American Journal of Animal and Veterinary Sciences

Original Research Paper

Sevoflurane Requirements Concerning Continuous Infusion of Dexmedetomidine in Rabbits

Gissela Chisag, Jorge Moposita-Maiza, Andrés Guerrero and Jenny Lozada

Hospital Docente Veterinario-UTA, Facultad de Ciencias Agropecuarias, Universidad Técnica de Ambato, Campus Querochaca, Cevallos, Ecuador

Article history
Received: 12-07-2024
Revised: 11-02-2025
Accepted: 13-02-2025

Corresponding Author:
Jenny Lozada
Hospital Docente Veterinario-UTA, Facultad de Ciencias Agropecuarias, Universidad Técnica de Ambato, Campus Querochaca, Cevallos, Ecuador
Email: jp.lozada@uta.edu.ec

Abstract: Dexmedetomidine provides a satisfactory sedative and analgesic effect in balanced anaesthesia of small animals. In rabbits, it provides effective sedation and intravenous infusion of one or more drugs are commonly used to induce or maintain general anaesthesia. We aimed to evaluate the effect of continuous infusion of dexmedetomidine on the Minimum Alveolar Concentration (MAC) of sevoflurane and anaesthetic efficacy in ovariohysterectomy in rabbits. A total of 24 Female rabbits of Creole, New Zealand and California breeds were randomly divided into T1 (CIR of DEX a dose of 3.5 ug/kg/h). T2 (CIR of DEX a dose of 5 ug/kg/h). For maintenance, we used sevoflurane according to the patient's needs and T3 Control (sterile saline solution). The parameters evaluated were heart rate, respiratory rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, partial oxygen saturation and Minimum Alveolar Concentration (MAC) of sevoflurane. The Heart Rate (HR) showed a significant difference between treatments after 20 min ($p = 0.0087$) (T1 177,50 and T2 177,88 pm). However, T3 control causes an increase in HR. Dexmedetomidine CIR at a dose of 3.5 µg/kg/h reduced sevoflurane requirements to 2.4% in the first 5 min, and at a dose of 5 ug/kg/h, it reduced from 3.7-1.6%. Therefore, there is a significant difference between treatments and provides efficient sedation in patients.

Keywords: Continuous Rate Infusion, Dexmedetomidine, Minimum Alveolar Concentration, Rabbits

Introduction

Research on exotic or unconventional pets has been gaining momentum due to the large number of people who are passionate about having a different animal in their homes. However, society is used to dealing with common animals, and the lack of knowledge leads to a lack of information about this type of species.

Anaesthetic drugs for rabbits are usually similar to those used for conventional pets; however, to perform surgical procedures in rabbits, there is a need to work with related drugs and adequate doses that avoid risks at an intraoperative level. The drugs that control analgesia and deep sedation in patients are used in continuous infusions at a certain time, whose results are satisfactory while maintaining hemodynamic parameters within the range (Steffey *et al*., 2015). However, anaesthesia in rabbits should be even more monitored since these animals have a higher anaesthetic risk than other species; in addition to the factors mentioned above, they present episodes of hypothermia and cardiorespiratory complications (Bernaola, 2018).

The use of anaesthetic protocols based on the use of meloxican, acepromazine, propofol, and xylazine has been described as safe at the suggested doses. Therefore, the heart rate, respiratory rate and oxygen saturation remain stable. However, active thermal support is recommended during anaesthesia (Vilcahuamán *et al*., 2019; Fisher and Graham, 2018).

Dexmedetomidine (DEX) is a specific α2 receptor agonist with sedative, anxiolytic, sympatholytic and analgesic-sparing effects and minimal depression of respiratory function (Weerink *et al*., 2017). Authors suggest the dose of dexmedetomidine for rabbits of 0.005 mg/kg intramuscular as a preanesthetic combined with ketamine and the doses suggested for induction and maintenance are 0.035- 0.05 mg/kg (Fisher and Graham, 2018). To ensure adequate anaesthetic management, constant rate infusion or CRI, which is a method of drug supplementation at a continuous rate in which drugs are administered intravenously, has been used to ensure adequate anaesthetic management, usually has better anaesthetic effects and reduces the total dose of some drugs (Quirós Carmona *et al*., 2014).

Other authors evaluated DEX requirements in continuous infusion at a dose of 3.5 ug/kg/h; the results showed that DEX reduced sevoflurane requirement by 33% and propofol requirement by 11% (Terada *et al*., 2014). DEX can decrease blood pressure and heart rate in rabbits in a dose-dependent manner but does not affect myocardial systolic and diastolic function (Ren *et al*., 2018). Thus, we aimed to evaluate the effect of continuous infusion of dexmedetomidine on the minimum alveolar concentration (MAC) of sevoflurane and its anesthetic efficacy in ovariohysterectomy in rabbits.

Materials and Methods

This investigation was carried out in the Veterinary Teaching Hospital of the Technical University of Ambato (HDV-UTA: *Hospital Docente Veterinario de la Universidad Técnica de Ambato*), which is in the city of Cevallos km 2 road to Quero. Querochaca sector in the Tungurahua province, Ecuador. Its geographic coordinates are 1°21'0" S y 78°37'0" W. The HDV-UTA altitude is 2,885 masl. The weather conditions for the study were optimal. The study aimed to determine the use of dexmedetomidine (Sedavet ® Lavetec CIA.) in a Constant Rate Infusion (CRI) to verify dexmedetomidine effects in the Minimal Alveolar Concentration (MAC) of sevoflurane and how efficient the anaesthesia during ovariohysterectomy in rabbits. We used a completely randomized design with an Analysis Of Variance (ANOVA) and a Tukey test with a 5% sensibility and a p-value <0.05. Three treatments were used (T1, T2, T3) with eight repetitions n = 24.

Female rabbits of the Creole, New Zealand and California breeds at seven months and 1.8-3 kg. Rabbits were maintained in wooden cages in a group of four. The rabbits' diet was based on alfalfa. A fasting of 6 h of solids was imposed, while a fasting of 1 h of liquids was imposed before the procedure. A clinical examination of the rabbits was done before the procedure. The rabbit distribution was of 8 animals in each group. T1 anaesthetic premedication was ketamine (15 mg/kg) and midazolam (0.2 mg/kg), propofol was used as induction (2 mg/kg), dexmedetomidine was diluted in a 100 mL bag of sterile saline solution (NaCl 0.9%) at a dose of 3.5 µg/kg/h IV was administered during the surgery time in Constant Rate Infusion (CRI) with an infusion pump. T2 used the same anaesthetic protocol; however, the dexmedetomidine dose was 5 µg/kg/h. Finally, T3 used the same pre-anesthetic protocol through a sterile saline solution as a control. This dosing is similar to the one reported by Ren *et al*. (2018), where the dose used was 2.75 µg/kg and even twice or three times this base dosing.

Every rabbit was catheterized in the lateral saphenous vein with a G26 catheter. The patient was inducted with a dose of 2 mg/kg of propofol IV. A laryngeal mask for rabbits (V-Gel R1-R3) was used for oxygen administration. Anesthesia was maintained with or without a CRI of dexmedetomidine and sevoflurane in which the MAC was evaluated with the different treatments mentioned above. Then, parameters were monitored: Heart Rate (HR), Respiratory Rate (RR), Systolic Blood Pressure (SBP), diastolic blood pressure (DBP), Mean Arterial Pressure (MAP) and arterial saturation of oxygen (SpO_2). As mentioned, the MAC was selected based on the patient's response and the anaesthetic plane. Then, the parameters were evaluated every 5 min for 20 min.

Statistical Analysis

The data obtained were analyzed using a completely randomized statistical system, with three treatments and eight replicates with a total of 24 patients. Analysis of variance (ADEVA-ANOVA) and Tukey's test at 5% with a $p<0.05$ were used for comparison of averages.

Results and Discussion

The parameters evaluated were Heart Rate (HR), Respiratory Rate (RF), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), arterial oxygen saturation (SpO_2) and the centre of the study, Minimum Alveolar Concentration (MAC).

Heart Rate

Table (1) shows the treatments used. T1 CIR of DEX a dose of 3.5 ug/kg/h. T2 CIR of DEX a dose of 5 ug/kg/h, T3. Control (sterile saline solution). No statistical difference in heart rate was found in the first 10 min after dexmedetomidine infusion. However, a statistical difference was observed after 15-20 min of anaesthesia ($p>0.05$). In the first 5 min, the heart rate slightly differed from the values reported by Flores *et al*. (2008) who obtained lower means in HR (195.77 bpm) versus our study (T1: 203 bpm; T2 200 bpm).

The heart rate of the animals decreased at T1 and T2 versus control. As mentioned by Ren *et al*. (2018), the impact of DEX on the cardiovascular system mainly manifests as negative chronotropic and inotropic effects, namely reduction of the heart rate and blood pressure, especially as sedation time increases. Dexmedetomidine is known to affect HR but does not affect diastolic and systolic function. DEX acts on the vascular α^2 receptors and produces vasoconstriction or a relaxation effect, with the clinical manifestations appearing as HR reduction (Pan *et al*., 2021). HR values are consistent with a study that evaluates the anaesthetic and cardiopulmonary effects of ketofol infusion in combination with CRIs dexmedetomidine 3 µg/kg/h (197±32 beats/min) compared to higher frequencies found in patients who received an infusion of midazolam and fentanyl (Mofidi and Vesal, 2024).

Table 1: The effects of DEX on heart rate

Surgical time (minutes)	Treatments T1	T2	T3 (Control)	C.V.	p-value
5	203.88 a	200.88 a	220.88a	13.59	0.3332n .s
10	175.25 b	196.50 ab	225.25a	19.82	0.0594n .s
15	183.00 b	186.50 b	238.25a	19.08	0.0154< 0.05*
20	173.50 b	177.88 b	224.88a	17.13	0.0087< 0.05**

Note: a, b; mean with common letter are not significantly different (p<0.05) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5ug/kg/h. T2 = CRI dexmedetomidine at a dose of 5ug/kg/h. T3 = 0.9% sodium chloride

Respiratory Rate (RR)

Table (2) shows the treatments used. T1 CIR of DEX a dose of 3.5 ug/kg/h. T2 CIR of DEX a dose of 5 ug/kg/h, T3. Control (sterile saline solution). The respiratory rate during the 5, 10, 15 and 20 min did not show statistical significance between treatments. However, the Breaths Per Minute (BPM) T2 has the most stable averages during this process, and the Respiratory Rate (RR) remains within normal parameters; according to Quesenberry *et al*. (2021), the physiologically normal value in this species is 30-60 rpm.

Lima *et al*. (2014) mention that the respiratory rate maintained a similar behaviour throughout the experiment with averages of 89, 55, 60 and 67 bpm during the 5, 10, 15 and 20 min, respectively. Our study is consistent with these results, where RR maintained a similar behaviour. As evaluated in another study, the use of dexmedetomidine by infusion at a dose of 1 ug/kg/h does not alter respiratory rate (Quirós Carmona *et al*., 2014; Julià Hernández *et al*., 2019). On the other hand, Mofidi and Vesal (2024) reported a respiratory rate (breaths/min) with CRIs dexmedetomidine at 5 min (32±9), at 10 min (28±10), at 15 min (30±14) and 20 min (24±11). The RR values are similar to those obtained in our study. Therefore, better anaesthetic efficacy is confirmed with the use of dexmedetomidine compared to the use of other drugs, such as CRIs fentanyl, where the occurrence of apnea is significantly greater.

Systolic Blood Pressure (SBP)

Table (3) shows the treatments used. T1 CIR of DEX a dose of 3.5 ug/kg/h. T2 CIR of DEX a dose of 5 ug/kg/h, T3. Control (sterile saline solution). Systolic blood pressure during the 5 min between treatments does not show a statistically significant difference. However, treatments T1 and T3 are higher than T2, with 82.88 mmHg on average. Systolic blood pressure during the 10 min between treatments does not show a significant difference. However, T2, on average, together with T3, exceeds T1, demonstrating that the SBP in these treatments is within the stable physiological ranges, but the T2 is at the limit of the lower range.

Regarding systolic blood pressure in the 15 min, there is no significant evidence, but clinically, T2 has more precise values with 95.00 mmHg compared to T1 and T3. Consequently, at 20 min, systolic blood pressure did not show a significant difference (p = 0.788); in turn, T2 (103.88 mmHg) versus T3 (106.13 mmHg) yielded the best results. Therefore, during these surgical times, the SBP remains stable in T2 from minutes 10, 15 and 20 and in T3 in minutes 10 and 20, as mentioned by Lance (2016), whose values are 92.7-135 mmHg.

The systolic blood pressure in our study is consistent with Ren *et al*. (2018), who obtained similar values at times 5, 10 and 20 minutes, where the SBP showed values between (86-119 mmHg). In this sense, the SBP in our research remained stable after 10 min but at a low range limit; this may be due to the anaesthetic protocol that was established with propofol (2 mg/kg) that generates hypotension in the patients. This study agrees with that described by Cárdenas Carbajal (2019), who showed that at minute 15, the patients presented hypotension due to the use of propofol accompanied by acepromazine and tramadol; however, after that minute, they returned to normal values.

Table 2: The effects of DEX on respiratory frequency

Surgical Time (Minutes)	Treatments T1	T2	T3 (Control)	C.V.	p-value
5	39.25 a	44.00 a	40.00 a	17.04	0.3629 n.s
10	41.75 a	48.00 a	42.75 a	16.06	0.1913 n.s
15	48.38 a	49.25 a	45.00 a	20.43	0.6580 n.s
20	47.13 a	50.00 a	49.25 a	17.46	0.7848 n.s

Note: a, b; mean with common letter are not significantly different (p<0.05) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5ug/kg/h. T2 = CRI dexmedetomidine at a dose of 5 ug/kg/h. T3 = 0.9% sodium chloride

Table 3: The effects of DEX on systolic blood pressure (SBP)

Surgical Time (Minutes)	Treatments T1	T2	T3 (Control)	C.V.	p-value
5	92.50a	82.88 a	84.63a	16.28	0.6332 n.s
10	79.50a	92.75 a	125.00a	8.63	0.0831 n.s
15	82.13a	95.00 a	81.63a	14.71	0.4269 n.s
20	87.25a	103.8 8a	106.13a	16.50	0.7882 n.s

Note: a, b; mean with common letter are not significantly different (p<0.05) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5ug/kg/h. T2 = CRI dexmedetomidine at a dose of 5 ug/kg/h. T3 = 0.9% sodium chloride

Diastolic Blood Pressure (DBP)

Table (4) shows the treatments used. T1 CIR of DEX a dose of 3.5 ug/kg/h. T2 CIR of DEX a dose of 5 ug/kg/h, T3. Control (sterile saline solution). Diastolic blood pressure during the 5 min T1, whose value is higher than T2 and T3, respectively. Diastolic blood pressure at 10 min T3 is higher compared to T1 and T2, respectively. Concerning minute 15, T2 with 57, 63 mmHg is higher than T1 and T3; at 20 min, the control shows higher values. However, the diastolic blood pressure in the four surgical stages remains stable in T1 and T2, but the values recorded are not similar to those mentioned by Lance (2016) 64-75 mmHg, whose values are normal in this species.

Cárdenas Carbajal (2019) reported that DBP decreased from minute 15, generating hypotension in patients. This may be related to the protocol used (midazolam and ketamine). Similar results were obtained in our study with a reduction in DBP at 5 min, which could be related to the use of a similar protocol (midazolam 0.2 mg/kg-ketamine 15 mg/kg) and propofol (2 mg/kg), which generates a decrease in left ventricular relaxation related to the increase in the size of the patient's blood vessels. Hypotension at certain surgical moments may be caused by the use of dexmedetomidine; being an alpha-2 agonist, it generates a decrease in the release of norepinephrine in the nerve endings of the sympathetic system, causing a decrease in mean arterial pressure (Afonso and Reis, 2012).

Mean Arterial Pressure (MAP)

Table (5) shows the treatments used. T1 CIR of DEX a dose of 3.5 ug/kg/h. T2 CIR of DEX a dose of 5 ug/kg/h, T3. Control (sterile saline solution).

Table 4: The effects of DEX on Diastolic Blood Pressure variable (DBP)

Surgical Time (Minutes)	Treatments			C.V.	p-value
	T1	T2	T3 (Control)		
5	55.13 a	48.00 a	52.25 a	18.48	0.8280 n.s
10	40.75 b	58.13 ab	81.88 a	12.18	0.0552 n.s
15	42.25 a	57.63 a	47.63 a	15.99	0.4519 n.s
20	43.00 a	47.00 a	83.25 a	18.15	0.6170 n.s

Note: a, b; mean with common letter are not significantly different ($p<0.05$) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5 ug/kg/h. T2 = CRI dexmedetomidine at a dose of 5 ug/kg/h. T3 = 0.9% sodium chloride

Table 5: The effects of DEX on mean arterial pressure in rabbits

Surgical Time (Minutes)	Treatments			C.V.	p-value
	T1	T2	T3 (Control)		
5	67.88 a	67.38 a	60.00 a	12.20	0.1634 n.s
10	64.38 a	71.00 a	101.63 a	12.20	0.1634 n.s
15	66.63 a	79.13 a	61.25 a	14.44	0.3434 n.s
20	71.25 a	64.38 a	93.63 a	16.71	0.9486 n.s

Note: a, b; mean with common letter are not significantly different ($p<0.05$) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5 ug/kg/h. T2 = CRI dexmedetomidine at a dose of 5 ug/kg/h. T3= 0.9% sodium chloride

The mean arterial pressure values are (80-91 mmHg) (Lance, 2016). However, they are not those obtained in our study; in the three treatments, the means do not reach the established values; this may be due to the hypotension generated by the alpha-2 adrenergic drugs. Similar findings were described in another study where MAP had a reduction in the values associated with the release of noradrenaline in α-adrenergic receptors caused by drugs that cause depression of the central vasomotor (Cárdenas Carbajal, 2019). This hypotension was not seen in the control group with the use of saline solution.

Peripheral Oxygen Saturation (SpO_2)

Table (6) shows the treatments used. T1 CIR of DEX a dose of 3.5 ug/kg/h. T2 CIR of DEX a dose of 5 ug/kg/h, T3. Control (sterile saline solution). SpO_2 values remained stable at all times evaluated. These data agree with another study using CRI of DEX 3 µg/kg/h, where oxygen saturation was maintained during the 20 min at values of 99±1 (Mofidi and Vesal, 2024).

Minimum Alveolar Concentration (MAC)

The alveolar concentration at 5 min shows significant differences between treatments ($p = 0.005$); T2 reduces the MAC of sevoflurane to 1.69% versus T1 and T3. At 10 min, T2, T1 and T3, thus T2 CIR of DEX at a dose of 5 ug/kg/h reduces the MAC of sevoflurane, favouring anaesthetic savings and showing a positive effect against this treatment ($p = 0.075$). At 15 min, there are significant differences between treatments ($p = 0.015$), with T2 generating a 1.13% reduction in MAC compared to T1 and T3. Finally, at 20 min, there is a highly significant difference ($p = 0.002$); T1 and T2 reduce the MAC of sevoflurane compared to T3.

Research in dogs and cats has shown that DEX by continuous infusion generates anaesthetic and analgesic efficacy (Chávez Monteagudo *et al*., 2024); these results are similar to ours because DEX causes deep sedation in T1 and T2 treatments. However, in T3, the patient remains somatized; the patient appears awake but does not respond to stimuli.

Table 6: The effects of DEX on peripheral oxygen saturation

Surgical Time (Minutes)	Treatments T1	T2	T3 (Control)	C.V.	p-value
5	97.00a	96.25a	97.00	3.19	0.8549n.s
10	92.38a	96.00a	96.88a	6.33	0.3050n.s
15	94.88a	96.38a	95.75	5.21	0.8344n.s
20	93.25a	97.00a	97.25	5.23	0.2254n.s

Note: a, b; mean with common letter are not significantly different ($p<0.05$) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5 ug/kg/h. T2= CRI dexmedetomidine at a dose of 5 ug/kg/h. T3 = 0.9% sodium chloride

Table 7: The effects of DEX on minimum alveolar concentration of sevoflurane in rabbits

Surgical Time (Minutes)	Treatments T1	T2	T3 (Control)	C.V.	p-value
5	2.44ab	1.69a	3.31b	6.13	0.0057<0.05*
10	2.19ab	1.63a	3.56b	7.85	0.0075<0.05*
15	2.44ab	1.13a	3.00b	8.20	0.0154<0.05*
20	1.06a	0.91a	2.56b	5.93	0.0002>0.05*

Note: a, b; mean with common letter are not significantly different ($p<0.05$) C.V. Coefficient of variation. n. s = Not significant * = Significant at 0.05 T1 = CRI dexmedetomidine at a dose of 3.5 ug/kg/h. T2 = CRI dexmedetomidine at a dose of 5ug/kg/h. T3= 0.9% sodium chloride

Other studies report that constant rate infusions of dexmedetomidine decrease to be equipotent to 1.5 MAC according to the MAC effects of dexmedetomidine, and the reduction is greater than 50% (Akashi *et al*., 2020-2021).

The use of CIR of DEX allows for maintaining anaesthetic efficacy, unlike its use in Total Intravenous Anesthesia (TIVA), where it is generally necessary to administer more injections of dexmedetomidine during the surgical procedure, which does not allow the animal to undergo deep anaesthesia (Bellini *et al*. 2014).

Conclusion

The use of constant rate infusion of dexmedetomidine can be a useful adjunct during anesthesia in rabbits. The dose of 5ug/kg/h reduces the initial MAC of sevoflurane from 3.7% to an average of 1.34%, this decreases the costs of high quality surgical procedures. Further studies are needed to evaluate the potential benefits of dexmedetomidine over a longer surgical time to determine the optimal dose regimen for dexmedetomidine CRIs in terms of anesthetic-sparing effects in rabbits.

Acknowledgement

We thank the work team of Hospital Docente Veterinario- UTA. On the other hand, thank you to Katherine Jaramillo for contributing to the experimental phase.

Funding Information

This study was entirely self-funded by the author. The UTA-Veterinary Teaching Hospital provided in-kind support, including access to facilities, medical equipment, and professional expertise. No external grants or financial sponsorships were received for this research.

Author's Contributions

Gissela Chisag: Assisted in data collection and analysis of data and drafted the article.

Jorge Moposita-Maiza: Assisted in conducting research.

Andrés Guerrero: Assisted in conducting research.

Jenny Lozada: Conducted research and drafted the article.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript, and no ethical issues are involved.

References

Afonso, J., & Reis, F. (2012). Dexmedetomidine: Current Role in Anesthesia and Intensive Care. *Brazilian Journal of Anesthesiology*, *62*(1), 118–133. https://doi.org/10.1016/s0034-7094(12)70110-1

Akashi, N., Murahata, Y., Hosokawa, M., Hikasa, Y., Okamoto, Y., & Imagawa, T. (2021). Cardiovascular and renal effects of constant rate infusions of remifentanil, dexmedetomidine and their combination in dogs anesthetized with sevoflurane. *Journal of Veterinary Medical Science*, *83*(2), 285–296. https://doi.org/10.1292/jvms.20-0457

Akashi, N., Murahata, Y., Kishida, H., Hikasa, Y., Azuma, K., & Imagawa, T. (2020). Effects of constant rate infusions of dexmedetomidine, remifentanil and their combination on minimum alveolar concentration of sevoflurane in dogs. *Veterinary Anaesthesia and Analgesia*, *47*(4), 490–498. https://doi.org/10.1016/j.vaa.2020.04.002

Bellini, L., Banzato, T., Contiero, B., & Zotti, A. (2014). Evaluation of sedation and clinical effects of midazolam with ketamine or dexmedetomidine in pet rabbits. *Veterinary Record*, *175*(15), 372–372. https://doi.org/10.1136/vr.102595

Bernaola, G. V. (2018). *Monitoreo anestésico en conejos (Oryctolagus cuniculus) con un protocolo de acepromazina, propofol y tramadol*.

Cárdenas Carbajal, J. D. (2019). Measurement of blood pressure in rabbits (Oryctolagus cuniculus) subjected to three anesthetic protocols. https://repositorio.urp.edu.pe/entities/publication/7d3b0b66-70ad-42d9-9cfa-a94afd123794

Chávez Monteagudo, J. R., Paz Campos, M. A., & Ibancovichi Camarillo, J. A. (2024). Use of Dexmedetomidine in the dog and cat clinic. *Revista Especializada En Clinica de Pequeñas Especies y Equinos*.

Fisher, P., & Graham, J. (2018). Rabbits. In J. Carpenter & C. Marion (Eds.), Exotic Animal Formulary (pp. 494–531). Elsevier. https://doi.org/10.1016/B978-0-323-44450-7.00010-2

Flores, E., Rufino, D., Bastías, A., Cattaneo, G., & Morales, A. (2008). Description of a protocol based on dexmedetomidine and ketamine in demented rabbits. *Av.Cs. Vet*, *23*, 5–12. https://doi.org/10.5354/acv.v23i1-2.9074

Julià Hernández, A., Bonastre Ráfales, C., & de Torre Martínez, A. (2019). Efecto de una infusión continua de dexmedetomidina en las necesidades anestésicas y analgésicas en esterilizaciones en perras.

Lance, J. (2016). Exotic Animal Medicine: A Quick Reference Guide. Second edition. Saunders.

Mofidi, A., & Vesal, N. (2024). Total intravenous anesthesia with Ketofol in rabbits: a comparison of the effects of constant rate infusion of midazolam, fentanyl or dexmedetomidine. *BMC Veterinary Research*, *20*(1), 253. https://doi.org/10.1186/s12917-024-04112-w

Pan, S.-Y., Liu, G., Lin, J.-H., & Jin, Y.-P. (2021). Efficacy and Safety of Dexmedetomidine Premedication in Balanced Anesthesia: A Systematic Review and Meta-Analysis in Dogs. *Animals*, *11*(11), 3254. https://doi.org/10.3390/ani11113254

Quesenberry, K. E., Orcutt, C. J., Mans, C., & Carpenter, J. W. (2021). Dedication. *Ferrets, Rabbits, and Rodents (Fourth Edition)*, 2. https://doi.org/10.1016/b978-0-323-48435-0.03001-x

Quirós Carmona, S., Navarrete-Calvo, R., Granados, M. M., Domínguez, J. M., Morgaz, J., Fernández-Sarmiento, J. A., Muñoz-Rascón, P., & Gómez-Villamandos, R. J. (2014). Cardiorespiratory and anaesthetic effects of two continuous rate infusions of dexmedetomidine in alfaxalone anaesthetized dogs. *Research in Veterinary Science*, *97*(1), 132–139. https://doi.org/10.1016/j.rvsc.2014.03.022

Ren, J., Li, C., Ma, S., Wu, J., & Yang, Y. (2018). Impact of dexmedetomidine on hemodynamics in rabbits. *Acta Cirurgica Brasileira*, *33*(4), 314–323. https://doi.org/10.1590/s0102-865020180040000003

Lima, D. A. S. D., de Souza, A. P., Moreira Borges, O. M., de Santana, V. L., de Araújo, A. L., de Figueirêdo, L. da C. M., Neto, P. I. da N., & Lima, W. C. (2014). Estudo comparativo da associação de Cetamina à Dexmedetomidina, Medetomidina ou Xilazina em coelhos. *Brazilian Journal of Veterinary Medicine*, *36*(3), 35–41.

Steffey, E., Mama, K., & Brosnan, R. (2015). Inhalation Anesthetics. In K. Grimm, L. Lamont, W. Tranquilli, S. Greene, & S. Robertson (Eds.), Veterinary Anesthesia and Analgesia (Fifth, pp. 297–331).

Terada, Y., Ishiyama, T., Asano, N., Kotoda, M., Ikemoto, K., Shintani, N., Sessler, D. I., & Matsukawa, T. (2014). Optimal doses of sevoflurane and propofol in rabbits. *BMC Research Notes*, *7*(1), 820. https://doi.org/10.1186/1756-0500-7-820

Vilcahuamán, G., Delgado, L., & Jara, M. (2019). Monitoreo Anestésico En Cuatro Parámetros Fisiológicos En Conejos (Oryctolagus Cuniculus) Con Un Protocolo De Anestésicos Basados En Meloxican, Acetopromazine, Propofol, Xilacine Y Tramadol. *Biotempo*, *16*(1), 75–84. https://doi.org/10.31381/biotempo.v16i1.2178

Weerink, M. A. S., Struys, M. M. R. F., Hannivoort, L. N., Barends, C. R. M., Absalom, A. R., & Colin, P. (2017). Clinical Pharmacokinetics and Pharmacodynamics of Dexmedetomidine. *Farmacocinética Clínica*, *56*(8), 893–913. https://doi.org/10.1007/s40262-017-0507-7