Veterinary
Anaesthesia and Analgesia
Formerly the Journal of Veterinary Anaesthesia

Veterinary Anaesthesia and Analgesia, 2012 doi:10.1111/j.1467-2995.2012.00782.x

RESEARCH PAPER

Assessment of unassisted recovery from repeated general isoflurane anesthesia in horses following post-anesthetic administration of xylazine or acepromazine or a combination of xylazine and ketamine

Alexander Valverde, Belinda Black, Nicola C Cribb, Amanda Hathway & Alice Daw
Department of Clinical Studies, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada

Correspondence: Alexander Valverde. Department of Clinical Studies, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada N1G 2W1. E-mail: valverde@uoguelph.ca

Abstract

Objectives To compare the effects of sedative doses of acepromazine, xylazine or xylazine/ketamine administered to horses after isoflurane anesthesia on the quality of recovery and anesthesia recovery times. To determine if recovery scores improve after repeated consecutive anesthetic episodes.

Study design Prospective, randomized, crossover study.

Animals Fifteen adult research horses, 6.5 ± 3.4 years old and weighing 499 ± 40 kg.

Methods Horses undergoing three anesthetic episodes with isoflurane for magnetic resonance of the forelimbs were administered acepromazine (0.02 mg kg^{-1} IV) or xylazine (0.3 mg kg^{-1} IV) or xylazine (0.15 mg kg^{-1} IV) combined with ketamine (0.3 mg kg^{-1} IV) in random order upon arrival in recovery. The quality of recovery was compared between the three treatments using a composite numerical rating and a general descriptive scoring system.

Results Horses administered xylazine had better recovery scores than horses administered xylazine/ketamine, associated with better scores during their move to sternal, strength and number of attempts to standing. Horses administered acepromazine had similar recovery scores to horses administered xylazine and to horses administered xylazine/ketamine. Time to sternal recumbency and time to extubation were statistically longer for the xylazine treatment. Time to standing was similar between treatments. Horses had better recovery scores during the third anesthetic episode, regardless of the sedative drug administered, associated with better scores for strength and number of attempts to standing.

Conclusions Xylazine administration was superior to xylazine/ketamine but similar to acepromazine. This study also indicates that horses improve the quality of recovery during consecutive anesthetics associated with longer time to sternal and to standing, regardless of the sedative used.

Clinical relevance All treatments provided good quality recoveries. The experience of the individual horse gained during recent previous anesthetic episodes may have a positive effect in facilitating a better recovery.

Keywords recovery, xylazine, acepromazine, ketamine, sedation.

Introduction

The recovery period is an especially important part of general anesthesia in horses. Complications such as

fractures, occurring during this period account for 23–26% of mortality rate associated with inhalant anesthesia (Johnston et al. 2002, 2004). In addition, myopathy or neurological pathology, usually first noticed during the recovery period, represents 7% of mortality causes (Johnston et al. 2002, 2004).

Sedatives, mostly alpha-2 agonists, have been advocated in the recovery period after inhalant anesthesia to improve the quality of recovery based on the principle that by calming the horse consciousness and muscle strength are regained in a more gradual and coordinated fashion. Alpha-2 agonists administered after inhalant anesthesia induced longer times to standing but fewer attempts and less ataxia than a placebo (Santos et al. 2003). Other protocols have also included the combination of ketamine with alpha-2 agonists (Valverde et al. 2005, 2010; Wagner et al. 2008). However, in one of the studies the authors did not demonstrate a positive effect on recovery scores when compared to a placebo (Wagner et al. 2008). Acepromazine has also been administered in the recovery period to induce a calm state and prevent excitation (Driessen et al. 2011).

The use of different protocols that include the alternatives mentioned above has not been compared. The purpose of this study was to assess three sedative regimes commonly used in the recovery period: xylazine, xylazine/ketamine, and acepromazine and to test our hypothesis that recovery scores will be similar between the three treatments. In view of the study design we also aimed at determining if a horse's quality of recovery improves after repetitive consecutive anesthetic episodes.

Materials and methods

Animals

Fifteen adult horses were used in this study (Table 1). Horses were judged to be in good health (American Society of Anesthesiologists classification I) based on complete physical examination, venous acid-base analysis, electrolytes, total protein and

Table 1 Population and anesthesia characteristics of 15 horses each anesthetized three times with isoflurane for forelimb MRI and administered acepromazine (0.02 mg kg^{-1} IV), xylazine (0.3 mg kg^{-1} IV), and xylazine/ketamine (0.15 mg kg^{-1}/0.3 mg kg^{-1} IV) upon arrival in the recovery stall

Weight (kg)	499 ± 40		
Age (years)	6.5 ± 3.4		
Gender	12 females; 2 geldings; 1 colt		
Breed	12 Standardbreds; 3 Thoroughbreds		
	Acepromazine	Xylazine	Xylazine/Ketamine
Position in surgery	8 Left, 7 Right	9 Left, 6 Right	7 Left, 8 Right
Xylazine (mg kg^{-1})	0.42 (0.40–0.45)	0.42 (0.39–0.44)	0.42 (0.39–0.44)
Guaifenesin (mg kg^{-1})	97 ± 4	97 ± 4	97 ± 4
Ketamine (mg kg^{-1})	2 ± 0	2 ± 0	2 ± 0
Pre-sedation score	1.4 (1.1–1.6) [1 (1–3)]	1.2 (0.9–1.5) [1 (1–2)]	1.2 (0.9–1.5) [1 (1–3)]
Dobutamine dose (μg kg^{-1} minute^{-1})	0.8 (0.7–1.0)	0.9 (0.8–1.0)	0.9 (0.8–1.0)
T_{anesth} (minutes)	81 (76–87)	79 (73–84)	79 (73–85)
T_{off} (minutes)	5 (4.2–5.8)	6 (4.9–6.5)	5 (4.4–6.0)
E′Iso (%)	1.08 (1.05–1.11)	1.06 (1.03–1.09)	1.06 (1.03–1.09)
$T_{sternal}$ (minutes)	26 (22–31)[a] $p = 0.03$	31 (27–36)	26 (21–30)[a] $p = 0.01$
$T_{stern\ stand}$ (minutes)	14 (7–20)	12 (6–18)	13 (6–19)
$T_{standing}$ (minutes)	40 (30–50)	43 (33–53)	38 (28–48)
T_{extub} (minutes)	32 (26–39)[a] $p = 0.009$	39 (32–45)	33 (26–39)[a] $p = 0.01$

Values expressed as mean ± SD for descriptive data and as mean (95% confidence interval range) for remaining variables in each treatment. Pre-sedation score also expressed as [median (lowest-highest value)]. [a]Significant difference from the xylazine treatment. T_{anesth} = Anesthesia time, T_{off} = Time off inhalant until transported to recovery stall, $T_{sternal}$ = Time from entering recovery stall to sternal, $T_{stern\ stand}$ = Time from sternal to standing, $T_{standing}$ = Time from entering recovery stall to standing, T_{extub} = Time from entering recovery stall to extubation.