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Emergency intubation for the non-anesthetist rural physician

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The ability to manage the airway of a critically ill or injured patient appropriately is an invaluable skill for physicians working in rural emergency departments. When less invasive procedures fail,

the patient must be intubated tracheally to prevent further morbidity and death. In rural settings the physician often cannot rely on back-up and must be prepared to intubate.

Emergency intubation with neuromuscular blockade is safe and is the optimal way to capture the airway in critically compromised patients when performed in the emergency department.1,2 The advantages and methods of emergency intubation have been well documented.1-10

This article describes an approach to emergency intubation that we think is suitable for appropriately trained and experienced non-anesthetist rural physicians. The protocol is based on our experience and on accepted principles of emergency airway management.2-4,6,7,11 Our article is meant to supplement appropriate training, experience and continuing education. The protocol we suggest will work most of the time and can be used as a quick reference when a rural physician occasionally has to intubate a patient. Physicians with additional training may use other drugs and procedures. Rural physicians should review the pharmacology of medications for emergency intubation regularly and rehearse both bag-valve-mask (BVM) ventilation and the manual skills.

This protocol is however not a "recipe" and should only be used by physicians who are thoroughly comfortable and familiar with the drugs employed and with the full spectrum of ventilation options available. It should be borne clearly in mind that this protocol includes patient paralysis, so the physician should be confident of her or his ability to deal with any drug-related complications and his or her ability to continue to safely ventilate the patient, should the intubation attempt fail.

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Indications

Emergency intubation should be used when securing the airway of a critically ill or injured patient and is required in a rural setting for the following reasons:

- there is an existing or high risk of respiratory failure
- the patient is unable to protect his or her own airway
- there is a need for controlled hyperventilation
- there is a need to stabilize a high-risk patient before interfacility transport.

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Contraindications

Absolute
Emergency intubation should not be used when examination reveals that it will be anatomically difficult to use a BVM to ventilate the patient.

Relative
Emergency intubation should not be used if less invasive measures appear to be adequate. Owing to the relative difficulty of performing emergency intubation in a transport vehicle, judicious use of emergency intubation in the rural hospital before transfer is appropriate when less invasive measures are marginally successful or the patient is at high risk of requiring emergency intubation during transport.

Following is a pictorial overview of the procedure in a trauma patient

Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 7

Fig. 8 Fig. 9 Fig. 10 Fig. 11 Fig. 12 Fig. 13 Fig. 14

Further detail is provided later in the text.

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Details of the procedure in a trauma patient

1. Airway: To every critically ill patient always apply the A,B,Cs: Airway, Breathing, Circulation.
2. Cervical spine: Always assume cervical spine fracture in trauma.
3. Intravenous access: Establish access with 1 large-bore cannula (14 to 18 gauge).
4. Monitors: Attach the blood pressure cuff, cardiac monitor and oxygen saturation monitor.
5. Assess the patient: ensure that facial injuries and anatomy will allow you to ventilate the patient with a BVM. Remove false teeth, check the patient's history and anatomy for risk of failed intubation (previous difficult intubation, previous airway surgery or trauma, limited jaw excursion, a short fat neck, prominent upper incisors, receding chin, cervical spine abnormalities and obesity).12 A gentle look with a laryngoscope before induction can reassure you that the airway is obtainable. A good view of the posterior pharynx means that intubation is likely to succeed. A patient passes the "3-3-2" test if the mandible opens to allow 3 fingers between teeth, if the distance between the hyoid bone and mentum is 3 fingers wide, and if the distance between the hyoid bone and the chin-neck junction is 2 fingers wide. The risk of failed intubation, even in a patient with an apparently difficult airway, is low, so the probability that a rural physician in rural practice will encounter an airway that is impossible to intubate is very low.

6. Review your plan for subsequent steps and consider alternatives in the event of failed intubation. Alternatives include simply bagging if oxygenation can be maintained, insertion of a laryngeal mask or surgical cricothyrotomy.
7. Preoxygenate: Give oxygen (15 L/min) by mask or BVM, using an oropharyngeal airway as required if the patient cannot maintain an open airway spontaneously. Spontaneous ventilation is preferred to minimize the regurgitation and gastric dis- tension that can be caused by BVM ventilation.
8. Prepare tools and assistants:
    - ET (7.0 to 7.5 for adult women, 8.0 to 8.5 for adult men, uncuffed tubes for children aged 10 years and under where size = age/4 + 4) with stylet. Always use a stylet and put a little hockey stick bend in the end of the tube.
    - 10 mL syringe for the cuff. If a cuff is present check that it inflates and stays inflated with a 10 mL syringe.
    - Lubricating gel.
    - Yankhauer suction.
    - ET suction.
    - Laryngoscope battery, blade and light bulb. The choice of a straight versus curved laryngoscope blade in adults and older children is discretionary.
    - Carbon dioxide detector.
    - Oxygen.
    - All drugs that you will use.
    - Check pediatric tube sizes and drug doses with a Broselow tape.
    - Prepare assistants: one to apply cricoid pressure (Sellick manoeuvre) to minimize regurgitation and aspiration as the patient becomes sedated and paralysed; another assistant will be needed, in the case of trauma, to stabilize the head. Always assume the patient has a full stomach.
9. Lidocaine: 100 mg intravenous push in adults or 1.5 mg/kg intravenous push in children if the patient has a head injury. Lidocaine is thought to blunt intracranial and intraocular pressure spiking during succinylcholine paralysis and intubation by suppressing laryngeal neurogenic reflexes.
10. Fentanyl (Sublimaze; Janssen-Ortho Inc., North York, Ont.): 50 to 100 µg intravenous push in adults and 2 to 3 µg/kg intravenous push in children for analgesia. Use the higher end of the dose range if the patient has good blood pressure and is awake when you start, lower if they are smaller or compromised. This is not needed if the patient is already moribund. Administer over 30 to 60 seconds rather than by intravenous push if the situation permits and if given with a benzodiazepine to avoid respiratory depression and hypotension.
11. Midazolam (Versed; Hoffmann-La Roche Ltd., Mississauga, Ont.) 2 to 5 mg intravenous push in adults and 0.1 to 0.2 mg/kg intravenous push in children for anxiolysis and amnesia. Use the higher end of the dose range if the patient has good blood pressure and is awake when you start, lower if they are smaller or compromised. This is not needed if the patient is already moribund. Administer over 30 to 60 seconds rather than by intravenous push if the situation permits and if given with an opiate to avoid respiratory depression and

hypotension.

12. Atropine for children under 5 years of age: 0.02 mg/kg intravenous push, minimum 0.1 mg, maximum 1.0 mg, to prevent vagal bradycardia and asystole from succinylcholine and tube stimulation.
13. Succinylcholine (Anectine; Glaxo Wellcome Inc., Mississauga, Ont.): 120 mg intravenous push for a large adult, 100 mg intravenous push for a 70-kg adult, 80 mg for a small adult (1.5 mg/kg) or 2.0 mg/kg intravenous push in children for full paralysis. The patient should be paralysed in 1 to 2 minutes and remain paralysed for up to 5 minutes. Paralysis will last longer at a higher dose.
14. Oxygenation/ventilation: Preoxygenate. A well-oxygenated, paralysed patient can sustain oxygenation for 3 to 5 minutes without ventilation, although the goal should be to complete intubation within 2 minutes. Do not bag the patient during succinylcholine paralysis, to avoid inflating the stomach and causing regurgitation or aspiration. An exception would be in a patient with decreasing oxygen saturation who cannot be intubated. That patient should be bagged until the succinylcholine wears off, but watch for regurgitation to prevent aspiration. Maintain cricoid pressure while the patient is paralysed to minimize the risk of aspiration.
15. Align airway: In trauma you can't bend the neck to line up the airway but you can insert the laryngoscope gently to help. You will need the anterior hockey stick bend in the end of the ET if the entrance to the trachea is not clearly visible. In non-trauma, flex the neck at C7 and extend the head at C1 to line up the airway before intubation. Put a small towel under the occiput in adults, except when cervical spine injury is a possibility.
16. Intubate when fasciculations cease. Intubate through the cords with the ET to 22 to 24 cm at the gums in adults, or (age + 10 cm) in children. Try to watch the tube pass between the cords.
17. Check tube placement: Watching the ET pass through the cords is optimal. Ask the assistant doing cricoid pressure if s/he can feel the tube pass into the trachea. Look for evidence of exhaled carbon dioxide with a detector device that attaches to the tube. Look for moist air in the tube on exhalation. Look for equal chest expansion at the apices and auscultate the apices, lateral chest and stomach with a stethoscope. Maintain cricoid pressure until tube placement is confirmed as correct, the cuff is inflated and the tube is secured. If oxygen saturation falls or there is doubt about tube placement immediately remove the tube, ventilate with a BVM and start over.
18. Check tube depth: If air entry is decreased in the left lung then consider intubating the right main-stem bronchus. Deflate the cuff and pull the tube back slightly then auscultate again.
19. Ventilate initially at the rates shown in Table 1, then adjust based on blood gas results.
20. Maintain paralysis: Give pancuronium (Pavulon; Abbott Laboratories Ltd., St. Laurent, Que.) 8 mg intravenously (0.1 mg/kg intravenously in children).
21. Secure the tube. Check tube measurement at the teeth edge before and after securing the tube to ensure that the depth of insertion is maintained. Add a bite block if the patient is likely to bite the tube.
22. Ventilate: Adjust bagging to the bedside blood-gas-analyser results, if available. Ideally, ventilate the patient with a simple transport ventilator to ensure an even ventilation rate

and minute volume or just bag once every 5 seconds (count "thousands") in adults.

23. X-ray: Obtain a portable chest x-ray to confirm tube position.
24. The patient is now under full and optimal control physiologically. Treat hypotension with intravenous fluids. Put down a nasogastric tube. Put in chest tubes if pneumothorax is suspected. Insert a Foley catheter if the urethra appears to be intact and the rectal examination is normal. Titrate more fentanyl 50 µg intravenously in adults (1 to 2 µg/kg in children) and midazolam 1 to 2 mg intravenously every 10 to 15 minutes to ensure that the patient is comfortable while paralysed. Tachycardia in a paralysed patient can signify hypotension, psychological distress or pain.

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Managing complications

Failed intubation

Failed intubation is rare in the hands of trained and experienced emergency physicians.1,5 Ventilate the patient using a BVM and an oropharyngeal airway until the patient begins breathing spontaneously. Maintain cricoid pressure as long as the patient is paralysed. Rural physicians who can practise periodically with a laryngeal mask in a nearby operating room with an anesthetist might want to learn how to use this device. Always be prepared to obtain an airway surgically by cricothyrotomy; however, this is unlikely to be necessary because emergency intubation is so effective.

Difficult ventilation after intubation and paralysis

Consider tube or airway obstruction with secretions or blood, displacement of the tube, pneumothorax, bronchospasm, agitation due to sedatives wearing off, or muscular tension due to pancuronium wearing off. Suction and check the placement of the tube, then consider giving inhaled salbutamol (Ventolin; Glaxo Wellcome Inc., Mississauga, Ont.), additional doses of fentanyl or midazolam intravenously, or both, and small supplemental doses of pancuronium intravenously.

Arrhythmia

Treat arrhythmias with standard Advanced Cardiac Life Support measures.

Hypotension

Give boluses of 500 mL of normal saline as needed in an adult (20 mL/kg in children) to improve perfusion (bring systolic blood pressure over 100 mm Hg in adults).

Malignant hyperthermia

Malignant hyperthermia is a very rare complication of succinylcholine administration. The condition is a drug-induced increase in brain serotonin activity ("serotonin syndrome"). Early

recognition is crucial. Early signs include sudden tachycardia, tachypnea, unstable blood pressure, arrhythmia, cyanosis, profuse sweating, fever, and fasiculations or rigidity, or both. The treatment includes hyperventilation with 100% oxygen, administration of dantrolene sodium and emergent transfer. Call the malignant hyperthermia hotline at 1 800 644-9737 (1 800 MH-HYPER) and ask for "index zero" to obtain the name and phone number of an anesthesiologist on call for diagnosis and management advice.

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Notes

Fentanyl (Sublimaze)
Fentanyl is given for its analgesic and euphoric effect, because paralysis without analgesia and sedation causes unnecessary suffering, and to blunt the catecholamine surge caused by intubation. It is less likely to cause hypotension and has faster onset and shorter duration than morphine, but fentanyl-induced loss of sympathetic tone can cause hypotension in compromised patients. Treat hypotension with intravenous fluids. During a long transport expect to give about 50 µg in adults every 20 minutes to maintain adequate sedation and analgesia during paralysis. Give these additional doses depending on indications of distress, such as increased blood pressure and heart rate. Fentanyl can cause chest wall rigidity usually associated with rapid intravenous infusion, but this is rare. The rigidity can be relaxed with paralysing agents. Some physicians prefer morphine, which lasts longer but may have a more hypotensive effect in hemodynamically unstable patients.

Midazolam (Versed)
Midazolam is given for its anxiolytic and sedative effects and it complements fentanyl. It is shorter acting than diazepam (Valium; Hoffmann-La Roche Ltd., Mississauga, Ont.). Combined with fentanyl, midazolam can cause respiratory depression and hypotension, which can be avoided when time permits by infusing the drug over 30 to 60 seconds. It can lower blood pressure in compromised patients or if larger doses are used. The hypotension responds to intravenous fluid boluses. A large dose of 8 to 10 mg causes deep sedation in a healthy patient but is likely to cause cardiorespiratory compromise in an ill patient, 4 to 5 mg causes moderate sedation and 2 to 3 mg promotes light sedation. Some physicians prefer diazepam, whose effect lasts longer.

Succinylcholine (Anectine)
You cannot give too much succinylcholine — its paralytic effect simply persists longer. It is relatively contraindicated in massive muscle damage and massive burns due to potassium release, but this is not a problem until 24 to 48 hours or more after injury. It can increase intraocular pressure causing further eye damage in open eye wounds. It usually causes bradycardia in children, who should be pretreated with atropine. Succinylcholine can be repeated once at the same dose if the first is ineffective. This can be associated with longer paralysis and with

bradycardia. Give atropine before the second dose. Pseudocholinesterase deficiency is rare and will only cause prolonged paralysis. Reactions owing to myotonia congenita and malignant hyperthermia are very rare and highly unlikely to occur during a rural physician's career.

Pancuronium (Pavulon)
The full paralytic dose of 0.1 mg/kg in adults and children lasts an hour. Supplemental doses as required of 2 mg in adults (0.05 mg/kg every 30 to 60 minutes in children) improve relaxation during transport and significantly increase the duration of paralysis. During a long transport expect to have to give supplemental doses about every half hour. Pancuronium can cause mild tachycardia.

Pediatrics
Major differences in children include airway dimensions, smaller doses of drugs, smaller tubes and a tendency to vagal bradycardia.6 Use a Broselow tape to determine doses and equipment sizes. When crash-intubating a child without intravenous access, for example as a result of loss of consciousness from deep hypoxia caused by airway obstruction, give atropine 0.02 mg/kg intramuscularly to relieve bradycardia if it occurs. When an intravenous line cannot be started, succinylcholine and midazolam can be given intramuscularly and lidocaine can be given by pharyngeal spray.

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Refinements and alternatives

Our suggested protocol gets the job done safely and effectively in most cases. Individual physicians might prefer a variety of refinements and alternative instruments or medications.6,8

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