# Success and Complication Rates with Prehospital Placement of an Esophageal-Tracheal Combitube as a Rescue Airway

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**Abbreviations:**
BMV = bag-valve-mask
EMS = emergency medical services
EMT-D = emergency medical technician-defibrillation
EOA = Esophageal Obturator Airway
ETC = Esophageal-Tracheal Combitube
ETT = endotracheal tube
QA = quality assurance
OR = odds ratio
ROSC = return of spontaneous circulation

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## Abstract

**Introduction:** Previous studies have proven the success of the Esophageal-Tracheal Combitube (ETC) as a primary airway, but not as a rescue airway.

**Objective:** The object of this study was to observe success and complication rates of paramedic placement of an ETC as a rescue airway, and to compare success rates with endotracheal tube (ETT) intubation. The primary outcome indicator was placement with successful ventilation. Complication rates, esophageal placement, and return of spontaneous circulation (ROSC) were secondary measures.

**Methods:** A retrospective review of the records of patients who had ETC attempts by Emergency Medical Services (EMS) was conducted for a period of three years. Complications were defined *a priori*. The ETC is used primarily as rescue airway for a failed attempt at an endotracheal tube (ETT) intubation. A control group for ETT placements was drawn from the EMS quality assurance (QA) database for the same period.

**Results:** Esophageal-Tracheal Combitube insertion was attempted on 162 patients, of which, 113 (70%) were successful, 46 (28%) failed, and the outcome of three (2%) was not recorded. Inability to place the ETC occurred in 29 (18%) patients, and accounted for 48% (22/46) of failures. The use of the ETC caused dental trauma in one patient, and one placement of the ETC was related to the onset of subcutaneous emphysema. Blood in the ETC from active upper gatrointestinal bleeding occurred in nine patients (6%), and four tubes (3%) became dislodged en route to the hospital. The *a priori* complication rate was 44/162 (27%). Inability to determine placement of the ETC due to emesis from both ports occurred in 21 cases. Combining these problems with the *a priori* complications, the overall rate was 40% (65/162). Esophageal-Tracheal Combitube location was noted in a subset of 90 charts, of which, 76 (84%) were esophageal, and 14 (16%) were tracheal. Thirteen of 126 (10%) patients in cardiac arrest had return of spontaneous circulation (ROSC) in the field after placement of the ETC. An ETT was attempted in 128 control patients, of which, 107 (84%) were successful, 21 (16%) failed (odds ratio (OR) for ETT vs. ETC = 2.1; 95% CI = 1.12–3.86).

**Conclusion:** Despite a low ROSC rate, the complication and success rates of ETC are acceptable for a rescue airway device. Tracheal placement of the Combitube is uncommon, but requires fail-safe discrimination. Similar to previous reports, the success ratio for ETT was greater than for the ETC.

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## Introduction

A patent airway and adequate ventilation are critical for survival. When assessments detect an obstructed airway, absence of a gag reflex, and/or inadequate levels of ventilation; insertion of an advanced airway is indicated. Due to difficulties in training prehospital personnel to perform endotracheal intubation (ETT), devices have been developed to secure the airway more easily.[1] The Esophageal Tracheal Combitube (ETC)® (Kendall-Sheridan Catheter

| | n | (%) |
|---|---|---|
| Cardiopulmonary Arrest | 128 | (79.0) |
| Respiratory Arrest | 14 | (8.6) |
| Isolated Head Injury | 2 | (1.2) |
| Multiple Trauma | 14 | (8.6) |
| Submersion Injury | 4 | (2.5) |
| **Total** | **162** | **(100.0)** |



Table 1—Patient diagnosis per emergency medical services chart

Corp., Argyle, New York), a double lumen airway device, was developed for blind insertion into either the esophagus or trachea, with ventilation possible through either lumen. Studies have shown its effectiveness in laboratory and inpatient settings.[2-7] Although several studies have shown the ETC to be effective in establishing an airway in the prehospital setting,[8-10] this study attempted to identify complication rates with use of the ETC as a rescue airway.

## Methods

A three-year, retrospective review of consecutive charts from 01 January 1997 to 01 January 2000 was performed on all patients in whom ETC insertion was attempted. The study setting was an emergency medical services (EMS) system in Orange County, California, a county of three million people. First responders are firefighters, followed by emergency medical technician (EMT)-paramedics. Orange County paramedics are certified after 1,200 hours of training and are recertified annually with all airway devices including ETT, ETC, and bag-valve-mask (BVM). County protocol dictates that after failed ETT placement, the ETC should be placed as a rescue airway, with BVM used only as a bridge between the two definitive airways. Annual training with all of the devices is done with manikins in conjunction with a three-hour didactic session.

A total of 162 charts of the patients who had attempts at ETC insertion from the county EMS quality assurance (QA) database were reviewed. Chart reviewers were blinded to the hypotheses and were trained for two hours to abstract the data. Then, the reviewers abstracted data onto standardized forms. The two reviewers abstracted a common subset of 30 charts, and inter-observer agreement was calculated using a $K$-value = 5.0.

Successful placement of an ETC was defined as the ability to ventilate the patient adequately with appropriate chest rise, as determined from the paramedic run report. No esophageal detector devices, end-tidal $CO_2$ monitors, or pulse oximetry devices were used. *A priori*, complications were defined as: (1) inability to pass the tube; (2) dental trauma; (3) development of subcutaneous air; (4) dislodgement of the tube; and/or (5) oral bleeding. Several patients had emesis noted coming from both ETC ports. This was interpreted as the discovery of aspiration by the Combitube, and thus, these were not included in the overall complications rates. Return of spontaneous circulation was defined as a return of a palpable pulse at any time during resuscitation effort following the placement of the ETC.

As a control group, ETT intubations from the first day of each calendar month during the same time period were analyzed for success. The ETCs and ETTs were placed by the same general group of paramedics, but no attempt was made to match the data for individual paramedics.

A Chi-square analysis was used for categorical variables, and $p$-values, odds ratios, and 95% confidence intervals were calculated using True Epistat (ver. 5.0, Richardson, Texas).

This study was approved by the Institutional Review Boards of both the University of California at Irvine, and the Orange County EMS agency.

Placement of the ETC with successful ventilation when an ETC was used as a rescue airway, was the primary outcome measure used. Complications, esophageal placement, and ROSC are reported. Finally, rates of successful ETC insertion with a control group of patients who had attempted ETT placements from the same prehospital system, and with ETC insertions by emergency medical technician-defibrillation (EMT-Ds) from a previously reported series are included.[8]

## Results

During the three-year study, airway management by paramedics was required in 7,197 patients either by BVM, ETT, or ETC. Therefore, the 162 ETC uses accounted for 2.2% of the total airways managed by paramedics.

The diagnoses that led to insertion of the ETC are listed in Table 1. The majority of patients (n = 128, 79%) were in cardiopulmonary arrest. Most were men (n = 119, 73%). Of the 162 patients who had an ETC insertion attempt by a paramedic, 113 were successful (69.8%), 46 failed (28.4%), and three (1.9%) were not recorded. Of the 90 patients (56% of total ETCs used) in whom paramedics noted the location of the ETC following placement, 76 (84%) were in the esophagus, while 14 (16%) were in the trachea. Endotracheal tube insertion was tried as the primary device before insertcion of the ETC was attempted in 90% of the cases (n = 145). However, in the remaining 17 patients, paramedics chose the ETC as the primary airway device, without first trying to place an ETT. Reasons for this deviation from the standard protocol were not recorded.

Inability to insert the ETC was the most commonly encountered problem (29/162, 17.9%), and emesis from both ports occurred in 21 cases (13%). Oral bleeding was noted following ETC placement in nine patients (6%). Four tubes (2.5%) became dislodged during transport, with partial extrusion from the oral cavity that resulted in the inability to effectively ventilate the patient. Insertion of the ETC caused dental trauma in one patient, and another patient developed subcutaneous emphysema following insertion. Difficulty in placement of the ETC was followed by oral bleeding in one patient. Total complications defined *a priori* occurred in 27%. However, if emesis from both ports is included (not defined as a complication *a priori*), then the complication rate was 65/162 (40%) (Figure 1).



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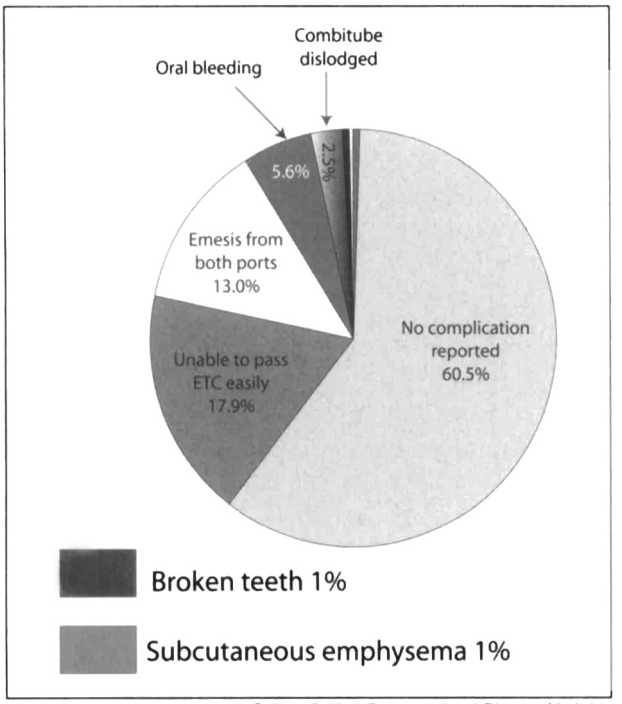




**Figure 1**—Complications from Esophageal-Tracheal Combitube insertion

Regarding ROSC, of the 126 study patients who had no vital signs upon paramedic arrival, 13 (10%) had ROSC following the placement of the Combitube.

As a control, 128 EMS charts in which ETT placement was attempted were reviewed. Endotracheal tubes were placed successfully in 108 patients (84%), as confirmed by direct laryngoscopy by a physician in the emergency department. The rate of successful placement as a rescue airway of the ETT in the Control Group versus the ETC group use as a rescue airway was statistically significant ($p = 0.019$, OR = 2.1, 95% CI = 1.12–3.86).

## Discussion

Maintaining a patent airway is one of the most important skills of prehospital providers, and previous studies have shown that prehospital, invasive airway management using an ETT improves oxygen delivery.[11,12] However, ETT skills are difficult to maintain and occasionally the use of other rescue airway devices is necessary.[1,12-14] Prior to the invention of the ETC, the Esophageal Obturator Airway (EOA) device was a common rescue device.[15] Like the ETC, the EOA was intended to be a low skill, blind insertion device, but if it was placed inadvertently in the trachea, it would suffocate the patient.[16–18] The ETC solved this limitation of the EOA by having a double lumen, and therefore, is a true fail-safe, blind insertion device.[3]

Results were compared with an earlier study in San Diego County, where the EMT-Ds had a similar success rate (155/195 or 79%) as paramedics had in this study (70%) ($p = 0.087$, OR = 1.58; 95% CI = 0.94–2.65).[8] Table 2 summarizes the $p$-value, odds ratios, and confidence intervals comparing ETC and ETT in the present study

| | Orange County ETC vs. Orange County ETT | Orange County ETC vs. San Diego ETC |
|---|---|---|
| $p$-value | 0.019 | 0.087 |
| Odds Ratio | 2.1 | 1.58 |
| 95% Confidence Interval | 1.12-3.86 | 0.9-2.65 |



**Table 2**—Comparison of Orange County paramedic successful ETC placement, ETT placement and San Diego county EMT-D placement of ETC (ETC = Esophageal-Tracheal Combitube; ETT = endotracheal tube)

and ETC success rates between the paramedics in Orange County and the EMT-Ds in San Diego County.

Previous studies have shown wide variations in successful airway management in the prehospital setting. Paramedic success rates for ETT placement are between 82–96%.[11,12,19,20] and ETC placement are between 64–79%.[8–10,21] The results obtained by paramedics in this study were within these previously reported ranges. However, Ochs *et al* published a higher success rate (79%) by EMT providers than were obtained by the paramedics in this study.[8] Although this difference did not reach statistical significance, the trend for higher success rates by EMTs could be explained by paramedics in this study using the ETC primarily as a rescue airway.

The complication rate for ETC placement was higher in this study than in a previous report by Vezina *et al*.[22] In addition, emesis coming from both ports is a complication that has not been reported. Most likely, this problem was not caused by the ETC, but rather was associated with prior vomiting and aspiration. As a result, ventilation and confirmation of ETC position was not possible. Therefore, emesis from both ports was included in the complication rate of 40%.

There are several limitations to this study that are typical of a retrospective chart review. Initially, prehospital records were to be linked with hospital records so as to be able to follow outcomes. However, due to lack of demographics on prehospital run sheets, only 26 hospital charts were available for review, and therefore, patient outcomes beyond ROSC were not included in the results. Future studies should enroll patients prospectively and list the medical record number on the EMS charts to facilitate complete hospital follow-up necessary for quality assurance. Other limitations include incorporation bias of sicker patients into the study group. Because the ETC was used as a rescue airway, these patients had prolonged hypoxia due to failure of other preferred methods. Also, bias may have played a role in paramedics not reporting all of their complications of placing the ETC. Likely, the charts were completed after the paramedic run and depended on the paramedics' recollection of events. Finally, as ETC ventilation was determined purely on clinical grounds, the success rate could be overstated.

In this study, the majority of the ETC patients initially were diagnosed with cardiac arrest. There was a 10%



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ROSC with the ETC used as a rescue airway compared with 16–26% ROSC with out-of-hospital cardiac arrest using traditional airway devices.[27–29] The prognosis for out-of-hospital cardiac arrest already is poor, with survival to discharge of 2.5–15%.[23–26] When a difficult airway requiring ETC placement further prolongs a patient's hypoxia, this portends an even worse outcome. The decreased ROSC found here likely stems from previous studies examining all patients with out-of-hospital cardiac arrest, in contrast to this study which included only patients who required the insertion of rescue airways.

## Conclusion

Esophageal-Tracheal Combitubes are used in a small minority of patients requiring placement of an advanced airway. They have been used typically following failed ETT intubations. This study identified a success rate of ETC placement slightly lower than previous studies, but its use as a rescue airway with inherently more difficult airways, may explain this difference. Resumption of vital signs after ETC placement is uncommon. Comparison studies of survival to discharge and neurological outcomes must be done using BVM ventilation, ETT, and ETC to identify an advantage for their use in the prehospital setting.


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