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FIELD CASTRATION OF TEN STALLIONS: ANESTHESIA AND RECOVERY MONITORING

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Abstract

This study evaluates an anesthetic protocol for 10 mixed-breed horses (2-22 years old) that have undergone field surgical castration. Premedication was administered intravenously in the left jugular vein with Detomidine ($\bar{X}$ = 0.02 mg/kg). Induction was achieved with a combination of Ketamine ($\bar{X}$ = 2.38 mg/kg) and Midazolam ($\bar{X}$ = 0.038 mg/kg), administered intravenously, in the same syringe. Heart rate ($\bar{X}$ = 43.46 bpm), respiratory rate ($\bar{X}$ = 20.65 bpm), capillary refill time ($\bar{X}$ = 1.26 sec), Oxygen saturation ($\bar{X}$ = 85.73), and rectal temperature ($\bar{X}$ = 37.15 °C) were measured from induction until full recovery. We evaluated the time between premedication and induction (T0 - $\bar{X}$ = 5.5 minutes), from induction until lateral recumbency (T1 - $\bar{X}$ = 1.4 minutes), surgery duration (T2 - $\bar{X}$ = 10.5 minutes), time from the surgery until recovery in standing position (T3- $\bar{X}$ = 22.9 minutes). All animals required assistance until complete recovery and were ataxic while standing/walking for T4- $\bar{X}$ = 12.3 minutes. The anesthetic protocol provided good analgesia and muscle relaxation. All horses recovered well and no postoperative complications were seen.

Key words*: anesthesia, equine, castration, midazolam, recovery.*

INTRODUCTION

Complications associated with castration of stallions can be mild but also life-threatening, their appropriate management diminishes or even helps prevent some risks that lead to complications (hemorrhage, post-operative swelling, seroma formation, infection, eventration, peritonitis, penile damage, continued stallion-like behavior and hydrocele formation (Kilcoyne, 2013).

The recovery phase is always the hardest part of anesthesia with horses and has one of the biggest mortality rates (Gozalo-Marcilla et al., 2021). Monitoring of anesthesia (Muir et al., 2009) and the recovery time were evaluated to assess the level of postoperative complications during field conditions. Equine assisted recovery in the field and its limitations with the elected protocol of anesthesia are evaluated.

MATERIALS AND METHODS

The study took place between October and November 2021, in Ploiești county. Ambient temperatures ranged from 16ºC to 20ºC during the day with an average of 18ºC), with an average and a maximum wind speed of 3.2 m/s. No castrations were performed during bad weather conditions. The study's main purpose was to castrate ten fractious stallions without any complications. Ten abused male equines originated from different environments and were rescued by a horse sanctuary and had to be castrated to prevent hormonal-driven activities such as conspecific aggressivity and undesired female mountings (Siegal et al., 1996). Horses were difficult to approach and at least one caretaker was always present. Food and water were restricted and restrained on the day of surgery (Costea, 2017).

The weight was measured with a measuring tape and according to the established formula: weight (kg) = (heart girth × heart girth × body length)/(11,880 cm^3). Protocols were decided, and respectively dosages were adjusted according to the temperament and age of each stallion (Wagner et al., 2011). The anesthesia protocol implies a premedication with Detomidine (D) 0.015-0.025 mg/kg, followed

by induction (administered intravenously) with Ketamine (K) 2.2-2.4 mg/kg and Midazolam (M) 0.03-0.04 mg/kg.
As a part of a multimodal approach, a loco-regional bilateral intratesticular block with Procaine hydrochloride (X=3.5-4.5 mg/kg) completed the protocol. After induction, horses achieved the anesthetic plane necessary for the surgical procedure and were immediately castrated.
The elected surgical technique was the scrotal closed castration in lateral recumbency with the Henderson equine castrating instrument. (McKinnon et al., 2011). The patient was monitored during anesthesia and the time in minutes between premedication and induction (T0), the time from induction until lateral recumbency (T1), the duration of surgery (T2), time from the end of surgery until standing position (T3) and the time of ataxia while standing/walking until complete recovery (T4).
During anesthesia, heart rate, pulse rate and oxygen hemoglobin saturation SpO_2 were evaluated using a stethoscope and with the pulseoximeter, Nonin® 2500 A; Minneapolis, USA with a probe attached to the upper lip or tongue, and respiratory rate was evaluated using a stethoscope or by observing the thoracic movements, rectal temperature via a digital thermometer and capillary refill was taken, every five to ten minutes from induction until complete recovery (Figure 1).
The stallions needed to be assisted during recovery. The head blanket was gently removed and they were guided from lateral recumbency to sternal recumbency, then to a standing position (either by themselves or supporting the head and the tail to prevent rolling over or falling again).

Figure 1. Monitoring the stallion in lateral recumbency

As a standard protocol, from T3 (moment of lateral recumbency) until T4, the time of complete recovery is assessed, as a key aspect of a smooth recovery in the field. The standard protocol was applied to all recumbent stallions.
Postoperatively, they received the following protocol: Flunixin meglumine 1.1 mg/kg administered intravenously, Amoxicillin trihydrate 8 mg/kg intramuscular, Gentamicin 6 mg/kg administered intravenously (subcutaneous route of administration) as a standard dose of 6000 UI/horse.

RESULTS AND DISCUSSIONS

Each horse received a halter before the administration of premedication (if this wasn't possible because the stallion was fractious, it was put on after induction) that helped with guiding his head, along with the rump (by pulling the tail) and keeping it in standing position as long as it was needed (Figure 2).
The time between premedication and induction (T0 - $\bar{X}$ = 5.5 minutes), induction until lateral recumbency (T1 - $\bar{X}$ = 1.4 minutes), surgery duration (T2 - $\bar{X}$ = 10.5 minutes), time from the end of surgery until standing position (T3) and the time of ataxia while standing/walking until complete recovery (T4), were assessed and recorded.

Figure 2. Holding the stallion in a standing position to facilitate a smoother recovery and marking the key aspects of complete recovery without complications

All animals required assistance until complete recovery and were ataxic while standing or walking for T4- $\bar{X}$ = 12.3 minutes. All horses presented ataxia, from mild to moderate, and were assisted during recovery. Safety for the handler and the stallion were key attributes evaluated on the ground at all times.

Chemical immobilizations such as the standard remote combination of Ketamine-Medetomidine administered through a dart gun (Roşu et al., 2021), were always taken into consideration but this study was achieved by administering the substances via the intravenous route to all ten intractable stallions.

Table 1. Field anesthesia doses for intractable horses (calculated after weight measurement) with the meaning of N as the number of horses that took part in the study, A as the age of the horses in years, W = weight after applying the formula and obtaining a value in kilograms, D = Detomidine, dose in mg/kg, K = Ketamine, dose in mg/kg and M = Midazolam, dose in mg/kg

N	A (years)	W (kg)	D (mg/k)	K (mg/k)	M (mg/kg)
1.	8	350	0.037	2.2	0.028
2.	4	300	0.023	2.66	0.033
3.	21	350	0.017	2.28	0.042
4.	4	400	0.015	2.25	0.0375
5.	3	325	0.018	2.46	0.038
6.	20	250	0.02	2.8	0.04
7.	15	350	0.017	2.28	0.042
8.	22	250	0.016	2.4	0.04
9.	2	320	0.015	2.18	0.039
10.	3	300	0.023	2.33	0.041

Premedication was administered intravenously in the left jugular vein with Detomidine ($\bar{X}$ = 0.02 mg/kg). Induction was achieved with a combination of Ketamine ($\bar{X}$ = 2.38 mg/kg) and Midazolam ($\bar{X}$ = 0.038 mg/kg), administered intravenously in the left jugular vein, in the same syringe. All stallions received an intratesticular block with Procaine hydrochloride ($\bar{X}$ = 4.25 mg/kg). For the entire protocol, from T0 until Heart rate ($\bar{X}$ = 43.46 bpm,), respiratory rate ($\bar{X}$ = 20.65 rpm, capillary refill time ($\bar{X}$ = 1.26 sec), SpO_2 ($\bar{X}$ = 85.73), and rectal temperature ($\bar{X}$ = 37.15°C) were evaluated from induction until full recovery.

Table 2. Recorded mean values of all stallions from T1 until T3. Legend: N = number of horses, HR = heart rate, RR = respiratory rate, CRT = capillary refill time

N	HR	RR	SpO_2	CRT
1	47.5	30.25	87.25	1
2	34	21	77	1.5
3	48.75	21.75	86.25	1.375
4	45	19.5	84.5	1
5	46.75	25.25	90.5	1
6	40.3	10.66	73.6	1.5
7	47.5	18.25	91.25	1.25
8	40.5	21.75	79.66	2
9	37.6	20.33	97	1
10	46.75	17.75	90.33	1

The physiological measurements (heart rate, respiratory rate, oxygenation, and capillary refill time) were assessed, in line with the recorded times of anesthesia and recovery. One out of ten stallions had the HR of 65 beats/minute (first recorded tachycardia). Stallion number 1 started with a HR of 65 that lowered to 36 until T2 finished, others recorded with normal HR. Stallion number 10 started with a HR of 58 beats/minute (bpm) in T1 and the last value, recorded in T3, was 38 bpm in T4. All heart rates were in normal ranges in the recovery phase (all the values were monitored in T3, as part of recovery), with one exception (horse 3) that had a 54 bpm in T3. All increasing HR (horses 1, 3 and 10) have been linked to increased stress due to manipulation (horses 1 and 10) as the horses were fractious, and due to a normal HR specific to individual (horse 3), as it was increased in every recording, and the gut motility was normal at auscultation (done only for horse 3 with diagnosis purpose).

The two stallions had the longest surgery duration (T2 increased, 16 and 20 minutes). This did not affect the anesthetic plane during the surgery and after.

All stallions remained in lateral recumbency for at least 30 minutes after induction (with the blanket over the eyes, and nostrils exposed), calculating T2 and T3 with a mean of 33.4 minutes. They had to be supervised, otherwise, they would try to stand after the surgery but could not do it on their own, not even with assisted recovery. The transition from lateral recumbency to standing position was well coordinated and mild ataxia was present in all stallions afterward. The stallions have been through light to medium plane of anesthesia, turning to light again towards the end of anesthesia (acknowledging the end as the time of removal of the blanket from the head and revealing visual and hearing stimuli). Palpebral and corneal reflexes were present at all times. No stallion showed signs of pain (muscle tremors, movements, sounds) (Muir et al., 2009).

Recovery was well coordinated, assisted in all ten horses. The stallions were evaluated after a week and they were assessed as clinically healthy with all signs leading to a normal behaviour (the usual eating and drinking habits,

normal social interaction and no physiological or musculoskeletal weakness).

Table 3. Recovery times (monitored in minutes) with N = number of horse evaluated, T0 as the time in minutes between premedication and induction, T1 as the time from induction until lateral recumbency, the duration of surgery (T2), time from induction until recovery - from lateral recumbency to standing position (T3) and the time of ataxia while standing/walking until complete recovery (T4)

N	T0 (min)	T1 (min)	T2 (min)	T3 (min)	T4 (min)
1.	13	2	7	30	5
2.	2	1	20	14	8
3.	7	1	12	26	7
4.	2	2	8	22	8
5.	6	2	16	17	6
6.	3	2	9	25	5
7.	5	1	7	27	30
8.	4	1	6	28	15
9.	5	1	10	20	5
10.	8	1	10	20	34

CONCLUSIONS

The used combination of Detomidine in premedication and Ketamine - Midazolam in induction proved to be reliable for the field castration of intractable stallions reducing the risk of postoperative complications.

Mild ataxia was present with the elected protocol but can be significantly reduced by prolonging the time the stallion remains in lateral recumbency for at least 30 minutes after induction (calculating T2 and T3) and has no visual stimuli (with the blanket over the eyes, and nostrils exposed). Prolonging the time that the horse stays in lateral recumbence (maintenance of anesthesia) reduces the time the horse remains ataxic in a standing position before walking carelessly.

All recoveries were assisted, proving that there should be a team of at least two people monitoring the horse for safety reasons. An assisted recovery is always recommended.

The authors recommend the possibility of supplemental Oxygen in field conditions that was unavailable for this study.

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