ijvm.2019.269704.1004942

Iranian Journal of Veterinary Medicine
Volume 13- Issue 04

Original Article
Online ISSN : 2252-0554

The Clinical Comparison of Intraosseous and Intravenous Anesthesia (Thiopental-Na) in Pigeon

Samane Bakhshi[1], Mohammad Reza Aghchelou[*2], Dariush Saadati[3]

[1]*Graduated from the Faculty of Veterinary Medicine, University of Zabol, Zabol, Iran*
[2]*Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Zabol, Zabol, Iran*
[3]*Department of Food Hygiene and Quality Control, Faculty of Veterinary Medicine, University of Zabol, Zabol, Iran*

Abstract

BACKGROUND: Intraosseous injection is a way of administration of drugs.

OBJECTIVES: The clinical comparison of intraosseous and intravenous injection of Thiopental-Na.

METHODS: First, all birds (twenty-six healthy pigeons) were split out into two groups randomly. Group A received 20 mg kg-1 Thiopental-Na by intraosseous route and group B by intravenous route. After one week that iInt J Radiat Biol, s needed for washing out the drug, group A received 20 mg kg-1 Thiopental-Na by intravenous route and group B by intraosseous route. The respiratory rate (fR), heart rate (HR) and cloacal temperature (T) were measured before (0 minute) and 1, 5, 10, 20 and 30 minutes after anesthetic drug administration. Reaction to injection, number of efforts for injection, duration to onset of anesthesia and different scores of anesthesia were checked. Returning from anesthesia in the two groups was recorded and compared.

RESULTS: Statistical assessment showed anesthesia onset in the method of intravenous injection was significantly less than the method of intraosseous injection (P=0.003), and the fR in two groups was different in 1 min after drug administration (P=0.036). There was not statistically difference in other minutes for fR, HR and T in two groups (P >0.05). Statistical analysis showed that there were no significant differences in terms of number of efforts for anaesthetizing as well as anesthesia stage in both methods in different minutes (P>0.05). Also, no significant alterations were recorded for recovery time for both groups. There was not any visible lameness or pain for intraosseous route after recovery.

CONCLUSIONS: Intraosseous anesthesia injection in birds is a practicable and fast procedure and comparable with intravenous route.

KEYWORDS: anesthesia, intraosseous injection, intravenous injection, Thiopental-Na, pigeon

Correspondence
Mohammad Reza Aghchelou, Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Zabol, Zabol, Iran
Tel: +98(543) 1232250, Fax: +98(543)1232251, Email: mraghchelou@gmail.com
Received: 2019-05-21
Accepted: 2019-09-03

How to Cite This Article
Bakhshi, M., Aghchelou, M. R., & Saadati, D. (2019). The Clinical Comparison of Intraosseous and Intravenous Anesthesia (Thiopental-Na) in Pigeon. Iranian Journal of Veterinary Medicine, 13(4), 401-409.

Introduction

Intraosseous (IO) drug administration has been reported in human, when intravenous (IV) access is unsuccessful (Hamed et al., 2013) and for drug regional administration like knee joint degeneration (Su et al., 2018). Regional intraosseous administration of prophylactic antibiotics is used in a mouse model of total knee arthroplasty (Young et al., 2015) but in horses the intravenous route showed fewer side effects than intraosseous injection for antimicrobial regional limb perfusion (Rubio-Martínez et al., 2012). In rabbits, intraosseous injection was used for subchondral intraosseous pressure measurement (Beverly et al., 2018), protein-based drug administration (Massarwi et al., 2013) and anesthesia (Mazaheri-Khameneh et al., 2012). The comparison of intraosseous and intravenous administration of rocuronium (Nemeth et al., 2016) and vasopressin (Wimmer et al., 2016) in a hypovolemic cardiac arrest swine model was performed. Intraosseous injection is mentioned when access to the vein is difficult, as occurs with hypotensive and in very small birds (Paul-Murphy et al., 2001). Intraosseous pentobarbital injection was used for euthanasia in passerine birds (Paul-Murphy et al., 2017). Lactated Ringer's and 0.9% sodium chloride solutions were administrated intraosseously and there were not differences between the two solutions on the electrolytes and acid-base balance in pigeons (Carregaro et al., 2015).

In a study intravenous and intraosseous injections of morphine sulfate in human were compared. No significant differences between two groups in pharmacokinetic factors were found and it was mentioned that intraosseous injection is as effective as intravenous injection (Von Hoff et al., 2008). In a study, induction of anesthesia was compared by the IV and the IO route in rabbits (Sarrafzadeh Rezaei et al., 2008). That study showed that the IO injection of thiopental is a fast and reliable route for induction of general anesthesia. In avian practice some surgical techniques, like fracture repair and abdominal surgery are performed (Bennett & Kuzma 1992). Avian anesthetic and surgical techniques have improved significantly. The anesthesia and administration of drugs are very important for success in surgery. In various birds, general anesthesia is performed by using parenteral and inhalation anesthetic agents (Paul-Murphy et al., 2001). Long-term, stable anesthesia was performed by isoflurane and butorphanol in normal chickens (O'Kane et al., 2016) but long-term anesthesia is almost impossible by parenteral injection because of providing renal and hepatic complication. Inhalation anesthesia in avian medicine is an advantage but needs expensive instruments. Injection anesthesia in comparison with an inhalant anesthesia for short time anesthesia may be beneficial for onset of anesthesia, requiring minimal instruments and it is inexpensive (Paul-Murphy et al., 2001). There are various methods for intraosseous injection. Intraosseous injection can be done in the ulnar or the tibial bones (Paul-Murphy et al., 2001; Valverde et al., 1993). Thiopental belongs to the Barbiturates and is one of the parenteral anesthetic agents. Function of thiopental is increasing the inhibitory performance of GABA (gamma-aminobutyric acid) in the brain (Thorp, 2008). In pet birds, injection of anesthesia is important for surgical and diagnostic techniques. Comparison of intraosseous and intravenous anesthesia by Thiopental-Na in pigeon and checking for possible clinical complications are the aim of study.

Materials and Methods

Animals

Healthy pigeons (n=26) were kept in a clean environment at room temperature and a stress-free condition. They were given food and water on a daily basis. For one week they were under clinical surveillance. Only clinically healthy birds were included in the study. Ethics approval for this experiment was obtained from the Institutional Animal Care and Research Committee.

Study protocol

Crossover design was used for this study. All birds were divided into two groups randomly. Group A received 20 mg kg-1 Thiopental-Na 2.5% (Specia Rhone-Poulenc Rorer, Paris, France) by intraosseous route (n=13) and group B received 20 mg kg-1 Thiopental-Na intravenously (n=13). One week was needed for washing out the drug, afterwards, 20 mg kg-1 Thiopental-Na was injected in group A, intravenously (n=13) and 20 mg kg-1 Thiopental-Na was injected in group B, intraosseously (n=13). In this method each group was considered for its control. After tying the legs of the pigeon, intravenous injecting was done in the pigeon`s wing vein using insulin syringe. In the method of intraosseous, anesthetic agent was injected in tibial tuberosity by using insulin syringe (Ilam Sorang Co., Ilam, Iran) at an angle of 90 degrees. Before starting anesthesia, respiratory rate (fR), heart rate (HR) and cloacal temperature (T) of pigeons were recorded as the time of zero. During injection, reaction to the injection and the number of attempts to inject were noted. Number of fR, HR and T of birds were recorded during anesthesia in various timings of 0(before), 1, 5, 10, 20, and 30 min after injection. The HR was measured on the left ribs by stethoscope as well as the fR by number of chest movements. The T was measured though cloaca by thermometer. The Onset, duration of the anesthesia and return from anesthesia in two groups were recorded and compared. Anesthesia stage for each pigeon at the times mentioned, were investigated. Anesthesia stage was studied according to various reflexes such as reflex of finger-tightening, wing-flapping, reflex to tapping on the table and balance reflex. Based on reflexes, anesthetic stage was determined; Anesthesia stage I: Standing situation and severe reaction to painful stimulus. Anesthesia stage II: Sitting situation and medium reaction to painful stimulus (bird gathered his legs when squeezed). Anesthesia stage III: Stay on the back of the ground, extremely weak reactions to painful stimulus. After recovery birds were checked for pain or lameness in injection sites.

Statistics

Data averages of the fR, HR, and temperature of pigeons at various times were compared between intraosseous method and intravenous method by paired t test. Also, due to the lack of normality, Mann-Whitney U test was used to compare the number of attempts at injection and onset of anesthesia (induction) between the two methods. The results were shown as the mean ± standard deviation. The statistical significance level was $P \leq 0.05$. PASW/SPSS® software was used for statistical analysis.

Results

In this research, there was not a significant difference in number of attempts at injection between intraosseous (1.42±0.76 times) and intravenous route (1.35 ± 0.63 times) (P-Value=0.869). It was revealed that Onset of anesthesia in intravenous injection (7.67±5.1 s) was significantly faster than intraosseous

injection (85.56±139.5 s) (P-Value=0.003). Mean and standard deviation of recovery time in two routes of intravenous and intraosseous administration were 28.85±13.66 min and 29.04±12.8 min respectively. There was no significant difference in recovery time in two groups (P-Value=0.910). There was a statistical significant difference just in first minute after injection, for fR in two groups (P-Value=0.036). In other minutes there were not statistical differences for fR between two groups (all P-Values>0.05) (Figure 1).

The HR and T do not have statistical differences in two groups for 0,1,5,10,20 and 30 min after injection (P-Value>0.05) (Figs. 2 & 3). Also, there were not significant differences in stage of anesthesia in two groups for 0,1,5,10,20 and 30 min after injection (all P-Values>0.05) (Fig. 4).

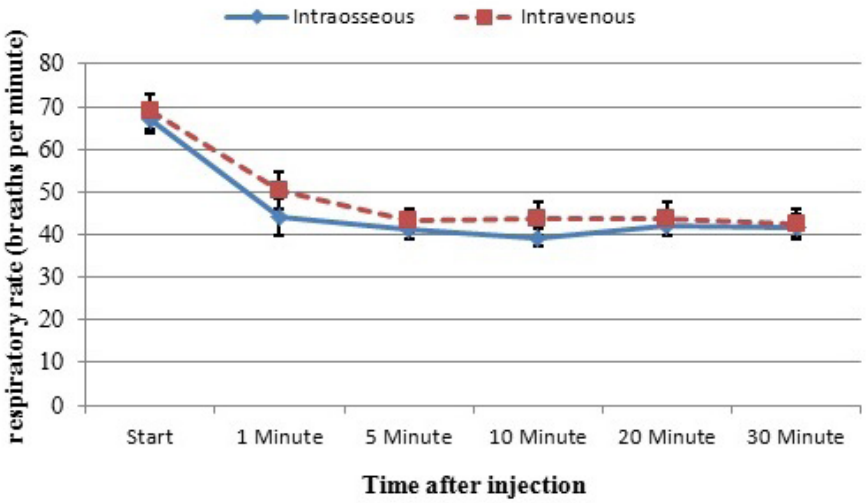

Figure 1. The mean and standard error of Respiratory rate in pigeons in intravenous and intraosseous administration of Thiopental-Na.

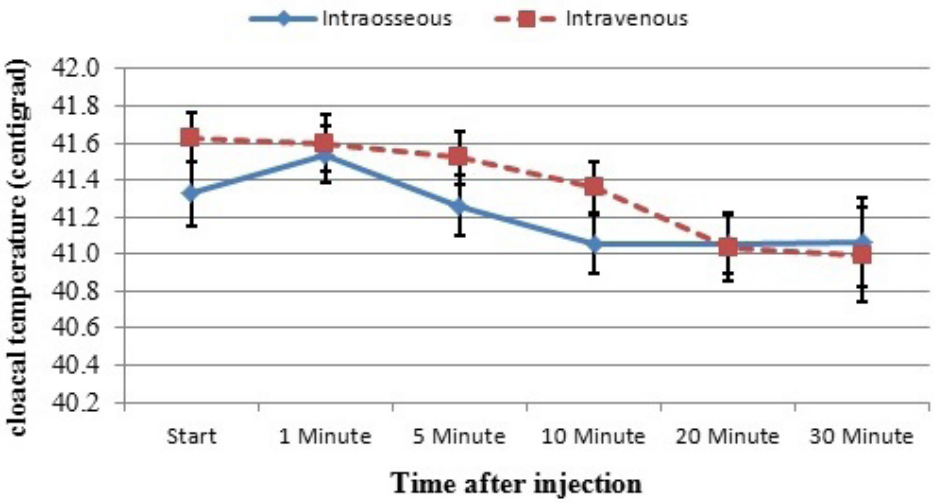

Figure 2. The mean and standard error of cloacal temperature in pigeons in intravenous and intraosseous administration of Thiopental-Na.

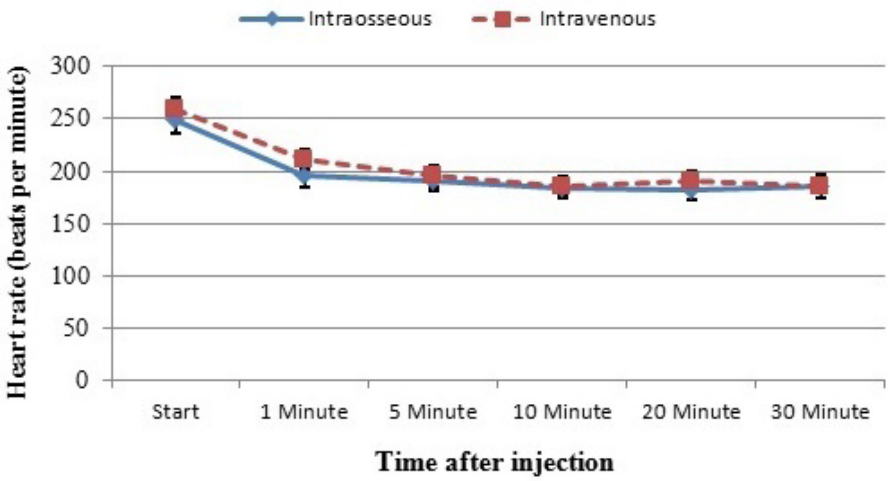

Figure 3. The mean and standard error of heart rate in pigeons in intravenous and intraosseous administration of Thiopental-Na.

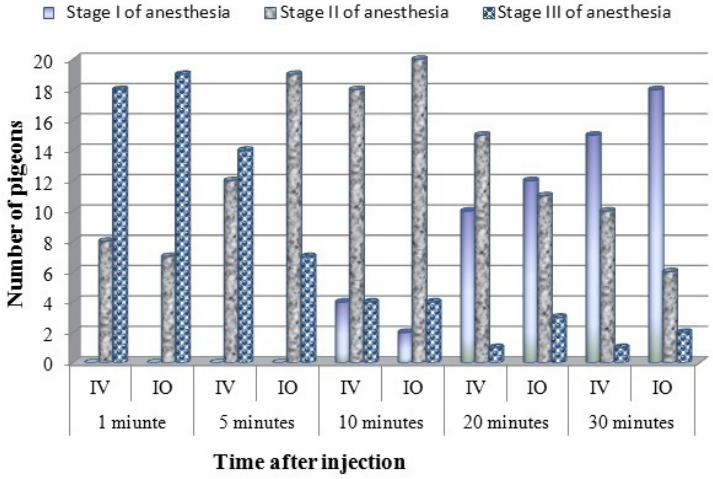

Figure 4. Anesthesia quality induced by intraosseous (IO) and intravenous (IV) injection of Thiopental-Na during 30 minutes after injection. Stage I of anesthesia (standing situation and severe reaction to painful stimulus.) Stage II of anesthesia (sitting situation and medium reaction to painful stimulus; bird gathered its legs when squeezed) and Stage III of anesthesia (stay on the ground, extremely weak reactions to painful stimulus).

Discussion

In a study IO and IV injection of propofol-ketamine combination were compared in quails. The anesthesia duration time in IV group was shorter than IO group significantly but no significant differences were recorded for the onset of anaesthesia in two groups. (Yayla et al., 2014) In our study while the duration time of anesthesia in two groups showed no significant differences, the anesthesia onset in IV group was faster than IO group significantly.

Intraosseous and intramuscular ketamine administration was compared in pigeons (Kamiloglu et al., 2008). However, intraosseous drug administration prepared a faster and more effective anaesthesia in that study compared with intramuscular injection and we compared intraosseous and intravenous Thiopental-Na injection in pigeon.

In a study main histopathologic changes were not seen with IO injection of thiopental

in the injection site in bone marrow samples and it was mentioned this may be used for induction anesthesia in chickens (Valverde et al., 1993). We obtained the same results and there was no side effect reaction to injection like lameness and pain by intraosseous injection. It would seem that intraosseous administration of drugs like marbofloxacin and carboplatin is effective and practical for the rapid delivery in birds (Garcia-Montijano et al., 2006; Filippich et al., 2004).

There are some substitute routes for intravascular injection in pediatric medicine like intraosseous (IO) and umbilical venous catheterization (UVC) and in one study IO was faster and easier than UVC (Abe et al.,2000). No significant difference was seen in terms of number of attempts for injection and anesthesia stage and recovery time in both routes of intravenous and intraosseous in this study.

In a study on the canine cadaver an automatic rotary insertion device for IO catheterization was used and it was mentioned it is more rapid and successful than cut-down technique for jugular vein catheterization (Allukian et al., 2017).

Some instruments are used for intraosseous especially in medicine like Cook and Jamshidi intraosseous (IO) needles, SBMN (standard bone marrow aspiration needle) and Sur-Fast screw-tipped intraosseous needle (Jun et al., 2000). In this study insulin syringe was used simply without any problem. It would seem structure of tibial bone in pigeon allows for intraosseous injection.

Another study mentioned that the IO injection method must be based on age. That study shows that there are a lot of differences in preference in the turkey, chicken and plastic models (Ota et al., 2003).

Results of this study show that IO injection of Thiopental-Na is an effective and simple method for induction of general anesthesia in small birds when access to the vein is not possible. Healthy birds were chosen for intraosseous injection in this study, it is better that sickly birds be included in further researches.

Acknowledgments

Authors thank university of Zabol for supporting this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

References

Abe, K.K., Blum, G.T., Yamamoto, L.G. (2000). Intraosseous is faster and easier than umbilical venous catheterization in newborn emergency vascular access models. Am J Emerg Med, 18(2), 126-9. https://doi.org/10.1016/S0735-6757(00)90001-9. PMID: 10750913.

Allukian, A.R., Abelson, A.L., Babyak, J., Rozanski, E.A. (2017). Comparison of time to obtain intraosseous versus jugular venous catheterization on canine cadavers. J Vet Emerg Crit Care (San Antonio), 27(5),506-511. https://doi.org/10.1111/vec.12633. PMID: 28796429.

Bennett, R.A., Kuzma, A.B. (1992). Fracture management in birds. J Zoo and Wildl Med, 23, 5–38.

Beverly, M., Mellon, S., Kennedy, J.A., Murray, D.W.(2018). Intraosseous pressure during loading and with vascular occlusion in an animal model. Bone Joint Res, 7(8),511-516. https://doi.org/10.1302/2046-3758.78.BJR-2017-0343.R2. PMID: 30258570.

Carregaro, A.B., Gehrcke, M.I., Marques, J.S., Silva, A.N.E., Gomes, K.T. (2015). Lactated Ringer's solution or 0.9% sodium chloride as fluid therapy in pigeons (*Columba livia*) submitted to humerus osteosynthesis. Pesq Vet Bras, 35(1),95-98. https://doi.org/10.1590/S0100-736X2015000100018.

Filippich, L.J., Charles, B.G., Sutton, R.H., Bucher, A.M. (2004). Carboplatin pharmacokinetics following a single-dose infusion in sulphur-crested cockatoos (*Cacatua galerita*). Aust Vet J 82, 366-9.PMID: 15267096.

Garcia-Montijano, M., Waxman, S., Lucas, J.J. et al. (2006). The pharmacokinetic behaviour of marbofloxacin in Eurasian buzzards (*Buteo buteo*) after intraosseous administration. Vet J, 171, 551-5. https://doi.org/10.1016/j.tvjl.2005.01.003. PMID: 16624724.

Hamed, R.K., Hartmans, S., Gausche-Hill, M. (2013). Anesthesia through an intraosseous line using an 18-gauge intravenous needle for emergency pediatric surgery. J Clin Anesth, 25(6),447-51. https://doi.org/10.1016/j.jclinane.2013.03.013. PMID: 24008191.

Jun, H., Haruyama, A.Z., Chang, K.S., Yamamoto, L.G. (2000). Comparison of a new screw-tipped intraosseous needle versus a standard bone marrow aspiration needle for infusion. Am J Emerg Med, 18,135-9. https://doi.org/10.1016/S0735-6757(00)90003-2. PMID: 10750915.

Kamiloglu, A., Atalan, G., Kamiloglu, N.N. (2008). Comparison of intraosseous and intramuscular drug administration for induction of anaesthesia in domestic pigeons. Res Vet Sci, 85, 171-5. https://doi.org/10.1016/j.rvsc.2007.09.002. PMID: 18028968.

Massarwi, M., Gat-Yablonski, G., Shtaif, B., Phillip, M., Berkovitch, M. (2013). The efficiency of intraosseous human growth hormone administration: a feasibility pilot study in a rabbit model. Am J Emerg Med, 31(8),1255-9. https://doi.org/10.1016/j.ajem.2013.05.020.

PMID: 23809088.

Mazaheri-Khameneh, R., Sarrafzadeh-Rezaei, F., Asri-Rezaei, S., Dalir-Naghadeh, B. (2012). Comparison of time to loss of consciousness and maintenance of anesthesia following intraosseous and intravenous administration of propofol in rabbits. J Am Vet Med Assoc, 241(1),73-80.https://doi.org/10.2460/javma.241.1.73. PMID: 22720990.

Nemeth, M., Williams, G.N 3rd., Prichard, D., McConnico, A., Johnson, D., Loughren, M. (2016). Onset and duration of intravenous and intraosseous rocuronium in hypovolemic swine. Am J Disaster Med, 11(4),279-282. https://doi.org/10.5055/ajdm.2016.0250. PMID: 28140443.

O'Kane, P.M., Connerton, I.F., White, K.L.(2016). Pilot study of long-term anaesthesia in broiler chickens. Vet Anaesth Analg, 43,72-5. https://doi.org/10.1111/vaa.12305. PMID: 26449623.

Ota, F.S., Yee, L.L., Garcia, F.J. et al. (2003). Which IO model best simulates the real thing? Pediatr Emerg Care, 19,393-6. PMID: 14676487.

Paul-Murphy, J.R., Engilis, A. Jr., Pascoe, P.J., Williams, D.C., Gustavsen, K.A., Drazenovich, T.L., Keel, M.K., Polley, T.M., Engilis, I.E. (2017). Comparison of intraosseous pentobarbital administration and thoracic compression for euthanasia of anesthetized sparrows (*Passer domesticus*) and starlings (*Sturnus vulgaris*). Am J Vet Res, 78(8),887-899. https:// doi.org/10.2460/ajvr.78.8.887.PMID: 28738007.

Paul-Murphy, J.R., Fialkowski, J. (2001). Injectable Anesthesia and Analgesia of Birds. In: Recent Advances in Veterinary Anesthesia and Analgesia: Companion Animals. Gleed, R. D., Ludders, J. W.(Eds.) Publisher: International veterinary information service (www.ivis.org), Ithaca, New York, USA.

Rubio-Martínez, L.M., Elmas, C.R., Black, B., Monteith, G. (2012). Clinical use of antimicrobial regional limb perfusion in horses: 174 cases (1999-2009). J Am Vet Med Assoc, 241(12),1650-8. https://doi.org/10.2460/javma.241.12.1650. PMID: 23216042 .

Sarrafzadeh Rezaei, F., Dalir, Naghadeh. B., Hassanpour, H. (2008). Induction of general anaesthesia with intraosseous injection of thiopental in rabbits. Iran J Vet Res, 9,227-32. https://doi.org/10.22099/IJVR.2008.569.

Su, K., Bai, Y., Wang, J., Zhang, H., Liu, H., Ma, S. (2018). Comparison of hyaluronic acid and PRP intra-articular injection with combined intra-articular and intraosseous PRP injections to treat patients with knee osteoarthritis. Clin Rheumatol, 37(5),1341-1350. https://doi.org/10.1007/s10067-018-3985-6. PMID: 29388085.

Thorp, C.M. (2008). Pharmacology for the Health Care Professions (1 st edn), John wiley & Sons

Ltd, London, UK, p. 231-242.

Valverde, A., Bienzle, D., Smith, D. et al.(1993). Intraosseous cannulation and drug administration for induction of anaesthesia in chickens. Vet Surg, 22,240–244. https://doi.org/10.1111/j.1532-950X.1993.tb00392.x. PMID: 8362509.

Von Hoff, D.D., Kuhn, J.G., Burris, H.A. 3 rd, Miller, L.J. (2008). Does intraosseous equal intravenous? A pharmacokinetic study. Am J Emerg Med, 26, 31-8. https://doi.org/10.1016/j.ajem.2007.03.024. PMID: 18082778.

Wimmer, M.H., Heffner, K., Smithers, M., Culley, R., Coyner, J., Loughren, M., Johnson, D. (2016). The comparison of humeral intraosseous and intravenous administration of vasopressin on return of spontaneous circulation and pharmacokinetics in a hypovolemic cardiac arrest swine model. Am J Disaster Med, 11(4),237-242. https://doi.org/10.5055/ajdm.2016.0245. PMID: 28140438.

Yayla, S., Kamiloghlu, N., Kamiloghlu, A., Ozaydin, I. (2014). Comparision of intravenous and intraosseous administration of Propofol-Ketamine combination for anesthesia in quails (*Coturnix coturnix japonica*). Kocatepe Vet J, 7(1), 11-16. https://doi.org/10.5578/kvj.7020.

Young, S.W., Roberts, T., Johnson, S., Dalton, J.P., Coleman, B., Wiles, S. (2015). Regional intraosseous administration of prophylactic antibiotics is more effective than systemic administration in a mouse model of TKA. Clin Orthop Relat Res, 473(11),3573-84. https://doi.org/10.1007/s11999-015-4464-x. PMID: 26224291.

ijvm.2019.269704.1004942

Iranian Journal of Veterinary Medicine
Abstracts in Persian Language

Online ISSN *2252-0554*

مجله طب دامی ایران، ۱۳۹۷، دوره ۱۳، شماره ۴، ۴۰۹-۴۰۱

مقایسه بالینی بی هوشی داخل استخوانی و داخل وریدی (تیوپنتال سدیم) در کبوتر

سمانه بخشی[۱]، محمد رضا آقچه لو*[۲]، داریوش سعادتی[۳]

[۱]دانش آموخته دانشکده دامپزشکی دانشگاه زابل، زابل، ایران
[۲]گروه علوم درمانگاهی، دانشکده دامپزشکی دانشگاه زابل، زابل، ایران
[۳]گروه بهداشت و کنترل کیفی مواد غذایی، دانشکده دامپزشکی دانشگاه زابل، زابل، ایران

(دریافت مقاله: ۳۱ اردیبهشت ماه ۱۳۹۸، پذیرش نهایی: ۱۲ شهریور ماه ۱۳۹۸)

چکیده

زمینه مطالعه: تزریق داخل استخوانی یک روش برای تجویز داروها است.

هدف: مقایسه بالینی تجویز تیوپنتال سدیم به روش داخل استخوانی و داخل وریدی است.

روش کار: ابتدا همه پرندگان (۲۶ کبوتر سالم) به دو گروه تصادفی تقسیم می شوند. گروه A ۲۰ میلی گرم به ازائ هر کیلوگرم وزن بدن تیو پنتال سدیم به روش داخل استخوانی و گروه B به روش داخل وریدی دریافت کردند. بعد از یک هفته گروه A ۲۰ میلی گرم به ازائ هر کیلوگرم وزن بدن تیو پنتال سدیم به روش داخل وریدی و گروه B به روش داخل استخوانی دریافت نمودند. تعداد ضربان قلب (HR) تعداد تنفس (fR) و دمای کلواک (T) قبل از تزریق (دقیقه صفر) و ۱، ۵، ۱۰، ۲۰ و ۳۰ دقیقه بعد از تزریق ثبت شد. واکنش به تزریق، تعداد تلاشها برای تزریق دارو، زمان شروع بیهوشی ، امتیاز برای مرحله بی هوشی و زمان بازگشت از بی هوشی بررسی و مقایسه شد.

نتایـــج: بررسی های آماری نشان می دهد که شروع بی هوشی در روش داخل وریدی به طور معنی داری سریعتر از روش داخل استخوانی می باشد و تعداد تنفس در دو گروه در دقیقه اول بعد از تزریق تفاوت معنی دار دارد. در سایر دقایق برای تعداد تنفس، تعداد ضربان قلب و دمای کلواک تفاوت معنی دار مشاهده نشد. همچنین در واکنش به تزریق، تعداد تلاشها برای تزریق دارو و مراحل بی هوشی در دقایق مختلف بین دو گروه تفاوت معنی داری مشاهده نگردید. تغییرات معنی دار در زمان بازگشت از بی هوشی بین دو گروه مشاهده نشد. لنگش و درد قابل مشاهده در روش داخل استخوانی مشاهده نگردید.

نتیجه گیری نهایی: تزریق داخل استخوانی یک روش کاربردی ، سریع و قابل مقایسه با تزریق داخل وریدی در پرندگان است.

واژه‌های کلیدی:

تیوپنتال سدیم، بی هوشی عمومی، تزریق داخل استخوانی، تزریق داخل وریدی، کبوتر

نویسندهٔ مسئول: محمد رضا آقچه لو، گروه علوم درمانگاهی، دانشکده دامپزشکی دانشگاه زابل، زابل، ایران. ایمیل: *mraghchelou@gmail.com*