ITLS
International Trauma LIfe Support

Harry Sibold, MD, FACEP

State EMS Medical Director

Montana Board of Medical Examiners

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Topic for discussion today!

EMS Airway Management: Past, Present and Future

Harry Sibold, MD, FACEP
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Disclosures: None

A Reversal

Thank you!

ITLS International Trauma Life Support

But first…..

- Park Ranger/Park Medic
  National Park Service

- Paramedic
  Phoenix
  Phoenix Fire Department

  San Diego-Hartson
  member S.T.A.R. team
  hi-angle rescue, surf rescue & tactical/SWAT EMS

Medical School

East Tennessee State University
Quillen College of Medicine

Residency

Wake Forest University School of Medicine
NC Baptist Hospital
Emergency Medicine
Member: NC *S.O.R.T.* (NDMS) team

Board Certified: Emergency Medicine
Secondary Board: Undersea & Hyperbaric Medicine

Fellow – American College of Emergency Physicians

Emergency Physician 1995-1998
Boise, ID
Medical Director – Ada County EMS-High Angle Rescue team

Metro Life Flight 1995-2000
Flight Physician
Cleveland, OH
Past-president: *Air Medical Physician Association*
Consultant and lecturer on air medical transport

Mid Atlantic Emergency Medical Associates
Staff Emergency Physician
Member and past chair:
Charlotte/Mecklenburg MEDIC control board
Medical Director: NC SMAT team; Katrina deployment

A little historical perspective

- When did we start…?
- 1960s-1970s?
- 1950s-Korea?
- WW2?

A bit further back…

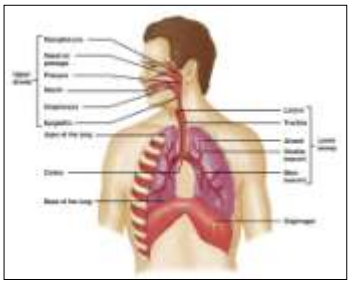
tracheotomy was portrayed on Egyptian tablets dating back to 3,600 BC

Alexander the Great (356-323 BC) saved a soldier from suffocation by using the tip of his dagger

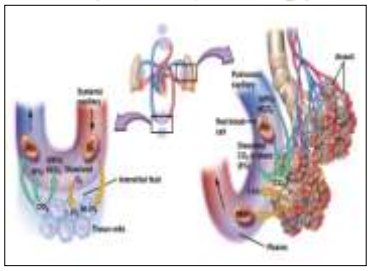
In the 1800s, O'Dwyer & Kuhn created metallic endotracheal tubes intended for blind insertion

Technology Evolution is NOT new

Basic Anatomy Review



Anatomy & Physiology Review



- Assessment, assessment, assessment!!!

Opening the Airway (Manual)

- Head tilt-chin lift
  - Nontrauma pts
  - Medical pts
- Jaw-thrust
  - Suspected spinal injury

- Effectiveness of the jaw-thrust maneuver in opening the airway: a flexible fiberoptic endoscopic study.
- Uzun L, Ugur MB, Altunkaya H, Ozer Y, Ozkocak I, Demirel CB
- ORL J Otorhinolaryngol Relat Spec. 2005;67(1):39.
-

- OBJECTIVE: A prospective study was carried out to find the exact site of obstruction in sleep model and to quantitatively evaluate the effect of Jaw-thrust maneuver (JTM) in opening the obstructed airway using flexible fiberoptic endoscope.

- RESULTS: The strictly curved (Omega-shaped or concaved) epiglottis supplied a salvage pathway for airflow that resisted collapsing with the posterior movement of the tongue base in 2 patients. When we compared GrIns with GrExp for epiglottis the difference was statistically significant (chi(2) = 0.001), but the difference for tongue base was not (chi(2) = 0.152). After JTM, GrJTM for both epiglottis and tongue base were significantly better than GrIns and GrExp (chi(2)<0.001).

- CONCLUSION: **Tongue base was the principal site of obstruction** although during the respiratory cycle the position of epiglottis changed prominently and increased the obstruction in inspiration**. JTM alone significantly relieved the obstruction at the tongue base and epiglottis** levels and increased the retroglossal airway.

Effectiveness of the jaw-thrust maneuver in opening the airway: a flexible fiberoptic endoscopic study

CONCLUSION:

Tongue base was the principal site of obstruction

JTM alone significantly relieved the obstruction at the tongue base and epiglottis levels

- The effect of airway maneuvers on the unstable C1-C2 segment. A cadaver study.
- Donaldson WF 3rd, Heil BV, Donaldson VP, Silvaggio VJ
- Spine (Phila Pa 1976). 1997;22(11):1215.
- STUDY DESIGN: This is a cadaver study in which video fluoroscopy is used to measure motion of the unstable spine at C1-C2 during intubation maneuvers.
- OBJECTIVES: To quantify the amount of motion that occurs at an unstable C1-C2 spinal segment during the use of various intubation techniques using a cadaver model.
- METHODS: Six human cadavers were used for the study. Measurements before and after transoral osteotomy of the odontoid were performed using video fluoroscopy. Pre-intubationmaneuvers and oral and nasal intubation were studied.
- RESULTS: Oral intubation and nasal intubation caused similar diminution of space available for the cord. Chin lift and jaw thrust caused a larger diminution of space available for the cord than either nasal or oral intubation techniques.
- CONCLUSIONS: Although nasal intubation is the accepted procedure for intubation of the unstable spine, nasal and oral intubation seemed to have the same ability to narrow the space available for the cord in the model in this study. **Great care should be taken while performing the chin lift/jaw thrust maneuvers in preparation for intubation, because these pre-intubation techniques caused the most motion and hence narrowed the space available for the cord in the unstable cervical spine.**
- Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Pennsylvania, USA.

Conclusion:

Great care should be taken while performing the chin lift/jaw thrust maneuvers in preparation for intubation, because these pre-intubation techniques caused the most motion and hence narrowed the space available for the cord in the unstable cervical spine.

- Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Pennsylvania, USA.

Basic Anatomy Review

Normal Breathing Rates

Adult	12-20 breaths/min
Child	15-30 breaths/min
Infant	25-50 breaths/min

Death by hyperventilation: a common and life-threatening problem during cardiopulmonary resuscitation.

Aufderheide TP, Lurie KG
Crit Care Med. 2004;32(9 Suppl):S345.

- CONTEXT: This translational research initiative focused on the physiology of cardiopulmonary resuscitation (CPR) initiated by a clinical observation of consistent hyperventilation by professional rescuers in out-of-hospital cardiac arrest. This observation generated scientific hypotheses that could only ethically be tested in the animal laboratory.

  OBJECTIVE: To examine the hypothesis that excessive ventilation rates during performance of CPR by overzealous but well-trained rescue personnel causes a significant decrease in coronary perfusion pressure and an increased likelihood of death.

- MAIN OUTCOME MEASURES: Ventilation rate and duration in humans; mean intratracheal pressure, coronary perfusion pressure, and survival rates in animals.

  RESULTS: In 13 consecutive adults (average age, 63 +/- 5.8 yrs) receiving CPR (seven men) the average ventilation rate was 30 +/- 3.2 breaths/min (range, 15 to 49 breaths/min) and the average duration of each breath was 1.0 +/- 0.07 sec. The average percentage of time in which a positive pressure was recorded in the lungs was 47.3 +/- 4.3%. No patient survived. In animals treated with 12, 20, and 30 breaths/min, the mean intratracheal pressures and coronary perfusion pressures were 7.1 +/- 0.7, 11.6 +/- 0.7, 17.5 +/- 1.0 mm Hg/min (p<.0001) and 23.4 +/- 1.0, 19.5 +/- 1.8, 16.9 +/- 1.8 mm Hg (p = .03) with each of the different ventilation rates, respectively (p = comparison of 12 breaths/min vs. 30 breaths/min for mean intratracheal pressure and coronary perfusion pressure). Survival rates were six of seven, one of seven, and one of seven with 12, 30, and 30 + CO2 breaths/min, respectively (p = .006).

- CONCLUSIONS: **Despite seemingly adequate training, professional rescuers consistently hyperventilated patients during out-of-hospital CPR.** Subsequent hemodynamic and survival studies in pigs demonstrated that excessive ventilation rates significantly decreased coronary perfusion pressures and survival rates, despite supplemental CO2 to prevent hypocapnia. TThis translationalresearch initiative demonstrates an inversely proportional relationship between mean intratracheal pressure and coronary perfusion pressure during CPR. Additional education of CPR providers is urgently needed to reduce these newly identified and deadly consequences of hyperventilation during CPR. These findings also have significant implications for interpretation and design of resuscitation research, CPR guidelines, education, the development of biomedical devices, emergency medical services quality assurance, and clinical practice.

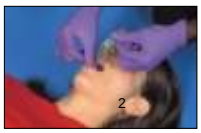
Department of Emergency Medicine, Medical College of Wisconsin Milwaukee, Wisconsin, USA.

Critical Care Medicine

Death by hyperventilation: a common and life-threatening problem during cardiopulmonary resuscitation.

CONCLUSIONS: Despite seemingly adequate training, professional rescuers consistently hyperventilated patients during out-of-hospital CPR.

Basic Airway Adjuncts (Mechanical)



Basic Airway Adjuncts (Mechanical)

Oxygen Delivery Equipment

- **Nonrebreathing mask**
  Provides up to 90% oxygen
  Used at 10 to 15 L/min

- **Nasal cannula**
  Provides 24% to 44% oxygen
  Used at 1 to 6 L/min

Assessment…!

Inadequate Breathing

- Irregular rhythm
- Labored breathing / position
- Muscle retractions
- Pale, blue, cool, clammy skin
- Difficulty speaking
- Faster / slower respiratory rate

Direct signs of airway compromise

- Dyspnea
- Stridor

Indirect signs of airway compromise

- Drooling
- Trismus
- Painful swallowing (odynophagia)
- Tracheal deviation
- Other anatomic abnormality involving the larynx or trachea

Signs of developing airway compromise

- Nonsuperficial burns of the face or neck
- Severe bleeding in the oropharynx or nasopharynx
- Subcutaneous air (crepitus) in the neck or upper chest
- Hematoma in the neck or lower face
- Hoarseness or other alterations in voice
- Subjective sense of shortness of breath despite adequate oxygen saturation

Patients requiring high index of suspicion

- Unstable mandible or midface injuries
- Steady bleeding into the oropharynx or nasopharynx
- Worsening or fluctuating level of consciousness

The Message?

Don't forget basic assessment and skills
Don't underestimate their value

More Important Literature

King LT-D use by urban basic life support first responders as the primary airway device for out-of-hospital cardiac arrest.

Gahan, K. Studnek, JR. Vandeventer S.

Source: Carolinas Medical Center, Department of Emergency Medicine, Charlotte, NC, USA.

Abstract

Objective: The objective of this study was to compare the **frequency of first attempt success** between basic life support (BLS) first responder initiated **King LT-D** placement and **paramedic initiated endotracheal intubation (ETI)** among patients experiencing out-of-hospital cardiac arrest (OOHCA).

Methods: In 2009 a large, urban EMS agency modified their out-of-hospital, non-traumatic, cardiac arrest protocol from paramedic initiated ETI to first responder initiated King LT-D placement. This retrospective analysis of all adult, non-traumatic cardiac arrests occurred four months before and four months after protocol implementation. The outcome variable in this analysis was first attempt airway management success defined as placement of the device with end tidal CO2 wave form or colorimetric color change, auscultation of bilateral breath sounds, and improved or normal pulse oximetry reading. The independent variable of interest was initial device utilized to secure the airway, King LT-D or ETI.

Results: There were 351 adult, non-traumatic OOHCAs with 184 patients (52.4%) enrolled during the ETI period and 167 (47.6%) during the King LT-D period. The frequency of first attempt success was 57.6% in the ETI group and 87.8% in the King LT-D group. Patients in the King LT-D group were significantly more likely to experience first attempt success versus standard ETI methods (OR 5.3; 95%CI 2.9–9.5).

Conclusion: In this analysis of OOHCA airway management, first attempt BLS King LT-D placement success exceeded that of first attempt paramedic ETI success. In addition, patients in the King LT-D group were more likely to have had an advanced airway attempted and to have had a successful advanced airway placed when multiple attempts were required.

Conclusion:

In this analysis of OOHCA airway management, first attempt BLS King LT-D placement success exceeded that of first attempt paramedic ETI success.

Center for Prehospital Care
Carolinas Medical Center
Department of Emergency Medicine, Charlotte, NC, USA

The association between prehospital endotracheal intubation attempts and survival to hospital discharge among out-of-hospital cardiac arrest patients.

Studnek, JR Thestrup, L. Vandeventer, S. Ward, SR Staley, K. Garvey, L . Blackwell, T.

Center for Prehospital Medicine, Charlotte, NC, USA.

OBJECTIVES:

- The benefit of prehospital endotracheal intubation (ETI) among individuals experiencing out-of-hospital cardiac arrest (OOHCA) has not been fully examined. The objective of this study was to determine if prehospital ETI attempts were associated with return of spontaneous circulation (ROSC) and survival to discharge among individuals experiencing OOHCA.
- **METHODS:**
- This retrospective study included individuals who experienced a medical cardiac arrest between July 2006 and December 2008 and had resuscitation efforts initiated by paramedics from Mecklenburg County, North Carolina. Outcome variables were prehospital ROSC and survival to hospital discharge, while the primary independent variable was the number of prehospital ETI attempts.
- **RESULTS:**
- There were 1,142 cardiac arrests included in the analytic data set. Prehospital ROSC occurred in 299 individuals (26.2%). When controlling for initial arrest rhythm and other confounding variables, individuals with no ETI attempted were 2.33 (95% confidence interval [CI] = 1.63 to 3.33) times more likely to have ROSC compared to those with one successful ETI attempt. Of the 299 individuals with prehospital ROSC, 118 (39.5%) were subsequently discharged alive from the hospital. Individuals having no ETI were 5.46 (95% CI = 3.36 to 8.90) times more likely to be discharged from the hospital alive compared to individuals with one successful ETI attempt.

CONCLUSIONS:

- Results from these analyses suggest a negative association between prehospital ETI attempts and survival from OOHCA.
- In this study, the individuals most likely to have prehospital ROSC and survival to hospital discharge were those who did not have a reported ETI attempt. Further comparative research should assess the potential causes of the demonstrated associations

Assessing the Impact of Prehospital Intubation on Survival in Out-of-Hospital Cardiac Arrest

Joshua Egly, MD, Don Custodio, MD, Nathan Bishop, DO, Michael Prescott, MD, Victoria Lucia, PhD, Raymond E. Jackson, MD, Robert A. Swor, DO

- Endotracheal intubation significantly decreased survival to discharge in VF/VTpatients by about 50% (OR = 0.52)
- Intubation increased survival to hospital but not discharge alive in AS and PEA

Association of Prehospital Advanced Airway Management With Neurologic Outcome and Survival in Patients With Out-of-Hospital Cardiac Arrest

Kohei Hasegawa, MD, MPH; Atsushi Hirasde, MD, PhD; Yoshiaki Chang, PhD; David F. M. Brown

Importance It is unclear whether advanced airway management such as endotracheal intubation or use of supraglottic airway devices in the prehospital setting improves outcomes following out-of-hospital cardiac arrest (OHCA) compared with conventional bag-valve-mask ventilation.

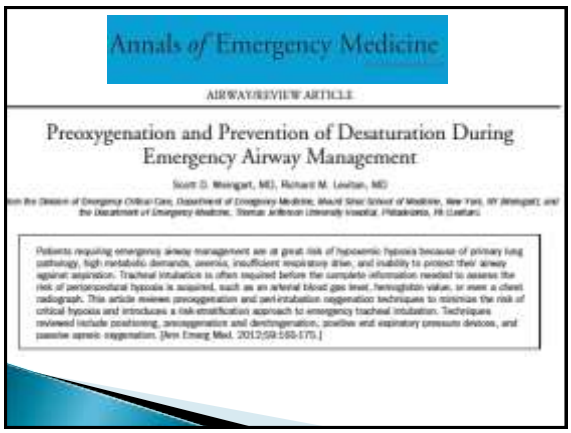
Objective To test the hypothesis that prehospital advanced airway management is associated with favorable outcome after adult OHCA.

Authors comment:

…study was sufficiently large to clearly demonstrate the negative association between advanced airway management and neurologically favorable survival after cardiac arrest

The Takeaway

- More studies needed to confirm seemingly conflicting data
- Prospective, human studies desirable/necessary


Annals of Emergency Medicine

AIRWAY/REVIEW ARTICLE

Preoxygenation and Prevention of Desaturation During Emergency Airway Management

Patients requiring emergency airway management are at great risk hypoxia because of primary lung pathology, high metabolic demands, anemia, insufficient respiratory drive, and inability to protect their airway against aspiration.

Tracheal intubation is often required before the complete information needed to assess the pre-procedural risk is acquired (ABG, Hgb, CXR)

reviews pre-oxygenation and peri-intubation oxygenation techniques to minimize the risk hypoxia

risk-stratification approach to emergency tracheal intubation.

At the time (2011), a novel set of concepts toward improving success and outcome

NO new technology or devices

Simply a well thought out clinical approach using thoroughly considered physiologic principles

Technology

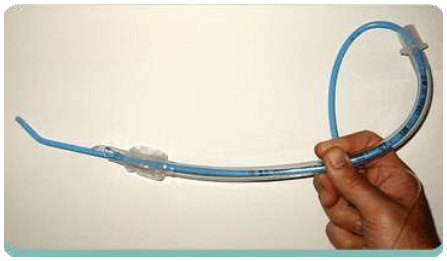
from traditional...

Technology

to transitional…

Technology

to transitional…



Technology

to present practice

Technology

Technology

Technology

Technology

how will it be integrated into our EMR

What's Next??

- No matter the future concepts, must consider basic airway assessment
- Improved training and skills retention
- Rapid technology evolution is occurring
- It is NOT just technology that is evolving
- Research often proves elusive, confusing or contradictory
- Studies can show surprising, unexpected results
- Outside influences (e.g. evolving c-spine care)

Technology and Integration

Future concepts?

IS THIS OUR FUTURE?

IS THIS OUR FUTURE?

IS THIS OUR FUTURE?

AND, FINALLY…

For those of you involved in training, oversight of training or paramedic program creation (or simply interested in your own training and re-certification)…

American Society of Anesthesiologists

A resolution was presented to the ASA House of Delegates at the annual meeting in October 2013 encouraging anesthesiologists to support the Paramedic practice of airway management in hospitals and anesthesiology programs.

Resolutions being transcribed by the Society at this time.
Not yet available to the public.
Result of vote not yet published nor made public (as of 11/2/2013)

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Thanks, for spending this time..

Any questions?

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OK, then we're out of here….

THIS SLIDE AND ANY FURTHER ARE "PARKED" HERE OR PLACEHOLDER SLIDES ONLY…NOT PART OF THE PRECEDING PRESENTATION

GOOGLE GLASS, FUTHER MINITURIZATION, DECREASING COSTS OF OUR TECHNOLOGY, PERSONALIZATION, INTEGRATED TECHNOLOGY

CHALLENGES: LOSS OF TRADITIONAL SKILLS, SCOPE OF PRACTICE, COSTS?, CHOOSING OUR TECHNOLOGY

SMALLER VENTS,

Technology Evolution is NOT new

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- CONTEXT: This translational research initiative focused on the physiology of cardiopulmonary resuscitation (CPR) initiated by a clinical observation of consistent hyperventilation by professional rescuers in out-of-hospital cardiac arrest. This observation generated scientific hypotheses that could only ethically be tested in the animal laboratory.
  OBJECTIVE: To examine the hypothesis that excessive ventilation rates during performance of CPR by overzealous but well-trained rescue personnel causes a significant decrease in coronary perfusion pressure and an increased likelihood of death.
- DESIGN AND SETTING: In the in vivo human aspect of the study, we set out to objectively and electronically record rate and duration of ventilation during performance of CPR by trained professional rescue personnel in a prospective clinical trial in intubated, adult patients with out-of-hospital cardiac arrest. In the in vivo animal aspect of the study, to simulate the clinically observed hyperventilation, nine pigs in cardiac arrest were ventilated in a random order with 12, 20, or 30 breaths/min, and physiologic variables were assessed. Next, three groups of seven pigsin cardiac arrest were ventilated at 12 breaths/min with 100% oxygen, 30 breaths/rlin with 100% oxygen, or 30 breaths/mit with 5% CO2/95% oxygen, and survival was assessed.
- MAIN OUTCOME MEASURES: Ventilation rate and duration in humans; mean intratracheal pressure, coronary perfusion pressure, and survival rates in animals.
  RESULTS: In 13 consecutive adults (average age, 63 +/- 5.8 yrs) receiving CPR (seven men) the average ventilation rate was 30 +/- 3.2 breaths/min (range, 15 to 49 breaths/min) and the average duration of each breath was 1.0 +/- 0.07 sec. The average percentage of time in which a positive pressure was recorded in the lungs was 47.3 +/- 4.3%. No patient survived. In animals treated with 12, 20, and 30 breaths/min, the mean intratracheal pressures and coronary perfusion pressures were 7.1 +/- 0.7, 11.6 +/- 0.7, 17.5 +/- 1.0 mm Hg/min (p<.0001) and 23.4 +/- 1.0, 19.5 +/- 1.8, 16.9 +/- 1.8 mm Hg (p = .03) with each of the different ventilation rates, respectively (p = comparison of 12 breaths/min vs. 30 breaths/min for mean intratracheal pressure and coronary perfusion pressure). Survival rates were six of seven, one of seven, and one of seven with 12, 30, and 30 + CO2 breaths/min, respectively (p = .006).
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- Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, Wisconsin, USA.