The Future of EMS as Revealed through Research

A Window into the Near Future
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IMMEDIATE Trial

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The emerging of a subspecialty: EMS Medicine
Approaching the Patient
“See what you see!”

“People look, but they don’t see”

...A. Fowler, Jr.
Alertness?
Level of distress?
Noises?
Respirations?
The pulse rate?
Skin?
Obvious things (bleeding)
Our pulse can only go so fast under sympathetic stimulation:

220 minus age
Baby = \( (220 - 0) = 220 \)

Snerd = \( (220 - 53) = 167 \)

Aunt Minnie = \( (220 - 70) = 150 \)
What is this rhythm?

Correct answer: “It COULD be sinus tach”

220 – 55 = 165
What is this rhythm?

220 – 60 = 160

Correct answer: “This HAS to be an arrhythmia”
If you forget everything else that I say:

Remember that patients having near maximum sinus tachycardia at rest are dying!
A “physiological response”
Something mobilizing a massive physiological response
Your job is to determine if a rapid rhythm MAY be sinus tach.

If it is, you must take action.
Because so many EMS courses are too long, too boring, and teach difficult concepts to medics who will never use that information.
• Airway
• Breathing
• Circulation
• Drugs
• Disaster
• Electrocardiography
Airway
It is not at all clear what the best airway devices are now or what they will be.
Paramedic Drug Assisted Intubation (DAI) in Georgia

Overview
The attached annotated bibliography contains most of the significant literature covering prehospital intubation and prehospital drug assisted intubation (DAI). Review of this literature will help to develop a policy on prehospital airway management and prehospital DAI.

Fundamental Questions
- What is the definition of efficacious in the context of prehospital ETI?
- Is prehospital ETI feasible or efficacious?
- Is prehospital ETI facilitated with medications safe and efficacious?
- Can the characteristics of a safe and efficacious prehospital medication facilitated ETI program be defined and quantified?

**CONCLUSION:** Prehospital intubation is associated with a decrease in survival among patients with moderate-to-severe TBI. More critically injured patients may benefit from prehospital intubation but may be difficult to identify prospectively.

CONCLUSION:
Paramedic RSI was associated with an increase in mortality compared with matched historical controls. The association between hyperventilation and mortality was confirmed. In addition, patients transported by helicopter after paramedic RSI had improved outcomes. Paramedic RSI did not seem to prevent aspiration pneumonia.

Intubation was performed outside the operating room. There was a significant increase in the rate of airway-related complications as the number of laryngoscopic attempts increased (\(\leq 2\) versus >2 attempts): hypoxemia (11.8% versus 70%), regurgitation of gastric contents (1.9% versus 22%), aspiration of gastric contents (0.8% versus 13%) bradycardia (1.6% versus 21%), and cardiac arrest (0.2% versus 11%, \(p = 0.001\)). Although predictable, this analysis provides data that confirm the number of laryngoscopic attempts is associated with the incidence of airway and hemodynamic adverse events. These data support the recommendation of the ASA Task Force on the Management of the Difficult Airway to limit laryngoscopic attempts to three in lieu of the considerable patient injury that may occur.

**CONCLUSION:** No unrecognized misplaced intubations were found in patients for whom paramedics used continuous ETCO2 monitoring. Failure to use continuous ETCO2 monitoring was associated with a 23% unrecognized misplaced intubation rate.

9.08). Patients endotracheally intubated in the PH setting are more likely to have aspirated gastric contents than those intubated in the ED.
Position Paper
National Association of EMS Physicians

Recommended Guidelines for Uniform Reporting of Data from Out-of-hospital Airway Management:
Position Statement of the National Association of EMS Physicians

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CONCLUSION

Airway management, including endotracheal intubation, is the most important procedure performed in the prehospital setting. EMS services should closely monitor the performance of ETI to ensure that the highest level of care is provided. EMS services should adhere to the recommended standards for defining, collecting, and reporting airway management data. Although there are many methods for collecting airway management data, systems should use methods that result in the most accurate reports of treatment courses and outcomes.
RECOMMENDED FORMAT FOR REPORTING SYSTEM-WIDE PERFORMANCE OF AIRWAY MANAGEMENT

Prehospital services should use the following guidelines for summarizing systemwide performance of airway management:

1. ETI success rate (percentage and relative frequency) for all ETI (pooled [based on overall outcome of patient encounter], not per attempt)
2. ETI success rate (percentage and relative frequency) for subset of patients in cardiac arrest
3. ETI success rate (percentage and relative frequency) for subset of patients with a pulse (nonarrest)
4. For patients with a pulse (nonarrest), ETI success rates (percentage and relative frequency) stratified by overall ETI method:
   a. Orotracheal
   b. Nasotracheal
   c. Sedation-facilitated intubation
   d. Rapid-sequence intubation
5. ETI success rates (percentage and relative frequency) for subset of pediatric patients (<18 years of age) (individual services may choose to further stratify this group by specific age ranges)
6. ETI success rates (percentage and relative frequency) for subset of trauma patients
7. Cumulative success rates for consecutive ETI attempts
8. Frequencies of critical complications
9. Frequencies of rescue airway use
10. Patients receiving no ETI attempts but in whom airway or ventilatory support is required

(2,301, 56.1%). Adjusted odds of death were higher for out-of-hospital endotracheal intubation than ED endotracheal intubation (odds ratio [OR] 3.99; 95% confidence interval [CI] 3.21 to 4.93). Out of hospital endotracheal intubation was associated with an increased adjusted odds of poor neurologic outcome (OR 1.61; 95% CI 1.15 to 2.26), moderate or severe functional impairment (Functional Impairment Score 6 to 15; OR 1.92; 95% CI 1.40 to 2.64), and severe functional impairment (Functional Impairment Score 11 to 15; OR 1.80; 95% CI 1.29 to 2.52). CONCLUSION: Out-of-hospital endotracheal intubation was associated with adverse outcomes after severe traumatic brain injury. The implications for current clinical care remain undefined.
median per-service return rate was 75%. Non-response (data form not returned for attempted intubation) was problematic, with nine services demonstrating data return rates less than 50%. Data return rates could not be calculated for an additional nine services. The missing data entry rate was 0.5-22.2%. The overall reported ETI success rate was 86.8% (92.8% for cardiac arrests and 76.8% for non-arrests) and did not appear to vary between population settings. There were two cases of delayed intubation due to difficulty in identifying the site for insertion, which were resolved through alternative procedures.

**RESULTS:** Paramedics successfully intubated 95.5% (1,582) of all patients receiving succinylcholine, 94% (1,045) of trauma patients, and 98% (538) of medical patients. They were unable to intubate 4.5% (74) of the patients. All of these were successfully managed by alternative methods. Unrecognized esophageal intubation occurred in six (0.3%) patients. The addition of capnography and a tube aspiration device, in 1990, decreased the incidence of esophageal intubations.

**CONCLUSION:** Paramedics trained to use succinylcholine, to assist the process of endotracheal intubation, can safely intubate a high percentage of patients.
What does all of this mean?
Endotracheal intubation in the field may be rarely indicated
Endotracheal intubation in the field may be harmful...

...indeed, if you tracked your own survival data, you would likely find that people were less likely to survive with Field ETI
Field ETI

- Prolonged attempts
- Hypoxia during attempts
- Multiple attempts
- Aspiration during attempts
- Hyperventilation AFTER intubation
- Instrumenting the airway in critical patients
Example

Medic reports to Medical Director that an elderly patient in respiratory distress was cared for in the field, given nebs and oxygen, improved to GCS 8

On arrival to ED, Doc takes one look at her and makes 8 attempts to intubate her, during which she bradys down and dies
Example

What does that mean?

Did that patient need to be intubated who was improving with oxygen and supportive care?
Fowler’s Maxim

“The First Five Minutes”
Fowler’s Maxim

In some patients you have to act right now:

Airway obstruction
Exsanguination
Cardiac Arrest
Profound respiratory distress
Shock
Fowler’s Maxim

In most patients, you have five minutes

The patient who seems stable for the moment, with a decent pressure, with a decent pulse ox, whose airway is not immediately threatened

TAKE A MINUTE OR TWO TO THINK
Delaney’s Corollary

If it took them a couple of days or more to get sick, then you probably have at least five minutes to stop and think.

While you’re getting oxygen, IV’s, other supportive care, arranging for transport to the appropriate facility.
The Airway of the future will be fast, effective, and virtually hazard free.

Avoiding airway trauma virtually always goes in

Easy to train

Easy to remember
The Easy Tube
The Easy Tube
The Airway of the future will be fast, effective, and virtually hazard free.
Breathing and Circulation
Resuscitation Outcomes
Consortium

A consortium of ten cities and states across North America designated by the National Institutes of Health to be the largest EMS research group in the history of medicine
Resuscitation Outcomes Consortium

Will be initially looking at hypertonic saline infusions for traumatic brain injury and hemorrhagic shock due to trauma

Already in use in the military, just not studied in large civilian populations
Resuscitation Outcomes Consortium

Will next look at the Impedance Threshold Device to improve negative intrathoracic pressure during cardiac compressions.
Impedance Threshold Device

Turns chest compressions from a “one stroke engine” to a “two stroke engine”
Resuscitation Outcomes Consortium

Impedance Threshold Device

Makes use of chest recoil with tiny, momentary airway occlusion to increase venous return
Resuscitation Outcomes Consortium

Impedance Threshold Device

Essentially normalizes blood pressure during chest compressions
Impedance Threshold Device May Improve Survival in Out-of-Hospital Cardiac Arrest

Peggy Peck

Nov. 12, 2004 (New Orleans) — Use of an investigational inspiratory impedance threshold device (ITD) — ResQPod Circulatory Enhancer — during standard cardiopulmonary resuscitation (CPR) was associated with a doubling of short-term survival in patients with pulseless electrical activity (PEA) at any time during resuscitation, according to study results presented here at the American Heart Association 2004 Scientific Session.

Lead investigator Tom P. Aufderheide, a professor of emergency medicine at the Medical College of Wisconsin in Milwaukee, told Medscape he predicts the device "will have as great an impact on CPR efforts and treatment of out-of-hospital cardiac arrest as AEDs." He said use of the device increases blood supply to the brain and heart during the resuscitation.

The study compared the device, made by Advance Circulatory Systems Inc. in Eden Prairie, Minnesota, to a sham device for use during standard manual CPR. The device can be used with a face mask or can be attached to an endotracheal tube, and it is equipped with a timing light that flashes at a rate of 12 breaths a minute with each breath lasting a maximum of 1.6 seconds.

The primary end point was admission to an intensive care unit.

There were 116 patients randomized to the sham device and 114 were randomized to the ITD. Of the patients randomized to the active device, the one-hour survival rate was 26%, the ICU admission rate was 25%, and 24-hour survival rate was 17%. For patients in the sham device group the rates were lower — 18%, 17%, and 12%, respectively — but the differences were not statistically significant.
Introducing the Most Advanced Device for Enhancing Circulation during Cardiopulmonary Resuscitation (CPR)

The ResQPOD Circulatory Enhancer®

- Increases blood flow to the heart and brain during CPR
- Increases the opportunity for survival and normal neurological outcome
- May be used with standard CPR or pump-assisted (active compression decompression - ACD) CPR
- Works in conjunction with standard resuscitation techniques and equipment
Physiology

Oxygen -> lungs -> alveoli -> blood

breath

CO₂

lungs

blood

Oxygen

muscles + organs

CO₂

energy

Oxygen

cells

Oxygen + Glucose

3/29/2006
The negative pressure inside the thorax “pulls” blood back from the positive pressure areas.

Positive pressure

Negative pressure

Positive pressure

3/29/2006
Maintaining the “negativity” of the pressure inside of the thorax is one of the most vital areas of understanding resuscitation.
Signs of Shock

Early
- Weak, thirsty, lightheaded
- Pale, then sweaty
- Tachycardia
- Tachypnea
- Diminished urinary output

Late
- Hypotension
- Altered LOC
- Cardiac arrest
- Death
What does a low blood pressure mean?

Either...

Or a combination of any of these

...from BTLS, editions 2, 3, 4, and 5 Fowler et al
Shock

Cardiogenic
- Rapid pulse
- Distended neck veins
- Cyanosis

Volume Loss
- Rapid pulse
- Flat neck veins
- Pale

Vasodilatory
- Variable pulse
- Flat neck veins
- Pale or pink
We have been overventilating patients in circulatory collapse to death for years, without knowing it.

After all, if a little oxygen is GOOD, more is better, right?
WRONG!
Overventilation raises intrathoracic pressure, decreasing venous return, and dropping cardiac output.
Blood pressure = (Cardiac output) \times (Volume) \times (Peripheral resistance)
If you drop venous return, cardiac output drops.

That is, if the pump can’t fill, then the pump can’t pump.
Research is clear on the fact that medics (and all providers) bag patients too fast with too big of a squeeze and too fast on the squeeze.
Slow down the rate of ventilation until capnography begins to rise.

Maintain a minute ventilation of approximately five liters and see where capnography goes from there.

One hand squeeze every 8 seconds.
Boussignac CPAP System

For Acute Pulmonary Edema (APE)

Lowest O2 consumption rate of any CPAP system
- Only 15-30L/min flow rate for 3.5-10cmH2O

System doesn't require a flow generator
- Eliminates investment in capital equipment and repair
- Boussignac CPAP only needs O2 source and flowmeter

Only completely open CPAP system
- Eliminates re-breathing
- Reduces risk of barotrauma
- Decreases the work of breathing
- Accommodates patient's high peak inspiratory flow demand
- Allows use of suction catheter or bronchoscope without loss of CPAP

Only CPAP system that depends entirely on the O2 flow rate
- CPAP easily adjusts to patient's need (2.5-20cmH2O) simply by titrating O2 flow
- PEEP adjustable by changing flow rate, no valves to change
- Constant, accurate pressure measurement via optional manometer

Complete, easy to use, portable, single use system
- CPAP set up in <2 minutes, therefore ideal for all EMS and ED settings
- Requires 73% less space in field packs than competitive systems
- Boussignac CPAP weighs only 10grams, 2" long
- Permits CPAP without interruption during transport
Boussignac CPAP works the same way as the turbines of a jet engine.

**Oxygen supply**
Oxygen molecules enter the chamber.

**Oxygen acceleration**
The molecules of oxygen are accelerated at the speed of sound as they pass through micro channels.

**Oxygen braking**
The molecules of oxygen strike a deflector which sends them back to the central zone (mixing zone).

**Establishment of a virtual valve**
The collision of the molecules generates a turbulence which transforms the speed into pressure.
What about the AutoPulse?
Drugs and ECG’s
Drugs

It is clear that overventilation has changed patient outcomes over the years and prevented us from seeing what drugs could
Which Drugs to Revisit?

Antiarrhythmics in arrest
Pressors during arrest
Future Drugs

Artificial hemoglobins?
Vasopressin?
...but just when we thought life was getting easier...
Electrocardiography

12 Lead Interpretation by medics is now the standard of care even if the 12 lead is NOT on your rig
ECG Interpretation

Anatomically speaking...
SA

AV

Bundle of His

Bundle Branches
Multifocal Atrial Tachycardia
IMMEDIATE Trial
IMMEDIATE Trial

Medic identifies the Acute Coronary Syndrome through patient History and Physical and through 12 Lead Interpretation

Medic gets consent

Medic initiates an infusion of Glucose, Insulin, and Potassium in the field to limit incidence of sudden death and infarct size
IMMEDIATE Trial

Over time EMS will likely be giving medication to limit infarct size and incidence of sudden death.

This will ultimately increase survival from acute coronary syndrome and decrease the burden of CHF post infarct to patients and the community.
IMMEDIATE Trial

Turns out that sick tissue likes a little extra insulin around

Insulin turns off fat metabolism and turns on carbohydrate metabolism, giving more energy per gram of substrate to sick cells

This has been known for over 40 years
What is the patient’s blood pressure?
A 15 year old AA male is found confused, sweaty, with a respiratory rate of 36, a systolic pressure of 80, and this EKG rhythm strip.
60 year old Aunt Minnie presents with systolic of 90 and no cardiac history. She has been ill for two days.
60 year old with rate of 158
220 – 60 = 160

What statement can you make?
60 year old with rate of 158
220 - 60 = 160

Does she need Adenosine?
Synthesis
So, Who's Foolin' Who??
EMS professionals are primary members of the emergency medical team. The scope of practice of these EMS professionals continues to grow with passing years.
Let us then apply our best efforts to monitor emerging research with the sharpened focus of clarity and simplification, pooling our individual creativities for the greater good of those we serve.
This Talk may be found at

www.rayfowler.com

drray@doctorfowler.com
and Good Morning!

Questions or comments?