Critical Review Form
Therapy

PGY-3

Studnek JR, Thestrup L, Vandeventer S, Ward SR, Staley K, Garvey L, et al. The association between prehospital endotracheal intubation attempts and survival to hospital discharge among out-of-hospital cardiac arrest patients. Acad Emerg Med. 2010 Sep;17(9):918-25.

Objectives: **"To determine if pre- hospital endotracheal intubation (ETI) attempts performed on out-of-hospital cardiac arrest (OOHCA) patients were associated with return of spontaneous circulation (ROSC) and survival to hospital discharge."**

Methods: **Retrospective review of an EMS registry in Mecklenburg County, North Carolina including OOHCA cases occurring between July 1, 2006 and December 31, 2008. Included cases involved adults aged ≥ 18 years with nontraumatic cardiac arrest, defined as the absence of a pulse and lack of normal breathing, with resuscitation efforts initiated by paramedics. Exclusion criteria included:**

1) **Inter-facility transfer**
2) **Drowning**
3) **Electrocution**
4) **Obvious signs of death (rigor mortis or lividity)**
5) **Valid do not resuscitate order presented during resuscitation.**

The involved EMS agency served a population of 867,000 in Mecklenburg County, of whom 630,400 reside in the city of Charlotte. Patients were transported to any of 7 area hospitals, including one academic center and one tertiary care facility. Per protocol, ETI was attempted at paramedic discretion after 2 minutes of CPR, defibrillation (if indicated), and concurrently or after administration of epinephrine. RSI was not available, and paramedics had the option of laryngeal mask airway or bag-valve-mask ventilation in the case of failed ETI.

The main outcomes were sustained prehospital ROSC (determined by review of EMS patient care report forms, and defined as the return of pulses during resuscitation that were sustained at hospital arrival) and survival to hospital discharge (obtained by review of hospital medical records). Neurologic status at time of discharge was not available. The main independent variable was the number of prehospital ETI attempts, categorized as a single successful ETI, a single unsuccessful ETI, a multiattempt successful ETI, a multiattempt unsuccessful ETI, or no ETI attempt.

There were 1323 cardiac arrests during the study period, of which 1142 met criteria for inclusion. Most patients were male (61%) and white (54.2%); the mean age was 63.7 ± 16.8 years. The presenting rhythm was ventricular fibrillation or ventricular tachycardia (VF/VT) in 302 (26.5%) cases. There was no ETI attempt in 203 (17.8%)

cases; successful ETI occurred on the first attempt in 577 (50.5%) cases; a single unsuccessful ETI attempt occurred in 70 (6.1%) cases; multiple ETI attempts occurred with eventual success in 132 (11.6%) cases; multiple ETI occurred without success in 160 (14.0%) cases.

Guide		Comments
I.	**Are the results valid?**	
A.	**Did experimental and control groups begin the study with a similar prognosis (answer the questions posed below)?**	
1.	Were patients randomized?	No. This was a retrospective observational study. Treatment was at the discretion of EMS personnel.
2.	Was randomization concealed (blinded)?	No. Patients were not randomized and treatment was not concealed.
3.	Were patients analyzed in the groups to which they were randomized?	No. Patients were not randomized. They were analyzed according to the number of ETI attempts (none, one, or multiple attempts) and the success or failure of these attempts.
4.	Were patients in the treatment and control groups similar with respect to known prognostic factors?	No. While the authors state that "the occurrence of an ETI attempt was not associated with age, sex, race, presenting rhythm, or defibrillator usage," they provide no table or data to support this. Those individuals with OOHCA witnessed by EMS or those with bystander CPR were less likely to receive an ETI attempt. Such patients have been shown to have a better prognosis, biasing the results in favor of no attempted ETI (Sasson 2010, Axelsson 2012). Additionally, there is no data with regards to medical comorbidities, such as a history of cardiac disease.
B.	**Did experimental and control groups retain a similar prognosis after the study started (answer the questions posed below)?**	
1.	Were patients aware of group allocation?	Yes and no. While blinding of participants is generally recommended when feasible, these were patients suffering cardiac arrest and hence were unresponsive.
2.	Were clinicians aware of group allocation?	Yes. Blinding of EMS personnel to the decision to perform ETI, and the number of ETI attempts, would not be feasible. Additionally, in this study the decision to perform ETI and number of attempts performed was at the discretion of the paramedics. This could result in the introduction of performance bias.
3.	Were outcome assessors aware of group allocation?	Yes. Data was extracted from the Utstein-style database with no blinding to outcomes.

<table>
<tr><td>4.</td><td>Was follow-up complete?</td><td>Yes and no. Data was available for all patients with regards to prehospital ROSC. Of the 299 patients with ROSC, 48 (16%) whose final discharge status was unknown, and who were analyzed as not surviving to hospital discharge. We are not told the numbers of these 48 with zero, one, or multiple ETI attempts and whether such attempts were successful.</td></tr>
<tr><td>II.</td><td>What are the results (answer the questions posed below)?</td><td></td></tr>
<tr><td>1.</td><td>How large was the treatment effect?
Adjusted ORs:
Table 2
Logistic Regression Model for ROSC<table><tr><th>Variable Name</th><th>OR (95% CI)</th></tr><tr><td>Presenting rhythm</td><td></td></tr><tr><td>Non-VF/VT</td><td>Referent</td></tr><tr><td>VF/VT</td><td>3.25 (2.39–4.44)</td></tr><tr><td>Witnessed arrest</td><td></td></tr><tr><td>No</td><td>Referent</td></tr><tr><td>Family/bystander</td><td>1.59 (1.13–2.25)</td></tr><tr><td>EMS/FR</td><td>2.08 (1.31–3.31)</td></tr><tr><td>Sex</td><td></td></tr><tr><td>Female</td><td>Referent</td></tr><tr><td>Male</td><td>0.66 (0.49–0.89)</td></tr><tr><td>Race</td><td></td></tr><tr><td>Nonwhite</td><td>Referent</td></tr><tr><td>White</td><td>1.39 (1.04–1.86)</td></tr><tr><td>Intubation</td><td></td></tr><tr><td>One attempt with success</td><td>Referent</td></tr><tr><td>One attempt with failure</td><td>1.00 (0.56–1.80)</td></tr><tr><td>More than one attempt with success</td><td>0.60 (0.36–0.99)</td></tr><tr><td>More than one attempt with failure</td><td>0.40 (0.23–0.69)</td></tr><tr><td>No attempt</td><td>2.33 (1.63–3.33)</td></tr></table>EMS/FR = emergency medical services/first responder; ROSC = return of spontaneous circulation; VF/VT = ventricular fibrillation/ventricular tachycardia.
Table 4
Logistic Regression Model for Survival to Hospital Discharge<table><tr><th>Variable Name</th><th>OR (95% CI)</th></tr><tr><td>Presenting rhythm</td><td></td></tr><tr><td>Non-VF/VT</td><td>Referent</td></tr><tr><td>VF/VT</td><td>5.32 (3.41–8.31)</td></tr><tr><td>Witnessed arrest</td><td></td></tr><tr><td>No</td><td>Referent</td></tr><tr><td>Family/bystander</td><td>1.81 (1.03–3.18)</td></tr><tr><td>EMS/FR</td><td>1.84 (0.91–3.69)</td></tr><tr><td>Sex</td><td></td></tr><tr><td>Female</td><td>Referent</td></tr><tr><td>Male</td><td>0.59 (0.38–0.91)</td></tr><tr><td>Age</td><td></td></tr><tr><td>5-year increase</td><td>0.90 (0.85–0.96)</td></tr><tr><td>Intubation</td><td></td></tr><tr><td>One attempt with success</td><td>Referent</td></tr><tr><td>One attempt with failure</td><td>1.87 (0.87–4.02)</td></tr><tr><td>More than one attempt with success</td><td>0.68 (0.29–1.59)</td></tr><tr><td>More than one attempt with failure</td><td>0.40 (0.15–1.06)</td></tr><tr><td>No attempt</td><td>5.46 (3.36–8.90)</td></tr></table>EMS/FR = emergency medical services/first responder; VF/VT = ventricular fibrillation/ventricular tachycardia.</td><td>*See table 2 (sidebar) for adjusted odds ratios for ROSC and table 3 (sidebar) for adjusted odds ratios for survival to hospital discharge.
Converting OR to NNT: NNT = 5 to provide one sustained ROSC by hospital discharge for “no attempted intubation” in Table 3, and NNT = 3 to provide one survival at hospital discharge for the “no attempted intubation” in Table 4.
Unadjusted ORs for prehospital ROSC (95% CI):
One attempt with success: referent
One attempt with failure: 1.18 (0.68-2.05)
Multiple attempts with success: 0.62 (0.38-1.01)
Multiple attempts with failure: 0.37 (0.22-0.63)
No attempt: 2.44 (1.75-3.41)
Unadjusted ORs for survival to discharge (95% CI):
One attempt with success: referent
One attempt with failure: 2.31 (1.13-4.73)
Multiple attempts with success: 0.69 (0.31-1.58)
Multiple attempts with failure: 0.40 (0.15-1.03)
No attempt: 4.96 (3.22-7.67)
In the logistic regression model for prehospital ROSC, the presence of VF/VT, witnessed arrest by bystander/family, witnessed arrest by EMS, female sex, white race, and no ETI attempt were associated with a statistically significant improvement in outcome (see Table 2).

In the logistic regression model for survival to discharge, the presence of VF/VT, witnessed arrest by family/bystander, female sex, younger age, and no ETI attempt were associated with a statistically significant improvement in outcome (see Table 2).

The logistic regression models in tables 2 and 4 demonstrated good fit by the Hosmer-Lemeshaw</td></tr>
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		goodness of fit test (P=0.82 and 0.89, respectively).
2.	How precise was the estimate of the treatment effect?	See above.
III.	**How can I apply the results to patient care (answer the questions posed below)?**	
1.	Were the study patients similar to my patient?	Yes. These were primarily older (mean age 63.7), predominantly male (61%) patients. The majority suffered non-VF/VT cardiac arrest (73.5%). The majority of patients underwent at least one attempt at ETI. This seems similar to our patient population and current EMS practice. While there are no data regarding past history of cardiac disease, hypertension, diabetes, or other important prognostic indicators, I would expect rates to be similar.
2.	Were all clinically important outcomes considered?	No. The outcomes included prehospital ROSC and survival to hospital discharge. More important outcomes would include neurologically intact survival, neurologic outcomes, hospital length of stay, healthcare costs, and quality of life.
3.	Are the likely treatment benefits worth the potential harm and costs?	Uncertain. While the study showed a statistically significant improvement in prehospital ROSC (OR 2.44, 95% CI 1.75-3.41) and survival to hospital discharge (OR 4.96, 95% CI 3.22-7.67) with no attempt at ETI, such a finding indicates association, but not necessarily causation. Other observational studies have shown that ETI improves outcomes (Tanabe 2012, Wang 2012). The authors indicate that patients with EMS-witnessed arrest or bystander CPR were more likely to receive no ETI attempt; both of these factors have been shown to improve outcomes (Sladjana 2011, Hostler 2010), and would likely bias the results in favor of no ETI. In this retrospective observational study, other unknown confounding factors may have biased the results even further. Additionally, the outcomes assessed are not necessarily patient-important outcomes. More important outcomes such as neurologically intact survival, neurologic outcomes, and quality of life would be more important to patients.

Limitations:

1) **In this non-randomized trial the decision to perform ETI was at paramedic discretion and may have been dictated by factors that would affect the outcome. A randomized trial would limit such selection bias.**
2) **While the authors used multivariable logistic regression to control for known confounding factors, unknown confounders may still bias the results. Such limitations have been noted in observational trials of out-of-hospital ETI (Wang 2010).**
3) **Individuals experiencing OOHCA with pre-arrival CPR or witnessed arrest by EMS/first responders were less likely to receive an intubation attempt. Such patients have been shown to have higher survival rates, skewing results in favor of no intubation.**
4) **Outcomes did not include neurologic intact survival or neurologic status.**

Bottom Line:

Patients with no attempts at ETI had improved rates of ROSC and survival to hospital discharge compared to those with one successful ETI attempt. Patients with one failed ETI attempt were shown to have an improved rate of survival to discharge (but not ROSC) compared to patients with one successful ETI attempt). Patients with multiple attempts at ETI, regardless of success or failure, showed trends toward decreased ROSC and survival to discharge, with the exception that those with multiple attempts with failure showed a statistically significant decrease in ROSC. The data suggest that improved outcomes will occur with no attempt at ETI in OOHCA, though several factors limit the validity and applicability of the results.