

# Sedation and Anesthesia in Military Horses and Mules. Review and Use in the Swiss Armed Forces.

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## RESUME

### Sédation et anesthésie chez les chevaux et mules militaires. Revue et utilisation dans l'armée suisse.

*L'armée suisse utilise depuis plus de 100 ans différents types de chevaux pour des missions spéciales. Trois races sont utilisées : Les chevaux de race demi-sang suisse pour l'équitation, les chevaux Franches-Montagnes et les mulets comme « chevaux de bât » pour le transport. Cet article passe en revue les substances, dosages et voies d'administration qui permettent de réaliser des sédations et des anesthésies simples chez le cheval comme sur le mulet, dans le terrain et dans un contexte militaire. Cette contribution est aussi destinée aux autres armées qui utilisent des mulets dans la mesure où la littérature n'est pas très riche dans ce domaine. Des recommandations et indications sont données sous forme de tableaux dans cette optique.*

**KEYWORDS:** Horse, Mule, Sedation, Anesthesia, Swiss Armed Forces.

**MOTS-CLÉS :** Cheval, Mulet, Sedation, Anesthésie, Armée Suisse.

## INTRODUCTION

Equids are escape animals that are difficult to examine and manipulate in certain situations. For a long time they could only be restricted physically, which was often stressful and dangerous for both animal and human. In recent decades, new opportunities have developed with the help of medicines. The art of anaesthesiology, especially in the field of sedation, has opened up new possibilities in the safe handling of horses. In the Swiss Armed Forces, for example, these drugs have become an important part of the veterinary equipment.

Sedatives, in combination with analgesics, allow us to perform painful procedures safely on the standing animal. Short anaesthesia in the form of injection anaesthesia enables us to perform minor operations in the field.

The Swiss Armed Forces uses horses of the Swiss Warmblood breed (Figure 1), Franches-Montagnes breed (Figure 2) as well as mules (Figure 3). During a recruit school there are about 55 horses and 10 mules on duty. The animals are kept in boxes and are prepared for work in stalls. All animals are moved daily and are allowed to graze on suitable ground conditions. In this respect, the Swiss Armed Forces fulfill completely the very strong and severe law on animal protection.

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*Figure 1: Swiss Warmblood horses for riding education purposes.*

(Sources: Swiss Armed Forces)



*Figure 2: The Freiburger horse as a packhorse for transportation in every situation.*

(Sources: Swiss Armed Forces)



This work provides an overview of the various medications used by the Swiss Armed Forces Veterinary Service for sedation and short anaesthesia of the equids during service. Corresponding tables give dosage recommendations for stable sedation as used in the military context. The necessary dosages may vary from individual to individual and must always be adapted to the situation. In addition, there are great differences between horses and mules with regard to the application of individual active substances.

*Figure 3: The mule as a packhorse for transportation in every situation.*

(Sources: Swiss Armed Forces)



## BASIC INFORMATION ON SEDATION AND ANAESTHESIA

### 1. Mules

Mules differ greatly from horses in some areas. In this paper only the differences regarding the sedation of mules will be discussed. In order to explain the differences, the donkey is used again and again. Donkeys seem to have a greater capacity for the metabolism of different drugs, such as xylazine. For this reason, donkeys often need a higher dose or the drugs have to be administered in a shorter interval. It cannot be assumed that mules are exactly in the middle between donkeys and horses in terms of the rate of metabolism. In certain areas, the mule appears to be more like the horse (Matthews & Taylor, 2002).

### 2. Application possibilities

Sedatives and anaesthetics can be administered in different ways. For safe administration, it is very important to have an assistant who is in control of the equine animal. An easy way of administering sedatives is sublingual or oral administration. In the Swiss Armed Forces, this form of administration is only possible with detomidine, since only one oral preparation with this active ingredient is approved on the Swiss market. The disadvantage of sublingual or oral administration is the low bioavailability. Detomidine administered sublingually has a bioavailability of approx. 27% (Institute of Veterinary Pharmacology and

Toxicology, 2020). For intravenous application, the external jugular vein is chosen in all equids. The vein is dammed in the jugular and then the drug is administered into the vein using a 20 gauge cannula and a syringe (Figure 4).

Intramuscular injections are administered into the neck muscles. A 22 gauge cannula is used for intramuscular injection (Figure 5). The advantage of an intramuscular injection is that it is easier to administer. The disadvantage is the longer duration until the onset of action.

### 3. Indications

In various situations, sedation can be helpful to ensure safer handling of the animal. The most common reasons for sedation by the Swiss Armed Forces Veterinary Service are wound care and shoeing.

Wound care involves simple cleaning and disinfection of superficial wounds in uncooperative animals, as well as closure of small to medium-sized wounds. Furthermore, equines are sedated for dental treatment or, if necessary, for hair clipping. In rare cases, sedation is required for a complete clinical examination or certain manipulations, such as the insertion of a nasopharyngeal probe. Around 100 horses per year are sedated by the Swiss Armed Forces Veterinary Service. Depending on the cause of the sedation, different agents are used. These differences are described in more detail on the following pages.

Around 20 short general anaesthetics are performed per year. These are mainly castrations of stallions, which are carried out twice a year by the veterinarian section of recruit school as part of an exercise and for instruction purposes. These short anaesthetics are injection anaesthetics in the field.

### 4. Estimation of weight

The Swiss Armed Forces uses the estimation of weight since no precise devices can be found in the field and used in action. However, it is essential to estimate the weight as accurately as possible in order to ensure good and safe sedation or anaesthesia. The experience of the examining veterinarians is of great importance.

The following weight estimates can be used as a guide:

- Swiss warmbloods (riding horses) between 550kg and 650kg.
- Freiburger horses (pack animals) between 450kg and 550kg.
- Mules (pack animals) between 400kg and 500kg.

## SEDATION

This chapter discusses the process of sedation and then the active substances used in the Swiss Armed Forces.

### 1. Procedure

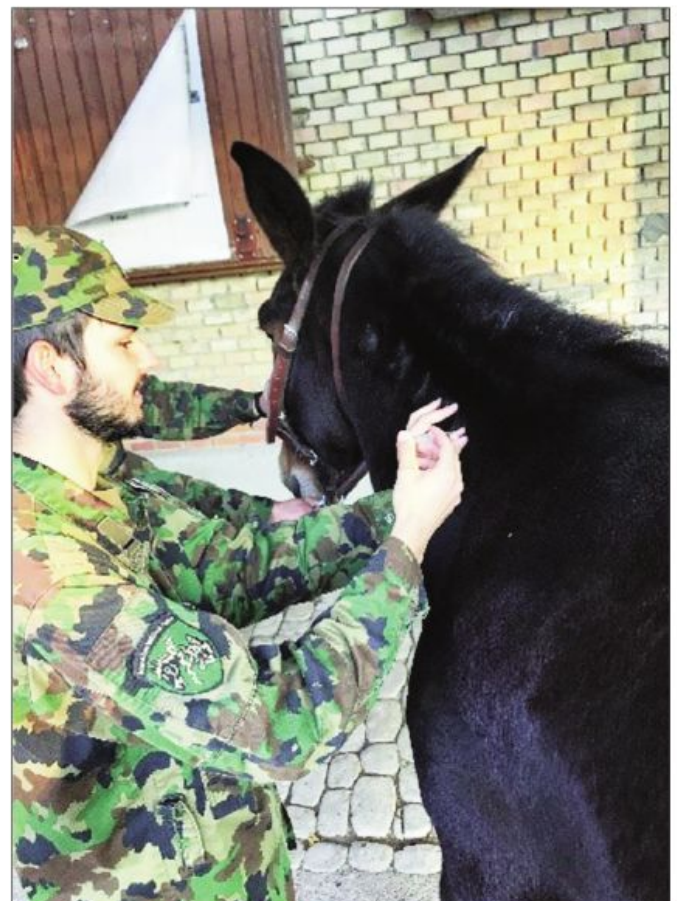
#### 1.1. Pre-sedative examination

A pre-sedative examination in the form of a short clinical

Figure 4: Intravenous injection in a Freiburger horse. (Sources: Swiss Armed Forces)



Figure 5: Intramuscular injection in a mule. (Sources: Swiss Armed Forces)



examination should be carried out before each sedation to detect any unknown diseases that may affect the sedation safety. As a minimum, the respiratory rate, pulse rate, temperature, mucous membranes and capillary refilling time (CRT) should be measured and recorded. The heart and lungs should also be auscultated. In case of known or suspected bleeding, the haematocrit and plasma proteins should also be checked.

### 1.2. *Avoiding stress*

In various situations, sedation can be helpful to ensure safer handling of the animal.

### 1.3. *Post-sedative approach*

Animals that are not yet fully awake should not eat to avoid aspiration of food or obstruction of the throat. Feed withdrawal is indicated until the horse is fully awake again.

## 2. Sedatives

### 2.1. *Alpha2-Adrenoreceptor-Agonist*

The sedative effect is achieved by stimulation in the brain, more precisely in the locus coeruleus. Suppression of the noradrenal nociceptive neurons in the spinal cord leads to analgesia. In addition, the stimulation of inhibitory descending pathways also inhibits the transmission of pain.

Since the alpha2-adrenoreceptors are found in many parts of the body, the undesirable drug effects are very diverse. Sedation with alpha2 agonists often leads to diuresis. Various mechanisms such as an increased filtration rate and an inhibition of the ADH (anti-diuretical hormone) effect lead to this.

Initially, there is often a rise in blood pressure due to vasoconstriction. After a few minutes, the active substance passes the blood-brain barrier and the central antihypertensive effect predominates. As a result, the blood pressure drops below the initial value.

There is also a reduction in insulin secretion by activating the alpha2-adrenoreceptors in the beta cells of pancreatic islet cells (Mac Donald & Virtanen, 1992). Further, there is a reduction in intestinal motility, which increases the risk of ileus. Furthermore, colic symptoms can be masked by the analgesic effects (Lowe & Hilfiger, 1968).

Alpha2 agonists are generally very well suited for use in the Swiss Armed Forces. They are usually administered in combination with butorphanol to reduce the required amount and thus also the side effects. In this case one speaks of neuroleptanalgesia (Levionnois, 2007).

#### 2.1.1. *Xylazine*

Xylazine is a sedative and analgesic with muscle relaxant properties. Its visceral analgesic properties are stronger than those of butorphanol. Equids which are sedated with xylazine lower the head and the facial muscles relax. As a result, the lower lip hangs limply downwards. The penis is also excised. Unlike acepromazine, there are

no reports of priapism after the application of xylazine. Even if the horses seem to be well sedated, they can still react to external stimuli. These are usually acoustic stimuli, which can lead to rashes. This risk can be reduced by combining them with opioids such as butorphanol.

Xylazine is indicated for short sedations such as minor surgery. A combination with a local anaesthetic can greatly improve the effect. Xylazine has an analgesic effect which has a shorter half-life than the sedative effect. Xylazine is also used for pre-medication prior to anaesthetic induction. The active substance can be administered intramuscularly or intravenously. During intramuscular administration, the active substance is absorbed rapidly. The disadvantage is the low bioavailability of 40-48%. With intravenous application, the effect is already felt within 1-2 minutes. The maximum effect is reached after 3-10 minutes. The effect lasts about 1.5 hours and it takes 2-3 hours until complete recovery. Accidental intra-arterial injection may cause seizures or collapse (Plumb, 2002).

The product Xylazine Streuli® ad us vet (Streuli Pharma AG, Switzerland) is used in the Swiss Armed Forces. The recommended dose is 0.6 - 1.0mg/kg BW (Body Weight). According to the package insert, the route of administration is intravenous (Institute of Veterinary Pharmacology and Toxicology, 2020). For dental examinations, the Swiss Armed Forces likes to use sedation with xylazine in combination with butorphanol. With a dosage of 0.4 - 0.8mg/kg BW xylazine and 0.01mg/kg BW butorphanol, sufficient sedation is achieved in horses. As no sedation has been used for dental treatment of mules in the present period, no data are available so far.

According to the study by Latzel (2012), the duration of effect of sedation with xylazine is shorter in mules compared to horses. In the study mentioned above, 6 horses and 14 mules were sedated with 0.6mg/kg BW of xylazine for dental treatment and various parameters were measured to identify species-specific differences in pharmacokinetics and pharmacodynamics. A shorter half-life and a shorter effective period in the peripheral compartment was observed in the mammal. The drug elimination in the mule is more efficient and therefore faster, since more drug is bound to plasma proteins and therefore less drug is assimilated in the tissue. In order to achieve an appropriate sedation depth in the mule, a dosage of 0.9mg/kg BW had to be selected (Latzel, 2012). This finding is confirmed by Matthews and Taylor. They report that a 50% higher dose should be chosen to achieve sufficient sedation in the mule (Matthews & Taylor, 2002).

The side effects of xylazine are multiple and varied. The administration of xylazine inhibits the thermoregulatory center. A horse sedated with xylazine should therefore be protected from extreme temperatures. As with all alpha2 agonists, xylazine causes a rise in blood pressure immediately after administration, followed by a prolonged drop in blood pressure. Gastrointestinal motility is also reduced and polyuria may occur. For this reason, great caution should be used if intestinal obstipation is

suspected. Xylazine can trigger uterine contractions. This is not relevant in the Swiss Armed Forces, as no pregnant mares are used. If pregnancy occurs in the last trimester, there is a risk of miscarriage after application of xylazine (Plumb, 2002).

### 2.1.2. Detomidine

Detomidine, like xylazine, is an alpha<sub>2</sub> agonist. The sedative and analgesic effects of both agents are dose-dependent. There are preparations for sublingual and intravenous application. The onset of action of detomidine is longer compared to xylazine. In order to achieve an ideal effect, it is necessary to wait 10-15 minutes after the application before starting the treatment (Plumb, 2002). After sublingual application, the effect starts after about 30-35 minutes, while the same effect is achieved after 10-20 minutes after intramuscular application. With intravenous application, the effect occurs after 3-5 minutes. The duration of effect after intravenous or intramuscular injection depends on the dose and is between 1 and 4 hours. After sublingual application of 0.04mg/kg BW detomidine the effect lasts for 3 hours (Institute of Veterinary Pharmacology and Toxicology, 2020). In order to improve the sedation quality and to reduce the undesired drug effects by lowering the required dose, a combination with butorphanol is recommended.

The Swiss Armed Forces Veterinary Service uses the preparations Medesedan® (Virbac AG, Switzerland) and Equisedan® (Dr. E. Graeub AG, Switzerland) for intravenous administration. Domosedan® (Provet AG, Switzerland) is used for sublingual application. Whenever possible, intravenous or intramuscular administration is preferred to sublingual administration, as the effect is much faster onset and the duration of action is more controllable due to the better variation possibilities in dosage. When using the Domosedan paste®, a dose of 0.04mg/kg BW is administered. The dosage is given according to the dosage table on the package leaflet (Institute of Veterinary Pharmacology and Toxicology, 2020).

Detomidine in combination with butorphanol is used in the Swiss Armed Forces as the most common combination of active substances for the sedation of equids. The possible applications are very diverse and range from sedation for shoeing to sedation for clipping horses to sedation for wound treatment or clinical examinations. According to the package insert of Equisedan®, a dosage of 0.012mg/kg BW detomidine butorphanol and 0.025mg/kg BW butorphanol for intravenous injection is recommended for the combination detomidine with butorphanol (Institute of Veterinary Pharmacology and Toxicology, 2020). For the injection of detomidine alone, doses between 0.01mg/kg and 0.08mg/kg are recommended. For sedation at the farrier, a dosage of 0.01mg BW detomidine and 0.01mg butorphanol is usually sufficient. For sedation due to wound care, a better analgesia is important and a dosage as mentioned in the package insert above is required. As with xylazine, the dosage should be adjusted in mules. In the case of Swiss Armed Forces mules, it has

been shown for detomidine that an increase in dosage of 50% is recommended for adequate sedation depth.

The adverse drug reactions are comparable to those of xylazine, which is why not everything is repeated in this chapter.

### 2.1.3. Romifidine

Romifidine is the third representative of the alpha<sub>2</sub> agonists used in the Swiss Armed Forces Veterinary Service. Romifidine is mainly used for sedation of the hoof or for wound treatment of the hind limbs. Unlike xylazine and detomidine, romifidine has a longer duration of action (England GCW, 1992). As with the alpha<sub>2</sub> agonists described above, a combination with butorphanol leads to a reduced response to external influences and fewer adverse drug reactions. Horses sedated with romifidine show less ataxia compared to those sedated with xylazine or detomidine (Levionnois, 2007).

The Swiss Armed Forces Veterinary Service uses the preparation Sedivet® (Boehringer Ingelheim GmbH Switzerland). A dosage between 0.04mg/kg BW to 0.12mg/kg BW for intravenous injection is recommended by the manufacturer. The Swiss Armed Forces's Veterinary Service uses romifidine alone or in combination with butorphanol. In the case of romifidine alone, satisfactory results can be achieved in horses with a dosage between 0.02mg/kg BW and 0.05mg/kg BW. For mules, romifidine is usually combined with butorphanol. A single application requires a dose of 0.06mg/kg BW to 0.08mg/kg BW. In combination with butorphanol, for horses a dose of 0.02mg/kg BW to 0.025mg/kg BW romifidine combined with 0.01mg/kg BW butorphanol is usually sufficient. This is clearly below the recommendation of the manufacturer of the butorphanol preparation of 0.04-0.08mg/kg BW romifidine and 0.02-0.025mg/kg BW butorphanol (Institute for Veterinary Pharmacology and Toxicology, 2020). For mules, the Swiss Armed Forces Veterinary Service uses the same dosage as for horses when the two active ingredients are combined.

## 3 Analgesics

### 3.1. Opioid

Opioids act by binding to opioid receptors. When administered alone, opioids have no sedative properties. In combination with alpha<sub>2</sub> agonists or acepromazine, they can potentiate their effects. In combination with opioids, the dosage of sedatives can also be lowered, thus reducing the adverse drug effects. In horses, butorphanol is usually used as an opioid (Levionnois, 2007).

#### 3.1.1. Butorphanol

Butorphanol activates the receptors and blocks the  $\mu$ -receptors. It is a so-called  $\kappa$  agonist and  $\mu$ -antagonist. As mentioned above, butorphanol is used in combination with alpha<sub>2</sub> agonists. Due to the analgesic effect, a better sedation can be achieved. Butorphanol can be administered intravenously, but also intramuscularly.

The Swiss Armed Forces Veterinary Service carries Morphasol-10® ad us vet (Dr E. Graeb AG, Switzerland) as butorphanol preparation. The dosages can be obtained from the dosage tables or can be found with the respective sedatives.

## GENERAL ANAESTHESIA

This chapter discusses general anaesthesia as it is performed in the Swiss Armed Forces. The Swiss Armed Forces Veterinary Service only performs injection anaesthesia for horses and not in mules. Inhalation anaesthesia for equids is only carried out in cases of referral by the appropriate clinic.

### 1. Procedure

#### 1.1. Fasting

Before general anaesthesia the horses should be fasted for 8-12 hours. Water may be given to the horse until premedication. This is to avoid reflux with subsequent aspiration and a possible gastric tympany. If the horse was not fasted before the anaesthesia, it is advisable to intubate the animal immediately after induction. Unfortunately this is usually not possible in the field.

#### 1.2. Preoperative Examination

The preoperative examination, like the presedative examination, is carried out before any general anaesthesia. The content corresponds to the presedative examination.

#### 1.3. Avoiding Stress

As in the case of sedation, it is important to ensure a quiet environment and a calm approach to the ground. After general anaesthesia, the recovery phase must be as quiet as possible to avoid the animals getting up prematurely. This can reduce the risk of injury during the recovery phase.

#### 1.4. Intravenous indwelling catheter

For safety reasons, an indwelling catheter should always be inserted before general anaesthesia. The Swiss Armed Forces Veterinary Service uses commonly a 12 to 14 gauge indwelling Teflon® catheter (2 inch for up to three days and a 5 1/2 inch for longer use). It is used to be able to react quickly in case of anaesthetic problems.

#### 1.5. Premedication and induction of general anaesthesia

The patient is premedicated before each general anaesthesia. As part of this premedication, the patient receives an NSAID, usually flunixin meglumine, acepromazine and antibiotic prophylaxis.

To induce general anaesthesia, the horse is sedated with 1.0mg/kg BW xylazin. The horses must be sedated so strongly that the head hangs at the level of the carpal joints. If this cannot be achieved with the initial dose, half of the original dose of xylazine must be re-injected. Once the horse has been sedated deeply enough, 2mg/kg BW ketamine with 0.03mg/kg BW

diazepam can be injected in a joint syringe. The effect will be felt within a few minutes and the horse will go down. To maintain the injection anaesthesia, half the dose of xylazine and ketamine must be re-injected every 10 minutes. A re-injection of half the original dose may be made three times. This results in a maximum surgery duration of 40 minutes. By maintaining injection anaesthesia with an alpha2 agonist, the recovery phase is usually relatively calm and controlled (Levionnois, 2007).

#### 1.6. Duration of anaesthesia

The basic rule is to keep the duration of anaesthesia in the field as short as possible.

#### 1.7. Postoperative

Animals that are not yet fully awake should not eat in order to avoid aspiration of food or gullet formation.

### 2. Sedatives

#### 2.1. Alpha2-Agonisten

The same alpha2 agonists are used as described in the chapter on sedation.

#### 2.2. Benzodiazepines

Benzodiazepines have an antagonistic effect on various inhibitors of central neurotransmitters. One of these neurotransmitters is gamma amino butyric acid (GABA), the main neurotransmitter of inhibitory synapses in the central nervous system. The use of benzodiazepines increases the effect of GABA. Benzodiazepines are mainly hypnotic, but also have muscle relaxant and antispasmodic effects. In adult horses this causes strong ataxias and excitation, which can put the horses into anxiety states. Therefore a benzodiazepine preparation alone should not be used to sedate an adult horse. They are mainly used in combination with ketamine under general anaesthesia (Levionnois, 2007).

##### 2.2.1. Diazepam

Diazepam is used to induce general anaesthesia. It is administered intravenously together with ketamine. Diazepam settles on plastic over time. For this reason, diazepam should not be absorbed until before an immediate administration. In the Swiss Armed Forces Veterinary Service the drug Valium® (Roche Pharma AG, Switzerland) is used.

#### 2.3. Phenothiazines

Phenothiazines have a calming effect, but do not have any analgesic properties themselves. In combination with alpha2 agonists or opioids, the analgesic properties of these agents are enhanced. The action of phenothiazines is achieved by centrally inhibiting dopamine. Peripheral blocking of the alpha-adrenoreceptors causes arterial hypotension. This can be dangerous in dehydrated animals or animals with bleeding (Hubbell, 2009).

##### 2.3.1. Acepromazine

Acepromazine is used in the Swiss Armed Forces Veterinary Service only under general anaesthesia. Due

to its vasodilatory effect, the muscles can also be well supplied with oxygen during general anaesthesia and the horse can muster enough strength to stand up safely at the end.

The Swiss Armed Forces uses the preparation Prequillan® (Fatro S.p.A., Italy). As it is a preparation which is not authorised for horses, the withdrawal period under Article 13 (4) of the Veterinary Medicines Regulation must be 6 months (Swiss Federal Council, 2020).

A possible complication of administering acepromazine is a paralysis of the M. retractor penis. In combination with testosterone administration or when administered to stallions, this paralysis can be irreversible (EquiMed LLC, 2014).

### 3. Aesthetics

A distinction is made between inhalation anaesthetics and injection anaesthetics. Regardless of whether inhalation or injection anaesthetics are used, a pre-medication must be administered first. The Swiss Armed Forces Veterinary Service uses only injection anaesthetics for equids.

#### 3.1. Ketamine

Ketamine acts antagonistically on NMDA (N-methyl-D-aspartate) receptors and agonistically on opiate receptors. The condition caused by ketamine is called dissociative anaesthesia. It is mainly induced by its effect on NMDA receptors. In addition, central sympathomimetic effects are triggered. Ketamine may be present in form of one of the two enantiomers S-ketamine or R-ketamine or as a racemate of both enantiomers. The difference between these forms can be found in the specialist literature (Adams & Werner, 1997).

Ketamine can be administered intravenously, intramuscularly or per orally. Since the horses in the Swiss

Armed Forces already have a venous catheter and are heavily sedated, ketamine is always administered intravenously. The onset of action follows within one minute. To achieve a relaxation of the skeletal muscles, ketamine must be mixed with other substances (Adams & Werner, 1997).

The Swiss Armed Forces Veterinary Service uses the preparation Narketan® (Vetoquinol AG, Switzerland), which is approved for all animal species. A dosage of 2.2mg/kg BW, when combined with xylazine, is sufficient. The horse lies down immediately after application. The duration of action is 10-30 minutes. An additional dosage after 15 minutes is necessary (Institute for Veterinary Pharmacology and Toxicology, 2017).

### WITHDRAWAL TIMES

All militarised horses retain their farm animal status. That means they can enter the food chain for human consumption. Therefore, only preparations may be used whose active ingredients are either approved for farm animals in Switzerland (Federal Department of Home Affairs, 2016) or whose active ingredients are on the positive list for equids (European Commission, 2013).

Each drug application must be documented in the treatment journal of the corresponding equine animal. This must be kept with the equine passport. The respective withdrawal periods can be found in the package insert. Prequillan is an exception. More details about the rededication can be found in the subchapter Acepromazine.

### TABLES OF USE AND DOSAGE

These dosages are given as guidelines. Not every horse reacts in exactly the same way to the listed drugs. Each sedation/anaesthesia must be individually adapted to the horse and situation in question. See tables 1, 2, 3.

*Table 1: General anesthesia: Dosages, premedication anesthesia with Detomidine and Butorphanol and anesthesia with Diazepam and Ketamin.  
(Sources: Swiss Armed Forces)*

BODY WEIGHT	PREMEDICATION BEFORE NARCOSIS (iv)		NARCOSIS IV. (AFTER 10 MIN)	
	DETOMIDIN MEDESEDAN®	+ BUTORPHANOL MORPHASOL® -10	DIAZEPAM VALIUM®	+ KETAMIN NARKETAN®
100kg	0,3ml	+ 0,3ml	0,2ml	+ 2ml
200kg	0,6ml	+ 0,6ml	0,4ml	+ 4ml
300kg	0,9ml	+ 0,9ml	0,6ml	+ 6ml
400kg	1,2ml	+ 1,2ml	0,8ml	+ 8ml
450kg	1,35ml	+ 1,35ml	0,9ml	+ 9ml
500kg	1,5ml	+ 1,5ml	1ml	+ 10ml
550kg	1,65ml	+ 1,65ml	1,1ml	+ 11ml
600kg	1,8ml	+ 1,8ml	1,2ml	+ 12ml
650kg	2,1ml	+ 2,1ml	1,3ml	+ 13ml
700kg	2,25ml	+ 2,25ml	1,4ml	+ 14ml

**Table 2:** Dosages light - medium sedation with Romifidine, Xylazine, Detomidine and Detomidine in combination with Morphasol.

(Sources: Swiss Armed Forces)

BODY WEIGHT	ROMIFIDIN IV. SEDIVET®	XYLAZIN IV. XYLAZIN STREULI®	DETOMIDIN IV./IM. MEDESEDAN®	DETOMIDIN MEDESEDAN®	+ BUTORPHANOL MORPHASOL® -10
100kg	0,4ml	2,5ml	0,2ml	0,1ml	+ 0,1ml
200kg	0,8ml	5ml	0,4ml	0,2ml	+ 0,2ml
300kg	1,2ml	7,5ml	0,6ml	0,3ml	+ 0,3ml
400kg	1,6ml	10ml	0,8ml	0,4ml	+ 0,4ml
450kg	1,8ml	11,25ml	0,9ml	0,45ml	+ 0,45ml
500kg	2,0ml	12,5ml	1ml	0,5ml	+ 0,5ml
550kg	2,2ml	13,75ml	1,1ml	0,55ml	+ 0,55ml
600kg	2,4ml	15ml	1,2ml	0,6ml	+0,6ml
650kg	2,6ml	16.25ml	1,3ml	0,65ml	+ 0,65ml
700kg	2,8ml	17.5ml	1,4ml	0,7ml	+ 0,7ml

**Table 3:** Dosages strong sedation with Romifidine, Xylazine, Detomidine and Detomidine in combination with Morphasol.

(Sources: Swiss Armed Forces)

BODY WEIGHT	ROMIFIDIN IV. SEDIVET®	XYLAZIN IV. XYLAZIN STREULI®	DETOMIDIN IV./IM. MEDESEDAN®	DETOMIDIN MEDESEDAN®	+ BUTORPHANOL MORPHASOL® -10
100kg	0,8ml	5ml	0,4ml	0,2ml	+ 0,1ml
200kg	1,6ml	10ml	0,8ml	0,4ml	+ 0,2ml
300kg	2,4ml	15ml	1,2ml	0,6ml	+ 0,3ml
400kg	3,2ml	20ml	1,6ml	0,8ml	+ 0,4ml
450kg	3,6ml	22,5ml	1,8ml	0,9ml	+ 0,45ml
500kg	4,0ml	25ml	2ml	1ml	+ 0,5ml
550kg	4,4ml	27.5ml	2,2ml	1,1ml	+ 0,55ml
600kg	4,8ml	30ml	2,4ml	1,2ml	+0,6ml
650kg	5,2ml	32.5ml	2,6ml	1,3ml	+ 0,65ml
700kg	5,6ml	35ml	2,8ml	1,4ml	+ 0,7ml

## ABSTRACT

The Swiss Armed Forces is using for more than 100 years different kind of horses for special missions. Three breeds are used: Swiss Warmblood horses for riding purposes, Swiss Freiburger horses and mules as "pack horses" for transportation. This article reviews the substances, dosages and routes of administration for simple sedation and anaesthesia in horses and mules, in the field and in a military context. This contribution is also intended for other armies that use mules as the literature is not very rich in this field. Recommendations and indications are given in the form of tables.

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