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Airway physical examination tests for detection of difficult airway



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[Diagnostic Test Accuracy Review]

Airway physical examination tests for detection of difficult airway management in apparently normal adult patients

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ABSTRACT

Background

The unanticipated difficult airway is a potentially life-threatening event during anaesthesia or acute conditions. An unsuccessfully managed upper airway is associated with serious morbidity and mortality. Several bedside screening tests are used in clinical practice to identify those at high risk of difficult airway. Their accuracy and benefit however, remains unclear.

Objectives

The objective of this review was to characterize and compare the diagnostic accuracy of the Mallampati classification and other commonly used airway examination tests for assessing the physical status of the airway in adult patients with no apparent anatomical airway abnormalities. We performed this individually for each of the four descriptors of the difficult airway: difficult face mask ventilation, difficult laryngoscopy, difficult tracheal intubation, and failed intubation.

Search methods

We searched major electronic databases including CENTRAL, MEDLINE, Embase, ISI Web of Science, CINAHL, as well as regional, subject specific, and dissertation and theses databases from inception to 16 December 2016, without language restrictions. In addition, we searched the Science Citation Index and checked the references of all the relevant studies. We also handsearched selected journals, conference proceedings, and relevant guidelines. We updated this search in March 2018, but we have not yet incorporated these results.

Selection criteria

We considered full-text diagnostic test accuracy studies of any individual index test, or a combination of tests, against a reference standard. Participants were adults without obvious airway abnormalities, who were having laryngoscopy performed with a standard laryngoscope and the trachea intubated with a standard tracheal tube. Index tests included the Mallampati test, modified Mallampati test, Wilson risk score, thyromental distance, sternomental distance, mouth opening test, upper lip bite test, or any combination of these. The target condition was difficult airway, with one of the following reference standards: difficult face mask ventilation, difficult laryngoscopy, difficult tracheal intubation, and failed intubation.



Data collection and analysis

We performed screening and selection of the studies, data extraction and assessment of methodological quality (using QUADAS-2) independently and in duplicate. We designed a Microsoft Access database for data collection and used Review Manager 5 and R for data analysis. For each index test and each reference standard, we assessed sensitivity and specificity. We produced forest plots and summary receiver operating characteristic (ROC) plots to summarize the data. Where possible, we performed meta-analyses to calculate pooled estimates and compare test accuracy indirectly using bivariate models. We investigated heterogeneity and performed sensitivity analyses.

Main results

We included 133 (127 cohort type and 6 case-control) studies involving 844,206 participants. We evaluated a total of seven different prespecified index tests in the 133 studies, as well as 69 non-prespecified, and 32 combinations. For the prespecified index tests, we found six studies for the Mallampati test, 105 for the modified Mallampati test, six for the Wilson risk score, 52 for thyromental distance, 18 for sternomental distance, 34 for the mouth opening test, and 30 for the upper lip bite test. Difficult face mask ventilation was the reference standard in seven studies, difficult laryngoscopy in 92 studies, difficult tracheal intubation in 50 studies, and failed intubation in two studies. Across all studies, we judged the risk of bias to be variable for the different domains; we mostly observed low risk of bias for patient selection, flow and timing, and unclear risk of bias for reference standard and index test. Applicability concerns were generally low for all domains. For difficult laryngoscopy, the summary sensitivity ranged from 0.22 (95% confidence interval (CI) 0.13 to 0.33; mouth opening test) to 0.67 (95% CI 0.45 to 0.83; upper lip bite test) and the summary specificity ranged from 0.80 (95% CI 0.74 to 0.85; modified Mallampati test) to 0.95 (95% CI 0.88 to 0.98; Wilson risk score). The upper lip bite test for diagnosing difficult laryngoscopy provided the highest sensitivity compared to the other tests (P < 0.001). For difficult tracheal intubation, summary sensitivity ranged from 0.87 (95% CI 0.82 to 0.91; modified Mallampati test) to 0.93 (0.87 to 0.96; mouth opening test). The modified Mallampati test had the highest sensitivity for diagnosing difficult tracheal intubation compared to the other tests (P < 0.001). For difficult face mask ventilation, we could only estimate summary sensitivity (0.17, 95% CI 0.06 to 0.39) and specificity (0.90, 95% CI 0.81 to 0.95) for the modified Mallampati test.

Authors' conclusions

Bedside airway examination tests, for assessing the physical status of the airway in adults with no apparent anatomical airway abnormalities, are designed as screening tests. Screening tests are expected to have high sensitivities. We found that all investigated index tests had relatively low sensitivities with high variability. In contrast, specificities were consistently and markedly higher than sensitivities across all tests. The standard bedside airway examination tests should be interpreted with caution, as they do not appear to be good screening tests. Among the tests we examined, the upper lip bite test showed the most favourable diagnostic test accuracy properties. Given the paucity of available data, future research is needed to develop tests with high sensitivities to make them useful, and to consider their use for screening difficult face mask ventilation and failed intubation. The 27 studies in 'Studies awaiting classification' may alter the conclusions of the review, once we have assessed them.

PLAIN LANGUAGE SUMMARY

Bedside examination tests to detect beforehand adults who are likely to be difficult to intubate

Review question

We looked for the most suitable and accurate rapid screening test in adults with no obvious airway abnormalities, to identify those who are likely to be difficult to intubate (i.e. insertion of a tube into the windpipe).

Background

Intubation ensures a patient's airway is clear while they are heavily sedated, unconscious or anaesthetized, so their breathing can be controlled by machine (ventilation), and appropriate levels of oxygen can be given during surgery, following major trauma, during critical illness, or following cardiac arrest. Having an airway that is difficult to intubate is a potentially life-threatening situation.

Tube insertion is preceded by laryngoscopy (insertion of mini-camera to view route of tube insertion), requires advanced skills, and is generally uneventful. Intubation is difficult in approximately 10% of patients, who require special equipment and precautions. Several physical features are associated with difficult airways and failed intubation, so warning of potentially difficult airways would be helpful. Several quick bedside tests are in routine clinical use to identify those at high risk for difficult airways, but how accurate these are remains unclear.

Population

We included studies of adults aged 16 years or older without obvious airway abnormalities who were to receive standard intubation.

Test under investigation

We assessed the seven most common bedside tests, routinely used to detect difficult airways. These take only a few seconds to complete and require no special equipment.



The index tests (diagnostic tests of interest) included:

- the Mallampati test (original or modified; asking a sitting patient to open his mouth and to protrude the tongue as much as possible so that visibility can be determined);
- Wilson risk score (including patient's weight, head and neck movement, jaw movement, receding chin, buck teeth);
- thyromental distance (length between the chin and the upper edge of Adam's apple);
- sternomental distance (length between the chin and the notch between the collar bones);
- mouth opening test;
- upper lip bite test;
- or any combination of these tests.

Search date

The evidence is current to 16 December 2016. (We searched for new studies in March 2018, but we have not yet included them in the review.)

Study characteristics

We included 133 studies (844,206 participants) which investigated the accuracy of the seven tests above, plus 69 other common tests and 32 test combinations, in detection of difficult airways.

Key results

For difficult laryngoscopy, the average sensitivity (percentage of correctly identified difficult airways) ranged from 22% (mouth opening test) to 63% (upper lip bite test). The average specificity (percentage of correctly classified patients without difficult airways) ranged from 80% (modified Mallampati test) to 95% (Wilson risk score). The upper lip bite test had the highest sensitivity of all tests considered.

For difficult tube insertion, the average sensitivity ranged from 24% (thyromental distance) to 51% (modified Mallampati test) and the average specificity ranged from 87% (modified Mallampati test) to 93% (mouth opening test). The modified Mallampati test had the highest sensitivity of all tests considered.

For difficult face mask ventilation (another indication of a difficult airway), there were only enough data to calculate average sensitivity of 17% and specificity 90% for the modified Mallampati test.

Quality of the evidence

Overall, the evidence from the studies was of moderate to high quality. The likelihood of the studies providing reliable results was generally high, although in half of them, the intubating physician knew the result of the preceding test, which may have influenced results, but this is the normal situation in routine clinical care. The characteristics of patients, tests, and conditions were comparable to those seen in a wide range of everyday clinical settings. The results of this review should apply to standard preoperative airway assessments in apparently normal hospital patients worldwide.

Conclusion

The bedside screening tests examined in this review are not well suited for the purpose of detecting unanticipated difficult airways because they missed a large number of people who had a difficult airway.