Pre-Hospital Rapid Sequence Intubation
“What does research tell us?”

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Evidence Based Practice

The age of prehospital endotracheal intubation as we know it is rapidly coming to an end!
RSI and endotracheal intubation is the procedure that paramedics perform that carries the greatest potential for adverse outcome!

The History of Rapid sequence Intubation

- Originally described in anesthesia literature in 1970
- Presented as a 15 step process to prevent aspiration in surgical patients with a full stomach
- RSI in the ED (1982) paralleled the advent of emergency medicine and was related to the difficulty in controlling airways in intoxicated or combative patients

The History of Rapid Sequence Intubation

- Has now progressed to a technique for rapid control of the airway following traumatic injury or acute illness
- Also has the intention of blunting physiologic responses to laryngoscopy
- Different strategies but all include use of a sedating agent and neuromuscular blockade
Pre-hospital use of rapid sequence intubation

- May have been done as early as 1972 in Seattle, Washington
- First published report was of 95 RSI procedures performed by paramedics in Thurston County, Washington (1988)
- In 1997, 29 states—but not the whole state!—allowed prehospital use of RSI (current statistics probably higher)

The danger of “sedative only” thinking

- Since these theoretically do not totally remove airway reflexes, some clinicians favor this practice as safer than RSI
- A 2000 study (Wang et al.) with midazolam showed an intubation success rate of only 62.5%
- A 2006 study (Bozeman et al.) with etomidate assisted intubation demonstrated 83% required more etomidate of RSI while only 4% of RSI group required additional medication
- Delaware has extensive experience with etomidate and report an 85% success rate

The root of intubation misses in the pre-hospital setting

- Intuitively consider that intubating failures would only occur in “awake” or inadequately relaxed patients
- A 2003 study (Wang et al.) of 742 pre-hospital intubation failures in a multi-center trial 40% were in patients in cardiac arrest
- Over 2/3 of field intubations performed on patients in cardiac arrest
- Conclusions that can be drawn from this data
How often do we really need RSI?

- The NEED for pre-hospital use of RSI is deceivingly small
- In Wang’s study of the 741 field intubations 35 received RSI in the field and 12 in the ED this calculated to be about 5%
- A related study in Pittsburgh (170 paramedics) 350 intubations per year- 5%=18 RSI per year= one RSI per paramedic per decade

How often do we really need RSI? Extrapolation from the ED

- The vast majority of pre-hospital interventions have their basis on ED care and research
- The demographics of the ED and training are very different
- Most intubations are performed on awake/non-arrest patients
- Persons performing tasks are small in number with increased educational resources

Causes of Pre-hospital intubating failure

- Wang et al (2003) listed 5 factors independently associated with failure
- Clenched jaw/trismus
- Inability to pass the tube past cords
- Inability to visualize the cords
- Intact gag reflex
- Increased weight
Can RSI remedy any of these factors?

- Clenched jaw/trismus
- Inability to pass the tube past cords
- Inability to visualize the cords
- Intact gag reflex
- Increased weight

What about other field limitations?

- Obstruction (blood/vomitus)
- Space considerations
- Experience
- Difficult anatomy/traumatic injuries to face or airway

If RSI saves lives in the ED, shouldn’t the same be true in the field?

- We don’t know if RSI saves lives in the ED
- Limited outcome data
- Studies on success rates, effects of selected drugs, and adverse events
- Little data on impact of intubation and laryngoscopy
Laryngoscopy/Succinylcholine both increase intracranial pressure
- RSI theoretically blunts this response
- This has only been discussed theoretically
- We have never ascertained whether these rises in ICP are harmful
- Succinylcholine raises ICP/defasculating doses again without data to defend
- No data that links sux/raised ICP/adverse outcome

Lidocaine use in RSI
- Included in most protocols for RSI in head injured patient
- Extrapolated from limited OR data (Kindler et al and Splinter)
- There is no data to support the use of lidocaine in trauma patients
- No data that links ED intubation to outcome even though there is a swelling call to defend the same practice in the pre-hospital setting

The limitations of pre-hospital RSI research
- Nearly all retrospective
- Single site
- Limited sample sizes
- Many are done with flight programs and mobile ICU’s whose staff receive increased training
- Makes it very difficult to generalize
- But we do!
Limitations of pre-hospital RSI research

- No standard nomenclature
- "What is an attempt?"
- "What is a failure"
- "What drugs should be used"
- "Who will be included/excluded?"
- Definitions of an "adverse event"

The link between pre-hospital intervention and outcome

- This is the most important relationship in any intervention
- Only a handful attempt to connect pre-hospital RSI with the most important variable—survival
- Gausche et al (2000) prospective trial of pediatric ETI (non RSI) vs. BVM ventilation: no difference in mortality or neurologic outcome but significant delay in transport

Other pertinent research

- Dunford et al (2003) found that 57% of patient desaturate and become bradycardic during paramedic RSI while 81% of paramedics rated the intubations as "easy"
What does all this research tell us (so far)
• RSI is potentially useful in a small subset of patients
• The factors that lead to pre-hospital intubation failure are multi-factorial and RSI improves only some of them
• We have no idea whether the use of RSI in the ED or the field impacts morbidity or mortality

Does pre-hospital RSI come with a price too high to outweigh the benefits?
• Arriving with an ET tube in place may not be the most important factor
• How the intubation was obtained and adverse physiologic conditions imposed by the procedure may be more important
• Most research focuses on traumatic brain injury

Evidence in support of pre-hospital intubation/RSI for TBI
• Magnitude of evidence that proves apnea/hypoxia are devastating following head injury
• Loss of airway reflexes/potential for aspiration
• Chestnut (1993) showed mortality increased with prehospital hypoxia that increases 7 fold with concomitant hypotension
Evidence in support of pre-hospital intubation/RSI for TBI

- Much comes from the air medical field
- Garner et al (1999) demonstrated a decrease in mortality in head injured patients intubated by physician when compared to similar patients transported by paramedics
- Baxt and Moody demonstrated the same in crews with flight nurses and physicians when compared to paramedics
- These studies point out the challenges discussed previously

Evidence in support of pre-hospital intubation/RSI for TBI

- What about ground paramedics?
- Winchell and Hoyt (1997) showed a 21% mortality benefit in patients with a GCS of 3-8
- Problems with study include a low rate of intubation in patients with GCS of 3
- Suggestive of bias

Evidence against pre-hospital intubation/RSI for TBI

- Animal models show that hyperoxgenation may be damaging to the brain in early stages of TBI
- Eckstein (2000) compared 496 trauma patients in the field vs BVM and intubation in the ED and improved outcomes were seen in the BVM patients
The San Diego paramedic RSI trial

- Designed to assess the impact of succinylcholine assisted ETI in head injury
- Results challenge the role of RSI and ETI
- All head injured patients with GCS <8 entered
- First ETI attempt without RSI
- Subsequent attempts with midazolam and succinylcholine
- Combitube after 3 attempts

The San Diego paramedic RSI trial

- After first year ET success rate 84% (up from 61%)
- 14% of trauma patients with GCS <8 arrived without secure airway
- Despite improvements in success initial outcome data showed an adverse effects associated with RSI

The San Diego paramedic RSI trial

- Each intubated patient was matched to three non-intubated control patient from the county trauma register
- Matched for age, gender, MOI, ISS and AIS scores
- Also matched with invasive procedures, vital signs on arrival, and head injury diagnosis
The San Diego paramedic RSI trial-Results

- Mortality was significantly higher in the RSI cohort for all patients (33% vs. 24%)
- The trial was suspended and further analysis matched initial results
- Why these results? Methodological flaw?
- Inexperienced personnel? Adverse effect of ETI?

The San Diego paramedic RSI trial-Results

- Hyperventilation
- Manley et al (2000) reported hyperventilation (ETCO2 <30) in 79% of patients and severe hyperventilation (ETCO2 <25) in 59%
- The only group that did not have increased mortality was an RSI cohort with an air medical crew that used ETCO2 to guide ventilation

The San Diego paramedic RSI trial-Results

- Surprisingly only profound desaturation has been associated with increased mortality in the trauma patient
- Transport delays- these delays have been extensively linked to increased morbidity and mortality
- In the San Diego trial RSI added 15 minutes to scene time on average
The San Diego paramedic RSI trial-Results

- Aspiration
- This may happen often prior to paramedic intervention
- 25% of patients in trial were reported by paramedics to have blood/vomitus in airway
- The rate of aspiration was higher in all RSI groups leading to suspicion of this factors impact on mortality

The San Diego paramedic RSI trial-Inclusion criteria

- Used GCS to include patients
- 25% of these patients did not have significant head injuries
- The decision to intubate may have been grossly oversimplified
- Current decision algorithms are being developed that address physiologic, anatomic, and clinical parameters to define the need for RSI/ETI

The San Diego paramedic RSI trial-Training

- Paramedics were given a 7 hour mannequin based class with no OR time
- Follow up education was poorly defined
- Training and RSI/ETI success needs further study
The San Diego paramedic RSI trial—What we can take away

- Monitoring with pulse oximetry and end tidal capnography should be mandatory when performing RSI/ETI
- Pre-oxygenation and close oxygen monitoring should be routine
- Hyperventilation should be avoided at all costs
- Selection criteria and training need to be better defined

Paramedic training success

- Bellingham, Washington full time fire department paramedics
- Initial paramedic instruction includes 20 hours of classroom instruction including video instruction, medication competency testing, and mannequin simulation
- After classroom instruction the student must perform a minimum of 20 human ETI with anesthesiologist guidance

- After OR time three months as a full time third rider
- Once licensed must perform an ETI per month for 3 years (field or OR)
- All paramedics must complete an annual airway class and laboratory
Standards of the program

- Excellent patient and basic airway skills
- Excellence on progression from basic to advanced airway management
- Recognition on when to add medications and paralytics
- Comprehensive knowledge of all meds (actions, contraindications, side effects, indications)
- Comprehensive monitoring (pulse ox, ECG, continuous capnography)
- Use of rescue airway or cricothyrotomy when ETI cannot be achieved

Paramedic training success

- The 5 P’s
  - Preparation
  - Preoxygenation
  - Pretreatment (atropine/lidocaine)
  - Paralysis
  - Pass and confirm the tube

DELAYED SEQUENCE INDUCTION
Pre-oxygenation

- Delays hypoxemia
- “Buys time”
- Always required with RSI
- Especially important in anticipated difficult airways
- Sellick maneuver

Methods of pre-oxygenation

- 3 minute normal tidal volume breathing with 100% O2
- 4 deep breaths in 30 seconds
- 8 deep breaths in 60 seconds

Results

- After 2,978 patients 96.6% success in intubation within 3 attempts
- 48 cases of aspiration
- 1 unrecognized esophageal intubation
- No episodes of desaturation and bradycardia
- In children (11 months-15 years) 131 patients with a 97.6% success rate
What if we don’t do RSI

• Rapid Sequence Airway (RSA)
• Recently reported by case study (Braude and Richards 2007)
• Sedation and paralysis followed by rescue airway placement (LMA) \textit{without} prior intubation attempt

Complications of traditional RSI which RSA may improve

• Transport delay
• Hypoxia
• Undetected esophageal placement
• Airway trauma
• Bradycardia
• Personnel considerations

Complications of traditional RSI that may not be remedied with RSA

• Aspiration
• Increased ICP
• Medication side effects
• Not applicable in all situations (burns/severe upper airway hemorrhage)
The new generation of rescue airways (LMA/King/Combitube)

- Recent research demonstrates these devices may provide better airway protection than commonly accepted
- Deliver adequate airway pressures when appropriately sized
- Some allow for blind intubation or fibreoptic approaches in the ED

Video laryngoscopy

Summary

- Training makes a marked difference in intubation success and decreasing complications
- Better selection criteria are needed
- Monitoring equipment is MANDATORY for safe practice
- The role of rescue airways/video laryngoscopy will expand and potentially replace most pre-hospital airway interventions