Original Article

Comparison Of Bed Up Head Elevated Position with Sniffing Position in Rapid Sequence Intubation in Emergency Department.

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ABSTRACT

Background: Tracheal intubation is a vital component of emergency airway management, enabling airway patency and supporting oxygenation and ventilation. It is often required to safely administer sedation and paralysis in critically ill patients undergoing diagnostic or therapeutic procedures. Two common patient positions during intubation are the traditional sniffing position (supine with head elevation) and the bed-up head-elevated (BUHE) position (bed inclined at 20–30°, aligning the external auditory meatus with the sternal notch), which may offer improved glottic visualisation.

Objectives: The primary objective was to compare airway-related complications between the two positions. The secondary objective was to compare intubation time during RSI.

Methodology: A comparative observational study was conducted in the emergency department over two years. A total of 240 patients aged 18–70 were enrolled and equally divided into two groups: BUHE and sniffing position (n=120 each). Primary outcomes included airway-related complications and trauma. Secondary outcomes assessed were intubation time, number of attempts, use of adjuncts, hypoxia, and oesophageal intubation.

Results: The BUHE position resulted in significantly better laryngeal visualisation, reduced intubation time, and decreased reliance on accessory airway measures. It also led to fewer complications compared to the sniffing position during RSI.

Conclusion: The BUHE position offers notable advantages over the sniffing position in rapid sequence intubation. It enhances glottic exposure, shortens intubation time, and reduces airway-related complications. These findings support integrating BUHE positioning into standard emergency intubation protocols to improve patient safety and outcomes.

Keywords: Bed-up head-elevated position, sniffing position, rapid sequence intubation.

INTRODUCTION

Rapid sequence intubation (RSI) is a critical airway management technique designed to rapidly secure the trachea and ensure adequate oxygenation in critically ill patients presenting to the emergency department.(1,2) It is primarily employed to reduce the risk of pulmonary aspiration while facilitating optimal intubating conditions. RSI is commonly performed by emergency physicians, anesthesiologists, and critical care specialists in patients with impaired consciousness, respiratory failure, or altered respiratory mechanic. (1,3) In patients with seizures, agitation, or elevated intracranial pressure, RSI is preferred over awake intubation since it prevents further rises in intracranial pressure by inducing unconsciousness and

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paralysis, thus improving patient comfort and safety.(3,4) The "classical" RSI sequence consists of preoxygenation, intravenous induction with a rapid-onset anesthetic, application of cricoid pressure, administration of a neuromuscular blocking agent, avoidance of bag-mask ventilation, and rapid tracheal intubation. (3,5) Intravenous induction agents such as thiopentone, propofol, and etomidate are commonly used because of their rapid onset of action and short recovery profile, with etomidate often favored for its hemodynamic stability. (4,5) Among neuromuscular blockers, succinylcholine is traditionally considered the drug of choice due to its rapid onset and short duration, although it is associated with several systemic side effects. Rocuronium, with comparable intubating conditions, has emerged as a viable alternative.(6) Proper patient positioning plays a vital role in achieving successful laryngoscopy and endotracheal intubation. The conventional "sniffing position" (SP) or supine sniffing position involves flexion of the lower cervical spine and extension of the upper cervical spine, aligning the oral, pharyngeal, and laryngeal axes to improve glottic visualization. (7) However, in patients with obesity, cervical spine limitations, or airway anatomical challenges, glottic visualization may remain difficult.(8 An alternative position, the Bed-Up-Head-Elevated (BUHE) or ramped position, has been proposed to improve airway management. In this technique, the patient is shifted towards the head of the bed, with the external auditory meatus aligned with the sternal notch by elevating the head of the bed 15–45°.(7,8,9) Evidence suggests that BUHE positioning provides superior laryngeal exposure, higher Percentage of Glottic Opening (POGO) scores, and reduces the lifting force required for laryngoscopy. (10)Additionally, this position improves preoxygenation efficiency, prolongs the safe apnea period, and is particularly beneficial in obese and critically ill patients.(11) Despite its theoretical and practical benefits, RSI is associated with complications such as hypoxemia, hypotension, aspiration, and cardiovascular instability. (12,13)Aspiration risk, though minimized by RSI, persists during both intubation and extubation. (13,14)Risk factors for aspiration include gastroesophageal reflux, hiatal hernia, esophageal pathology, prior bariatric surgery, and delayed gastric emptying. Various scoring systems such as LEMON, Mallampati, MACOCHA, and Cormack-Lehane classification are employed to predict airway difficulty and guide preparation.(15) Given the life-saving nature of RSI, optimizing techniques for airway securement is essential. The potential benefits of the BUHE position over the traditional SP in terms of intubation success rates, laryngeal visualization, and complication profile warrant systematic evaluation. This study aims to compare the effectiveness of the Bed-Up-Head-Elevated position versus the Sniffing Position during rapid sequence intubation in the emergency department and provide evidence to guide safe and effective airway management practice.

MATERIAL AND METHODS

Study Design and Setting: This comparative observational study was conducted over two years in the Emergency Department of NH Rabindranath Tagore International Institute of Cardiac Sciences, a tertiary care center in Kolkata, India.

Participants: A total of 240 patients aged 18–70 years who required endotracheal intubation in the emergency department were enrolled using consecutive sampling. Patients were allocated to one of two groups based on the intubation position: Bed Up Head Elevated (BUHE) or Sniffing Position (SP), with 120 patients in each group.

Inclusion and Exclusion Criteria

Patients aged between 18 and 70 years who presented to the Emergency Department of NH Rabindranath Tagore International Institute of Cardiac Sciences and required endotracheal intubation were eligible for inclusion in the study. Only those who provided written informed consent, either directly or via a legal guardian, were enrolled. Patients were excluded if they had contraindications to neck extension, a known or anticipated difficult airway, a body mass index (BMI) greater than 35, or required crash intubation due to the emergent nature of their condition. These criteria ensured a homogenous study population suitable for comparison of intubation techniques while minimizing confounding variables that could impact airway management or visualization.

Sample Size Calculation

Sample size was calculated based on a previous study by Khandelwal et al. assuming airway-related complication rates of 22.6% in SP and 9.3% in BUHE groups. (3) With α = 0.05 and power = 80%, the required sample size was 238, rounded up to 240 (120 per group). Formula:

$$n = \frac{[Z_{\frac{\alpha}{2}}\sqrt{P_0(1-P_0)} + Z_\beta\sqrt{P_1(1-P_1)}]^2}{(P_0 - P_1)^2}$$

$$n = \frac{[1.96\sqrt{0.226(1-0.226)} + 0.84\sqrt{0.093(1-0.093)}]^2}{(0.093 - 0.226)^2}$$

n = 238

Study Procedure:

Patients requiring intubation were screened for eligibility and assigned to either BUHE or SP groups. BUHE positioning was standardized using an angle meter to achieve a 20–30° head elevation, aligning the external auditory meatus with the sternal notch. RSI was performed using standard protocols across both groups, including administration of induction and paralytic agents. The procedure was performed by junior or senior consultants, and outcomes were recorded immediately.
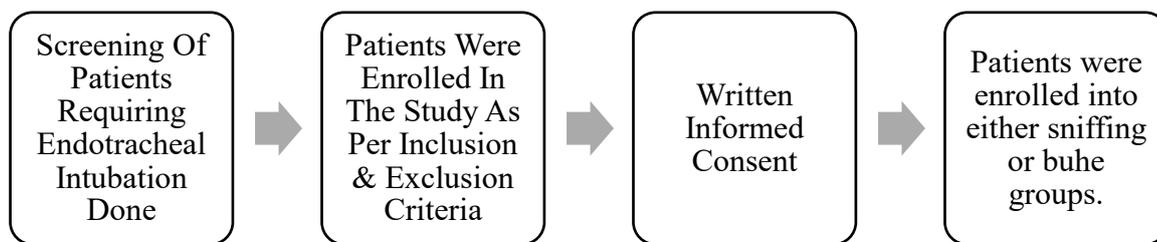
Outcome Measures

The primary outcome of the study was the occurrence of airway-related complications during rapid sequence intubation. These included trauma to the oral cavity (such as bleeding, broken teeth, or injury to the tongue and surrounding structures), hypoxia, hypotension, bradycardia, esophageal intubation, and cardiac arrest. Secondary outcomes included the time taken for successful intubation, defined as the duration in seconds from the insertion of the laryngoscope blade past the incisors to the confirmation of endotracheal tube placement by auscultation. Additional secondary measures included the number of intubation attempts, the use of airway adjuncts or external laryngeal manipulation to facilitate intubation, and the incidence of peri-intubation hypoxia, defined as a drop in oxygen saturation (SpO$_2$) below 90% during the procedure.

Data Management and Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS v25.(16) Descriptive statistics were reported as mean ± SD for continuous variables and percentages for categorical variables. Group comparisons were performed using t-tests or Mann–Whitney U tests for continuous variables and chi-square tests for categorical variables. A p-value < 0.05 was considered statistically significant.

Ethics Approval and Consent

The study received approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants or their legal representatives. All data were anonymized and stored securely with restricted access to authorized personnel.

RESULT

Table 1 shows the total of 240 patients requiring rapid sequence intubation were enrolled, with 120 allocated to the Bed Up Head Elevated (BUHE) position and 120 to the traditional sniffing position (SP). Baseline demographic characteristics showed no significant differences between groups. Participants were predominantly elderly (mean age 61-70 years: BUHE 37.5% vs SP 39.2%, p=0.23) with comparable gender distribution (male: BUHE 46.7% vs SP 59.2%, p=0.052) and BMI profiles (normal BMI 18.5-22.9 kg/m²: BUHE 32.5% vs SP 45.8%, p=0.09). Comorbidities were highly prevalent, including diabetes mellitus (71.3%), hypertension (68.3%), and coronary artery disease (45.8%), with no intergroup differences (p=0.4). The most common intubation indications were low Glasgow Coma Scale (32.1%) and hemodynamic instability (24.2%), which were evenly distributed (p=0.18).

Table 1: Baseline Demographics and Clinical Characteristics

Characteristic	BUHE (n=120)	Sniffing (n=120)	Total (n=240)	*p* value
Age (years)				
≤30	7 (5.8%)	10 (8.3%)	17 (7.1%)	
31–40	10 (8.3%)	6 (5.0%)	16 (6.7%)	
41–50	30 (25.0%)	19 (15.8%)	49 (20.4%)	0.23
51–60	28 (23.3%)	38 (31.7%)	66 (27.5%)	
61–70	45 (37.5%)	47 (39.2%)	92 (38.3%)	
Gender				
Male	56 (46.7%)	71 (59.2%)	127 (52.9%)	0.052

Characteristic	BUHE (n=120)	Sniffing (n=120)	Total (n=240)	*p* value
Female	64 (53.33%)	49 (40.83)	113 (47.08%)	
BMI (kg/m²)				
18.5–22.9 (Normal)	39 (32.5%)	55 (45.8%)	94 (39.2%)	0.09
23–24.9 (Overweight)	27 (22.5%)	25 (20.8%)	52 (21.7%)	
25–29.9 (Obese I)	46 (38.3%)	30 (25.0%)	76 (31.7%)	
>30 (Obese II/III)	8 (6.7%)	10 (8.3%)	18 (7.5%)	
Comorbidities				
Diabetes Mellitus	88 (73.3%)	83 (69.2%)	171 (71.3%)	0.40
Hypertension	76 (63.3%)	88 (73.3%)	164 (68.3%)	
Coronary Artery Disease	48 (40.0%)	62 (51.7%)	110 (45.8%)	
Intubation Indication				
Low GCS	43 (35.8%)	34 (28.3%)	77 (32.1%)	0.18
Hemodynamic Instability	27 (22.5%)	31 (25.8%)	58 (24.2%)	
Severe Hypoxia	17 (14.2%)	30 (25.0%)	47 (19.6%)	

Above table shows the notable baseline physiological differences emerged: The BUHE group had significantly higher prevalence of bradycardia (pulse <90 bpm: BUHE 48.3% vs SP 37.5%, p=0.01), while the SP group exhibited worse pre-intubation hypoxia (SpO_2 <85%: SP 35.8% vs BUHE 16.7%, p=0.003). Mean arterial pressure was comparable between groups (p=0.36).

Table 2: Pre-intubation Physiological Parameters

Parameter	BUHE (n=120)	Sniffing (n=120)	*p*-value
Pulse Rate (bpm)			
<90 (Bradycardia)	58 (48.3%)	45 (37.5%)	0.01
90–109	29 (24.2%)	18 (15.0%)	
110–159	26 (21.7%)	41 (34.2%)	
SpO_2 (%)			
<85 (Severe Hypoxia)	20 (16.7%)	43 (35.8%)	0.003
85–94 (Mild Hypoxia)	56 (46.7%)	36 (30.0%)	

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Parameter	BUHE (n=120)	Sniffing (n=120)	*p*-value
≥95 (Normal)	32 (26.7%)	26 (21.7%)	
Mean Arterial Pressure			
<60 mmHg	23 (19.2%)	22 (18.3%)	
60–100 mmHg	73 (60.8%)	71 (59.2%)	0.36
>100 mmHg	11 (9.2%)	11 (9.2%)	

Above table shows that the BUHE demonstrated superior intubation outcomes across multiple metrics. Laryngeal visualization was significantly improved, with Cormack-Lehane Grade 1 views achieved in 57.5% of BUHE patients versus 40.0% in SP (p=0.032), while Grade 3-4 views were reduced in BUHE (13.3% vs 25.0%). The mean time to successful intubation was substantially shorter in the BUHE group (18.06 ± 1.50 seconds vs 20.06 ± 2.23 seconds, p<0.000001). BUHE also reduced the need for accessory measures (bougie/external manipulation) by nearly half (24.2% vs 41.7% in SP; OR=2.2, 95%CI:1.3-3.89, p=0.003).

Table 3: Intubation Process Outcomes

Outcome	BUHE (n=120)	Sniffing (n=120)	p-value	Effect Size
Cormack-Lehane Grade				
Grade 1 (Full Glottic View)	69 (57.5%)	48 (40.0%)		
Grade 2 (Partial View)	35 (29.2%)	42 (35.0%)	0.032	
Grade 3–4 (Poor/No View)	16 (13.3%)	30 (25.0%)		
Time to Intubate (sec)	18.06 ± 1.50	20.06 ± 2.23	<0.00001	Δ = 2.0 s
Accessory Measures Used	29 (24.2%)	50 (41.7%)	0.003	OR = 2.2 (1.3–3.9)
Number of Attempts	1.22 ± 0.47	1.33 ± 0.60	0.11	

Above table represents the complication rates significantly favored BUHE positioning: Peri-intubation hypoxia occurred in 6.7% of BUHE patients versus 15.0% in SP (OR=2.47, 95%CI:1.03-5.92), airway bleeding in 13.3% vs 24.2% (OR=2.07, 95%CI:1.06-4.06), and bradycardia in 7.5% vs 21.7% (OR=3.41, 95%CI:1.52-7.64). Hypotension and cardiac arrest rates showed no significant differences.

Table 4: Peri-intubation Complications

Complication	BUHE (n=120)	Sniffing (n=120)	*p* value	Odds Ratio (95% CI)
Peri-intubation Hypoxia	8 (6.7%)	18 (15.0%)	0.03	2.47 (1.03–5.92)
Airway Bleeding	16 (13.3%)	29 (24.2%)	0.03	2.07 (1.06–4.06)
Bradycardia	9 (7.5%)	26 (21.7%)	0.001	3.41 (1.52–7.64)

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Complication	BUHE (n=120)	Sniffing (n=120)	*p* value	Odds Ratio (95% CI)
Hypotension	26 (21.7%)	28 (23.3%)	0.75	-
Cardiac Arrest	3 (2.5%)	6 (5.0%)	0.31	-

Above table depicts that the Operator experience significantly influenced outcomes in BUHE positioning. Senior consultants achieved 4.01-fold higher first-attempt success rates versus juniors specifically in BUHE (95%CI:1.11-14.48, p=0.02), an effect absent in SP (p=0.74). Seniors also performed faster intubations in both positions (BUHE: 16.85±1.39s vs juniors' 18.68±1.14s; SP: 18.98±2.27s vs 20.60±2.01s; p<0.0001 for both). The number of intubation attempts did not differ significantly between positions overall (BUHE mean 1.22 vs SP 1.33, p=0.11).

Table 5: Impact of Operator Experience on Intubation Outcomes

Outcome	BUHE Position	Sniffing Position		
	Senior	Junior	Senior	Junior
First-Attempt Success	38/41 (92.7%)	60/79 (75.9%)*	33/40 (82.5%)	64/80 (80.0%)
Time to Intubate (sec)	16.85 ± 1.39	18.68 ± 1.14†	18.98 ± 2.27	20.60 ± 2.01†

*OR = 4.01 (95% CI: 1.11–14.48; p=0.02) for seniors vs juniors in BUHE
†p<0.0001 for seniors vs juniors within same position

DISUSSION

This comparative observational study demonstrates that the Bed Up Head Elevated (BUHE) position significantly optimizes rapid sequence intubation (RSI) outcomes compared to the traditional sniffing position in emergency settings. Our findings reveal three critical advantages: superior laryngeal visualization, reduced procedural time, and fewer complications. The 57.5% incidence of Cormack-Lehane Grade 1 visualization in the BUHE group versus 40% in the sniffing position (p=0.032) corroborates the biomechanical rationale for gravitational alignment. By elevating the torso to 25-30°, BUHE achieves optimal triple-axis alignment (oral-pharyngeal-laryngeal) while reducing soft tissue obstruction through caudal displacement of laryngeal structures. This functionally expands the glottic opening area, consistent with Lee et al.'s report of 66.8% POGO scores in back-up positions versus 42.2% in supine positions.(17) The significantly reduced intubation time (18.06±1.50s BUHE vs 20.06±2.23s sniffing; p<0.000001) likely stems from diminished lifting force requirements—laryngoscope handle angulation decreases from 45° in sniffing to 20° in BUHE, minimizing tissue strain and operator fatigue.

The complication profile further underscores BUHE's safety advantages. Significantly lower odds were observed for peri-intubation hypoxia (OR=2.47, 95%CI:1.03-5.92), airway bleeding (OR=2.07, 95%CI:1.06-4.06), and bradycardia (OR=3.41, 95%CI:1.52-7.64) in the BUHE group. These benefits likely derive from multifactorial physiological mechanisms: enhanced preoxygenation through increased functional residual capacity (reducing hypoxemia risk during apnea), diminished mechanical trauma from reduced adjunct use (24.17% BUHE vs 41.67% sniffing; p=0.003), and attenuated vagal stimulation due to lower laryngoscope force vectors. Our complication rates align with Khandelwal et al.'s report of 9.3% adverse events in back-up versus 22.6% in supine positioning, but extend these findings by quantifying specific risk reductions in emergency settings. (18)

Notably, BUHE amplified the expertise advantage of senior clinicians. While first-attempt success rates showed no significant difference between positions overall (p=0.11), senior consultants achieved 4.01-fold higher success versus juniors specifically in BUHE positioning (95%CI:1.11-14.48; p=0.02)—an effect absent in the sniffing position. This suggests BUHE's biomechanical benefits are best leveraged by experienced operators who can optimize view acquisition techniques. The 18% reduction in intubation time for seniors versus juniors in BUHE further supports its role in high-stakes scenarios where rapid airway control is critical.

When contextualized with existing literature, our visualization findings align with Lee et al.'s RCT (56.2% CL Grade 1-2 in ramped vs 39.2% sniffing) but contrast with Tsan et al.'s video laryngoscopy comparison where GlideScope outperformed BUHE. This discrepancy highlights that BUHE's advantages are most pronounced in direct laryngoscopy—the dominant technique in resource-limited emergency settings.(19) The 32% reduction in adjunct use with BUHE mirrors

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Lee et al. report of 34% need for alternatives in ramped versus 56% in sniffing positions. (17) However, the absence of significant attempt reduction (1.22 BUHE vs 1.33 sniffing; p=0.11) suggests position alone cannot overcome profound anatomical challenges, reinforcing the need for comprehensive airway assessment.

Several limitations warrant consideration. Our single-center design may affect generalizability, though the diverse comorbidities (71.25% diabetes, 68.33% hypertension) reflect real-world emergency populations. Unblinded operators introduce potential performance bias, mitigated by standardized RSI protocols. Exclusion of BMI>35 patients precludes obesity-specific analysis—a significant gap given Ortiz VE et al.'s findings on functional residual capacity improvement in ramped obese patients. Baseline SpO$_2$ differences (more hypoxia in BUHE group) were addressed through multivariate adjustment, confirming position-independent effects. (20)

These findings advocate for incorporating BUHE positioning into emergency RSI protocols as a low-cost, high-impact intervention. Implementation requires: 1) bed angle standardization tools (e.g., integrated protractors), 2) training modules emphasizing hip flexion to prevent sliding, and 3) pre-intubation checklists verifying sternal notch-ear alignment. Future research should validate BUHE in pediatric/obese populations, quantify hemodynamic impacts via continuous monitoring, evaluate hybrid approaches (BUHE + video laryngoscopy), and assess long-term outcomes like ventilator-free days. By addressing these priorities, BUHE positioning may emerge as a foundational element in the evolution of evidence-based emergency airway management.

Limitations:
- Single-center study limits generalizability.
- Exclusion of BMI >35 prevents obesity-specific conclusions.
- Unblinded operators may introduce bias.

CONCLUSION
BUHE positioning during RSI is superior to the traditional sniffing position in emergency settings. Routine adoption may improve patient safety and intubation success
Conflict of interest: None declared
Funding: Nil.

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