



Pulse Oximetry and Cardiorespiratory Changes during Upper Gastrointestinal Endoscopy in Dogs

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Abstract

Objective- The objective of the present study was to determine the changes in heart rate, respiratory rate and arterial Oxygen saturation (SpO₂) by administration of three drug combinations during upper gastrointestinal endoscopy.

Design- Experimental study.

Animals- 21 healthy and adults dog were randomly divided into three groups.

Procedures- The IV combination of 6.5 mg/kg ketamine and 0.2 mg/kg diazepam was administered in group KD and 6.5 mg/kg ketamine and 0.3 mg/kg midazolam and 6.5 mg/kg ketamine and 0.4 mg/kg medetomidine were used in group KM_i and KMed respectively. Respiratory rate/min, heart rate/min and SpO₂ were recorded prior to induction of anesthesia and during endoscopy in esophagus, cardiac level, cardia and during exertion. In addition time to induction of anesthesia and duration of anesthesia were recorded in all dogs.

Results- Time to induction of anesthesia and duration of anesthesia were significantly shorter in group KM_i compared to group KD and KMed (P<0.05). All of the dogs were suffered from hypoxia. However the changes were significant in groups KD and KM_i (P<0.05).

Conclusion and Clinical Relevance- All combinations of the drugs produced hypoxia, however the hypoxia was less when the combination of ketamine and medetomidine was used. Oxygen supplementation is recommended during upper gastrointestinal endoscopy in dogs to prevent hypoxia.

Key Words- Diazepam, Midazolam, Medetomidine, Endoscopy, Dog.

Introduction

The application of endoscopy to diagnose and treat diseases of the gastrointestinal tract is widely increased. The procedure is non invasive and considered to be safe in most of the patients. However complications regarding upper gastrointestinal endoscopy have been reported. Among them cardiopulmonary complications are predominating.^{2,7,14,20} Tachycardia is often observed during upper gastrointestinal endoscopy. It sometimes could be very dangerous because it may lead to myocardial ischemia. Mild to moderate hypoxia may occur during routine endoscopy as well. These complications may contribute to postoperative morbidity in the patients.^{4,18,9,1} Hypoxia increases the risk of infection, wound dehiscence or delayed healing^{5,10}. Also adverse cardiovascular responses like cardiac

hypertension, tachycardia, cardiac arrhythmias and myocardial ischemia might occur as a result of hypoxia.^{3,7,11}

Because the procedure is non invasive and considered to be safe also it usually does not take a long time, short anesthesia time of the patient is concerned. Different combinations of the drugs have been examined to induce anesthesia during endoscopy. Because hypoxia and cardiovascular complications are warranted during or after the procedure, selection of appropriate drug combination that produces low cardiovascular and respiratory disturbances seems very valuable.

The objective of the present study was to determine the changes in heart rate, respiratory rate and arterial Oxygen saturation (SpO₂) by administration of the combination of diazepam, midazolam or medetomidine with ketamine during upper gastrointestinal endoscopy.

Materials and Methods

21 healthy and adult dogs without any obvious complication were randomly divided into three groups.

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General anesthesia induced by injection the selected drug combination through cephalic vein catheter in all of the patients as the following order:

Group KD: Combination of 6.5 mg/kg ketamine and 0.2 mg/kg diazepam

Group KMi: Combination of 6.5 mg/kg ketamine and 0.3 mg/kg midazolam

Group KMed: Combination of 6.5 mg/kg ketamine and 0.4 mg/kg medetomidine. The respiratory rate/min, heart rate/min and SpO2 % were recorded prior and during the upper gastrointestinal endoscopy. The patient restrained in ventral recumbency and the upper gastrointestinal endoscopy started. During the endoscopic examination, oxygen saturation using pulse oximetry and heart rate/min and respiratory rate/min values were recorded when the flexible endoscope inserted in the esophagus, at the heart base, cardia, inside the stomach and during the removal of the endoscope tube. In addition time to induction of anesthesia (time from the injection of the drug to loss of consciousness) and duration of anesthesia (time from loss of consciousness to sternal recumbency) were recorded in all dogs. Data were analyzed by SPSS Statistics version 22 using t-test, Chi-square and repeated measured ANOVA and Mann-Whitney tests for data analysis.

Results

The anesthesia was safe and all dogs recovered from anesthesia without any complication. The only observed complication was a severe emesis in one of the patients of group KMed. Mild to moderate tachycardia occurred in almost all of the patients, but the imbalances were more evident in group KD. However heart rate/min was not significantly different among the groups during the endoscopy. Also it was not statistically different within the groups at different measured points ($P>0.05$) (Table 1 and Fig 1). Respiration was affected in all of the groups and disturbances occurred. Respiratory rate/min was significantly increased in Group KD and KMi ($P<0.05$). The increase in respiratory rate was more evident when the endoscope tube passed through the cardia, stomach and during removal ($P<0.05$) (Fig 2). Levels of SpO2 were significantly higher in group KMed ($P=0001$) and animals in group KD and KMi suffered more from hypoxia. The minimum level of SpO2 was measured at the heart base in group KD

($80.2\pm 6.7\%$) (Fig 3). However levels of SpO2 were significantly lower in the stomach and during removal in group KD and KMi ($P<0.05$). Data are illustrated in table 1.

Time to induction of anesthesia and duration of anesthesia was significantly lower in group KMi ($P<0.05$) (Table 2). These variables were not statistically different between groups KD and KMed.

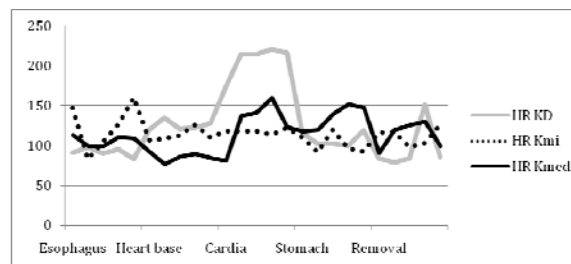


Figure 1- Changes in heart rate/ min during upper gastroendoscopy examination in groups.

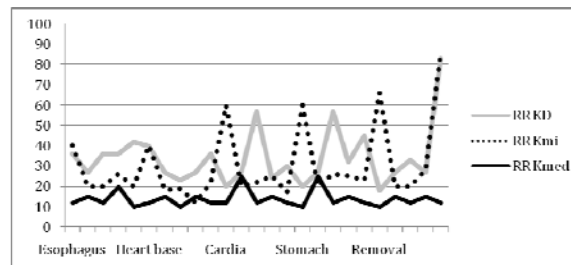


Figure 2- Changes in respiratory rate/ min during upper gastroendoscopy examination in groups.

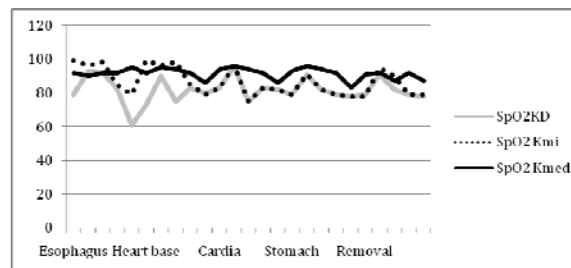


Figure 3- Changes in Oxygen saturation during upper gastroendoscopy examination in groups.

Table 1- Comparison of the Heart rate/Min, Respiratory rate/ Min and % SpO2 among the groups.

	KD	KMi	KMed
Heart rate (beats minute ⁻¹) [Median (range)]	126 (79-221)	113 (83-160)	114 (77-160)
Respiratory rate (beats minute ⁻¹)	34±14	30±18	13±4*
SpO2(%) [Median (range)]	81 (66-96)	86 (75-99)	93 (83-98)*

* Significant difference

Table 2- Comparing time to induction of anesthesia and duration of anesthesia among the groups (Mean±SD).

	KD	KMi	KMed	P
Time to induction of anesthesia	44±6	33±4*	50±9	0.02
Duration of anesthesia	61.2±2.7	31.8±5.8*	49.6±12	0.001

* Significant difference

Discussion

Different drug combinations have been used during endoscopic examination in dogs. The combinations of ketamine/diazepam and ketamine/midazolam have been reported to be safe in upper gastrointestinal endoscopy in dogs. Also medetomidine reported to have little cardiovascular effect in healthy dogs.^{8,16} The three different combinations used in this study were safe and sufficient to induce anesthesia in dogs going under upper gastrointestinal endoscopy. Time to induction of anesthesia was significantly lower when the combination of ketamine and midazolam was used in this study. Hellyer reported similar results by comparing the combination of midazolam/ketamine and diazepam/ketamine for induction of anesthesia in greyhounds.⁸ However our results are not consistent with those reported by Grint et al in rabbits. He reported less induction time of anesthesia when the combination of ketamine/ medetomidine used compared with ketamine/midazolam in rabbits.⁶

Although endoscopy is a safe diagnostic tool, complications are possible to occur. Among them cardiopulmonary complications during and after gastrointestinal are reported to be about 50% of all complication.⁷ Tachycardia occurred in of all of the dogs in the present study. Also Respiratory rate was affected more when ketamine used in combination of either diazepam or midazolam.

All of the animals in our study suffered from hypoxia. However the changes in SpO2 levels were significant in group KD and KMi. Sarwer et al reported mild to moderate hypoxia in 20 % of the patients during

endoscopy. In addition they reported that the hypoxia might be sever in 11% of the patients.¹⁷ We obtained similar results in the present study. Different reports are existed in the literature regarding occurrence of hypoxia by the use of midazolam during endoscopy. Mizuno and Yektin reported hypoxia during endoscopy when midazolam used to produce sedation.^{13, 20} Also Oxygen desaturation was observed when midazolam combined to ketamine in children in comparison to the use of ketamine only.¹⁹ However Kilic et al reported that midazolam is a safe sedative during endoscopy and does not affect heart rate and SpO2 levels as well.¹² We observed moderate to severe hypoxia when either diazepam or midazolam used in dogs during endoscopy. But the combination of ketamine and Medetomidine produced less hypoxia in dogs during upper gastrointestinal endoscopy. The significant increase in respiratory rate/min observed in groups KD and KMi might be a compensatory effect of hypoxia.

It is reported that hypoxia increases with duration of the procedure.^{7,15} The finding is in consistent with our findings. Because hypoxia was more evident at the end of the procedure while the probe was in the stomach and during removal.

It is concluded that hypoxia is very probable to occur during upper gastrointestinal endoscopy in dogs. Pre-oxygenation of the patients going under endoscopy is recommended in dogs. Although all of the drug combinations used in this study are safe to be used in dogs, the combination of ketamine/ medetomidine seems to be superior by less affecting the cardiopulmonary variables in dogs during endoscopy.

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تغییرات پالس اکسی متری و قلبی-تنفسی در طی اندوسکوپیی فوقانی دستگاه گوارش در سگ‌ها

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هدف- هدف از این مطالعه بررسی تغییرات ضربان قلب، تعداد تنفس و میزان اشباع بودن هموگلوبین از با استفاده از سه ادغام دارویی بیهوشی متفاوت طی اندوسکوپیی فوقانی دستگاه گوارش در سگها بود.

طرح- مطالعه تجربی

حیوانات- ۲۱ قلاده سگ سالم و بالغ از نژاد مخلوط به سه گروه مساوی تقسیم شدند.

روش کار- سه ادغام دارویی متفاوت با تزریق داخل وریدی جهت بیهوشی در سگها اعمال شد. ادغام دارویی دیازپام و کتامین (۰/۲ و ۶/۵ میلی گرم به ازای هر کیلوگرم وزن بدن) در گروه KD، ادغام دارویی میدازولام و کتامین (۰/۳ و ۶/۵ میلی گرم به ازای هر کیلوگرم وزن بدن) در گروه KMed تزریق شد. کلیه بیماران تحت اندوسکوپیی فوقانی دستگاه گوارش قرار گرفتند. تعداد تنفس و ضربان قلب در دقیقه، درصد اشباع بودن هموگلوبین از اکسیژن، پیش از القای بیهوشی، در زمان عبور اندوسکوپ از مری، قاعده قلب، کاردیا، درون معده و هنگام خروج ثبت شد. همچنین مدت زمان القای بیهوشی و طول دوره بیهوشی در کلیه سگها ثبت شد.

نتایج- مدت زمان القای بیهوشی و طول دوره بیهوشی به صورت معنی داری در گروه KMi نسبت به دو گروه دیگر کوتاهتر بود ($P < 0.05$). کلیه سگها دچار درجاتی از هیپوکسی شدند. هر چند درصد اشباع بودن هموگلوبین از اکسیژن در گروه KD و KMi به صورت معنی داری پایین تر بود ($P < 0.05$).

نتیجه گیری و کاربرد بالینی- هر سه ادغام دارویی تجویز شده موجب بروز هیپوکسی شدند. هر چند شدت هیپوکسی در گروهی که ادغام مدتومیدین و کتامین تجویز شده بود کمتر بود. دریافت اکسیژن مکمل از راه بینی در طی اندوسکوپیی فوقانی دستگاه گوارش در سگها در ممانعت از بروز هیپوکسی توصیه می شود.

کلمات کلیدی- دیازپام، میدازولام، مدتومیدین، اندوسکوپیی، سگ.

