Airway management in trauma

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Airway management in trauma

• Look at the issues
• Focus on intubation by paramedics in the setting of traumatic brain injury
  – Intubation controversial
  – Some evidence suggesting that intubation either makes no difference or makes the patient worse
  – An area where feelings are strong and emotions can run high
  – An area with some territorial conflict
Lots of sheep
We love eating our sheep (lamb)
We love to drink when we eat
We tend to crash a lot...
A largely rural country
Rural roads
We tend to crash a lot…
Imagine a high speed crash...
Imagine a high speed crash...
Imagine a trauma patient...

- Road crash, occupant
- Trapped, 30 min from hospital by road
- Poor airway with trismus, poor breathing, Sats 92% on high flow oxygen
- How should we manage this patient’s airway?
A range of airway options

- Oropharyngeal airway, nasopharyngeal airway, laryngeal mask airway
- Intubation without drugs
- Intubation with sedation alone
- Intubation with RSI by paramedic
- Intubation with RSI by doctor
- Cricothyroidotomy
- What is the evidence for intubation?
The evidence

- Pubmed search using terms pre-hospital and intubation, limited to last ten years
- 231 papers
The evidence

- Of these 231 papers only 79 looked at intubation by paramedics
- Of these 79 papers only 14 looked at outcomes
- Of these 14
  - Only one paper was randomised
  - Only two papers were prospective
  - 9 showed raised mortality in the intubated group vs non-intubated
  - 3 showed no difference in mortality
  - 1 showed lowered mortality in the intubated group vs non-intubated
### The evidence

#### Table. Studies evaluating survival or neurologic outcome after out-of-hospital endotracheal intubation.*

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Primary Population</th>
<th>Primary Comparison (Group Sizes)</th>
<th>Primary Finding</th>
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</thead>
<tbody>
<tr>
<td>Bochicchio et al, 2003³⁹</td>
<td>Prospective observational; single trauma center (Baltimore); univariable/stratified</td>
<td>Severe TBI; ETI in field or ED</td>
<td>OOH-ETI (78) vs ED-ETI (113)</td>
<td>Higher mortality (OR 2.1; 95% CI 0.9–5.0)* in OOH-ETI group</td>
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<tr>
<td>Buiger et al, 2005³⁹</td>
<td>Retrospective; single trauma center (Seattle); multivariable adjusted</td>
<td>Severe TBI; RSI or ETI in field</td>
<td>OOH-RSI (775) vs OOH-ETI (302)</td>
<td>Higher mortality (OR 1.6; 95% CI 1.0–2.4) and poorer neurologic outcome (1.7; 1.2–2.6) in OOH-ETI group</td>
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<tr>
<td>Christensen and Hoyer, 2003³³</td>
<td>Retrospective; single mobile emergency unit with anesthetist (Denmark)</td>
<td>All trauma; ETI in field with and without drugs</td>
<td>OOH-ETI with (62) vs without (12) drugs</td>
<td>Higher mortality (OR 15.2; 95% CI 1.9–673.2)* for OOH-ETI without drugs</td>
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<tr>
<td>Cooper et al, 2001³¹</td>
<td>Retrospective; National Pediatric Trauma Registry; univariable</td>
<td>Severe pediatric TBI</td>
<td>OOH-ETI (479) vs OOH-BVM (99)</td>
<td>No difference in mortality (OR 1.0; 95% CI 0.6–1.6)*</td>
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<tr>
<td>Davis et al, 2003²⁰</td>
<td>Prospective interventional series, historical controls; countywide (San Diego); multivariable adjusted</td>
<td>Severe TBI; RSI in field vs non-ETI historical controls</td>
<td>OOH-RSI (209) vs non-OOH-ETI (627)</td>
<td>Higher mortality (OR 1.6; 95% CI 1.1–2.2) and poorer neurologic outcome (1.6; 1.2–2.3) in OOH-RSI group</td>
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<tr>
<td>Davis et al, 2005²¹</td>
<td>Retrospective; countywide trauma registry (San Diego) multivariable adjusted</td>
<td>Severe TBI; ETI in field or ED</td>
<td>OOH-ETI (2,665) vs ED-ETI (2,220)</td>
<td>Higher mortality (OR 2.1; 95% CI 1.8–2.5)* in OOH-ETI group</td>
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<tr>
<td>DiRusso et al, 2005³²</td>
<td>Retrospective; National Pediatric Trauma Registry; multivariable adjusted</td>
<td>All pediatric trauma</td>
<td>OOH-ETI (1,928) vs non-trauma center ETI (1,647), trauma center ETI (1,874) and non-ETI (44,739)</td>
<td>Higher mortality for OOH-ETI vs non-trauma center ETI (OR 3.2; 95% CI 2.7–3.7)<em>; vs trauma center ETI (4.1; 3.5–4.8)</em>; vs non-ETI (142.0; 119.6–168.5)* Poorer neurologic outcome for OOH-ETI vs non-trauma center or trauma center ETI</td>
</tr>
</tbody>
</table>
The evidence

<table>
<thead>
<tr>
<th>Study</th>
<th>Design and Setting</th>
<th>Population</th>
<th>Comparator</th>
<th>Outcome Measures</th>
<th>Results</th>
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<tbody>
<tr>
<td>Gausche et al., 2000</td>
<td>Prospective controlled (pseudorandomized) intervention trial; countywide (LA)</td>
<td>Pediatrics; ETI or BVM in field</td>
<td>OOH-ETI/BVM (420) vs OOH-BVM (410)</td>
<td>No difference in mortality (OR 0.8; 95% CI 0.6–1.1) or neurologic outcome (0.9; 0.6–1.2)</td>
<td>Low (0.2%) survival</td>
</tr>
<tr>
<td>Lockey et al., 2001</td>
<td>Retrospective; single air medical service (Great Britain); descriptive</td>
<td>All trauma; ETI in field without drugs</td>
<td>Mortality of OOH-ETI without drugs (486)</td>
<td>Higher mortality (OR 4.2; 95% CI 2.1–8.9) in OOH-ETI group</td>
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<tr>
<td>Murray et al., 2000</td>
<td>Retrospective; countywide trauma registry (Los Angeles); multivariable matched/adjusted</td>
<td>Severe TBI</td>
<td>OOH-ETI (57) vs non-OOH-ETI (57)</td>
<td>No difference in mortality (OR 0.6; 95% CI 0.1–2.6) or neurologic outcome (1.1; 0.3–3.8)</td>
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<td>Sloane et al., 2000</td>
<td>Retrospective; single trauma center (San Diego); univariable</td>
<td>Severe TBI; RSI in field or ED</td>
<td>OOH-RSI (47) vs ED-RSI (267)</td>
<td>Higher mortality (OR 18.0; 95% CI 11.2–29.1) in OOH-ETI group</td>
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<tr>
<td>Stockinger et al., 2004</td>
<td>Retrospective; single trauma center (New Orleans); univariable/stratified</td>
<td>All trauma; ETI or BVM in field</td>
<td>OOH-ETI (316) vs OOH-BVM (217)</td>
<td>Lower mortality for OOH-ETI vs non–trauma center ETI (OR 0.1; 95% CI 0.002–1.1); no difference vs trauma center ETI (3.7; 0.9–15.8)</td>
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</tr>
<tr>
<td>Suominen et al., 2000</td>
<td>Retrospective; single trauma center (Finland); univariable</td>
<td>Severe pediatric TBI</td>
<td>OOH-ETI (24) vs non–trauma center ETI (13) vs trauma center ETI (22)</td>
<td>Higher mortality (OR 4.0, 95% CI 3.2–4.9), poorer neurologic outcome (1.6; 1.2–2.3), and poorer functional outcome (severe impairment 1.9; 1.3–2.5) in OOH-ETI group</td>
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<tr>
<td>Wang et al., 2004</td>
<td>Retrospective; statewide trauma registry (Pennsylvania); multivariable and propensity-score adjusted</td>
<td>Severe TBI; ETI in field or ED</td>
<td>OOH-ETI (1,797) vs ED-ETI (2,301)</td>
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</table>
Why do we intubate trauma patients pre-hospital?

• Observational studies showed increased mortality and morbidity when patients with traumatic brain injury (TBI) were exposed to secondary injury
  – Hypotension, hypoxia and hypercarbia

• Intubation promulgated as a good thing
  – Control and protect the airway
  – Control the breathing
  – Allow 100% oxygen to be given
  – Allow hypercarbia to be prevented
Paramedics took this on board

- Paramedics tried hard to intubate patients, but..
- Most patients with TBI have intact airway reflexes and these commonly prevent successful intubation
  - Successful intubation rates in this setting are relatively low (5-30%)
- Most trauma databases demonstrated high mortality rates (90-98%) in patients with TBI able to be intubated
  - The ability to intubate was a marker of mortality
Paramedics were damned…

• We thought intubation was a good thing but …
  – Those able to be intubated without additional medicines had an inherently high mortality rate that was unchanged by intubation
  – Successful intubation rates in the absence of medicines were very low
  – Some services reported increased success rates with the use of sedation to blunt airway reflexes

• Perhaps the answer was to sedate the patient…
Is sedation the answer?

- Sedation might allow airway reflexes to be overcome and thus allow patients to be intubated
- Most Australian and New Zealand services allowed this in the past
  - There was still a low success rate (50-60%) despite repeated doses
  - There was a high incidence of hypotension (50%)
- Controversial
  - Supporters claiming it was better than doing nothing
  - Opponents claiming it was more likely to produce secondary injury that to prevent it
Almost disappeared in Australasia

- The practice largely disappeared in Australia and New Zealand several years ago
  - Multiple trauma data-bases showed an increase in mortality in patients with TBI given sedation
  - Mortality even higher if sedated and intubation attempt was unsuccessful
- Clear message: intubation done badly is worse than basic airway care done well
- Perhaps rapid sequence intubation (RSI) was the answer…

Oh, he survived the crash, it was the intubation that killed him
Perhaps RSI was the answer…

- Perhaps the answer was to take complete control
- Some services introduced RSI in paramedic hands
- Usually some form of sedative combined with a rapid acting neuro-muscular blocker
  - Commonly midazolam and suxamethonium
- Controversial
  - Supporters claiming it was better than doing nothing at all
  - Opponents claiming it was too dangerous in paramedic hands and that the risks were too high
RSI in paramedic hands

- Those services that introduced RSI did so because
  - Trauma bypass policies were increasing the time to definitive airway care in some patients
  - RSI is the expected standard when the patient is in-hospital
  - Nothing about RSI that demarcates it as a medical only intervention
  - Given ideal intubating conditions intubation success rates were >95% in experienced paramedic hands
  - Potential risks were outweighed by the potential benefits
RSI – our experience

• We decided to introduce RSI as a feasibility trial
  – Selected top tier advanced paramedics (level 5)
  – Typically in a rapid response role (car or helicopter)

• Small group tuition and training

• One on one de-briefing of all RSIs and potential RSIs
  – They have to email and phone me afterward

• Criteria
  – GCS less than ten
  – Compromised airway
  – More than fifteen minutes from hospital
  – Note – not just patients with traumatic brain injury

• We use midazolam, suxamethonium and vecuronium
RSI – our procedure

- RSI procedure
  - Pre-oxygenate
  - Monitoring – pulseoximetry, capnography, ECG, NIBP
  - Front of collar undone, in line stabilisation
  - Midazolam (0-5 mg) and suxamethonium
  - Note – we do not use cricoid pressure but we do liberally use anterior tracheal pressure (modified BURP)
  - Confirm ETT placement with capnography
  - Ventilate to end tidal CO2 of 35 mmHg
  - Vecuronium to keep the patient still
  - Morphine and midazolam titrated to maintain sedation if required
  - Failed intubation drill if unable to intubate
Our failed Intubation Drill

Unable to intubate after fifteen seconds of laryngoscopy

OPA, bag, mask, O₂, ensure adequate oxygenation (but not hyperventilation)

One retry +/- bougie, ensure good positioning, use anterior tracheal pressure

Immediate check of ETT placement using end tidal CO₂

ETT not in trachea, remove ETT and insert LMA

Unable to ventilate and oxygenate

Able to ventilate and oxygenate

ETT in trachea, give long acting NMB, continue with management

Let sux wear off, continue with management

Cricothyroidotomy
RSI – our experience

• We have performed just over 350 RSIs
  – 75% trauma
  – 96% success rate, all failed intubations managed with LMA

• We have learnt some things
  – It adds 15 minutes scene time
  – Decision making skills more important than intubation skills
  – One on one debrief is important (including potential RSIs)
  – It is very easy to hyperventilate patients (even with capnography)
  – Suxamethonium lasts a long time out of the fridge

• Things I remain uncertain of
  – How many they need to do per year to maintain competency
  – How to get balance right between maximising numbers of trained officers and maximising individual exposure
  – Whether or not it actually helps the patient
But does it help the patient?

- Results of trials looking at interventions to reduce secondary injury have been disappointing so far
  - Intubation
  - Hypertonic saline fluid resuscitation
- Many other interventions that we thought were beneficial that have turned out to be harmful when an appropriately powered trial was done
- A study published in 2003 caused supporters of RSI in paramedic hands to take a deep breath…
  - The San Diego RSI trial
The San Diego RSI trial

The effect of paramecanic rapid sequence intubation on outcome in patients with severe traumatic brain injury.

Davis DP, Hoyt DB, Orme M, Fortlage D, Holbrook T, Marshall LK, Rosen P

Department of Emergency Medicine, UC San Diego, CA 92036-8076, USA.

OBJECTIVE: To evaluate the effect of paramedic rapid sequence intubation (RSI) on outcome in patients with severe traumatic brain injury. METHODS: Adult major trauma victims were prospectively enrolled over two years using the following inclusion criteria: Glasgow Coma Scale (GCS) 3-8, suspected head injury by mechanism or physical examination, transport time >10 min and inability to intubate without RSI. Midazolam and succinylcholine were administered before laryngoscopy; no succinylcholine was given after tube placement was confirmed using physical examination, capnometry, syringe aspiration, and pulse oximetry. The Combitube was used as a salvage airway device. For this analysis, trial patients were excluded for absence of a head injury (Head/Neck AIS score <2), failure to fulfill major trauma outcomes study criteria, unsuccessful intubation or Combitube insertion, or death in the field or in the resuscitation suite within 30 min of arrival. Each study patient was hand-matched to three nonadmitted historical controls from our trauma registry using the following parameters: age, sex, mechanism of injury, trauma center, and AIS score for each body system. Controls were excluded for Head/Neck AIS defined by a >2.5 cm injury or death in the field or in the resuscitation suite within 30 min of arrival. Chi-square, odds ratios, and logistic regression were used to investigate the impact of RSI on the primary outcome measures of mortality and incidence of a "good outcome," defined as discharge to home, rehabilitation, psychiatric facility, rural, or signing out against medical advice. RESULTS: A total of 29 trial patients were hand-matched to 67 controls. The groups were similar with regard to all matching parameters, admission vital signs, frequency of specific head injury diagnoses, and incidence of invasive procedures. Mortality was significantly decreased in the trial cohort versus controls for all patients (33.0% versus 24.2%, p < 0.05) and in those with Head/Neck AIS scores of 2 or greater (41.1% versus 35.3%, p < 0.05). The incidence of a "good outcome" was lower in the trial cohort versus controls (45.5% versus 37.9%, p < 0.01). Factors that may have contributed to the increase in mortality include transient hypotension, increased hyperventilation, and longer scene times associated with the RSI procedure. CONCLUSION: Paramedic RSI protocols to facilitate intubation of head-injured patients were associated with an increase in mortality and decrease in good outcomes versus matched historical controls.

PMID: 12634521 [PubMed - indexed for MEDLINE]
The San Diego RSI trial

- J Trauma. 2003 Mar:54(3):444-453
- A comparison of outcome before and after RSI introduced
- 2 years before and after RSI introduced
  - 209 patients intubated with RSI
  - Very similar indications and procedure to our own
  - Compared with 627 matched patients who had not been intubated prior to introduction of RSI
- Findings
  - Mortality rose: 41.1% vs 30.3% (p<0.05)
  - Good outcomes fell: 45.5% vs 57.9% (p<0.01)
- Publication resulted in heated discussion
  - Opponents of RSI in paramedic hands calling for it to be withdrawn
The San Diego RSI trial

• The reasons for the rise in mortality and morbidity were unclear
  – There was a lot of desaturation during laryngoscopy
  – They were not using wave form capnography and there was a lot of hyperventilation post intubation (very bad for the injured brain)
  – There was a large number of paramedics performing a small number of RSIs and individual exposure was very low
  – There was a high failed intubation rate (around 15%)

• Take home message: RSI done badly is worse than basic airway done well
RSI done badly is worse than basic airway care done well

• We looked at all of the issues
  – Our own circumstances were quite different from San Diego
  – We chose not to withdraw RSI
  – We might be doing harm though
  – Clearly time for a randomised trial
In conclusion

• Despite our pre-conceived ideas, existing evidence does not support pre-hospital intubation by paramedics for patients with TBI
• Intubation using sedative drugs (alone) to overcome airway reflexes is dangerous and should be banned
• The limited evidence does not support RSI pre-hospital in paramedic hands
  – The level of evidence is poor
• I think it is possible that RSI in paramedic hands is safe and feasible in selected, tightly controlled circumstances
  – Clearly time for a randomised trial
Thank you

Wizard of ID by Parker and Hart

How went the speech, sire?

...I got five rounds of applause and a standing ovation.

When did you get the standing ovation?

...when I said... "and in conclusion"