IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 25, Issue 11 Ser. 1 (November. 2026), PP 26-33
www.iosrjournals.org

Airway Management Practices and Postoperative Outcomes in Head and Neck Cancer Surgery: A Retrospective Observational Study

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Abstract
Background: *Airway planning for head and neck cancer surgery is influenced by tumour location, altered anatomy and postoperative airway requirements. This study described airway management practices and evaluated their associations with postoperative intensive care unit and hospital stay.* ***Methods:*** *This retrospective observational study included 59 surgical records managed under general anaesthesia from November 2022 through June 2024. Airway route, intubation device, perioperative tracheostomy, reconstruction and postoperative stay were analysed using Fisher's exact tests, odds ratios with 95% confidence intervals and limited multivariable logistic regression.* ***Results:*** *Mean age was 51.81 ± 13.48 years (95% confidence interval 48.30-55.32), and 49 (83.1%) records involved oral-cavity tumours. Nasal intubation was used in 48 (81.4%), video laryngoscopy in 26 (44.1%) and fibreoptic intubation in 16 (27.1%). Oral-cavity site was associated with nasal intubation (odds ratio 211.50, 95% confidence interval 17.29-2587.30; p<0.001), and Mallampati class III/IV was associated with fibreoptic intubation (p<0.001). Six (10.2%) records documented perioperative tracheostomy. Prolonged intensive care unit and hospital stay each occurred in 32 (54.2%); perioperative tracheostomy had imprecise associations with both outcomes (odds ratio 4.81, 95% confidence interval 0.53-44.05; p=0.205).* ***Conclusion:*** *Airway selection was associated with tumour site and Mallampati class. No airway route or device independently predicted prolonged postoperative stay.*

Keywords: *Airway Management; Head and Neck Neoplasms; Intubation, Intratracheal; Tracheostomy*

Date of Submission: 23-10-2026 Date of Acceptance: 04-11-2026

I. Introduction

Head and neck cancers account for a substantial component of the global cancer burden and are particularly important in South Asia, where oral-cavity cancers are common.[1,2] Surgical treatment frequently requires a shared operative airway. Tumour bulk, restricted oral access, previous treatment, tissue fibrosis and distortion of normal anatomy may complicate airway management and make loss of airway control especially hazardous.[3-5]

Preoperative assessment should consider conventional airway findings together with disease site and extent, planned resection and reconstruction, and the possibility of postoperative oedema or bleeding.[3-5] Direct laryngoscopy, video laryngoscopy, fibreoptic intubation and surgical airway access are complementary strategies. Nasotracheal intubation may facilitate oral-cavity surgery, whereas tracheostomy may be required for obstruction, failed intubation or postoperative airway protection.[4,5]

Airway strategy may appear to be related to postoperative outcomes, but this relationship is susceptible to confounding by indication: patients receiving tracheostomy or advanced airway techniques may have more extensive disease, complex reconstruction or anticipated airway compromise.[3,5] An observed association therefore cannot establish that the airway intervention caused a longer intensive care unit (ICU) or hospital stay.

The primary objective was to describe the airway routes and intubation devices used for head and neck cancer surgery; the corresponding primary outcome measures were their frequencies. Secondary objectives were to assess whether tumour location and Mallampati class were associated with airway selection and to explore factors associated with ICU stay longer than 24 hours and postoperative hospital stay longer than one week. The secondary outcome measures were the relevant unadjusted and adjusted associations.

II. Materials & Methods

This retrospective, single-centre observational study was conducted at a secondary healthcare institute. The study covered 20 months, from November 2022 through June 2024, and included head and neck cancer surgical records managed under general anaesthesia. Institutional Ethics Committee approval was obtained before data extraction (approval number: CIHSR-IEC/2024-25/Exp Rev/11). Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.[6]

All retrievable records from the prespecified period were assessed. Procedures performed without general anaesthesia and records lacking the clinical or perioperative information required for analysis were excluded. Total enumerative sampling was used. No prospective sample-size calculation was undertaken because all eligible records in the defined period were included; the final sample comprised 59 surgical episodes. The unit of analysis was a surgical record or episode.

The primary outcomes were the frequencies of primary airway routes and intubation devices. Secondary outcomes were the associations of oral-cavity tumour site with nasal intubation, Mallampati class III/IV with fibreoptic intubation, and selected clinical factors with prolonged ICU and hospital stay. Extracted variables included age, sex, tumour site, American Society of Anesthesiologists (ASA) physical status, comorbidities, Mallampati class, primary airway route, intubation device, timing of tracheostomy, reconstruction category, postoperative ICU stay and postoperative hospital stay.

Oral-cavity sites comprised the tongue, lateral border of tongue, buccal mucosa, oral cavity, alveolus, hard palate, maxilla, gingivobuccal sulcus, floor of mouth and retromolar trigone; other sites included the larynx, supraglottis, base of tongue, nasopharynx, sinonasal region, parotid and lacrimal sac. Primary airway route described how the airway was initially secured and was classified as nasal, oral or primary tracheostomy. Perioperative tracheostomy was analysed separately and included elective preoperative, emergency after failed intubation and postoperative tracheostomy. Prolonged ICU stay was defined as more than 24 hours and prolonged postoperative hospital stay as more than one week. Any reconstruction included reconstruction and local or distant flap categories.

Data were independently reanalysed using Python version 3.12.13, pandas version 2.2.3, NumPy version 2.3.5 and SciPy version 1.17.0. Continuous data were summarised as mean ± standard deviation with 95% confidence interval (CI), or as median and interquartile range when distributional assumptions were not appropriate. Categorical data were reported as frequency and percentage. Binary associations were examined using two-sided Fisher's exact test and expressed as unadjusted odds ratios (ORs) with 95% CIs; degrees of freedom are not applicable to this exact test. A Haldane-Anscombe correction was used to estimate the OR when a 2 × 2 table contained a zero cell. Two limited multivariable logistic regression models were fitted for prolonged ICU and hospital stay using three prespecified variables: ASA class III/IV, Mallampati class III/IV and any reconstruction. Wald tests used one degree of freedom for each coefficient. Perioperative tracheostomy was not adjusted for because only six exposed records were available. Analyses were exploratory; $p<0.05$ was considered statistically significant, and exact p values are reported except when $p<0.001$.

III. Results

Fifty-nine eligible surgical records were included in the final analysis (Figure 1). No included record lacked values required for the primary analyses.

Mean age was 51.81 ± 13.48 years (95% CI 48.30-55.32); median age was 54 years (interquartile range 41-62). Oral-cavity tumours predominated, and Mallampati class III/IV was recorded in more than half of the episodes (Table 1). Nasal intubation and video laryngoscopy were the most frequent airway route and device, respectively. Six episodes included perioperative tracheostomy, while tracheostomy was the primary airway route in one. Prolonged ICU and hospital stay each occurred in 32 (54.2%) records (Table 2).

Oral-cavity tumour site was strongly associated with nasal intubation (OR 211.50, 95% CI 17.29-2587.30; $p<0.001$). Mallampati class III/IV was associated with fibreoptic intubation; a corrected OR was required because no fibreoptic intubation occurred in Mallampati class I/II records (OR 45.49, 95% CI 2.56-807.45; $p<0.001$) (Table 3).

No tested airway route or intubation device had a statistically significant unadjusted association with prolonged ICU or hospital stay. Perioperative tracheostomy had the same imprecise association with both outcomes (OR 4.81, 95% CI 0.53-44.05; $p=0.205$). Reconstruction showed a possible unadjusted association

with prolonged ICU stay (OR 3.50, 95% CI 0.94-13.08; p=0.067) (Table 4). None of the three prespecified variables independently predicted either prolonged outcome in the limited multivariable models (Table 5).

IV. Discussion

This study provides an exploratory analysis of airway management in 59 head and neck cancer surgical records. Four findings are central. First, oral-cavity tumours predominated and were strongly associated with selection of the nasal route. Second, all fibreoptic intubations occurred in records with Mallampati class III/IV, suggesting that preoperative airway assessment influenced device selection. Third, perioperative tracheostomy occurred in six records, although only one episode used tracheostomy as the primary airway route. Fourth, no airway route or device independently predicted prolonged ICU or hospital stay. Although prolonged stay was more frequent with tracheostomy, the estimate was imprecise and should not be interpreted causally.

The study population was younger than that reported by Sturm et al., whose 201-patient oral-cavity cohort had a mean age of 64.19 years.[7] The nearly equal sex distribution also differed from the male predominance in other head and neck cancer series; Siddiqui et al. reported that 72.3% of 400 patients were men.[8] These contrasts may reflect differences in geography, referral patterns, tumour subsites and institutional case mix rather than airway practice.

Mallampati class III/IV was documented in 57.6% of the current records, compared with 49.8% in the Siddiqui cohort.[8] Fibreoptic intubation was selected in 47.1% of Mallampati III/IV records and in none with Mallampati I/II. This is clinically plausible and consistent with contemporary reviews indicating that fibreoptic techniques are preferentially selected when difficulty is anticipated.[3-5] Nevertheless, Mallampati class alone is imperfect. Sturm et al. found that a higher Mallampati class did not independently predict difficult airway or additional attempts.[7] Because mouth opening, thyromental distance, neck movement, mask ventilation, Cormack-Lehane grade and number of attempts were not recorded, this study can describe technique selection but not the incidence of actual difficult intubation.

Nasal intubation was used in 81.4% of records and in 95.9% of oral-cavity cases. This likely reflects the need to keep the oral field accessible during tumour resection and reconstruction, as described in recent airway reviews.[4,5]

The distribution differed from the series by Siddiqui et al., in which nasal intubation was used in 44.25%, oral intubation in 35.5% and tracheostomy in 20.25%.[8] Such differences do not show that one institution's practice is superior. Airway route depends on tumour site, planned surgical access, reconstruction, obstruction and local expertise. In the present data, neither nasal route nor fibreoptic intubation was associated with prolonged ICU or hospital stay, supporting their interpretation as planned management choices rather than direct determinants of resource use.

Six records (10.2%) documented perioperative tracheostomy: one elective preoperative, one after failed intubation and four postoperative. Prolonged ICU and hospital stay occurred in five of the six, compared with 50.9% of records without tracheostomy. The OR of 4.81 suggests a potentially important association, but its 95% CI (0.53-44.05) included the null and was compatible with substantial uncertainty. The data therefore cannot support a causal conclusion.

Larger studies have reported significant associations. Siddiqui et al. found a longer median hospital stay among tracheostomy patients (p=0.0005), while Sturm et al. reported longer mechanical ventilation and hospitalisation among patients undergoing intraoperative tracheostomy.[7,8] Myatra et al. showed that delayed extubation could be used in selected major oral cancer surgery patients as an alternative to routine elective tracheostomy.[9] This remains a clinically important controversy: extensive resection, flap reconstruction, advanced tumour and anticipated oedema may themselves increase length of stay. Because tumour stage, operative duration and prior radiotherapy were unavailable, the independent contribution of tracheostomy could not be separated from underlying complexity.

More than half of the surgical records had ICU stay longer than 24 hours and hospital stay longer than one week. Reconstruction showed a higher unadjusted frequency of prolonged ICU stay, but the adjusted estimate remained non-significant. Mohamed et al. found that renal dysfunction, peripheral vascular disease, heart failure and postoperative complications were associated with longer ICU stay after free-flap reconstruction.[10] Tang et al. likewise reported that ICU transfer and hospital length of stay reflect multiple perioperative factors rather than a single airway intervention.[11] Postoperative pulmonary complications and infections can further prolong recovery,[12,13] while enhanced-recovery pathways and structured critical-care planning provide a broader framework for reducing avoidable variation.[14,15]

The absence of statistically significant predictors in the adjusted models is not proof that clinically relevant relationships are absent. Wide CIs indicate limited precision. The results are best viewed as exploratory institutional estimates that identify variables for prospective collection, particularly tumour stage, prior radiation and surgery, detailed airway measurements, number of attempts, operative duration, flap type and postoperative complications.

A strength of this analysis is reconciliation of denominators and separation of primary airway route from later perioperative tracheostomy. Effect estimates and CIs are reported rather than percentages alone. Limitations include the retrospective single-centre design, small sample, sparse exposure groups, binary categorisation of length of stay and analysis by surgical episode; 59 records represented 57 unique hospital identifiers. Important severity and airway variables were unavailable, actual difficult airway and perioperative safety could not be evaluated comprehensively, and confounding by indication is likely. The regression models should therefore be considered exploratory rather than predictive.

The findings support structured preoperative assessment integrating tumour site, Mallampati class, surgical access and reconstructive requirements. Advanced devices and tracheostomy should be available when indicated, but their use should not be treated as evidence of failure or as the sole explanation for prolonged postoperative care. Future multicentre prospective studies should record standardised difficult-airway variables, first-attempt success, complications, tumour stage and operative complexity to distinguish anticipated difficulty, management strategy and postoperative consequences.

V. Conclusion

Nasal intubation predominated and was associated with oral-cavity surgery, while fibreoptic intubation was selected only in records with Mallampati class III/IV. No airway route or device independently predicted prolonged postoperative stay; these findings support individualised multidisciplinary airway planning.

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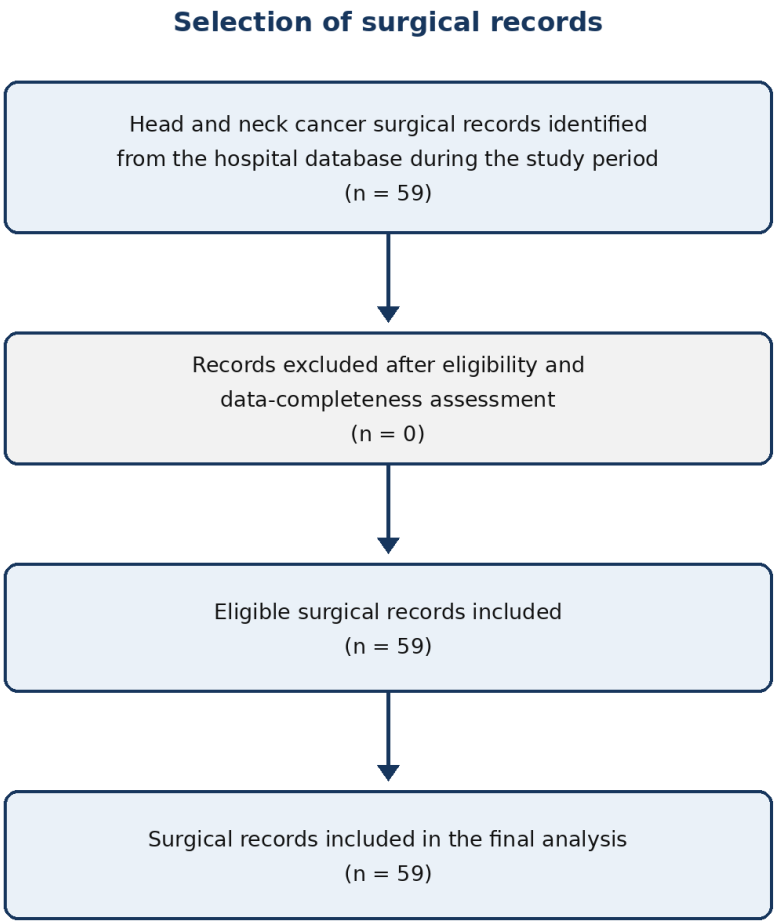


Figure 1. STROBE flow diagram for selection of surgical records.

Table 1. Baseline characteristics of the surgical records (n=59)

Characteristic	Value
Age, years, mean ± SD (95% CI)	51.81 ± 13.48 (48.30-55.32)
Age group: 21–40 years	14 (23.7)
Age group: 41–60 years	28 (47.5)
Age group: >60 years	17 (28.8)
Male sex	30 (50.8)
ASA class I/II	39 (66.1)
ASA class III/IV	20 (33.9)
Mallampati class I/II	25 (42.4)
Mallampati class III/IV	34 (57.6)
At least one recorded comorbidity	31 (52.5)
Hypertension	12 (20.3)
Diabetes mellitus	9 (15.3)
Tuberculosis	5 (8.5)

Characteristic	Value
Chronic obstructive pulmonary disease	2 (3.4)
Anaemia	8 (13.6)
Hypothyroidism	10 (16.9)
Oral-cavity tumour site	49 (83.1)
Buccal mucosa	13 (22.0)
Lateral border of tongue	10 (16.9)
Tongue	6 (10.2)
Lower alveolus	5 (8.5)
Other individual tumour sites	25 (42.4)

Table 2. Airway management, surgical procedure and postoperative outcomes

Variable	n	%
Primary airway route		
Nasal	48	81.4
Oral	10	16.9
Primary tracheostomy	1	1.7
Intubation device		
Video laryngoscope	26	44.1
Fibreoptic bronchoscope	16	27.1
Direct Macintosh laryngoscope	16	27.1
Not applicable: primary tracheostomy	1	1.7
Any perioperative tracheostomy	**6**	**10.2**
Postoperative	4	66.7*
Elective preoperative	1	16.7*
Emergency after failed intubation	1	16.7*
Surgical procedure		
Reconstruction	32	54.2
Local/distant flap	14	23.7
No reconstruction	13	22.0
Postoperative ICU stay >24 hours	32	54.2
Postoperative hospital stay >1 week	32	54.2

**Percentage among the six perioperative tracheostomies. ICU: intensive care unit.*

Table 3. Selected factors associated with airway management strategy

Factor	Strategy	Factor present, n/N (%)	Factor absent, n/N (%)	OR (95% CI)	p value
Oral-cavity tumour site	Nasal route	47/49 (95.9)	1/10 (10.0)	211.50 (17.29–2587.30)	<0.001
Mallampati class III/IV	Fibreoptic intubation	16/34 (47.1)	0/25 (0.0)	45.49 (2.56–807.45)	<0.001

Table 4. Unadjusted associations with prolonged postoperative stay

Factor	Outcome with factor, n/N (%)	Outcome without factor, n/N (%)	OR (95% CI); p value
Postoperative ICU stay >24 hours			
ASA class III/IV	13/20 (65.0)	19/39 (48.7)	1.95 (0.64–5.95); 0.279
Mallampati class III/IV	21/34 (61.8)	11/25 (44.0)	2.06 (0.72–5.87); 0.198
At least one recorded comorbidity	17/31 (54.8)	15/28 (53.6)	1.05 (0.38–2.93); 1.000
Any perioperative tracheostomy	5/6 (83.3)	27/53 (50.9)	4.81 (0.53–44.05); 0.205
Any reconstruction	28/46 (60.9)	4/13 (30.8)	3.50 (0.94–13.08); 0.067
Nasal primary airway route	28/48 (58.3)	4/11 (36.4)	2.45 (0.63–9.51); 0.315
Fibreoptic intubation	10/16 (62.5)	22/43 (51.2)	1.59 (0.49–5.15); 0.560
Oral-cavity tumour site	29/49 (59.2)	3/10 (30.0)	3.38 (0.78–14.68); 0.162
Postoperative hospital stay >1 week			
ASA class III/IV	13/20 (65.0)	19/39 (48.7)	1.95 (0.64–5.95); 0.279
Mallampati class III/IV	22/34 (64.7)	10/25 (40.0)	2.75 (0.95–7.98); 0.070
At least one recorded comorbidity	19/31 (61.3)	13/28 (46.4)	1.83 (0.65–5.15); 0.302
Any perioperative tracheostomy	5/6 (83.3)	27/53 (50.9)	4.81 (0.53–44.05); 0.205
Any reconstruction	27/46 (58.7)	5/13 (38.5)	2.27 (0.64–8.03); 0.224
Nasal primary airway route	27/48 (56.2)	5/11 (45.5)	1.54 (0.41–5.76); 0.739
Fibreoptic intubation	9/16 (56.2)	23/43 (53.5)	1.12 (0.35–3.55); 1.000
Oral-cavity tumour site	28/49 (57.1)	4/10 (40.0)	2.00 (0.50–8.00); 0.488

Table 5. Limited multivariable logistic regression for prolonged postoperative stay

Variable	ICU >24 h: adjusted OR (95% CI)	p value (df=1)	Hospital >1 week: adjusted OR (95% CI)	p value (df=1)
ASA class III/IV	1.37 (0.40–4.70)	0.620	1.26 (0.37–4.34)	0.713
Mallampati class III/IV	1.57 (0.49–5.05)	0.450	2.31 (0.72–7.41)	0.158
Any reconstruction	2.98 (0.77–11.56)	0.114	1.81 (0.48–6.80)	0.377