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The Emergency Department provides comprehensive emergency services to a large local urban and referral population as a Level One Trauma Center, paramedic base station, and training center. The fully accredited residency training program in Emergency Medicine at UC Davis Medical Center began almost two decades ago and currently has 60 residents. All faculty members are required to provide both bedside and didactic teaching to residents, medical students, and others rotating through the Emergency Department. The successful candidate will show a commitment to educating and mentoring a diverse student body to expand opportunities and enhance personal growth, retention, and academic success.

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# Factors Predicting Difficult Endotracheal Intubation

Brit Long, MD[1], Alex Koyfman, MD[2], and Michael Gottlieb, MD[3]

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| Summary heading | History of difficult intubation is the strongest predictor of a difficult intubation, followed by a high score on the upper lip bite test, retrognathia, and a short hyomental distance |
| Positive LR findings (LR+) | History: |
| | History of difficult intubation = 16–19 |
| | Signs: |
| | Upper lip bite test grade 3 = 14 |
| | Shorter hyomental distance = 6.4 |
| | Retrognathia = 6 |
| | Combination of findings on Wilson score = 9.1 |
| | Impaired neck mobility = 4.2 |
| | Modified Mallampati score > 3 = 4.1 |
| Negative LR findings (LR–) | History: |
| | Absence of a history of difficult intubation = 0.72–0.82 |
| | Signs (absence of): |
| | Upper lip bite test grade 3 = 0.42 |
| | Shorter hyomental distance = 0.84 |
| | Retrognathia = 0.85 |
| | Combination of findings on Wilson score = 0.60 |
| | Impaired neck mobility = 0.77 |
| | Modified Mallampati score > 3 = 0.52 |
| Who was in the studies | 62 studies comprising 33,559 patients, with all intubations completed in the operating room |

Editor's Note: Brass Tacks are concise reviews of published evidence. This series is a result of collaboration between *Academic Emergency Medicine* and the evidence-based medicine website www.TheNNT.com. For inquiries please contact the section editor, Shahriar Zehtabchi, MD (e-mail: Shahriar.zehtabchi@downstate.edu).

## NARRATIVE

Endotracheal intubation is a common procedure in emergency medicine, and recognizing a potentially difficult intubation is imperative in planning for the procedure. While the "can't intubate, can't ventilate" scenario is rare, it is catastrophic if the airway operator is not prepared.[1–3] Thus, predicting factors associated with difficult endotracheal intubation is important for emergency clinicians, with consideration of airway adjuncts such as video laryngoscopy, supraglottic airway devices, and cricothyrotomy.[4] Some of the factors associated with intubation failure (or difficult intubation) include a history of prior difficult intubation, limited upper lip bite test (the patient bites the upper lip with his/her lower incisors), retrognathia, short thyromental and hyomental distance, decreased cervical spinal motion, higher modified Mallampati classification (defined by visibility of oropharyngeal structures with maximal mouth opening and tongue protrusion), and composite scores such as the Wilson score (incorporating weight, mobility of the cervical spine and jaw, retrognathia, and incisor appearance).[4–7]

The systematic review discussed here included studies evaluating risk factors (based on medical history or physical examination) or clinical tests that could

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predict difficult intubation (outcome) in adults (>18 years) undergoing endotracheal intubation with direct laryngoscopy.[8] Authors assessed the quality of the included trials using the Rational Clinical Examination series quality checklist.[9]

The authors of the meta-analysis identified 62 relevant studies ($n$ = 33,559 patients), which were all performed in the operating room (OR). The overall prevalence of difficult intubation was 10% (95% confidence interval [CI] = 8.2%–12%), which was most commonly defined by Cormack-Lehane grade 3 or 4.[10] Cormack-Lehane grade 3 is defined as only the epiglottis visualized and grade 4 by neither glottis nor epiglottis seen on direct laryngoscopy.[10] Other definitions included combination of Cormack-Lehane grade with additional requirements such as number of intubation attempts, time, and use of bougie in six studies; percentage of glottic opening in one study; Intubation Difficulty Scale score > 5 in three studies; or minimum intubation time or number of attempts in five studies. History of prior difficult intubation was associated with an increased likelihood of difficult intubation (positive likelihood ratio [LR+] = 16–19). Clinical examination findings including upper lip bite test class 3, defined as inability to bite any part of the upper lip with lower incisors, was a strong predictor of difficult intubation (LR+ = 14, 95% CI = 8.9–22). Other findings, such as retrognathia (LR+ = 6.0, 95% CI = 3.1–11), hyomental distance < 3 to < 5.5 cm (LR+ = 6.4, 95% CI = 4.1–10), impaired neck mobility (LR+ = 4.2, 95% CI = 1.9–9.5), impaired mouth opening (LR+ = 3.6, 95% CI = 2.1– 6.1), and the modified Mallampati score > 3 (LR+ = 4.1, 95% CI = 3.0–5.6) also predicted difficult intubation. The Wilson score was also a strong predictor of difficult intubation (LR+ = 9.1, 95% CI = 5.1–16). However, no clinical factor or composite score was useful in excluding difficult intubation. Sensitivity analyses did not change interpretation of results.[8]

## CAVEATS

The trials included in the systematic review (rated as high-quality) identified certain findings are associated with an increased risk of difficult intubation. However, none of the findings were sufficient to exclude this. There was some variability in the reference standard used among studies to define a difficult airway, although the majority of studies incorporated the Cormack-Lehane classification system.[10] In addition, studies that used the time of intubation or number of intubation attempts to define a difficult airway might have been influenced by the individual clinician's ability or experience in intubation. Several predictors such as impaired cervical motion and retrognathia are subjective and vulnerable to interobserver variability.

Authors of the systematic review limited their analysis to studies with independent assessments of predictors and outcomes in order to reduce bias. This led to exclusion of studies conducted in emergency settings. Therefore, all studies included in the systematic review were performed in the OR setting, limiting the applicability to the emergency department (ED) setting. Endotracheal intubation in the OR setting is more commonly associated with a nonemergent need for endotracheal intubation. While ED patients may differ with regard to mental and hemodynamic status, presence of gastric contents or vomiting, and ability to cooperate well with the assessments, knowledge of factors associated with difficult intubation and adequate preparation are still essential. Finally, this analysis evaluated only direct laryngoscopy. Therefore, the results of this review may not reflect current airway technology incorporating video laryngoscopy, extraglottic airway devices, and other advanced techniques.

In summary, the existing evidence indicates that several findings predict a difficult endotracheal intubation, but their absence cannot reliably exclude this scenario. The most accurate assessment was the upper lip bite test, followed by shorter hyomental distance, retrognathia, impaired neck mobility, modified Mallampati score > 3, and the Wilson score. Future studies should incorporate new airway technology such as video laryngoscopy and include emergency situations.

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