

Research Article

# Comparison of Direct and Video Laryngoscopy in Patients with Restricted Cervical Spine Movement

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## Abstract

**Background:** Tracheal intubation in patients with restricted cervical spine movement is challenging because immobilisation may impair glottic visualisation and increase intubation difficulty. Video laryngoscopy may provide improved laryngeal visualisation without requiring substantial alignment of the airway axes. This study compared conventional Macintosh direct laryngoscopy with McGrath video laryngoscopy during manual in-line stabilisation.

**Methods:** This prospective randomized comparative study included 100 adult patients undergoing elective surgery under general anaesthesia. Patients were randomly allocated to Macintosh direct laryngoscopy (Group DL, n=50) or McGrath video laryngoscopy (Group VL, n=50). Cervical spine movement was restricted using manual in-line stabilisation. The primary outcome was time to successful tracheal intubation. Secondary outcomes included Cormack-Lehane grade, POGO score, first-attempt success, Intubation Difficulty Scale (IDS), requirement for optimisation manoeuvres, haemodynamic changes, and airway-related complications.

**Results:** Cormack-Lehane grade I view was obtained in 76.0% of patients with McGrath compared with 42.0% with Macintosh, while the mean POGO score was significantly higher with McGrath ( $86.2 \pm 13.7$  vs  $67.4 \pm 20.1$ ;  $p < 0.001$ ). First-attempt success was significantly greater with McGrath (94.0% vs 80.0%;  $p = 0.037$ ), and the median IDS score was lower [1 (IQR 0-2) vs 2 (IQR 1-4);  $p < 0.001$ ]. Optimisation manoeuvres were required less frequently with McGrath (16.0% vs 42.0%;  $p = 0.004$ ). Mean intubation time was comparable between the groups ( $48.9 \pm 16.2$  vs  $43.6 \pm 14.8$  seconds;  $p = 0.091$ ). Haemodynamic responses and airway-related complications were also comparable.

**Conclusion:** McGrath video laryngoscopy provided superior glottic visualisation, higher first-attempt success, and easier intubation with fewer optimisation manoeuvres than conventional Macintosh direct laryngoscopy during cervical spine immobilisation. However, intubation time, haemodynamic responses, and airway-related complications were comparable between the techniques.

**Keywords:** Cervical Spine Immobilisation, Direct Laryngoscopy, Video Laryngoscopy, McGrath Videolaryngoscope, Macintosh Laryngoscope, Manual In-Line Stabilisation, Tracheal Intubation.

## INTRODUCTION

Airway management in patients with restricted cervical spine movement is a major challenge in anaesthetic and emergency care. Such restriction may be encountered in patients with suspected or confirmed cervical spine injury, degenerative cervical disease, previous cervical surgery, ankylosing disorders, or those requiring cervical immobilisation.[1] In patients with actual or suspected cervical spine instability, tracheal intubation must be accomplished effectively while minimising unnecessary cervical movement, as excessive manipulation may potentially contribute to secondary neurological injury.[2] Manual in-line

stabilisation (MILS) is commonly used to restrict cervical spine movement during airway management. However, maintaining the head and neck in a neutral position limits optimal positioning for conventional laryngoscopy and may impair glottic visualisation. Cervical collars can additionally reduce mouth opening.[3] Consequently, cervical immobilisation may result in higher Cormack-Lehane grades, increased requirement for optimisation manoeuvres, and greater difficulty in tracheal intubation. Repeated or prolonged intubation attempts may further increase the risk of hypoxaemia, airway trauma, and haemodynamic disturbances.[4] Conventional

direct laryngoscopy using a Macintosh laryngoscope remains a widely used technique for tracheal intubation. It requires a direct line of sight to the glottis, which generally involves appropriate positioning of the head and some degree of cervical movement.[5] When cervical movement is restricted by MILS or external immobilisation, obtaining an adequate laryngeal view may become difficult. This limitation has encouraged the use of alternative airway devices that provide glottic visualisation without requiring substantial alignment of the oral, pharyngeal, and laryngeal axes.[6] Video laryngoscopy has emerged as an important alternative, particularly in anticipated difficult airways. Video laryngoscopes incorporate a camera near the distal portion of the blade and provide an indirect, magnified view of the laryngeal inlet on a screen. [7,8] As direct alignment of the airway axes is less critical, these devices may facilitate glottic visualisation with less requirement for head extension. Several studies have demonstrated improved laryngeal views and higher first-attempt intubation success with video laryngoscopy compared with conventional direct laryngoscopy during cervical spine immobilisation. [9,10] However, improved glottic visualisation does not necessarily result in easier or faster tracheal intubation. Advancement of the endotracheal tube through the vocal cords may remain challenging despite an adequate video-assisted view.[11] Intubation performance may also be influenced by blade design, stylet use, operator experience, and the degree of cervical immobilisation. Furthermore, studies have not consistently demonstrated a meaningful reduction in cervical spine movement with video laryngoscopy compared with direct laryngoscopy.[12] The McGrath® videolaryngoscope provides indirect visualisation of the glottis without requiring the degree of head extension generally associated with conventional Macintosh laryngoscopy and may therefore be advantageous when cervical movement is restricted.[13] The present study was undertaken to compare conventional Macintosh direct laryngoscopy with McGrath video laryngoscopy in adult patients with restricted cervical spine movement produced by manual in-line stabilisation.

## **MATERIALS AND METHODS**

This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology. The study was conducted in

accordance with the principles of the Declaration of Helsinki. A total of 100 adult patients scheduled to undergo elective surgical procedures under general anaesthesia requiring orotracheal intubation were enrolled. Restricted cervical spine movement was simulated using manual in-line stabilisation (MILS) during laryngoscopy and tracheal intubation. Patients were randomly allocated into two groups of 50 patients each:

- Group DL (n=50): Tracheal intubation was performed using a conventional Macintosh direct laryngoscope.
- Group VL (n=50): Tracheal intubation was performed using the McGrath® video laryngoscope.

## **Inclusion Criteria**

Patients aged 18–65 years, of either sex, belonging to American Society of Anesthesiologists (ASA) physical status I or II, and undergoing elective surgery under general anaesthesia requiring orotracheal intubation were included in the study.

## **Exclusion Criteria**

Patients with anticipated difficult airway unrelated to cervical immobilisation, mouth opening <2.5 cm, upper airway pathology, facial or maxillofacial abnormalities, increased risk of aspiration, emergency surgery, severe cardiopulmonary disease, or contraindication to any of the study procedures were excluded. Patients in whom more than two attempts at intubation were required were also considered for rescue airway management according to the institutional difficult-airway protocol.

## **Randomisation and Group Allocation**

Patients were randomly assigned to either Group DL or Group VL in a 1:1 ratio using a computer-generated randomisation sequence. Group allocation was concealed using sequentially numbered, opaque, sealed envelopes, which were opened immediately before induction of anaesthesia.

## **Pre-Anaesthetic Assessment**

All patients underwent routine pre-anaesthetic evaluation before surgery. Demographic characteristics including age, sex, weight, height, body mass index (BMI), and ASA physical status were recorded. Airway assessment included mouth opening, modified Mallampati class, thyromental distance, and other relevant predictors of difficult intubation.

Standard fasting guidelines were followed. Patients received premedication according to the institutional protocol.

#### **Anaesthetic Technique**

On arrival in the operating room, standard monitoring consisting of electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography was instituted. Baseline heart rate, blood pressure, and peripheral oxygen saturation were recorded.

Patients were preoxygenated with 100% oxygen for 3 minutes. General anaesthesia was induced using an intravenous induction agent and opioid in appropriate weight-based doses. After confirming adequate mask ventilation, a neuromuscular blocking agent was administered. Patients were ventilated with oxygen until adequate neuromuscular relaxation had been achieved.

#### **Manual In-Line Stabilisation**

Before laryngoscopy, an assistant applied manual in-line stabilisation to simulate restricted cervical spine movement. The assistant maintained the patient's head and neck in a neutral position by stabilising the mastoid processes and preventing flexion, extension, or rotational movement of the cervical spine. The same technique of MILS was maintained throughout laryngoscopy and tracheal intubation in both groups.

#### **Laryngoscopy and Tracheal Intubation**

In Group DL, laryngoscopy was performed using an appropriately sized Macintosh blade. The laryngeal view was assessed without releasing manual in-line stabilisation, and tracheal intubation was subsequently performed using an appropriately sized cuffed endotracheal tube. In Group VL, laryngoscopy was performed using the McGrath® video laryngoscope with an appropriately sized blade. The glottis was visualised on the video screen, and a cuffed endotracheal tube, shaped using an appropriate stylet when required, was advanced through the vocal cords.

All intubations were performed by an anaesthesiologist experienced in the use of both devices. Manual in-line stabilisation was maintained throughout the procedure. Successful tracheal intubation was confirmed by bilateral chest expansion, auscultation of bilateral breath sounds, and the presence of a continuous end-tidal carbon dioxide waveform on capnography.

#### **Assessment of Laryngoscopic View**

The laryngoscopic view was graded according to the Cormack–Lehane classification:

Grade I: Complete view of the glottis  
Grade II: Partial view of the glottis  
Grade III: Only the epiglottis visible  
Grade IV: Neither the epiglottis nor glottis visible.

The percentage of glottic opening (POGO) score was also recorded, where applicable, with 0% representing no visualisation of the glottis and 100% representing complete visualisation from the anterior commissure to the interarytenoid notch.

#### **Intubation Time**

The primary outcome was the time required for successful tracheal intubation. Intubation time was defined as the interval from insertion of the laryngoscope blade between the teeth until confirmation of successful tracheal intubation by the appearance of the first continuous end-tidal carbon dioxide waveform. If more than one attempt was required, the cumulative duration of all attempts was recorded.

#### **Intubation Attempts and Success**

An intubation attempt was defined as insertion of the laryngoscope blade into the oral cavity with the intention of tracheal intubation. First-attempt success and overall intubation success were recorded. If tracheal intubation could not be achieved within 120 seconds, if peripheral oxygen saturation decreased below 92%, or if more than two attempts were required, the study procedure was discontinued and airway management was performed according to the institutional difficult-airway protocol.

#### **Ease of Intubation and Optimisation Manoeuvres**

The requirement for additional manoeuvres, including external laryngeal manipulation, adjustment of head position where clinically permissible, use or repositioning of a stylet, or other optimisation manoeuvres, was documented. The difficulty of tracheal intubation was assessed using the Intubation Difficulty Scale (IDS), where applicable. An IDS score of 0 represented easy intubation, a score of 1–5 represented slight difficulty, and a score >5 represented moderate-to-major difficulty.

#### **Haemodynamic Assessment**

Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and peripheral oxygen saturation were recorded at baseline, immediately before laryngoscopy,

immediately after successful intubation, and at predefined intervals following intubation.

### Airway-Related Complications

Patients were assessed for complications associated with laryngoscopy and tracheal intubation. These included oxygen desaturation, visible blood on the laryngoscope blade or endotracheal tube, dental or oral trauma, mucosal injury, and other immediate airway-related complications. Postoperative sore throat and hoarseness were assessed during the postoperative period where applicable.

### Outcome Measures

The primary outcome measure was the time required for successful tracheal intubation. Secondary outcome measures included Cormack–Lehane grade, POGO score, first-attempt intubation success, overall intubation success, number of intubation attempts, Intubation Difficulty Scale score, requirement for optimisation manoeuvres, haemodynamic changes, and airway-related complications.

### Statistical Analysis

Data were entered into Microsoft Excel and analysed using an SPSS .21 statistical software package. Continuous variables were expressed as mean  $\pm$  standard deviation for normally distributed data and median with interquartile range for non-normally distributed data. Categorical variables were presented as

frequencies and percentages. The Shapiro–Wilk test was used to assess the normality of continuous variables. Normally distributed continuous variables were compared between the two groups using the independent-samples Student's t-test, while non-normally distributed variables were compared using the Mann–Whitney U test. Categorical variables, including first-attempt success, Cormack–Lehane grade, requirement for optimisation manoeuvres, and complications, were compared using the Chi-square test or Fisher's exact test, as appropriate. Repeated haemodynamic measurements were analysed using repeated-measures analysis of variance or an appropriate non-parametric alternative

### RESULTS

A total of 100 patients were included in the study and randomized equally into the Macintosh direct laryngoscopy group (Group DL, n=50) and McGrath video laryngoscopy group (Group VL, n=50). All patients completed the study and were included in the final analysis. The two groups were comparable with respect to age, sex, body mass index (BMI), ASA physical status, mouth opening, thyromental distance, and modified Mallampati class. The mean age was  $41.8 \pm 12.6$  years in Group DL and  $42.5 \pm 11.9$  years in Group VL ( $p=0.775$ ). Mean BMI was also comparable between the groups ( $25.7 \pm 3.4$  vs  $26.1 \pm 3.6$  kg/m<sup>2</sup>;  $p=0.568$ ). No statistically significant differences were observed in any baseline demographic or airway parameter (Table 1).

Table 1. Baseline Demographic and Airway Characteristics

| Parameter                                | Group DL (n=50) | Group VL (n=50) | p-value |
|------------------------------------------|-----------------|-----------------|---------|
| Age (years), mean $\pm$ SD               | $41.8 \pm 12.6$ | $42.5 \pm 11.9$ | 0.775   |
| Male, n (%)                              | 28 (56.0)       | 29 (58.0)       | 0.840   |
| Female, n (%)                            | 22 (44.0)       | 21 (42.0)       |         |
| BMI (kg/m <sup>2</sup> ), mean $\pm$ SD  | $25.7 \pm 3.4$  | $26.1 \pm 3.6$  | 0.568   |
| ASA I, n (%)                             | 31 (62.0)       | 30 (60.0)       | 0.838   |
| ASA II, n (%)                            | 19 (38.0)       | 20 (40.0)       |         |
| Mouth opening (cm), mean $\pm$ SD        | $4.3 \pm 0.5$   | $4.4 \pm 0.6$   | 0.366   |
| Thyromental distance (cm), mean $\pm$ SD | $6.8 \pm 0.7$   | $6.9 \pm 0.8$   | 0.507   |
| Mallampati I, n (%)                      | 17 (34.0)       | 18 (36.0)       | 0.964   |
| Mallampati II, n (%)                     | 27 (54.0)       | 26 (52.0)       |         |
| Mallampati III, n (%)                    | 6 (12.0)        | 6 (12.0)        |         |

The McGrath video laryngoscope provided significantly better glottic visualization than the Macintosh direct laryngoscope. Cormack–Lehane grade I view was obtained in 76.0% of patients in Group VL compared with 42.0% in Group DL. Conversely, grade III view occurred in 2.0% and 18.0% of patients, respectively.

The overall distribution of Cormack–Lehane grades differed significantly between the groups ( $p<0.001$ ). The mean POGO score was also significantly higher with video laryngoscopy ( $86.2 \pm 13.7\%$ ) than with direct laryngoscopy ( $67.4 \pm 20.1\%$ ;  $p<0.001$ ) (Table 2)( Figure 1)

Table 2. Comparison of Laryngoscopic View

| Parameter                     | Group DL (n=50) | Group VL (n=50) | p-value |
|-------------------------------|-----------------|-----------------|---------|
| Cormack–Lehane Grade I, n (%) | 21 (42.0)       | 38 (76.0)       | <0.001  |
| Grade II, n (%)               | 20 (40.0)       | 11 (22.0)       |         |
| Grade III, n (%)              | 9 (18.0)        | 1 (2.0)         |         |
| Grade IV, n (%)               | 0               | 0               |         |
| Grade I–II, n (%)             | 41 (82.0)       | 49 (98.0)       | 0.008   |
| Grade III–IV, n (%)           | 9 (18.0)        | 1 (2.0)         |         |
| POGO score (%), mean ± SD     | 67.4 ± 20.1     | 86.2 ± 13.7     | <0.001  |

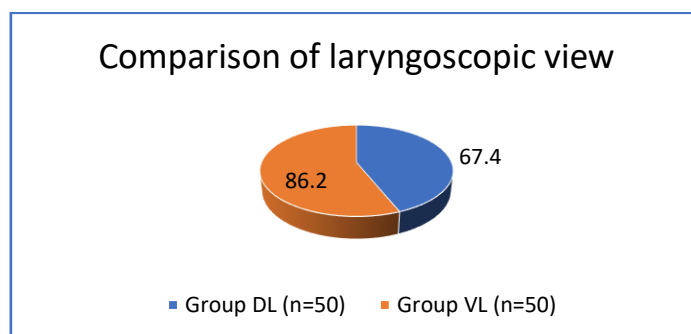
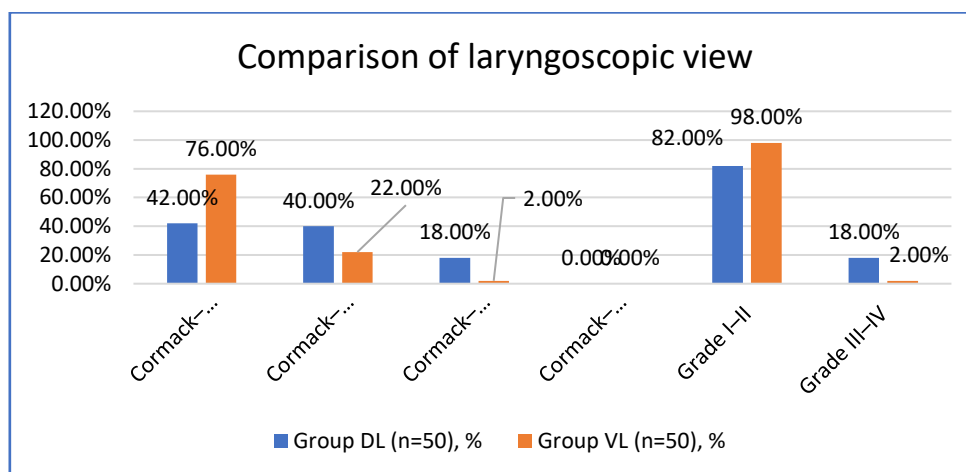


Figure 1. Comparison of Laryngoscopic View

The mean time required for successful tracheal intubation was  $43.6 \pm 14.8$  seconds with direct laryngoscopy and  $48.9 \pm 16.2$  seconds with video laryngoscopy. Although intubation took approximately 5 seconds longer with the McGrath device, the difference did not reach

statistical significance ( $p=0.091$ ). First-attempt intubation success was significantly higher in Group VL than Group DL (94.0% vs 80.0%;  $p=0.037$ ). Overall successful intubation was achieved in all patients in Group VL and 98.0% of patients in Group DL (Table 3)(Figure 2).

Table 3. Comparison of Intubation Time, Attempts, and Success

| Parameter                           | Group DL (n=50) | Group VL (n=50) | p-value |
|-------------------------------------|-----------------|-----------------|---------|
| Intubation time (s), mean ± SD      | 43.6 ± 14.8     | 48.9 ± 16.2     | 0.091   |
| Successful on first attempt, n (%)  | 40 (80.0)       | 47 (94.0)       | 0.037   |
| Successful on second attempt, n (%) | 9 (18.0)        | 3 (6.0)         | 0.065   |
| Failed intubation, n (%)            | 1 (2.0)         | 0               | 1.000   |
| Overall success, n (%)              | 49 (98.0)       | 50 (100.0)      | 1.000   |

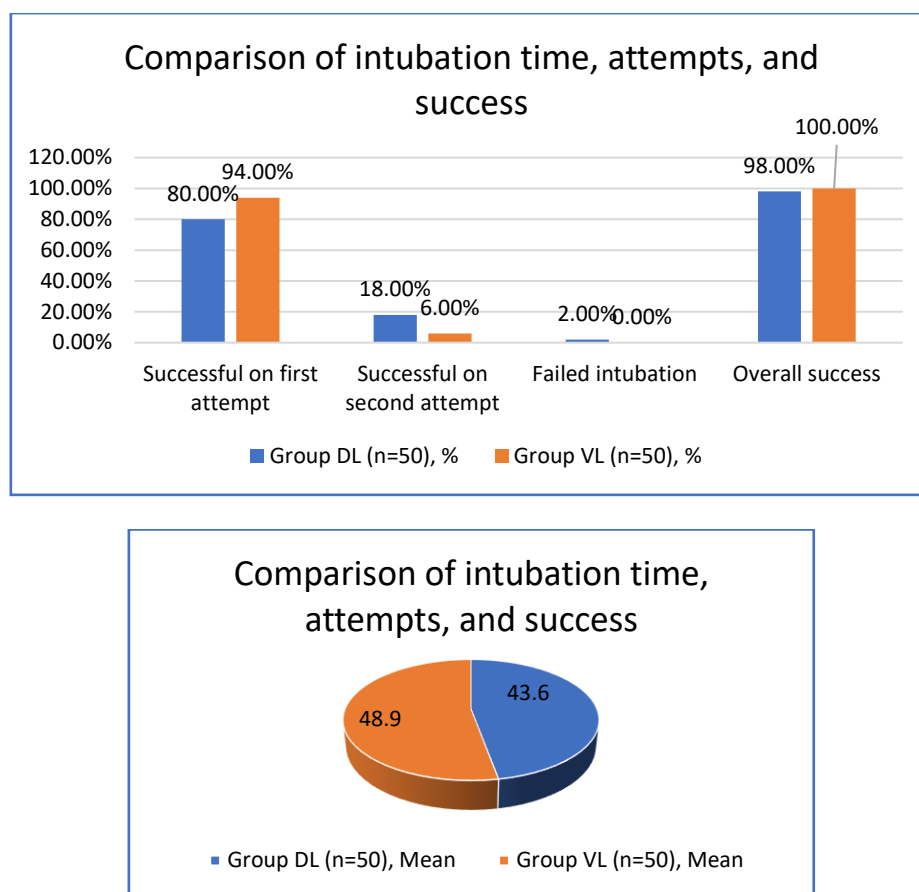


Figure 2. Comparison of Intubation Time, Attempts, and Success

Intubation was significantly easier with the McGrath video laryngoscope. The median Intubation Difficulty Scale (IDS) score was 2 (IQR 1–4) in Group DL compared with 1 (IQR 0–2) in Group VL ( $p < 0.001$ ). An IDS score of 0, indicating easy intubation, was observed in 38.0% of patients in Group VL compared with

16.0% in Group DL. Additional optimisation manoeuvres were required significantly more frequently with direct laryngoscopy (42.0% vs 16.0%;  $p = 0.004$ ). External laryngeal manipulation was required in 36.0% of Group DL compared with 12.0% of Group VL ( $p = 0.005$ ) (Table 4).

Table 4. Intubation Difficulty and Requirement for Optimisation Manoeuvres

| Parameter                              | Group DL (n=50) | Group VL (n=50) | p-value |
|----------------------------------------|-----------------|-----------------|---------|
| IDS score, median (IQR)                | 2 (1–4)         | 1 (0–2)         | <0.001  |
| IDS = 0, n (%)                         | 8 (16.0)        | 19 (38.0)       | 0.013   |
| IDS 1–5, n (%)                         | 37 (74.0)       | 30 (60.0)       |         |
| IDS >5, n (%)                          | 5 (10.0)        | 1 (2.0)         |         |
| Any optimisation manoeuvre, n (%)      | 21 (42.0)       | 8 (16.0)        | 0.004   |
| External laryngeal manipulation, n (%) | 18 (36.0)       | 6 (12.0)        | 0.005   |
| Repositioning/stylet adjustment, n (%) | 8 (16.0)        | 4 (8.0)         | 0.218   |

Baseline heart rate and mean arterial pressure were comparable between the two groups. Both groups demonstrated an increase in heart rate and mean arterial pressure immediately following tracheal intubation. The increase was numerically greater in Group DL; however,

between-group differences were not statistically significant at the measured time points. Haemodynamic parameters approached baseline values within 5 minutes after intubation (Table 5)(Figure3).

Table 5. Comparison of Haemodynamic Parameters

| Parameter | Group DL (n=50) | Group VL (n=50) | p-value |
|-----------|-----------------|-----------------|---------|
|-----------|-----------------|-----------------|---------|

|                                  |              |              |       |
|----------------------------------|--------------|--------------|-------|
| Baseline HR (beats/min)          | 78.4 ± 9.7   | 77.8 ± 9.4   | 0.754 |
| HR immediately after intubation  | 94.8 ± 11.6  | 91.5 ± 10.8  | 0.144 |
| HR at 5 min                      | 82.6 ± 9.8   | 81.3 ± 9.1   | 0.493 |
| Baseline MAP (mmHg)              | 91.6 ± 8.7   | 90.9 ± 8.4   | 0.683 |
| MAP immediately after intubation | 105.8 ± 10.6 | 102.7 ± 10.2 | 0.140 |
| MAP at 5 min                     | 94.2 ± 8.9   | 92.8 ± 8.6   | 0.426 |

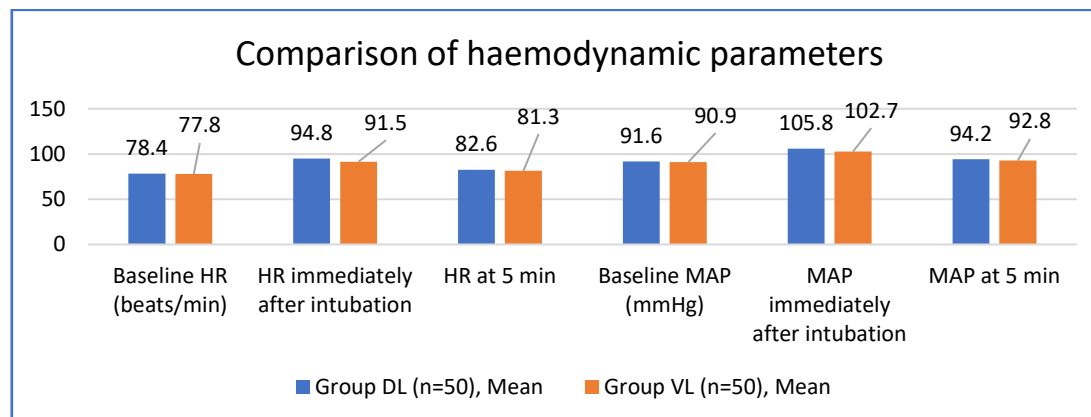


Figure 3. Comparison of Haemodynamic Parameters

Airway-related complications were infrequent in both groups. Mucosal trauma or blood staining was observed in 10.0% of patients in Group DL and 4.0% in Group VL ( $p=0.436$ ). Postoperative sore throat occurred in 20.0% and 14.0% of patients, respectively ( $p=0.424$ ), while hoarseness occurred in 10.0% and 6.0%, respectively ( $p=0.715$ ). No dental injury was

observed in either group. One patient in the direct laryngoscopy group experienced transient oxygen desaturation below 92%, whereas no such episode occurred in the video laryngoscopy group. None of the differences in airway-related complications reached statistical significance (Table 6).

Table 6. Airway-Related Complications

| Complication                         | Group DL (n=50) | Group VL (n=50) | p-value |
|--------------------------------------|-----------------|-----------------|---------|
| Mucosal trauma/blood staining, n (%) | 5 (10.0)        | 2 (4.0)         | 0.436   |
| Sore throat, n (%)                   | 10 (20.0)       | 7 (14.0)        | 0.424   |
| Hoarseness, n (%)                    | 5 (10.0)        | 3 (6.0)         | 0.715   |
| Dental injury, n (%)                 | 0               | 0               | —       |
| Desaturation <92%, n (%)             | 1 (2.0)         | 0               | 1.000   |
| Any airway complication, n (%)       | 13 (26.0)       | 9 (18.0)        | 0.334   |

## DISCUSSION

The present study compared Macintosh direct laryngoscopy with McGrath video laryngoscopy in 100 patients with restricted cervical spine movement produced by manual in-line stabilisation (MILS). McGrath provided better glottic visualisation, higher first-attempt intubation success, lower intubation difficulty, and fewer optimisation manoeuvres. However, intubation time, haemodynamic responses, and airway-related complications were comparable between the groups. Baseline demographic and airway characteristics were comparable between the groups. Mean age was  $41.8 \pm 12.6$  years in the Macintosh group and  $42.5 \pm 11.9$  years in the McGrath group, with no significant differences in BMI, mouth opening, thyromental

distance, ASA status, or Mallampati class. Similarly, Laosuwan et al. [14] reported comparable baseline and airway characteristics between Macintosh and McGrath groups during MILS. McGrath provided significantly superior glottic visualisation. Cormack–Lehane grade I was obtained in 76.0% of patients with McGrath compared with 42.0% with Macintosh, while grade III occurred in 2.0% versus 18.0%, respectively. The POGO score was also significantly higher with McGrath ( $86.2 \pm 13.7\%$  vs  $67.4 \pm 20.1\%$ ;  $p<0.001$ ). Ilyas et al. [15] similarly demonstrated superior glottic visualisation with McGrath during cervical immobilisation. Yoo et al. [16] also reported significantly better Cormack–Lehane grades and POGO scores with McGrath (both

$p < 0.001$ ). These findings support the advantage of indirect video-assisted visualisation when alignment of the airway axes is restricted. First-attempt intubation success was significantly greater with McGrath in our study (94.0% vs 80.0%;  $p = 0.037$ ), while overall success was 100% versus 98.0%. Yoo et al. [16] reported comparable findings, with successful intubation achieved in 95.5% of patients with McGrath and 77.3% with Macintosh. Higher first-pass success may be particularly beneficial during cervical immobilisation by reducing repeated airway manipulation. Despite better visualisation, intubation time was slightly longer with McGrath ( $48.9 \pm 16.2$  vs  $43.6 \pm 14.8$  seconds), although the difference was not significant ( $p = 0.091$ ). Ilyas et al. [15] reported significantly longer intubation with McGrath than Macintosh ( $82.7 \pm 80.0$  vs  $50.0 \pm 32.6$  seconds;  $p = 0.0003$ ). Laosuwan et al. [14] similarly reported times of  $35.07 \pm 9.49$  versus  $23.21 \pm 7.42$  seconds ( $p = 0.004$ ). Conversely, Yoo et al. [16] observed comparable median times of 45 versus 54 seconds ( $p = 0.089$ ). These variations may reflect differences in operator experience, device design, stylet use, and difficulty in advancing the tube despite adequate glottic visualisation. Intubation was significantly easier with McGrath, with a median IDS score of 1 (IQR 0–2) compared with 2 (IQR 1–4) with Macintosh ( $p < 0.001$ ). Yoo et al. [16] similarly reported IDS scores of 1 versus 3 ( $p < 0.001$ ). Optimisation manoeuvres were required in 16.0% versus 42.0% ( $p = 0.004$ ), while external laryngeal manipulation was required in 12.0% versus 36.0% ( $p = 0.005$ ). Yoo et al. [16] likewise reported external manipulation in only 4.5% with McGrath compared with 59.1% with Macintosh. Although cervical movement was not measured in our study, Laosuwan et al. [14] reported significantly less cumulative cervical movement with McGrath than Macintosh ( $9.18^\circ \pm 3.37^\circ$  vs  $17.18^\circ \pm 9.65^\circ$ ;  $p = 0.017$ ). Haemodynamic responses and airway complications in our study were comparable between groups, consistent with published observations. Overall, our findings suggest that McGrath video laryngoscopy improves glottic visualisation, first-attempt success, and ease of intubation during cervical spine immobilisation, although these advantages do not necessarily translate into shorter intubation time.

## CONCLUSION

The McGrath videolaryngoscope provided significantly better glottic visualisation, higher first-attempt intubation success, and lower intubation difficulty than conventional Macintosh direct laryngoscopy in patients with restricted cervical spine movement. It also reduced the requirement for additional optimisation manoeuvres. Although intubation time was slightly longer with McGrath, the difference was not statistically significant. Haemodynamic responses and airway-related complications were comparable between the two techniques. Overall, video laryngoscopy may provide favourable intubating conditions when cervical spine movement needs to be restricted.

## Limitations

The study was conducted at a single centre with a relatively small sample size, which may limit the generalisability of the findings. Cervical spine restriction was simulated using manual in-line stabilisation rather than studied in patients with actual cervical spine instability. Blinding of the operator was not possible, and operator experience could have influenced intubation performance. Additionally, cervical spine movement was not assessed radiologically during laryngoscopy and intubation.

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