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Research article

Posture comparison between supine and sternal recumbency for endotracheal intubation in dogs undergoing surgery

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Abstract

Endotracheal intubation is an important procedure performed prior to almost all surgeries. It is mandatory for anesthetists to use a laryngoscope during intubation. A general laryngoscope is designed to be inserted into oral space with the left hand and the endotracheal tube is managed with the right hand, while the patient lies in the supine position. Veterinarians are accustomed to laryngoscopes used in humans that have a curve or a straight blade with a wall on the right side. A veterinarian does a similar procedure with the laryngoscope, but animal posture is sternal or ventrolateral. It was thought that the right hand and endotracheal tube itself might hinder the laryngeal view during intubation. We studied positions of dogs during the endotracheal intubation including 11 short skull (brachycephalic) and 32 medium and long skull (normocephalic) breeds. This study showed that veterinarians could perform intubation very well in all sternal-postured anesthetized dogs but not so efficiently in dogs postured in a supine recumbent manner (Wilcoxon rank test, P=0.0007). Within the brachycephalic group of dogs, intubation times on both postures were not significantly different (Wilcoxon rank test, P=0.130). The current study thus implies that supine recumbency may be appropriate for brachycephalic dogs in general, while sternal posture is more appropriate for intubation in normocephalic dogs.

Keywords: Dog, Endotracheal Intubation, Laryngoscope

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INTRODUCTION

Endotracheal intubation in an anesthetized animal is a procedure integrated into almost all surgical subjects and performed by veterinarians routinely at an appropriate anesthetic level. A laryngoscope facilitates visibility and ensures a laryngeal view and proper tube placement. There are two types of laryngoscopes widely used in the veterinary field: curve blade (McIntosh type) and straight blade (Miller type) (Hartsfied, 2007; Hall et al., 2001), which are also commonly used in humans (Amornyotin et al., 2010).

The most common practice in veterinary is the intubation in sternal recumbent animals in which the mouth is opened wide by a veterinary nurse or assistant. On the other hand, in supine human patients, an endotracheal tube insertion does not need help from a nurse. Originally, the laryngoscope was designed such that the physician holds it by his left hand and introduces the tube by the right hand, while the patient lies in a supine position. The process of using left-hand to hold the laryngoscope and the right-hand to hold intubation in a sternal recumbent animal is widely used in veterinary practice, and the animal lies either on the sternum or laterally. The authors hypothesize that the maneuver using the right hand might cause the right blade wall of the laryngoscope to impede the laryngeal view during the intubation procedure.

The present study aimed to evaluate the endotracheal intubation procedure in a supine recumbent dog and its suitability in general when using a human-laryngoscope as a tool.

MATERIALS and METHODS

Animals

Forty-three dogs underwent scheduled general surgery at Kasetsart Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Kasetsart University. The dogs scheduled for elective surgical procedures requiring tracheal intubation were eligible for the study. Surgery procedures were general including ovariohysterectomy, urinary bladder surgery, tumor excision, etc. Animals who had either respiratory problems or diseases related to oronasal or pharyngeal organs were not included in this study. Dogs were categorized into two groups based on cranial architecture as brachycephalic and normocephalic (mesocephalic and dolichocephalic animals) groups. This study was approved by the Institutional Animal Care and Use Committee, Kasetsart University (Approval no. ACKU61- VET–019). Consent forms were acknowledged and signed by the owners as a part of an anesthesia consent for surgery.

Participant Veterinarians

The veterinary anesthetists who performed anesthetic duty during the time of the study were asked to perform the intubation without the knowledge of animal postures. They had experience from one (as interns) to eight years and were asked to intubate an anesthetized supine or sternal recumbent subject as per the outcome of coin-tossing. Veterinarians were guided on how to intubate before performing the procedure. The intubation procedure in the sternal position was performed as suggested by Hartsfied (2007) and Hall et al. (2001).

The guideline for intubation in man (Fell., 1996) was adapted for the procedure in the supine position.

Administration of Anesthesia

An established anesthetic protocol was adopted. Briefly, intravenous injections of diazepama (Atlantic Laboratories, Thailand) (0.5 mg/kg) as pre-medication and propofolb (Troikaa Pharmaceuticals, India) (3 mg/kg), as an induction agent, were given. The intubation procedure was performed under a medium plane of anesthesia. Isofluranec (Piramal Critical Care, USA; 2% in 100% oxygen) was used to maintain the dogs under the anesthetic stage during assigned surgery.

Intubation

Once the dogs were anesthetized to the appropriated stage, they were positioned in either supine or sternal recumbent manner and their mouth was opened in this position by a veterinary nurse (Figure 1). The diameter of the endotracheal tube (Murphy type) was selected as suggested (Hartsfied, 2007; Hall et al., 2010). The laryngoscope used in this study was either Miller or McIntosh type (Figure 2), as preferred by the anesthetists. Prior to the intubation procedure, the endotracheal tube was lubricated with K-Yd gel (Reckitt Benckiser Healthcare, UK). The intubation procedure in the sternal position was performed as suggested by Hartsfied (2007) and Hall et al. (2001). For the procedure in supine recumbent dogs, it was adapted from the guideline for intubation in man (Fell., 1996). The nurse laid down the dog on its back symmetrically and the veterinarian sat keeping his eyes on the same level as the animal's larynx. Once the dog was in a suitable stage of anesthesia with no resistance, the laryngeal blade was inserted into the mouth with the left hand and the tongue was lifted up to identify the laryngeal opening. Finally, a selected endotracheal tube was introduced into the trachea.

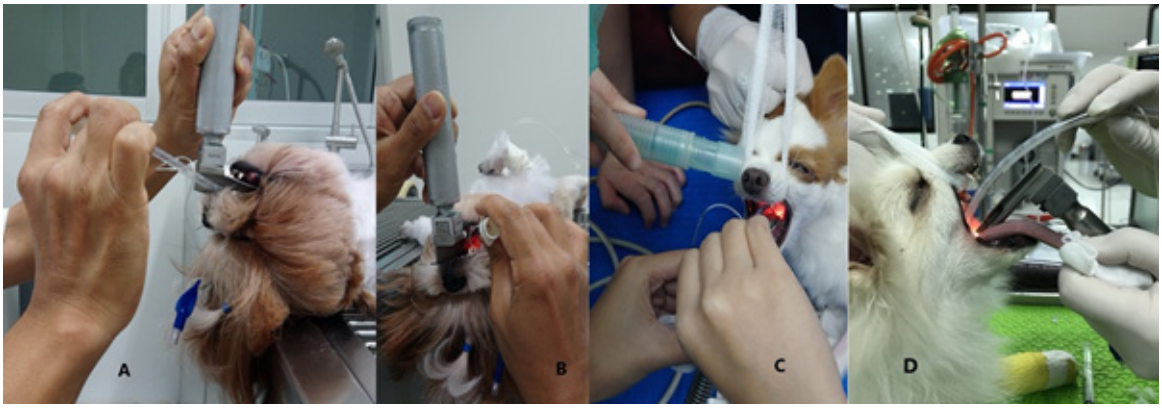

Figure 1 Intubation Procedure. (A) and (B) are Intubation procedure in a supine position while (C) and (D) are the procedure in a sternal position.

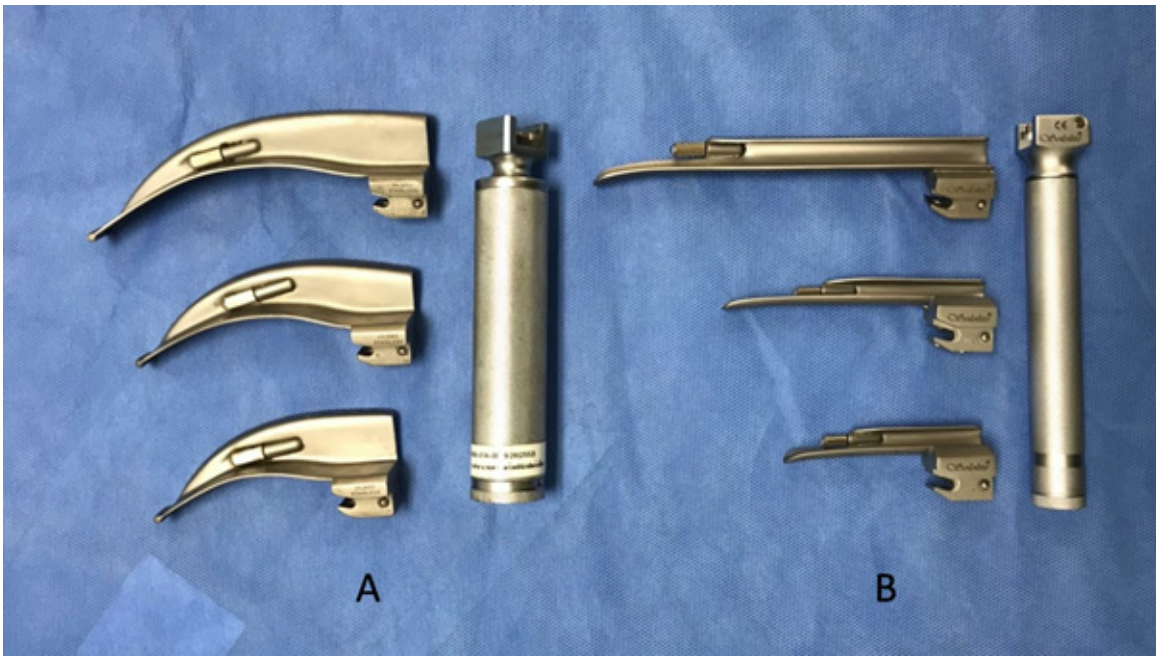

Figure 2 Laryngoscope used in general veterinary practice. A is Macintosh type laryngoscope and B is Miller type.

The attempt to intubate was terminated when the procedure could not succeed, the dog showed clinical signs of respiratory difficulty, resisted the procedure, or woke up. The second attempt was performed once stable clinical signs were observed. A third attempt and so on were repeated or halted as per the senior anesthetist's decision. The intubation time during procedures was recorded and defined as the time from insertion of the laryngoscope into the oropharynx until the positioning of the endotracheal tube in the trachea. Once the procedure was complete, the evaluation form was filled by the veterinarians. Satisfaction and difficulty in the procedures were separately plotted on a continuous scale from 0 cm to 10 cm. The range from 0 cm to 10 cm indicated the least satisfaction with the procedure or the least difficulty to the highest satisfaction or utmost difficulty

Statistical analysis

Intubation times of the two posture groups for each breed type were statistically analyzed. The lines plotted for satisfaction and difficulty were also evaluated. A two-sample t-test was used for statistical analysis and a P-value of 0.05 was considered significant. SAS university edition (2019) was used for statistical calculation

RESULTS

Animals

Forty-three dogs were categorized into two groups as 11 brachycephalic and 32 normocephalic (mesocephalic and dolichocephalic) dogs of different breeds. Brachycephalic breeds in this study included; Pomeranians (n=5), Shih Tzus (n=3), Chihuahuas (n=2) and French Bulldog (n=1), while normocephalic

dogs included; Labrador retrievers (n=3), Golden retriever (n=1), Beagles (n=2), Siberian Huskies (n=3), Poodles (n=7) and mongrel breed dogs (n=16). Of them, 18 normocephalic dogs and 6 brachycephalic dogs postured dorsally while 14 normocephalic dogs and 5 brachycephalic dogs postured sternally

Intubation procedure

The mean intubation times (±SD) were 10.80±6.9 s and 26.90±8.76 s for the dogs in sternal and supine recumbency, respectively. The intubation times to success were different between the sternal and supine recumbent groups (P=0.0007; Wilcoxon rank-sum test). It took more time to perform the procedure in a supine position than in the sternal position. Most of the veterinarians favored performing the procedure on the dogs in sternal recumbency (P=0.0006) and also described it as a smooth procedure (P=0.03) (Table 1)

Table 1 The parameters and P-values of the test statistics

Breed type	Position (number)		Intubation time (sec)		P	Difficulty scale		P	Satisfaction scale		P
	Sternal	Supine	Sternal (Mean±sd)	Supine (Mean±sd)		Sternal (Mean±sd)	Supine (Mean±sd)		Sternal (Mean±sd)	Supine (Mean±sd)	
P			0.86	0.75							
Brachycephaly	5	6	12.80±11.30	26.30±14.76	0.130	2.97±2.98	4.77±2.59	0.310	7.94±0.56	6.67±1.97	0.180
Normocephaly	14	18	10.10±5.10	27.10±20.29	0.003	2.41±0.65	4.20±2.92	0.060	8.48±1.69	6.22±2.01	0.004
Total	19	24	10.80 ±6.90	26.90±18.76	0.001	2.56±2.96	4.35±2.54	0.030	8.34±1.48	6.33±1.97	0.0006

Note: Intubation time is in seconds. Difficulty and Satisfaction range from 0 to 10 on a centimeter scale. Each veterinarian individually gave the score once the procedure was completed. The p-value was determined by a two-sample t-test. Brachycephaly included only brachycephalic dogs, while normocephaly included both mesocephalic and dolichocephalic dogs

The veterinarians took more time to perform the procedure on supine recumbent dogs (26.30±14.76; 25.90±20.29) than on sternal recumbent dogs (12.80±11.30; 10.10±5.10), both in brachycephalic and normocephalic groups, respectively. Intubation time in the normocephalic group varied between the procedure performed on dogs in supine and sternal positions (P=0.0029). However, no statistical difference in the intubation time between the supine and sternal positions within brachycephalic dogs was observed (P=0.13) (Table 1, Figure 3)

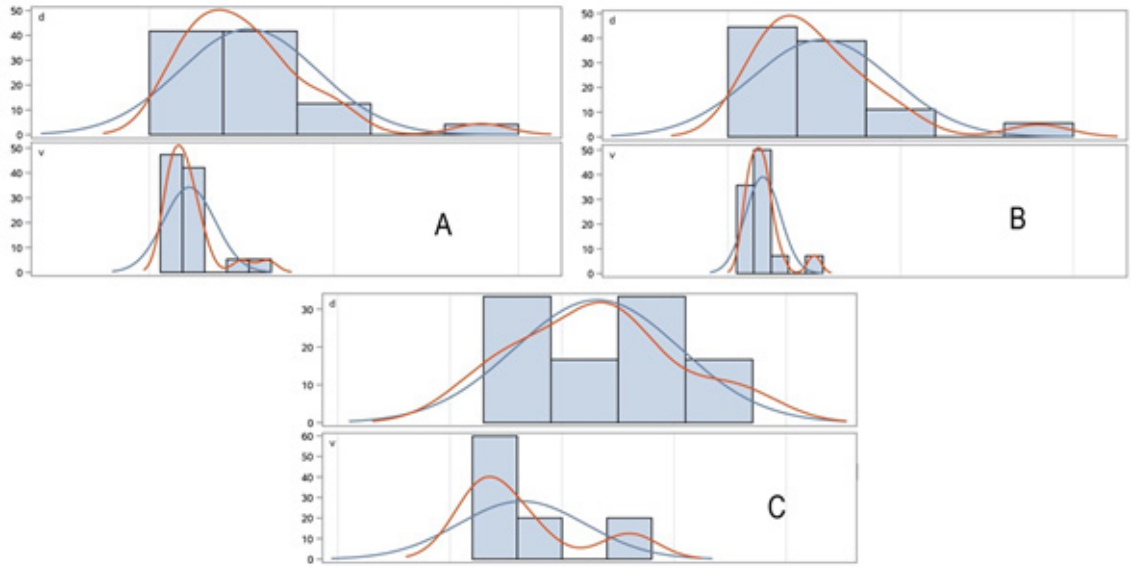

Figure 3 Intubation time. (A) Intubation times for all 43 dogs are depicted in separate graphs for the supine position (d) and sternal position (v). (B) and (C) are the intubation times for the normocephalic and brachycephalic groups, respectively. The horizontal axis represents intubation time, while the vertical axis presents the percentage of animals for the corresponding intubation time.

Intubation times did not vary between the brachycephalic and normocephalic dogs in the same posture (P=0.75 and 0.86 for supine and sternal postures, respectively). However, mean intubation times were nearly twice longer for supine posture than for the sternal posture in both brachycephalic and normocephalic groups (Table 1)

Difficulty and satisfaction scales

The mean difficulty scale was higher for intubation in the supine position (4.35±2.54) than for sternal position (2.56±2.96) in all dogs. Likewise, the mean satisfaction was higher in all dogs for the procedure in the sternal position (8.34±1.48) than for the supine position (6.33±1.97). While the difficulty and satisfaction scales in normocephalic dogs were statistically different, at P= 0.04 and 0.004 for supine and sternal postures, respectively, those in brachycephalic dogs did not vary significantly, at P= 0.31 and 0.18, respectively (Table 1)

DISCUSSION

The study showed that the endotracheal intubation procedure in sternal recumbent animals was quicker than in the supine recumbent animals. As expected, the veterinarians were able to perform the familiar intubation procedure well with the help of a veterinary nurse handling the animal mouth. The participant veterinarians favored intubation in the sternal position over that in the supine position, assisted by a veterinary nurse. However, it cannot be presumed that sternal posture of the animal patients is more appropriate for

intubation procedure, because the participants performed the same procedure without the help from a veterinary nurse to open the animal's mouth, and the same could not be done for the animals in a supine recumbent posture.

Within the group of brachycephalic dogs, intubation times between supine and sternal position did not vary statistically (P=0.13). Contrarily, this difference was obvious in the mesocephalic and dolichocephalic groups. In addition, difficulty and satisfaction scales did not vary significantly (P=0.31 and 0.18, respectively) in the brachycephalic group alone. Although the procedure seemed difficult on the supine posture, it did not show variations in difficulty scale as well as in the intubation time in short skull breeds, particularly. Thus, the short skull, brachycephalic dog breeds may benefit from the intubation procedure in supine recumbency.

Concerning skull architecture of human which is like that of a brachycephalic dog in which relatively short and narrow oropharynx is presented. The pharyngeal view is used to predict the difficulty of intubation in man by the maximally open mouth and protruded tongue and is positively correlated to the laryngoscopic view (Hobs.,1996). The pharyngeal view is relied on the anatomy of the tongue, pharyngeal wall, visibility of soft palate, while laryngoscopic view includes the presence of arytenoid cartilage, epiglottis and vocal cord. In general, dogs do not have difficulty in opening the mouth during intubation based on sound anatomy, appropriated assistance, and good light source, as mentioned in the guideline to insertion of the endotracheal tube by Hartsfied (2007). While a normocephalic dog may have a good laryngoscopic view, a brachycephalic dog is prone to pose difficulties during intubation due to the signs of obstructive airway syndrome including the abnormal soft palate, everted laryngeal saccule and variable degrees of abnormal laryngeal views (Temwichitr et al., 2019; Pichetto et al., 2011). The present study did not identify the quality of the laryngeal view in general, supine recumbency may not appropriate for performing a general laryngoscopic examination. Intubation in both postures can be applied in brachycephalic dogs. However, further studies on the positions for the intubation procedure in these dogs, as well as cats, are suggested.

In this study, intubation in dogs of all breeds in sternal position was easier because most animals were over-represented by medium and long skull breeds. This might be one of the limitations of the study subjects. However, clustering animals in a group of same characters of their breed into brachycephalic and normocephalic groups (including all breeds except short skull breeds) can reduce the effect of the small numbers in each breed. The authors realized that the anesthetic stage and the different levels of experience of the veterinarian might affect the intubation efficacy. This factor was reduced since all animals in the study were induced to the median plane of anesthesia during the procedure (Hartsfied, 2007). However, the different levels of experience of the veterinarian did not significantly affect the results of the study, as they never performed intubation in a supine posture. The adapted human intubation guideline (Fell., 1996) required them to have the same acceptable range of experience. However, the same reason does not apply to sternal postures, since more experience might result in shorter intubation time. Further studies involving a group of students or novice veterinarians might be helpful in drawing firm conclusions.

The present study used both MacIntoch and Miller type blades as per the preference of anesthetists. Thus, we cannot conclude from the results on the preference of blade type. Most veterinarians were familiar with the Miller blade, which led to its over-use in this study. However, in a study on human patients (Amornyothin et al., 2012), the MacIntoch blade was observed to be superior over the Miller blade in terms of less intubation time, even when used by novice nurses. Further study on the effective use of both blade types in the veterinary field or new specific veterinary type blade (e.g., left blade wall) should be carried out.

The modern laryngoscopes with a good laryngeal view can be used conveniently in any posture (Cierniak et al., 2016; Lee et al., 2016; Wallace et al., 2015). Nevertheless, traditional laryngoscope is still affordable and practical in the veterinary field. The results from our study imply that intubation in a supine recumbent animal should be performed and rehearsed on a regular basis by veterinarians, not only for enhancing their confidence but also for quicker maneuver in different circumstances.

CONCLUSION

The endotracheal intubation procedure can be effectively performed in both sternal and supine recumbent postures, especially in the brachycephalic dogs. However, the sternal posture is appropriate for all dogs in general for endotracheal intubation.

CONFLICT of INTEREST

The authors declare that there is no conflict of interest to disclose.

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AUTHORS CONTRIBUTION

Jedee Temwichitr performed analysis and writing. Piyathida Ardaum and Nattika Koatsang evaluated patient during the procedure.

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