National Board of Examinations - Journal of Medical Sciences
Volume 3, Issue 8, Pages 941–949, August 2025
DOI 10.61770/NBEJMS.2025.v03.i08.006

ORIGINAL ARTICLE

A Prospective Comparative Study on the Incidence and Predictors of Difficult Intubation in Cardiac Versus Non-Cardiac Surgical Patients in a Tertiary Care Centre

Jones Deepan Kumar,[1] Sudarsan Kasthuri,[2] Kaapian Thamizholi,[3] Amar Nandakumar[3] and Jeevithan Shanmugam[4,*]

[1]*Consultant anaesthetist, Sri Kumaran Hospital, Tirupur*
[2]*Associate Professor in Anesthesiology, KMCH Institute of Health Sciences and Research, Coimbatore – 14*
[4]*Consultant Anesthesiologist, KMCH Institute of Health Sciences and Research, Coimbatore – 14*
[4]*Professor in Community Medicine, KMCH Institute of Health Sciences and Research, Coimbatore – 14*

Accepted: 20-July-2025 / Published Online: 4-August-2025

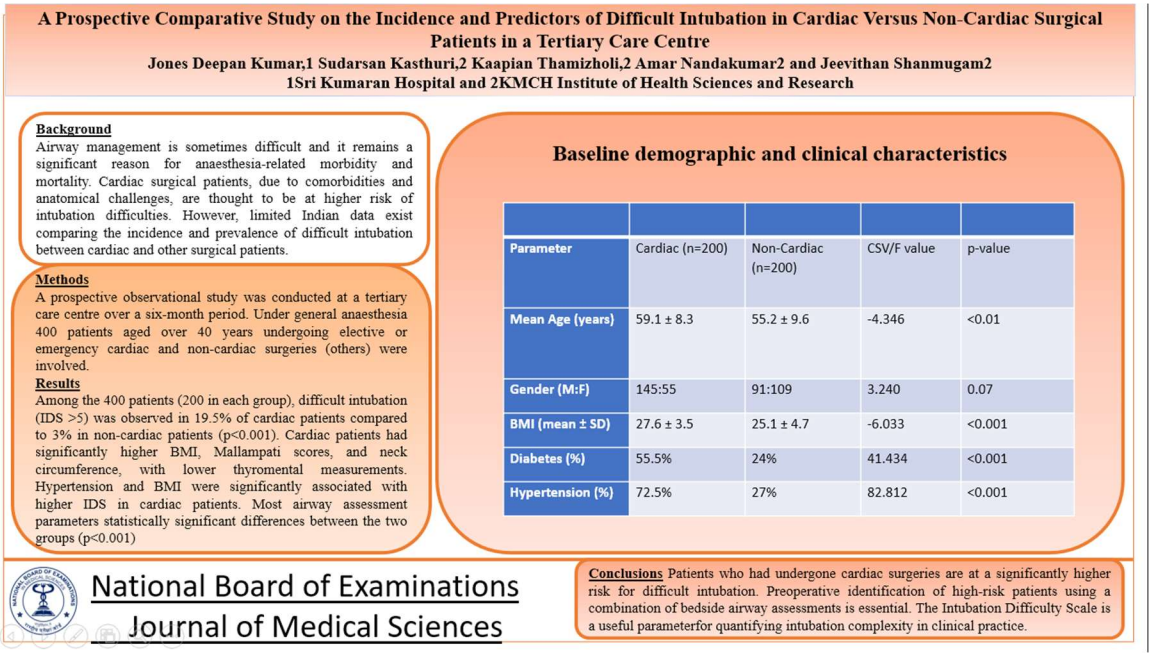
Abstract

Introduction: Airway management is sometimes difficult and it remains a significant reason for anaesthesia-related morbidity and mortality. Cardiac surgical patients, due to comorbidities and anatomical challenges, are thought to be at higher risk of intubation difficulties. However, limited Indian data exist comparing the incidence and prevalence of difficult intubation between cardiac and other surgical patients. The current research aims at assessment and comparison of the incidence and predictors of difficult intubation in these two patient groups. **Materials and Methods:** A prospective observational study was conducted at a tertiary care centre over a six-month period. Under general anaesthesia 400 patients aged over 40 years undergoing elective or emergency cardiac and non-cardiac surgeries (others) were involved. **Results:** Among the 400 patients (200 in each group), difficult intubation (IDS >5) was observed in 19.5% of cardiac patients compared to 3% in non-cardiac patients ($p<0.001$). Cardiac patients had significantly higher BMI, Mallampati scores, and neck circumference, with lower thyromental measurements. Hypertension and BMI were significantly associated with higher IDS in cardiac patients. Most airway assessment parameters statistically significant differences between the two groups ($p<0.001$). **Conclusion:** Patients who had undergone cardiac surgeries are at a significantly higher risk for difficult intubation. Preoperative identification of high-risk patients using a combination of bedside airway assessments is essential. The Intubation Difficulty Scale is a useful parameterfor quantifying intubation complexity in clinical practice.

Keywords: Difficult intubation, Cardiac anaesthesia, Intubation Difficulty Scale, Airway assessment, Predictive factors

*Corresponding Author: Jeevithan Shanmugam
Email: dr.jeevithan@gmail.com

Graphical Abstract



Introduction

Managing airway safely is the cornerstone of modern anaesthesia practice. Difficult tracheal intubation remains a major contributor to anaesthesia-related morbidity and mortality despite advancements in techniques and devices. Efficient airway control during the induction phase is both a challenge and a measure of success for the anaesthesiologist. A difficult airway is defined as "the clinical situation in which a conventionally trained anaesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation, or both" [1].

Difficult airway (DA) and intubation are frequently encountered in cardiac anaesthesia, partly due to the demographic profile and anthropometric measurements of the patients with cardiac conditions [2]. Many cardiovascular surgeries are performed under emergency settings, leaving insufficient time for a comprehensive preoperative airway assessment. Consequently, many difficult intubations in the cardiac operation theatre remain unanticipated [2]. Moreover, patients presenting for cardiac surgery often belong to an older age group and are typically called as American Society of Anesthesiologists (ASA) Physical Status III or above. Comorbidities such as diabetes mellitus, obesity, and hypertension are common in this population. These factors make the induction of anaesthesia particularly precarious, as any hemodynamic disturbance during intubation can be poorly tolerated [1].

These cardiac patients often have fixed cardiac output and impaired compensatory or restoratory mechanisms. Sympathetic responses elicited by laryngoscopy and tracheal intubation—resulting in abrupt changes in heart rate and systemic vascular resistance—can exacerbate hemodynamic instability. Additionally, conditions like diabetes mellitus may lead to limited joint mobility syndrome, including atlanto-occipital joint stiffness, which compromises optimal neck and head extension and increases the risk of difficult laryngoscopy [3].

Adverse outcomes associated with airway mismanagement continue to be a major cause of anaesthesia-related brain injury and mortality. According to closed claims analysis, failure to maintain the airway and subsequent hypoxaemia is the main concern for the majority of irreversible patient harm [4]. Although several bedside assessments such as thyromental distance, the Mallampati classification, and Wilson scoring are widely used [7–9], their accuracy is hindered by observer variability and non-uniform definitions of difficult intubation [5]. Imaging-based assessments, while more precise, are impractical for large-scale preoperative screening [6]. Hence, a comprehensive understanding of the predictors of difficult airway can potentially mitigate life-threatening complications [9–11].

However, predictive outcomes from existing studies have been inconsistent and often evolve over time [12]. In a large-scale analysis of over 21,000 cases using propensity score methods, Heinrich et al. demonstrated a statistically significant higher incidence of difficult laryngoscopy in cardiac surgical patients (7.5%) compared to general surgical patients (5.7%) [2]. In the Indian context, the available literature remains limited. Krishna et al. gave 8.5% incidence of difficult intubation, although their findings were based on optimal Cormack-Lehane grading with external manipulation. Furthermore, individual predictors show only modest sensitivity and specificity when used in isolation. Importantly, the surgical intervention is a potential independent risk factor for difficult intubation which has to be thoroughly investigated [13].

Given the limited data from Indian settings and the growing population of high-risk surgical candidates, this study was undertaken to explore whether patients posted for cardiac surgery face a higher incidence of difficult intubation. The primary objective was to compare the incidence of difficult intubation in patients posted for cardiac versus non-cardiac surgery. Secondary objectives included assessing the relationship between difficult intubation and associated comorbidities, as well as its correlation with laryngoscopic grading.

Materials and Methods

The present study is a prospective observational study conducted at Kovai Medical Centre and Hospital, a tertiary care centre in

Coimbatore, from October 2018 to April 2019. Patients above the age of 40 years who were posted for elective or emergency cardiac and other surgeries under general anesthesia with endotracheal intubation were included. The study was seen and approved by the Institutional Ethics Committee, and an informed written consent was received from the study participants.

Patients diagnosed with cervical spine fractures, upper airway pathology, pregnancy, or a known history of difficult laryngoscopy or with gastroesophageal reflux were not included in the study. A total of 400 patients were enrolled, with 200 in each group. The sample size was calculated based on retrospective data, with a power of 80%, alpha error of 5%, and an expected difference in proportions between the groups. Although the calculated sample size was 211 per group, 200 patients in each group were finally included.

Preoperative airway assessments included Modified Mallampati Score, inter-incisor distance, thyromental height, neck circumference, thyromental distance, range of head and neck movement, mandibular protrusion, and dentition. Standard monitors were applied in all patients. Additional arterial and central venous lines were inserted in cardiac surgery patients as per protocol. Anesthesia was induced with fentanyl, propofol or etomidate, and a muscle relaxant (atracurium or vecuronium). The choice of drugs and laryngoscope blade size were left under the choice of the attending anesthesiologist who has at least two years of experience.

For 3 minutes, all patients were preoxygenated. Intubation was done in the sniffing position using a Macintosh blade. In accordance with All India Difficult Airway Association guidelines, a difficult airway cart was kept ready. Using the Intubation Difficulty Scale (IDS), the intubation difficulty was evaluated which accounts for operators, number of attempts, alternative techniques, Cormack-Lehane grade, applied lifting force, need for external laryngeal pressure, and vocal cord position. A score of 0 was considered easy, 1–5 moderate difficulty, and >5 very difficult.

The endpoint of the study was an efficient tracheal intubation confirmed by capnography auscultation, chest rise,. Data was recorded in Microsoft Excel and analyzed using SPSS software. Descriptive statistics were used to summarize patient characteristics. Categorical variables were analysed using continuous variables using t-tests or non-parametric equivalents and chi-square or Fisher's exact test, depending on normality. Correlation analysis was performed to assess associations between continuous variables. A p-value of less than 0.05 was considered statistically significant.

Results

In this research, 400 patients were studied, comprising 200 undergoing cardiac surgery and 200 undergoing non-cardiac surgery. The

average age of the study population was 57.2 years (SD ±9.3), and 59% were males. The patients who had undergone Cardiac surgery had a higher prevalence of diabetes (55.5% vs. 24%) and hypertension (72.5% vs. 27%). Body Mass Index (BMI) was significantly higher in the cardiac group ($p<0.001$).

No statistically significant difference was observed in gender distribution between the groups ($p = 0.07$), suggesting that sex did not independently influence intubation difficulty.

Difficult intubation, defined as IDS >5, was seen in 19.5% of patients in the cardiac group compared to 3% in the non-cardiac group. The difference found was statistically significant ($\chi^2 = 33.29$, $p < 0.001$), which indicates a strong association between surgical group and intubation difficulty (Table 1).

Table 1. Baseline demographic and clinical characteristics

Parameter	Cardiac (n=200)	Non-Cardiac (n=200)	CSV/F value	p-value
Mean Age (years)	59.1 ± 8.3	55.2 ± 9.6	-4.346	<0.01
Gender (M:F)	145:55	91:109	3.240	0.07
BMI (mean ± SD)	27.6 ± 3.5	25.1 ± 4.7	-6.033	<0.001
Diabetes (%)	55.5%	24%	41.434	<0.001
Hypertension (%)	72.5%	27%	82.812	<0.001

Cardiac surgery patients had significantly higher Modified Mallampati Scores and Neck Circumference, with lower Thyromental Distance and Height, all statistically significant. The Intubation Difficulty Score (IDS) was also higher in the cardiac group (Table 2).

Table 2. Comparison of airway assessment parameters and Intubation Difficulty Score

Airway Parameter	Cardiac (Mean ± SD)	Non-Cardiac (Mean ± SD)	F value	p-value
Modified Mallampati Score	2.40 ± 0.49	2.00 ± 0.43	-8.677	<0.001
Inter-Incisor Distance (cm)	4.20 ± 0.32	4.48 ± 0.62	5.675	<0.001
Thyromental Distance (cm)	6.84 ± 0.22	7.23 ± 0.47	10.628	<0.001
Thyromental Height (cm)	4.37 ± 0.23	4.77 ± 0.42	11.813	<0.001
Neck	36.46 ± 2.90	35.22 ± 2.73	-4.403	<0.001

Circumference (cm)				
Intubation Difficulty Score	4.14 ± 1.25	1.93 ± 1.46	-16.261	<0.001

Further analysis revealed significant positive correlations between BMI and Intubation Difficulty Score ($r = 0.42$, $p < 0.001$), and between Neck Circumference and IDS ($r = 0.38$, $p < 0.001$), suggesting that patients with higher BMI and neck circumference are more likely to experience difficult intubation. Modified Mallampati Score also showed a moderate positive correlation with IDS ($r = 0.47$, $p < 0.001$).

Among patients with IDS >5, 70% belonged to the cardiac surgery group. The incidence of Cormack-Lehane Grade III or IV view was noted in 22 cardiac patients and only 5 non-cardiac patients. Intraoperative complications such as mucosal trauma and desaturation episodes were more reported in cardiac patients with high IDS scores, though not statistically analyzed in this study. Use of adjuncts like bougie and external laryngeal manipulation was required in 18.5% of cardiac patients versus 4.5% of non-cardiac patients.

This study evaluated 400 patients, evenly distributed between cardiac and non-cardiac surgical groups, to assess predictors and incidence of difficult intubation. The overall mean age was 57.18 years, with males constituting 59% of the cohort. Cardiac patients had more prevalence of complications like diabetes and hypertension. The incidence of overweight and obesity was also notably higher among cardiac surgical patients.

Difficult intubation (IDS >5) was observed in 19.5% of cardiac surgery patients and only 3% in non-cardiac patients, a statistically significant finding. These findings are slightly lower compared to Borde DP et al. who reported an overall incidence of 19.46%, with 24% among cardiac and 14.4% in non-cardiac groups [14].

Airway parameters like Modified Mallampati Score, thyromental distance, inter-incisor distance, thyromental height, and neck circumference were different significantly between the two groups. These measurements were correlated with higher IDS in cardiac patients, especially among those with elevated BMI, older age, and comorbidities. Although various studies suggest these tests individually have limited predictive value [19], combining them provides better diagnostic accuracy.

The Intubation Difficulty Scale (IDS), a validated tool blending subjective and objective criteria, proved effective for stratifying difficulty. Among obese cardiac patients, IDS >5 was found in 28.8% of cases, comparable to the 16.5% incidence reported by Siriussawaku et al. using

IDS [15]. Although laryngoscopy grade heavily influences IDS, poor glottic views do not universally indicate difficult intubation [16,17].

Correlation analysis revealed that both age and BMI correlated with IDS in non-cardiac patients, while in cardiac patients, only BMI showed a significant relationship. The presence of hypertension was significantly associated with IDS among cardiac patients. Smita Prakash et al. similarly identified several predictors including age, gender, Mallampati grade, inter-incisor and thyromental distances, and neck anatomy in an Indian population [18].

Although statistical significance was observed in many parameters, no single airway test was sufficiently predictive. A multifactorial approach remains essential. Complications of difficult airway management include mucosal trauma, hypoxemia, aspiration, and neurological injury, underlining the need for thorough preoperative assessment and preparedness.

Conclusion

This prospective observational study demonstrated a significantly higher incidence of difficult intubation among the cardiac surgery patients compared to non-cardiac surgery patients. Cardiac patients tended to have more comorbid conditions such as diabetes and hypertension, higher BMI, and altered airway anatomy—all contributing to increased intubation difficulty. Although various individual airway parameters like Mallampati score, neck circumference, and thyromental distance were associated with IDS, none showed adequate predictive power when used alone. Therefore, a composite approach incorporating clinical judgment, multiple bedside assessments, and patient comorbidities remains essential.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

No funding was received for conducting this study.

References

1. Choudhury A, Gupta N, Magoon R, Kapoor P. Airway management of the cardiac surgical patients: Current perspective. Ann Card Anaesth. 2017;20(5):26. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28074820
2. Heinrich S, Ackermann A, Prottengeier J, Castellanos I, Schmidt J, Schüttler J. Increased Rate of Poor Laryngoscopic Views in Patients Scheduled for Cardiac Surgery Versus Patients Scheduled for General Surgery: A Propensity Score-Based Analysis of 21,561 Cases. J Cardiothorac Vasc Anesth. 2015;29(6):1537–43. Available from:

http://www.ncbi.nlm.nih.gov/pubmed/26321122

3. Clough RA, Leavitt BJ, Morton JR, Plume SK, Hernandez F, Nugent W, et al. The effect of comorbid illness on mortality outcomes in cardiac surgery. In: Archives of Surgery. 2002;428–33. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11926947
4. Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW. Management of the difficult airway: a closed claims analysis. Anesthesiology. 2005;103(1):33–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15983454
5. Vijayalakshmi, Stehling L, Zauder H, Watson CB. Anesthesiology. Anesthesiol J Am Soc Anesthesiol. 1984;60(6):623–623. Available from: https://anesthesiology.pubs.asahq.org/article.aspx?articleid=1956093
6. Butler PJ, Dhara SS. Prediction of Difficult Laryngoscopy: An Assessment of the Thyromental Distance and Mallampati Predictive Tests. Anaesth Intensive Care. 1992;20(2):139–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1595845
7. Mallampati SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D, et al. A clinical sign to predict difficult tracheal intubation: a prospective study. Can Anaesth Soc J. 1985;32(4):429–34. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4027773
8. Ezri T, Weisenberg M, Khazin V, Zabeeda D, Sasson L, Shachner A, et al. Difficult laryngoscopy: Incidence and predictors in patients undergoing coronary artery bypass surgery versus general surgery patients. J Cardiothorac Vasc Anesth. 2003;17(3):321–4. Available from: https://www.ncbi.nlm.nih.gov/m/pubmed/12827579/
9. Bellhouse CP, Doré C. Criteria for Estimating Likelihood of Difficulty of Endotracheal Intubation with the Macintosh Laryngoscope. Anaesth Intensive Care. 1988;16(3):329–37. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3189744
10. Rose DK, Cohen MM. The airway: problems and predictions in 18,500 patients. Can J Anaesth. 1994;41(5):372–83. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8055603
11. Honarmand A, Safavi M, Zare N. A comparison of the ratio of patient′s height to thyromental distance with the modified Mallampati and the upper lip bite test in predicting difficult laryngoscopy. Saudi J Anaesth. 2011;5(3):258. Available from:

http://www.ncbi.nlm.nih.gov/pubmed/21957403

12. Lundstrøm LH, Vester-Andersen M, Møller AM, Charuluxananan S, L'Hermite J, Wetterslev J, et al. Poor prognostic value of the modified Mallampati score: a meta-analysis involving 177 088 patients. Br J Anaesth. 2011;107(5):659–67. Available from: http://www.ncbi.nlm.nih.gov/ pubmed/21948956
13. Research Society of Anaesthesiology Clinical Pharmacology. HM, Agarwal M, Dali JS, Rampal P, Dua CK. Journal of anaesthesiology, clinical pharmacology. Research Society of Anaesthesiology Clinical Pharmacology; 1985;257–260. Available from: https://manipal.pure.elsevier.com/en/publications/prediction-of-difficult-laryngoscopy-in-indian-population-role-of
14. Borde DP, Futane SS, Daunde V, Zine S, Joshi N, Jaiswal S, et al. Are cardiac surgical patients at increased risk of difficult intubation? Indian J Anaesth. 2017;61(8):629–35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28890557
15. American Society of Anesthesiologists. T, Wajima Z, Inoue T, Sakamoto A. Anesthesiology. The Journal of the American Society of Anesthesiologists. 2005;429–37. Available from: https://anesthesiology.pubs.asahq.org/article.aspx?articleid=1942057
16. Siriussawakul A, Limpawattana P. A validation study of the intubation difficulty scale for obese patients. J Clin Anesth. 2016;33:86–91. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0952818016300289
17. American Society of Anesthesiologists. F, Borron SW, Racine SX, Clemessy J-L, Fournier J-L, Plaisance P, et al. Anesthesiology. Anesthesiol J Am Soc Anesthesiol. 1997;87(6):1290–7. Available from: https://anesthesiology.pubs.asahq.org/article.aspx?articleid=1948562
18. Williams KN, Carli F, Cormack RS. Unexpected, difficult laryngoscopy: A prospective survey in routine general surgery. Br J Anaesth. 1991;66(1):38–44. Available from: https://www.sciencedirect.com/science/article/pii/S0007091217482481
19. Prakash S, Kumar A, Bhandari S, Mullick P, Singh R, Gogia AR. Difficult laryngoscopy and intubation in the Indian population: An assessment of anatomical and clinical risk factors. Indian J Anaesth. 2013;57(6):569–75. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24403616