketamine Stun</td>
<td>0.22-0.33 mg/kg</td>
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<td>0.08-0.11 mg/kg</td>
</tr>
<tr>
<td>IM Ketamine Stun</td>
<td>0.22-0.55 mg/kg</td>
<td>0.22-0.55 mg/kg</td>
<td>0.08-0.11 mg/kg</td>
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*Doses of the individual drugs are relatively small, which permits them to be safely rounded up in most instances (e.g. 14 mg becomes 15 mg, 17 mg becomes 20 mg, etc.). Rounding makes drawing doses and the record keeping involved easier. A 1 ml syringe should be used, which requires the use of large animal xylazine (100 mg/ml).

Intramuscular Ketamine Stun

The intramuscular Ketamine Stun is used when venous access is not available or a longer less intense chemical restraint effect is desired. A combination of xylazine, ketamine, and butorphanol is administered IM (Table 2). A graceful transition to recumbency occurs 2-10 minutes after intramuscular administration of the Ketamine Stun combination. Patients continue to appear surprisingly "alert", but are generally oblivious to their surroundings and procedures being performed. The level of chemical restraint and systemic analgesia is more variable and generally not as profound as that produced by the intravenous Ketamine Stun. Local anesthetic blockade is typically required for the more painful aspects of procedures. Recumbency generally lasts 20-40 minutes depending on the doses used and the demeanor of the patient. The intramuscular Ketamine Stun may not always produce recumbency in extremely anxious or unruly patients, especially when smaller doses are used.

References

(3) Coetzee, JF, Gehring, R Tarus-Sang, J, et al; Effect of sub-anesthetic xylazine and ketamine ("ketamine stun") administered to calves immediately prior to castration. Vet Anaesth Anlg 2010; 37(6):566-78