INTRODUCTION — Airway management is an essential skill for clinicians caring for critically ill or injured patients and is fundamental to the practice of emergency medicine. In emergency medicine practice, rapid sequence intubation (RSI) is the most frequently used and successful means of intubating the trachea [1-6]. It is employed in approximately 70 percent of all patients requiring intubation in academic emergency departments, and about 82 percent of those without cardiac arrest. Cardiac arrest patients, who are intubated without medications, comprise the bulk of the remaining patients.

Although RSI is generally the preferred approach in the emergency department (ED), it may be poorly suited for some patients with difficult airway attributes. Thus, a careful assessment for airway difficulty must precede the decision to use RSI [1,3].

This topic review will discuss an algorithmic approach to advanced emergency airway management in adults. Other issues related to airway management, including basic airway management, difficult airway assessment, and rapid sequence intubation, are discussed in detail elsewhere. (See "Basic airway management in adults" and "The difficult airway in adults" and "Rapid sequence intubation in adults".)

RSI AND THE DIFFICULT AIRWAY — Clinicians should employ an approach to emergency airway management that accounts for the possibility of difficult intubation, difficult bag-mask ventilation (BMV), difficult extraglottic device ventilation (EGV), and difficult cricothyroidotomy. Methods for evaluating airway difficulty and management of difficult and failed airways are discussed in detail elsewhere. (See "The difficult airway in adults" and "The failed airway in adults" and "Emergent surgical cricothyrotomy (cricothyroidotomy)".)

In general, rapid sequence intubation (RSI) is used in patients for whom successful intubation and successful bag-mask ventilation are anticipated, despite any difficult airway attributes that may be identified. A significant number of emergency department (ED) patients in need of endotracheal intubation (ETI) have anatomic characteristics that can increase the procedure's difficulty. Nevertheless, the great majority of such patients can be managed using RSI.

No discreet threshold exists at which RSI is deemed safe or when it is contraindicated. This
is due, in part, to the lack of sensitivity and specificity of commonly used guidelines for difficult airway prediction. The LEMON© mnemonic is one aid for remembering important predictors of intubation difficulty, and has been prospectively validated (table 1) [7]. (See "The difficult airway in adults".)

Difficult airway prediction guidelines are based primarily on the anesthesia experience, which often involves elective intubations of cooperative patients, and may not be applicable to the ED [8-12]. Furthermore, patients frequently present to the ED in extremis, and clinicians may be unable to obtain a history or to assess the airway adequately to determine whether a difficult intubation is likely [13]. Nevertheless, we suggest emergency clinicians assess any airway they may need to manage, to the extent possible given the constraints of time and patient cooperation, in order to be prepared for a potentially difficult airway.

Few studies have assessed difficult intubation in the ED and its true incidence is unknown. The difficult airway is likely more common among patients intubated in the ED than in the operating room, where patients are generally evaluated preoperatively and airway management can be done electively.

Part of the problem in determining the incidence of airway difficulty stems from the various ways of defining what constitutes a "difficult airway" or "difficult intubation." Depending on the definition, estimates of the rate of difficult intubation in the ED range as high as 30 percent [14]. Fortunately, intubation failure rates are much lower; cricothyroidotomy is performed in approximately 1 percent of ED patients at major trauma centers [3,15,16]. (See "The difficult airway in adults".)

THE MAIN AIRWAY ALGORITHM© — The algorithms presented in this review were developed as part of a national airway training course and represent an initial approach to advanced emergency airway management (algorithm 1 and algorithm 2) [17]. Once the need for intubation is decided, the clinician must determine the best approach. The following questions represent the major branch points in the main airway algorithm© and reflect the important principles underlying advanced airway management:

- Is the patient in arrest or an agonal state? If so, direct intubation without medications is appropriate (algorithm 2). (See 'The crash airway algorithm©' below.)

- Is the patient likely to respond to direct laryngoscopy (ie, gag, thrash, vomit)? If not, then the patient is unlikely to benefit from the time required to administer sedative and paralytic medications. Direct laryngoscopy, without medications, is indicated (algorithm 2). (See 'The crash airway algorithm©' below.)

  One exception to this recommendation is the patient who is unresponsive because of a critical intracranial insult (eg, intracranial hemorrhage). In such patients RSI provides superior control of adverse reflexes that may increase intracranial pressure. (See "Sedation or induction agents for rapid sequence intubation in adults", section on 'Head injury or stroke'.)

- If the patient is not in arrest or an agonal state, is a difficult airway predicted? The goal is to identify characteristics likely to result in significantly difficult intubation or ventilation. In such cases, it is prudent to choose an intubation technique that allows the patient to maintain spontaneous respirations (algorithm 3). (See "The difficult
As long as oxygenation is adequate and no significant difficulty with intubation or ventilation is anticipated, rapid sequence intubation using direct laryngoscopy is advised. (See "Rapid sequence intubation in adults".)

- If intubation was attempted but unsuccessful, is oxygenation adequate (ie, pulse oximetry above 90 percent)? If not, and if oxygenation does not immediately improve with better bag-mask ventilation, then a failed airway exists (algorithm 4). In most circumstances, a patient who is unable to be intubated and cannot be ventilated will require a surgical airway (ie, cricothyroidotomy). (See "The failed airway in adults".)

- If intubation is unsuccessful despite 3 attempts by an experienced operator, regardless of the ability to oxygenate, this too constitutes a failed airway. (See "The failed airway in adults".)

**THE CRASH AIRWAY ALGORITHM** — The crash approach is predicated on the need for immediate airway control in the unresponsive patient unlikely to benefit from medications. The "crash" patient is unconscious, unresponsive, and has absent or severely compromised cardiopulmonary function. The assumption is that the patient is relaxed and unresponsive, similar to the conditions achieved with rapid sequence intubation (RSI). The following questions represent the major branch points in the crash airway algorithm and reflect the important principles underlying crash airway management (algorithm 2) [17]:

- If intubation is attempted but unsuccessful, can oxygenation be maintained adequately with a bag and mask? This often cannot be determined by pulse oximetry, because the patient may not have a pulse oximetry waveform. Instead, the provider must rely on assessment of chest rise, mask seal, and bag compliance to determine the adequacy of bag-mask ventilation.

  If attempts at oxygenation are ineffective then a failed airway exists. (See "The failed airway in adults").

  If oxygenation is judged effective after the failed intubation attempt, then a single dose of a muscular relaxing agent is administered before subsequent intubation attempts. In the absence of contraindications, high dose succinylcholine (2 mg/kg) is useful to overcome residual muscular rigidity. The higher dose is recommended to increase the speed of onset in patients with severe circulatory compromise. If succinylcholine is felt to be contraindicated, rocuronium at a dose of 1 mg/kg can be used.

- If intubation is unsuccessful despite 3 attempts by an experienced operator then a failed airway exists. (See "The failed airway in adults").

**SUMMARY AND RECOMMENDATIONS**

- We recommend rapid sequence intubation (RSI) for emergency intubations when significant intubation difficulty is not anticipated and a crash airway scenario does not exist. The main airway algorithm provides an overall approach to emergency airway management (algorithm 1). The algorithm is discussed above. (See 'The main airway..."
The crash airway algorithm provides an approach to airway management in patients who are unconscious, unresponsive, and have absent or severely compromised cardiopulmonary function (algorithm 2). The algorithm is discussed above. (See 'The crash airway algorithm' above.)

We recommend that clinicians employ an approach to emergency airway management that accounts for the possibility of difficult intubation, difficult bag-mask ventilation, difficult extra-glottic device ventilation, and difficult cricothyroidotomy. Methods for evaluating airway difficulty and management of difficult and failed airways are discussed in detail elsewhere. (See "The difficult airway in adults" and "The failed airway in adults".)

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REFERENCES

13. Levitan RM, Everett WW, Ochroch EA. Limitations of difficult airway prediction in...


**GRAPHICS**

**The LEMON© mnemonic for predicting the difficult emergency airway**

- Look externally
- Evaluate 3-3-2
- Mallampati
- Obstruction/Obesity
- Neck mobility

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**Main emergency airway management algorithm©**

- Needs intubation
  - Unresponsive? Near death?
    - Yes: See crash airway algorithm
    - No: Predict difficult airway?
      - Yes: See difficult airway algorithm
      - No: RSI
        - From difficult airway algorithm: Attempt intubation
          - Successful?
            - Yes: Post-intubation management
            - No: Failure to maintain oxygenation?
              - Yes: See failed airway algorithm
              - No: ≥3 attempts at OTI by experienced operator?
                - Yes: See failed airway algorithm

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The crash airway algorithm

Crash airway

Maintain oxygenation

Intubation attempt successful?

Yes

Post-intubation management

No

Unable to bag ventilate?

Yes

Succinylcholine 2 mg/kg IVP

No

See failed airway algorithm

Attempt intubation

Successful?

Yes

Post-intubation management

No

Failure to maintain oxygenation?

Yes

≥3 attempts by experienced operator?

No

See failed airway algorithm

The difficult airway algorithm


* RSI may require a double set-up. See text for details.

* In children under 8 years of age an uncuffed or cuffed endotracheal tube may be placed. In neonates, uncuffed endotracheal tubes should be placed. Reproduced with permission from: The Difficult Airway Course®: Emergency and Walls, RM, Murphy, MF. Manual of Emergency Airway Management, 3rd ed, Lippincott Williams and Wilkins, Philadelphia 2008. Copyright © 2008 Lippincott Williams & Wilkins.