Mac Doshi laryngoscope blade makes tracheal cuff protection easier during double-lumen tube placement

Om P. Sanjeev[a], Prakash K. Dubey[b], Chetana Shamshery[a], Amit Rastogi[a]

[a]Department of Anaesthesiology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India, [b]Department of Anaesthesiology, Indira Gandhi Institute of Medical Sciences, Patna, India

Correspondence to Om P. Sanjeev, Department of Anaesthesiology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, S-457, Sanskriti Enclave, Eldeco Udyan II, Raebarelli Road, Lucknow - 226 014, Uttar Pradesh, India; Tel: 05226692000; e-mail: opsanjeev@gmail.com

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Introduction
Tracheal cuff rupture is a known complication during double-lumen tube (DLT) placement. Mac Doshi laryngoscope blade has an increased height of web. On account of its wider web, it provides a wider mouth opening and easier movement of the tongue to the left side. We hypothesized that this wider web should act as a guard and prevent brushing of tracheal cuff over teeth.
Aims and objectives
We designed this study to evaluate the usefulness of Mac Doshi laryngoscope blade for ease of tracheal cuff protection during DLT placement.
Patients and methods
After approval from the Institute Ethical Committee, 60 consenting patients of either sex with American Society of Anesthesiologists physical status II or III and scheduled for cardiac and thoracic procedures under general anaesthesia with DLT placement were recruited for this study. Patients were randomized with a computer-generated random number table and assigned to either of the two groups. In group 1, DLT placement was performed with Macintosh laryngoscope blade. In group 2, DLT placement was performed with Mac Doshi laryngoscope blade. Outcome parameters were incidence of tracheal cuff rupture and score given by physician for ease of tracheal cuff protection during DLT placement on Likert score for measure of agreement.
Results
The median score and interquartile range was 2 (2–4) in Macintosh versus 1.5 (1–2) in the Mac Doshi group. This difference was statistically significant (P=0.02). There was one case of tracheal cuff rupture in the Macintosh group and none in the Mac Doshi group.
Conclusion
Mac Doshi laryngoscope blade makes favourable condition for tracheal cuff protection during DLT placement.

Keywords:
double lumen tube (DLT), Mac Doshi laryngoscope blade, Macintosh laryngoscope, tracheal cuff, tracheal cuff rupture

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Introduction

Tracheal cuff rupture is a known complication during double-lumen tube (DLT) placement [1]. It occurs mostly because of the contact of cuff with the sharp teeth. Rupture of cuff necessitates replacement of DLT with another one, which causes added airway injuries, wastage of operation room time and adds extra cost.

As placement of DLT is difficult even in patients with normal airways because of its larger diameter and length, it is associated with various complications. Malpositioning, tube dislodgement during patient positioning, and airway and dental injuries are also encountered [2].

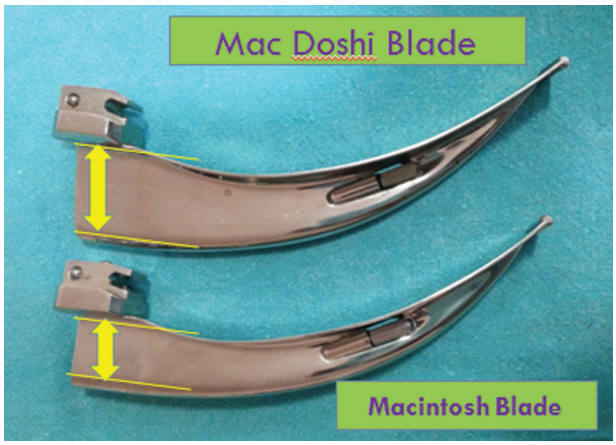
Mac Doshi laryngoscope blade (Mac Doshi blade; Trupati instruments, Banglore, India) has increased height of web by 7 mm (so the new height is 3 cm for blade size no. 4, Fig. 1) [3]. On account of its wider web, it provides a wider mouth opening and easier movement of the tongue to the left side. We hypothesized that this wider web should act as a guard and prevent brushing of tracheal cuff over teeth.

Aims and objectives

We designed this study to evaluate the following:

(1) Usefulness of Mac Doshi laryngoscope blade for ease of tracheal cuff protection during DLT placement.
(2) To observe the complications with the use of Mac Doshi laryngoscope blade during DLT placement.

Figure 1



Mac Doshi and Macintosh Laryngoscope blade size 4

Patients and methods

After approval from the Institute Ethical Committee, this randomized control trial was conducted in the department of Anaesthesiology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, over a period of one year from 2014 to 2015. Sixty consenting patients of either sex with American Society of Anesthesiologists physical status II or III and scheduled for cardiac and thoracic procedures under general anaesthesia with DLT placement were enrolled for this study. Cardiac surgery included in this study was Minimally Invasive Directly Coronary Artery Bypass. Thoracic procedures included lung lobectomy and lung decortication surgeries.

Patients with age less than 18 years and more than 70 years were excluded from the study. Moreover, anticipated difficult intubation, buck tooth, requirement of right-sided DLT placement, haemodynamic instability during preoperative period and pregnancy were exclusion criteria.

Preanaesthetic checkup and premedication

Thorough case history was obtained from patients. General examination and systemic examination were carried in all patients. Blood investigations for complete blood count, renal function test, liver function test and fasting blood sugar were carried in all patients. Tablet alprazolam 0.25 mg and tablet ranitidine 150 mg were given the night before surgery and also on the morning of surgery with a sip of water. All other previous medications were continued the night before surgery except oral hypoglycaemic agents and angiotensin receptor blockers. During preanaesthesia checkup the night before surgery, patients were randomized with a computer-generated random number table and assigned to either of the two groups.

Group 1: DLT placement was carried out with Macintosh laryngoscope blade.

Group 2: DLT placement was carried out with Mac Doshi laryngoscope blade.

Anaesthesia technique

After wheeling into operation room, patients were attached with noninvasive monitoring such as ECG, pulse oxymeter and noninvasive blood pressure. Intravenous access was achieved with an 18 G cannula and normal saline 500 ml infusion was started. Under local anaesthesia the left/right radial artery was cannulated with a 22 G arterial cannula and arterial blood pressure monitoring was started in all patients. Central venous access was achieved with 7.5 FG triple-lumen central venous catheter under local anaesthesia.

After preoxygenation for 3 min with 100% oxygen, anaesthesia was induced with midazolam 1 mg injection, fentanyl 2–5 μg/kg and thiopentone sodium up to 5 mg/kg. After ensuring mask ventilation, vecuronium 0.1 mg/kg injection was given to facilitate DLT intubation in all cases. After 3 min of mask ventilation direct laryngoscopy was performed either with Macintosh or Mac Doshi laryngoscope blade as per group allocation.

Thereafter, appropriately sized left DLT (Mallinckrodt LEFT Broncho-Cuath; Covidien Ltd, Tullamore, Ireland) placement was carried out. All DLT intubations were performed using either of the two cardiac anaesthesia registrar. After DLT placement, it was secured with elastic adhesive tapes. The correct placement was confirmed with fibreoptic bronchoscopy, and in case of misplaced bronchial tip of DLT, repositioning was carried out. Mechanical ventilation was set to deliver a tidal volume of 6 ml/kg and rate sufficient to maintain end tidal carbon dioxide within normal limit. After shifting to one-lung ventilation (OLV), FiO_2 was set up to 80% to maintain SPO_2 above 90% in lung surgical cases and 95% in cardiac surgical cases. Tidal volume was set at 5–6 ml/kg so that peak airway pressure must not to go beyond 30 cm of water.

Patient positioning was carried out as per the need of surgery. Anaesthesia was maintained with 40–50% oxygen in air with isoflurane 1–1.5% and intermittent boluses of vecuronium and fentanyl injections. After conclusion of surgery, DLT was replaced with single-lumen endotracheal tube of appropriate size for continuation of mechanical ventilation in postoperative period.

Definition of tracheal cuff puncture/rupture

Tracheal cuff was inflated with air up to cuff pressure of 20 cm H_2O measured by cuff pressure regulator. Cuff rupture was defined subjectively by the feel of rupture by the investigator. For objective assessment the volume of air required to inflate the cuff of DLT was noted. After 5 min, the cuff was deflated and volume of air retrieved was measured to detect cuff rupture. Any significant drop in volume was marked as cuff rupture. After extubation DLT was inspected for visible puncture of tracheal cuff.

Outcome parameters

(1) Incidence of tracheal cuff rupture.
(2) Score given by anaesthesia registrar for ease of tracheal cuff protection during DLT placement on Likert score for measure of agreement.
(3) Cormack-Lehane grading, number of intubation attempts, airway injury and positioning of bronchial cuff of DLT.

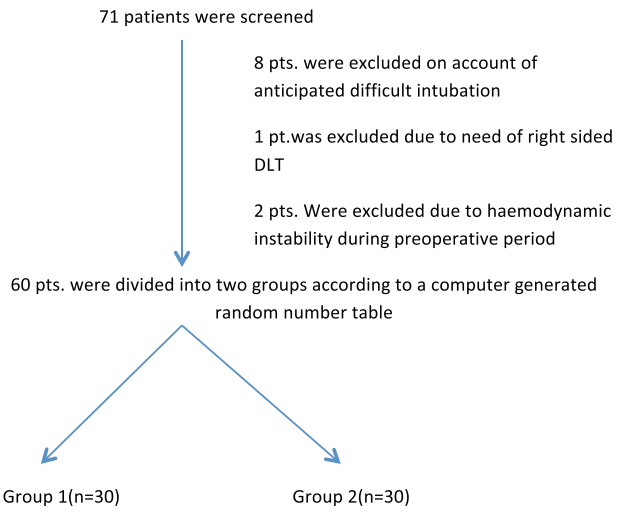
Likert Scoring System was adopted for the assessment of ease of tracheal cuff protection during DLT placement in this study:

1	2	3	4	5
Very easy	Easy	Cannot say	Difficult	Very difficult

Results

Seventy-one patients were screened for eligibility on the basis of inclusion and exclusion criteria to finally obtain a cohort of 60 patients (Fig. 2). All data were recorded in electronic study proforma and then exported to computer software SPSS, version 19 (SPSS Inc, Version 19.0, Chicago, IL, USA) for statistical analysis. For comparison of mean, Student's t-test was applied. For comparison of nominal data, the chi square test was applied. Score was represented as median and interquartile range and was compared using the Mann–Whitney test.

Figure 2



Flow chart of patient recruitment

Demographic profile, types of surgeries and other baseline characteristics were comparable between the groups (Table 1). In the Macintosh group, score of 4 or 5 was given for more than 50% of patients, whereas in the Mac Doshi group score of 1 or 2 was given for more than 50% of patients (Table 2). The median score and interquartile range was 2 (2–4) in the Macintosh versus 1.5 (1–2) in the Mac Doshi group. This difference was statistically significant (P=0.02).

There was one case of tracheal cuff rupture in the Macintosh group and none in the Mac Doshi group. However, to find the exact incidence of cuff rupture a larger sample size is required.

There were no statistical differences between the groups for Cormack-Lehane grading, number of intubation attempts, airway injuries and malpositioning of DLT (Table 3).

Discussion

Lung isolation and selective OLV is required for various cardiothoracic procedures. Modern plastic,

Table 1 Group characteristics

	Group 1	Group 2	*P* value
Age (mean±SD) (years)	56.97±11.87	53.67±12.99	>0.05
Body weight (mean±SD)	69.63±15.50	72.93±12.91	>0.05
Height (mean±SD) b	162.97±7.26	168.73±8.50	>0.05
Sex (male/female)	24/6	21/9	>0.05
Surgeries			
MIDCAB	22	24	>0.05
Lung lobectomy	1	0	>0.05
Decortication of Lung	7	6	>0.05
Size of DLTs used (FG)			
35	6	8	>0.05
37	21	17	>0.05
39	3	5	>0.05

DLT, double-lumen tube; MIDCAB, Minimally Invasive Directly Coronary Artery Bypass.

Table 2 Comparison of Likert score between the groups

	Likert scores							*P* value
	1	2	3	4	5	Median	IQR	
Group 1 (*n*)	2	8	4	10	6	2	2.4	0.02
Group 2 (*n*)	8	14	2	4	2	1.5	1.2	

IQR, interquartile range.

Table 3 Comparison of complications between the groups

	Group 1 (*n*=30)	Group 2 (*n*=30)	*P* value
Cormack and Lehane gradings			
Grade 1	9	7	>0.05
Grade 2	21	23	>0.05
Grade 3	0	0	
Grade 4	0	0	
Number of intubation attempts			
First	24	22	>0.05
Second	6	8	>0.05
Third or more (includes failed intubation)	0	0	
Airway injury	0	0	0
Mispositioned bronchial tip of DLT	4	6	>0.05

DLT, double-lumen tube.

disposable DLTs offer many advantages for lung separation [4]. The collapsed lung can be deflated and reinflated at will during the procedure. Material in the operated lung can be suctioned before reinflating the lung, and continuous positive airway pressure is easily applied during OLV [5].

A DLT is almost straight and only distal endobronchial portion is curved towards the bronchus. During direct rigid laryngoscopy, the distal end of the tube is inserted into the patient's mouth under direct vision and so the bronchial cuff is seldom lacerated. However, if the glottis is anterior, the fragile tracheal cuff is often torn by the patient's upper teeth during intubation attempts [6].

There are several proposed methods to protect the tracheal cuff rupture. Use of lubricated teeth guard [7], a lubricated penrose drain [8], increasing angle of bronchial portion of DLT using stylet and making a 'hockey stisk shape' [6,9] and use of retractable protective sheath [10] are few from the list.

Fibreoptic bronchoscopy (FOB) is an alternative to standard laryngoscopy in placing a DLT. This practice may help in cuff protection. However, the long length of the DLT and limited internal diameter of the bronchial lumen limits the usefulness of FOB in DLT placement. However, in patients with anticipated difficult direct laryngoscopy fibreoptic-assisted DLT placement has been recommended. A DLT can be rail rolled over FOB with the patient awake [11] or anaesthetized after preoxygenation and induction of anaesthesia [12,13]. In addition, fibreoptic bronchoscopy is used for confirmation of DLT placement [14,15]. Blue bronchial cuff is easily visualized with a flexible FOB passed through tracheal lumen.

Increased step distance increases the space to manipulate the DLT inside the mouth, which also helps in cases of patients with large tongue. It also increases the distance between the DLT, the incisor tooth and angle of the mouth, and hence the chances for cuff rupture is minimized. Our hypothesis and results are further strengthened by the observation of Gaeta et al. [16]. They observed that direct laryngoscopy for DLT placement is best accomplished using a Macintosh laryngoscope blade, as a curved laryngoscopy blade offers a wider view and more space compared with a straight blade. We made the mouth opening even wider with Mac Doshi laryngoscope blade and obtained better result.

Results of our study showed that tracheal cuff protection was easier to achieve with Mac Doshi laryngoscope blade. Tracheal cuff rupture was not encountered with Mac Doshi blade. However, only with a larger sample size it can be further authenticated.

Laryngoscopy and tracheal intubation with single-lumen endotracheal tube or DLT is associated with haemodynamic perturbations. This is a limitation of our study that we did not collect and compare the data of haemodynamic parameters during laryngoscopy and peri-intubation period between the groups. This omission can be attributed to the use of different drugs and in different doses according to the anaesthetic goals and was not set fixed. A study with a larger number of patients is required to authenticate the incidence of tracheal cuff rupture with Mac Doshi laryngoscope blade. Restricted mouth opening and buck teeth are the inherent limitations of the Mac Doshi blade.

Conclusion

Mac Doshi laryngoscope blade appears to give favourable condition for the tracheal cuff protection during DLT placement. It has a very reasonable cost and can be added to airway armamentarium.

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Nil.

Conflicts of interest
There is no conflict of interest.

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