TRACHEAL DEFORMITY INDEX – A NOVEL TOOL FOR PREDICTING DIFFICULT INTUBATION AND SELECTING THE AIRWAY MANAGEMENT METHOD

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Background. *Conventional scales for predicting difficult intubation (Mallampati, ULBT, Cormack–Lehane, and thyromental distance) assess upper airway anatomy but do not account for changes in the trachea itself, including luminal narrowing, axial deviation, and the length and level of the deformity. Consequently, cases of "unexpected" difficult intubation continue to occur in patients with goiter and mediastinal masses. Development of an integrated index combining multidetector computed tomography (MDCT) findings with clinical tests is therefore an important clinical need.*

Objective. To develop a Tracheal Deformity Index (TDI) for predicting difficult intubation in patients with tracheal deformity, evaluate its prognostic value, and substantiate an algorithm for selecting the intubation method based on the index.

Materials and Methods. A total of 100 patients (aged 19–84 years) who underwent surgery for tracheal deformity at the Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov and the Tashkent Medical Academy in 2016–2025 were evaluated. All patients underwent preoperative MDCT with 3D reconstruction, video tracheobronchoscopy, ultrasonography, and standard clinical tests. The TDI was calculated as the sum of six criteria on a 0–10-point scale: tracheal luminal narrowing (<30% – 0; 30–50% – 1; >50% – 2 points), axial deviation (<5 mm – 0; 5–10 mm – 1; >10 mm – 2 points), length of deformity (<30 mm – 0; 30–50 mm – 1; >50 mm – 2 points), Mallampati class III–IV (1 point), ULBT class III (1 point), mouth opening <4 cm (1 point), and stridor (1 point). The results were compared between bronchoscopic (Group I, n=62) and conventional laryngoscopic (Group II, n=38) intubation. Prognostic performance was assessed using ROC analysis, Spearman correlation, and multivariable logistic regression; in 2024–2025, the algorithm was prospectively evaluated in 19 patients.

Results. The mean TDI was 4.9±1.6 points, and 63% of patients had an index ≥5 points. In the conventional intubation group, the TDI predicted first-attempt failure with high accuracy: AUC 0.803 (95% CI 0.640–0.934); at a threshold of ≥5 points, sensitivity was 80.0% and specificity was 77.8%. This performance was significantly superior to that of conventional scales: Mallampati – AUC 0.608, ULBT – 0.589, Cormack–Lehane – 0.653, and percentage of narrowing on MDCT – 0.700. In patients with TDI <5, conventional intubation was successful on the first attempt in 77.8% of cases, whereas with TDI ≥5, this rate decreased to 20.0%; the incidence of hypoxia increased from 16.7% to 40.0%. In the bronchoscopic intubation group, the TDI level did not affect outcomes (success rates 94.7% and 88.4%; hypoxia 5.3% and 4.7%), indicating that this method provided stable results regardless of the severity of deformity. The TDI showed a moderate correlation with intubation duration (r=0.46; p=0.004). Based on these findings, a four-stage algorithm was developed: TDI ≥5 points, minimum lumen <6 mm, narrowing >50%, or presence of stridor – bronchoscopic intubation (for TDI ≥6, with spontaneous breathing preserved under dexmedetomidine sedation); TDI ≤4 – videolaryngoscopy as the first-attempt technique, with a bronchoscope kept in reserve. In the prospective application of the algorithm, first-attempt intubation was successful in 17 of 19 patients (89.5%), and no episodes of hypoxia were observed.

Conclusion. The Tracheal Deformity Index, combining MDCT morphometry with clinical tests, predicts difficult intubation more accurately than conventional scales (AUC 0.803). A TDI ≥5 points is an indication for bronchoscopic intubation; the index-based algorithm enables standardization of airway management and reduction of complications in patients with tracheal deformity.