Reviews in Pharmacy and Pharmaceutical Sciences
ISSN: 3069-4310

PRIME OPEN ACCESS

Volume 2, Issue 1

Research Article

Date of Submission: 19 Nov, 2025
Date of Acceptance: 09 Dec, 2025
Date of Publication: 19 Dec, 2025

Feasibility Study of Transesophago-Tracheal Ventilation in a Beagle Dog

Weihua Xu[1*], Jieqiong Wang[1], Haidong He[1], Ming Chen[1] and Linghe Luo[2]

[1]Pulmonary and Critical Care Medicine, Tongde Hospital of Zhejiang Province, Zhejiang Province, China

[2]Gastroenterology Department, Tongde Hospital of Zhejiang Province, Zhejiang Province, China

***Corresponding Author:** Weihua Xu, Pulmonary and Critical Care Medicine, Tongde Hospital of Zhejiang Province, Zhejiang Province, China.

Citation: Xu, W., Wang, J., He, H., Chen, M., Luo, L. (2025). Feasibility Study of Transesophago-Tracheal Ventilation in a Beagle Dog. *Rev Pharm Pharm Sci, 2*(1), 01-05.

Abstract

Objectives

Tracheal intubation is a commonly used technique which primarily employed for rescuing patients with respiratory failure or providing respiratory support during surgery. However, for patients with severe upper tracheal stenosis who cannot undergo intubation or tracheotomy, alternative methods are necessary to ensure adequate oxygen support. The extracorporeal membrane oxygenation (ECMO) system can supply oxygen without requiring tracheal intubation; however, this technology is expensive and not routinely available in most hospitals. This study aimed to preliminarily test the feasibility of transesophago-tracheal ventilation in a Beagle dog to solve this medical dilemma.

Methods

The operation was performed with the guidance of X-ray fluoroscopy. A Beagle dog was anesthetized followed by conventional tracheal intubation. The bronchoscope entered the esophagus through the mouth, and a needle punctured from the esophagus into the trachea through the endoscopic working channel, exiting with its distal end in the trachea. Subsequently, a cannula with an inner core was introduced into the trachea along with the puncture needle. Finally, the ventilation for Beagle dog was conducted via transesophago-tracheal tube.

Results

The experimental dog successfully completed the transesophago-tracheal intubation and ventilation under sedation and anesthesia. After successful intubation, the tracheal intubation channel was blocked, and the dog was ventilated solely through the transesophago-tracheal tube for 20 minutes. There was no significant decrease in SaO2 levels in the experimental dog. The dog resumed its diet on the second day after surgery, and no coughing occurred after drinking water. On the 7th day of post-operation, chest CT examination revealed neither mediastinal emphysema nor pneumothorax in the dog.

Conclusions

The preliminary results of this study confirm the feasibility of transesophago- tracheal ventilation. However, there are still several gaps for clinical application, and further studies will be needed in future experiments.

Keywords: Tracheal intubation, Mechanical ventilation, Fluoroscopy, Extracorporeal membrane oxygenation, Esophagus

Introduction

Tracheal intubation is a clinical technical procedure usually used to rescue patients with respiratory failure or to ensure intraoperative ventilation in patients under general anesthesia. However, the tracheal intubation procedure is not suitable for all patients. For example, when there is severe stenosis in the upper tracheal segment which is located at the tracheostomy site, it is not only impossible to intubate the trachea, but even the tracheostomy is difficult to carry out.
Are there alternative methods for ventilation when conventional intubation and tracheotomy are unsuitable for implementation? The purpose of this study was to find an alternative to tracheal intubation, namely transesophago-

tracheal intubation, and test its feasibility in Beagle dogs.

Methods

• Animal

An adult male Beagle dog weighing 12 kg was purchased from Changzhou Belo Laboratory Animal Breeding Co., Ltd, kept in a clean-grade animal house of the Animal Center of Traditional Chinese Medicine Institute of Zhejiang Province, and fed normally. It fasted for 12 hours and abstained from water for 6 hours before the experiment.

• Anesthesia and Sedation

Beagle dog was sedated by intramuscular injection of Midazolam (Jiangsu Nhwa Pharmaceutical Co., Ltd) at a dose of 0.3 mg/kg. Anesthesia was induced by intramuscular injection of Xylazine Hydrochloride (Changsha beast biological technology institute Co., Ltd) with the dose of 0.03 mL/kg and intraperitoneal injection of Pentobarbital sodium (Hangzhou Dawen Biotec Co., Ltd) at a dose of 0.3 mL/kg with the concentration of 30 g/L. Midazolam and Pentobarbital sodium were administered only once. Xylazine Hydrochloride intramuscular injection for anesthesia was repeated every 15 minutes or as needed based on the anesthetic effect in the experimental Beagle dog to maintain anesthesia and ensure spontaneous breathing. The expected duration of sedation and anesthesia was 100 minutes.

• Fixation and Monitoring

After anesthesia, the experimental dog was placed on the self-made fixing plate in a supine position. Its head and limbs were wrapped with bandages and secured to the nails of the fixing plate. When fixing the head, the dog's neck was extended as far back as possible, with the head tilted back so that the nose and lips are at the very end of the head, the upper lip positioned below, and the lower lip above. The lower lip of the experimental dog was pulled to open its mouth, and a bandage was used to press the upper palate and teeth, securing them to the surface of the fixing plate. Then, bandages were applied to cover the jaws and tongue of the experimental dog, providing traction toward the ventral side, thereby opening the oral cavity widely to expose the epiglottis, glottis, and esophagus. This allowed for endotracheal intubation to pass through the mouth into the throat and trachea, while the bronchoscope could enter the trachea and esophagus.

After the dog was anesthetized and immobilized, the animal surgery monitor (Cardell 9500HD, USA) monitored heart rate, respiratory rate, and blood oxygen saturation. In the right forelimb of the experimental dog, 500 ml of 5% glucose and sodium chloride was slowly injected intravenously for intraoperative fluid rehydration and intravenous administration if necessary.

• Tracheal Intubation

The epiglottis of the experimental dog was opened, and the glottis was exposed. The endotracheal cannula with an inner diameter of 7.5 mm was inserted into the trachea of the experimental dog through the glottis. The bronchoscope (aScope3, Ambu, Denmark) was inserted into the airway through a tracheal intubation catheter, and the position of the tracheal intubation was adjusted under the direct vision of the bronchoscope so that the distal end reached the proximal third of the trachea of the experimental dog, and the tracheal intubation was fixed.

Exit the bronchoscope. The dog continued to breathe on their own, inhaling outside air through the tracheal tube. After transesophageal tracheal intubation was successful, the tracheal intubation catheter was occluded, and the experimental dog could breathe outside air through the transesophageal tracheal intubation.

• Transesophageal Tracheal Intubation

To complete the transesophago-tracheal intubation, a ureteral channel sheath (FlexorTM, Cook Company, USA), with an inner core diameter of 14 mm and an outer sheath diameter of 16 mm, was selected as the catheter for transesophago-tracheal intubation. During transesophago-tracheal intubation, the bronchoscope was inserted into the esophagus of the experimental dog. Under fluoroscopy (Shubor VET-520, Shenzhen, China), the puncture needle (modified from the TBNA puncture needle, with a 60 cm thin wire welded at the end of the puncture needle to extend its length) was inserted into the esophagus through the working channel of the bronchoscope. Under X-ray fluoroscopic guidance, the puncture needle pierced the anterior wall of the esophagus and the posterior wall of the trachea, entering the middle part of the trachea, and the front end of the puncture needle was advanced into the right bronchus. The bronchoscope was then withdrawn while the puncture needle remained in place within the trachea and esophagus. The catheter (ureteral channel sheath) with the inner core was subsequently inserted through the esophagus into the trachea along the puncture needle guide wire, with its distal end reaching the lower part of the trachea. Finally, the puncture needle guide wire and the inner core were withdrawn from the catheter (ureteral channel sheath), and the catheter was secured in position.

After successful intubation of transesophago-tracheal tube, the lumen of the tracheal intubation was blocked, and the experimental dogs breathed through the transesophago-tracheal intubation for 20 minutes.

Physiological parameter data recording and collection: 1 minute before tracheal intubation (T1), 1 minute after tracheal intubation (T2), at the time of successful transeosophago-tracheal puncture (T3), when the transeosophago-tracheal intubation catheter entered the trachea (T4), after the transeosophago-tracheal intubation was successful (T5), transoesophago-tracheal ventilation was used alone at 1min (T6) and 15 minutes (T7), the heart rate, respiratory rate, and blood oxygen saturation of the experimental dogs were recorded at these time points.

During the whole operation, if the heart rate, respiration, and SaO2 of the experimental dog showed a significant decrease, the experiment should be stopped immediately, and rescue measures such as intravenous drug injection and/ or manual balloon ventilation should be given.

• Postoperative Observation and Management

After the experiment, the transoesophago-tracheal intubation catheter was removed, and the experimental dog breathed outside air through the tracheal tube. After the dogs recovered from anesthesia, the intubation tube and intravenous infusion were removed, and they were returned to the animal room. After 6 hours of fasting and water prohibition, the dog was given water for the first time, and cough symptoms were observed. If there was no cough after drinking water, gradually return to a normal diet. If the cough symptoms persisted, intravenous nutrition and normal saline were injected through the femoral vein to supplement physiological needs until the experimental dogs gradually return to a normal diet.

On the 7th day after the operation, the experimental dog underwent a chest CT scan to observe pneumothorax and mediastinal emphysema. If pneumothorax or mediastinal emphysema occurs, it should be treated accordingly.

Results

The experimental dog successfully underwent transoesophago-tracheal intubation under sedation and anesthesia, and transeosophageal tracheal ventilation alone had been performed for 20 minutes. SaO2 did not decrease significantly in the experimental dog.

The respiration, heart rate, and SaO2 data of Beagle dogs at 7 observation time points during the experiment were shown in Table 1.
The dog recovered well during postoperative observation. On the second day after the operation, the experimental dog resumed their diet and did not cough after drinking water.

Neither mediastinal emphysema nor pneumothorax was found on the 7th day after surgery by CT.

Discussion

Tracheal intubation, that is, the process of entering the trachea through the pharynx, larynx, and glottis via the nasal cavity or mouth (Figure 1). After endotracheal intubation, the proximal end of the catheter can be connected to a ventilator, and the patient can be mechanically ventilated. With mechanical ventilation, the patient receives more oxygen. Therefore, tracheal intubation is very important for the treatment of severely ill patients, especially those with respiratory failure. Moreover, patients can be anesthetized for a longer period under endotracheal intubation and mechanical ventilation, allowing them to successfully undergo long-term surgical treatment [1].

In addition to tracheal intubation, clinicians can also increase oxygen supply to patients through nasal catheter, nasopharyngeal airway, breathing mask, laryngeal mask, tracheotomy intubation, and other means [2-3]. These measures are all via transtracheal approach to increase the supply of oxygen to meet the oxygen needs of tissues under hypoxia or anesthesia.
However, in some special clinical conditions, these methods are still unable to provide effective oxygen supply. For example, when the upper tracheal tract, especially the cervical tracheal tract, is severely narrowed, the nasal catheter, nasopharyngeal airway, breathing mask, and laryngeal mask cannot provide adequate oxygen supply during tracheal stenosis surgery. However, due to cervical tracheal stenosis, tracheal intubation and tracheotomy are difficult to perform. At this time, if the narrow upper tracheal segment is bypassed, the puncture technique is used to enter the unobstructed middle and lower tracheal segment from the esophagus, the cannula is subsequently inserted into the trachea and connect to mechanical ventilation, this clinical problem may be satisfactorily solved.

Obviously, to accomplish this task, we need to solve how the catheter penetrates through the wall of the esophagus and the wall of the trachea. The second problem is real-time guidance during puncture. In this study, a puncture needle was first used to enter the trachea through esophageal puncture, and then a catheter with an internal core (ureteral channel sheath, a mature product on the market at present) was inserted into the trachea along the puncture needle guide wire. After the catheter is in place, the guide wire and the inner core of the catheter are removed, and the airway can be ventilated through the esophagus and trachea (Figure 2).

The real-time guidance of the transesophago-tracheal intubation was performed by fluoroscopy. In theory, this operation could also be performed using endobronchial ultrasonic real-time guidance, and this feasibility can be further investigated in future experiments. Since this experiment is a preliminary study of the feasibility of transesophago-tracheal intubation and is still in the animal experiment stage, no actual intubation products have been developed yet.

Whether the operation of transesophageo-tracheal intubation will lead to esophageal fistula, tracheal fistula, mediastinal emphysema, mediastinitis, and other complications is also a problem that needs to be studied. The observation of Beagle dog in this experiment did not find such situations, but this does not mean that these complications will not occur in future operations. Therefore, it is necessary to conduct multiple animal experiments to preliminarily observe similar complications.

The problem of severe upper tracheal stenosis ventilation can be solved by other methods, including percutaneous cardiopulmonary support (PCPS) and extracorporeal membrane oxygenation (ECMO) systems [4-5]. Among them, ECMO drains human blood into an isolated membrane oxygenation exchange system, providing sufficient oxygenation to the blood within the system, and then returning the oxygen-rich blood back to the human body, ensuring that the patient's body receives an adequate oxygen supply.

PCPS and ECMO systems are efficient in providing adequate oxygen supply to patients even in severe respiratory diseases, such as severe narrowing of the airways that prevents oxygen from reaching the lungs, or severe disease of the alveoli that prevents oxygen from diffusing into the blood. However, PCPS and ECMO systems are not available in general hospitals due to their complex operation and expensive equipment, which limits the widespread use of PCPS and ECMO systems [6-8].

It is precisely for the non-widespread use of PCPS and ECMO that transesophago-tracheal intubation still holds clinical significance. Once the technology becomes more refined, it can be relatively easily popularized even in primary hospitals.

Conclusion

The preliminary results of this study confirm the feasibility of transesophago-tracheal intubation and ventilation, but there are still many gaps to bridge before clinical application, and further research is needed in future experiments.

Ethics Statement: The operations conducted in the present study were ethically approved by the Experimental Animal Welfare Committee of Traditional Chinese Medicine Institute of Zhejiang Province with the Ethical Approval Number of KTSC2020154. This is an animal research. Clinical trial numbers are not applicable.

Consent for Publication: It is not applicable because this is an animal experiment rather than a human study.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interests: The authors declare that there is no conflict of interest.

Funding Statement: This research was supported by Zhejiang Provincial Natural Science Foundation of China under grant numbers LGD21C040002.

Authors' contributions:
Jieqiong Wang: Writing the manuscript; Investigation; Methodology.
Haidong He: Collecting the relevant clinical data; Revising the manuscript.
Ming Chen: Designing the operation; Methodology.
Linghe Luo: Ensuring the accuracy or integrity of the operation; Methodology.
Weihua Xu: Designing the operation; Final approval of the version to be published; Methodology.

Acknowledgments: We would also like to express our gratitude to Hangzhou Jiujiu Cat Animal Hospital for their guidance and assistance in animal anesthesia and related equipment.

References

1. Higgs A, Mcgrath BA, Goddard C, et al. Guidelines for the management of tracheal intubation in critically ill adults. Br J Anaesth, 2018, 120(2): 323-352.
2. Wang R, Pan C, Wang X, et al. The impact of tracheotomy timing in critically ill patients undergoing mechanical ventilation: A meta-analysis of randomized controlled clinical trials with trial sequential analysis. Heart Lung, 2019, 48(1): 46-54.
3. FIlauro M, Mazzola F, Missale F, et al. Endoscopic Preoperative Assessment, Classification of Stenosis, Decision-Making. Front Pediatr, 2020, 8(7): 532.
4. Aravena C, Almeida FA, Mukhopadhyay S, et al. Idiopathic subglottic stenosis: a review. J Thorac Dis, 2020, 12(3): 1100–1111.
5. Van Esch BF, Stegeman I, Smit AL. Comparison of laryngeal mask airway vs tracheal intubation: a systematic review on airway complications. J Clin Anesth, 2017, 36: 142-150.
6. Richa F. Intubating laryngeal mask airway combined to fibreoptic intubation in subglottic stenosis. BMJ Case Rep, 2013, 2013: bcr2013010194.
7. Soeda R, Taniguchi F, Sawada M, et al. Management of anesthesia under extracorporeal cardiopulmonary support

in an infant with severe subglottic stenosis. Case Rep Anesthesiol, 2016, 2016: 6871565.
8. Xu WH. Airway stents implantation with extra pulmonary or intrapulmonary oxygen support on respiratory failure patients. J of Respiratory Res, 2017, 3(1): 98-101.

Table 1: The Changes of Respiration, Heart Rate and Sao2 of Beagle Dog at 7 Observation Time Points During the Experiment

	Respiration	Heart rate	SaO_2
T1	15	67	98
T2	16	69	99
T3	16	75	98
T4	19	78	99
T5	17	72	96
T6	26	93	94
T7	25	81	95

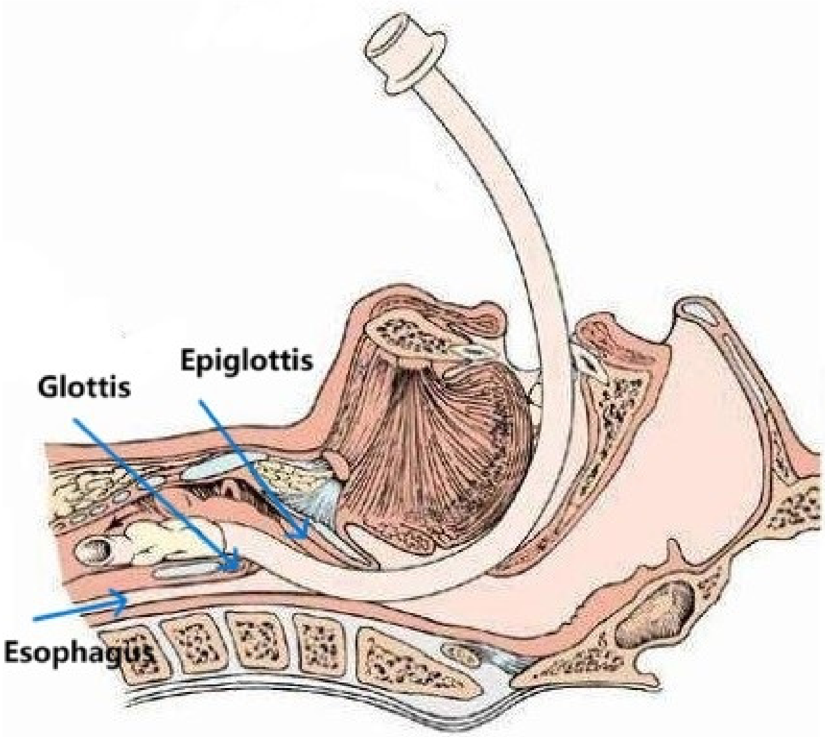

Figure 1: Traditional Tracheal Intubation Method

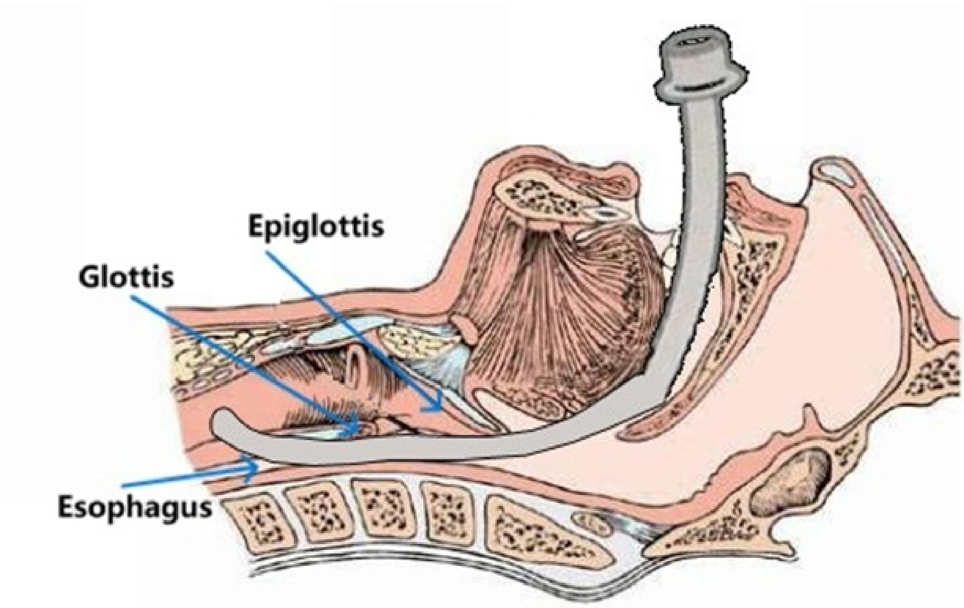

Figure 2: Transesophago-Tracheal Intubation Method