

## Are we glorifying the use of video laryngoscopes? A randomized control study comparing C-MAC(R) laryngoscope and McCoy blade for tracheal intubation in patients undergoing general anaesthesia with simulated immobilization of cervical spine

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### Abstract

**Objective:** Intubating patients with cervical spine injury is a challenge as the cervical spine is immobilized to prevent neurological damage. Although Fibre optic intubation is gold standard, many anaesthetist's use video laryngoscope or McCoy blade for intubation. The purpose of this study was to compare the efficacy of C-MAC(R) video laryngoscope and direct laryngoscope with McCoy blade in intubating patients with cervical spine immobilization simulating cervical spine injuries.

**Materials and Methods:** A total of 60 patients undergoing general anaesthesia were randomized into two groups. Intubation was attempted using C-MAC(R) video laryngoscope and McCoy blade after cervical immobilization using hard collar. Time to intubate, hemodynamic parameters and Intubation difficulty score was used to compare the groups.

**Result:** The laryngoscopic views and success of intubation was comparable in both video laryngoscope and Mc Coy group (30/30; 100% success in both the groups). The time to intubate was found to be less in McCoy group ( $29.83 \pm 1.46$  s and  $25.67 \pm 2.04$  s) when compared to C-MAC (R) video laryngoscope. The intubation response was lesser in C-MAC compared to McCoy blade ( $82.97 \pm 7.23$  s and  $88.30 \pm 6$  s). Time taken for the hemodynamic to return to baseline was the same in the groups ( $8.67 \pm 1.52$  s and  $9.13 \pm 1.25$  s).

**Conclusion:** Direct laryngoscopy and intubation with McCoy blade is faster when compared to C-MAC(R) video laryngoscope; but with exaggerated intubation response].

### Introduction

Every day all over the world thousands of patients undergo direct laryngoscopy and intubation. Special strategies and gadgets are required to intubate patients with anticipated difficult laryngoscopic view. Patients with cervical spine injury belong to the category of patients with difficult intubation as the cervical spine is immobilized with hard collar. This is done in order to prevent mobility of cervical spine and resultant injury to spinal cord.<sup>1,15</sup> The application of hard collar makes intubation difficult as we cannot extend the neck which is necessary to bring oro-pharyngo - laryngeal axis in one line.<sup>2</sup> Traditionally direct laryngoscopy with Macintosh blade is used for intubation. McCoy blade introduced in 1993, has an additional advantage that on pulling the lever, the hinged tip flexes elevating the distal structures including epiglottis thus improving the laryngoscopic view

The C-MAC<sup>(R)</sup> (Karl Storz, Tuttlingen, Germany) introduced in 2009; incorporates a standard Macintosh blade with a camera placed at its tip and a video display unit which makes even a limited laryngeal view with direct with

C-MAC<sup>(R)</sup>.<sup>3,4,16,17</sup> C-MAC<sup>(R)</sup> bypasses the oral axis and brings the pharyngeal and laryngeal axes, which have a close degree of slope to the same plane, in order to view the glottis.

The purpose of this randomized controlled study was to compare the C-MAC<sup>(R)</sup> video laryngoscope and conventional laryngoscope with McCoy blade for tracheal intubation in patients undergoing general anesthesia with simulated immobilization of cervical spine. The Primary end-points were intubation time, number of attempts for successful intubation and hemodynamic variations].

### Materials and Methods

After ethics committee approval and written informed consent patients, we studied 60 ASA physical status 1 or 2 patients; aged 16 or older undergoing surgical procedures requiring tracheal intubation. Patients were randomly allocated into two groups: Group C(C-MAC<sup>(R)</sup> laryngoscope) and group M (McCoy blade). Patients having difficult intubation (Mallampati class II or IV; thyromental distance <6cm, inter-incisor distance <3.5cm) patients at

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risk of aspiration and patients with BMI>30 were excluded from the study. All the data were collected by an independent observer.

Patients were monitored using ECG, Non-invasive arterial pressure, SpO<sub>2</sub> and end-tidal CO<sub>2</sub>. Patients were anaesthetized using a standard protocol. Patients were premedicated with Ondansetron 4 mg and pre oxygenate with 100% O<sub>2</sub> for 3 minutes. Patients received analgesic Fentanyl (2 µg kg<sup>-1</sup>) and were induced with Propofol (2-2.5 mgkg<sup>-1</sup>). After confirming adequate ventilation neuromuscular block was achieved using Vecuronium 0.1mgkg<sup>-1</sup>. After induction, patients were ventilated with O<sub>2</sub>:N<sub>2</sub>O: Sevoflurane (2%) for 3 minutes.

After the onset of neuromuscular block, hard neck collar was applied to prevent flexion extension or rotational movement of the neck. The trachea was then intubated by anaesthetist who has performed >100 intubations and experienced in using both C-MAC<sup>(R)</sup> and McCoy blade. Correct tube position was confirmed and Anaesthesia was maintained with Sevoflurane (1.25-2%) in a mixture of O<sub>2</sub>:N<sub>2</sub>O in a 3: 2 ratio. No other medications were administered or procedures were performed during the next 10 minute data collection period after intubation. The hard neck collar was removed at the end of 10 minutes. Subsequent management was left to the discretion of the anaesthetist providing care for the patient.

The primary outcome measure was the total time taken to secure the airway. The time taken to visualise the best possible vocal cord view (Laryngoscopy) was taken as T1.

It was defined as the time taken from insertion of the blade between the teeth until the anaesthetist had obtained the best possible view of the vocal cords. A maximum of three attempts were permitted after which anaesthetist utilized an alternative laryngoscope. The alternative laryngoscopes used were Macintosh or McCoy or C-MAC<sup>(R)</sup> selected as per choice of the anaesthetist. The time taken from visualization of vocal cord to the appearance of the first Capnographic curve (Intubation) was taken as T2. A failed intubation attempt was defined as an attempt in which the trachea was not intubated, or where the device was abandoned and another device utilized.

The secondary outcome measures were haemodynamic changes, time taken for Heart rate to reach baseline value, and Intubation difficulty score.<sup>5</sup>

When the C-MAC<sup>(R)</sup> was used, we pre-formed the TT (tracheal tube) into a hockey stick conformation with a stylet with 60° angulation as it has been previously shown that this facilitates tracheal intubation.<sup>6</sup> C-MAC<sup>(R)</sup> was used every single time as a video laryngoscope. For all attempts using the Mc Coy blade, the standard non-stylet non-hockey stick TT conformation was utilized.

Sample size calculation was based on the parent article where mean IDS score of 2 and standard deviation of 2.25 was considered as clinically important. Considering α error as 0.05 and β as 0.2, sample size was calculated to be 22. Taking into account the attrition rate; we enrolled 30 patients in each group].

**Table 1:** Baseline characteristics of patient undergoing intubation using McCoy and CMAC video-laryngoscope

Parameters	C-MAC	McCoy	T – test	p value
Age	34.87 ± 12.61	35 ± 12.61	0.041	0.967
Weight	62.47 ± 9.16	62.27 ± 9.06	-0.085	0.933
Inter incisor distance	4.66 ± 0.29	4.69 ± 0.26	0.460	0.647
Thyromental Distance	6.17 ± 0.40	6.11 ± 0.46	-0.506	0.615
T1	11.23 ± 0.97	10.93 ± 1.08	-1.131	0.263
T2	18.63 ± 1.19	14.80 ± 1.35	-11.676	0.0001
T	29.83 ± 1.46	25.67 ± 2.04	-9.089	0.0001

Abbreviations: [T1: Time to visualize the larynx, T2: Time to intubate after visualization; T: Total intubation time.]

**Table 2:** Haemodynamic observation in patients undergoing intubation with McCoy and CMAC video-laryngoscope-PR (Inter group variation)

	McCoy	C-MAC	T test	p value
PR before induction	79.2 ± 7.31	78.00 ± 7.35	0.634	0.529
0 min	83.10 ± 8.85	80.27 ± 8.22	1.285	0.204
2 min	97.53 ± 7.78	90.57 ± 7.34	3.568	0.001
4 min	94.00 ± 7.34	87.5 ± 7.05	3.525	0.001
6 min	88.30 ± 6.66	82.97 ± 7.23	2.972	0.004
8 min	82.9 ± 6.40	78.77 ± 7.43	2.308	0.025
10 min	76.53 ± 6.79	74.83 ± 6.86	0.965	0.339
Time to return to baseline	9.13 ± 1.25	8.67 ± 1.52	1.300	0.199

**Table 3:** Haemodynamic observation in patients undergoing intubation with McCoy and CMAC video-laryngoscope-MAP (Inter group variation)

	McCoy	CMAC	T test	p value
MAP before induction	95.80±10.813	93.73±10.82	0.740	0.462
0 min	92.37±10.67	85.73±9.75	2.513	0.015
2 min	106.00±11.86	84.33±8.93	7.991	0.0001
4 min	104.33±10.92	79.87±8.91	9.509	0.0001
6 min	98.73±10.42	77.23±8.26	8.860	0.0001
8 min	85.60±10.28	75.33±7.90	8.564	0.0001
10 min	93.67±10.64	73.80±6.94	8.563	0.0001

**Table 4:** Haemodynamic observation in patients undergoing intubation with McCoy and CMAC video-laryngoscope-PR (Intra group variation)

	Mccoy	Cmac
PR before induction	79.2 ±7.31	78.00±7.35
0 min	83.10±8.85	80.27±8.22
2 min	97.53±7.78	90.57±7.34
4 min	94.00±7.34	87.5±7.05
6 min	88.30±6.66	82.97±7.23
8 min	82.9±6.40	78.77±7.43
10 min	76.53±6.79	74.83±6.86
Friedman test	150.105	150.497
p value	0.0001	0.0001

**Table 5:** Haemodynamic observation in patients undergoing intubation with McCoy and CMAC video-laryngoscope-MAP (Intra group variation)

	McCoy	CMAC
MAP before induction	95.80±10.813	93.73±10.82
0 min	92.37±10.67	85.73±9.75
2 min	106.00±11.86	84.33±8.93
4 min	104.33±10.92	79.87±8.91
6 min	98.73±10.42	77.23±8.26
8 min	85.60±10.28	75.33±7.90
10 min	93.67±10.64	73.80±6.94
Friedman test	110.79	167.917
p value	0.0001	0.0001

## Results and Discussion

A total of 60 patients were enrolled for the study. Five patients with BMI>35, one with short neck and one with Thyromental distance of >6.5 were excluded from the study. There was no significant difference between the groups with regard to patients characteristics namely age, weight, ASA physical status, mouth opening, Modified Mallampati Score or Thyromental distance.

Time taken (seconds) to view the glottis (T1) was 11.23±0.97s for C-MAC<sup>(R)</sup> group and was 10.93±1.08 s for Mc COY group. Although time to visualize was lesser in faster in Mc COY group there was no statistically significant difference. Time to intubate (T2) was 18.63±1.19 in C-MAC<sup>(R)</sup> group while it was 14.80±1.35 s for McCOY group. This delay of 4 seconds was significant. It was reflected in the total intubation time also where T for McCOY was 25.67±2.04 and 29.83±1.46 s in C-MAC<sup>(R)</sup> group.

For the ease of using C-MAC<sup>(R)</sup> we had used stilet and preformed the tubes to the shape of hockey stick with 60o

angulation. Bougie was needed for intubation in two patients in C-MAC<sup>(R)</sup> group and one patient in McCOY group. External laryngeal manipulation (BURP maneuver) was needed in 3 patients in McCOY and 4 patients in C-MAC<sup>(R)</sup> group.

The variation in PR in response to intubation was noted with McCOY having significant rise in PR when compared to C-MAC<sup>(R)</sup>. In patient intubated with McCOY it took 9.13±1.25 min to return to baseline while in C-MAC<sup>(R)</sup> it took 8.67±1.52 min to return to baseline. There was significant rise in BP in McCOY group when compared to C-MAC<sup>(R)</sup>

Application of cervical collar can decrease cervical spine mobility by 30-50%, prevent the alignment of the Oro-Pharyngo-Laryngeal axis and restricts mouth opening. Intubation with conventional Macintosh laryngoscopes in patient's after the application of cervical collar can be challenging. The modification of Macintosh, the McCOY levering laryngoscope came as a great help due to the increased rate of successful intubation.<sup>19,20</sup> The introduction of video laryngoscope saw a paradigm shift in intubation

from Macintosh to video laryngoscopes. Video laryngoscopes are advantageous as we don't need Oro-Pharyngo-Laryngeal axis to come to straight line. In addition it can be introduced in patients with just 2 fingers (4cm) mouth opening.<sup>7,18</sup>

Byhahn et al<sup>8</sup> did extensive study using the video laryngoscopes and demonstrated that they have the advantage of enhancing the glottic view, improvement in Cormack Lehane grading, less haemodynamic response and overall increase in successful intubations.

In our study we decided to compare two different laryngoscopes which are already efficiently utilized in patients with limited neck extension. Non-obese ASA I and 2 patients who had no difficulty in intubation were selected. In all cases where McCoy was used we pulled up the lever. None of our patients had failed glottic view (CL grade 3 or grade 4). Time to obtain the glottic view was comparable in both the groups demonstrating that in patients with adequate mouth opening introduction of both the blades (McCoy & C-MAC<sup>(R)</sup>) take the same time. In addition both McCoy and C-MAC<sup>(R)</sup> don't mandate pushing the tongue to the left side for visualization of glottis. The visualization of glottis was easy with both the groups finishing in <11 seconds.

A 4 second delay was found in time for intubation (T2) using C-MAC<sup>(R)</sup> video laryngoscope. This is in contrast to the study by Jain et al<sup>9</sup> which reported an average mean of only 5 sec to intubate using C-MAC<sup>(R)</sup>, which we found too realistic. We attribute this 4 second delay to the time taken to remove the stillet, used to angulate the tube.

Another video laryngoscope Pentax -AWS was compared with Macintosh laryngoscope by Enomoto et al<sup>10</sup> and they found that Pentax-AWS provided a better view of glottis and higher success rate compared to conventional Macintosh laryngoscope. Bhat et al<sup>11</sup> compared intubation in lateral position using Macintosh and C-MAC<sup>(R)</sup> laryngoscopes and found that C-MAC<sup>(R)</sup> is better than Macintosh for intubation in lateral position. They found an overall intubation success rate of 100% with the time taken in C-MAC(R) group lesser when compared to conventional group C-MAC<sup>(R)</sup> 24.8 ± 8.5 s and in direct group 33.8 ± 9.12 s) and the Cormack - Lehane grade was better. They did not use of McCoy for intubation in lateral position and this definitely warrants studies.

A cross over manikin study done by Jacek et al comparing Macintosh & C-MAC<sup>(R)</sup> found that both success rate and intubation times were significantly less in C-MAC<sup>(R)</sup> group, when compared to Macintosh (20.5 sec versus 27.5 seconds) with only 51% success with intubation on first attempt using Macintosh.<sup>12</sup>

We found that there is significant increase in PR and BP in response to intubation on laryngoscopy in both the groups. But the rise was found to be more when McCoy blade is used in comparison to C-MAC<sup>(R)</sup>. Study by McCoy et al had demonstrated that the stress response to laryngoscopy and catechol amine concentrations were minimal in intubations using McCoy blade when compared to Macintosh blade. He justified the same stating that it is

probably due to a reduction in the force necessary to obtain a clear view of larynx

McCoy et al<sup>13</sup> also demonstrated that it took 5 min for the rise in PR & BP to touch baseline when Macintosh blade was used for intubation while McCoy had hardly any variation. In our study we found that in patients intubated with McCoy it took almost 9 minutes for PR to return to baseline after the rise, while in C-MAC<sup>(R)</sup> group it took 8.67 min to touch the baseline, much higher than the observation by McCoy et al. There was no significant difference in the time taken by PR to return to baseline. Regarding BP, there was a fall in the first reading in BP when compared to baseline values after induction in both the groups. In McCoy group there was a rise in BP in response to intubation, which was not noticed in C-MAC<sup>(R)</sup> group. The rise as a result of intubation response in McCoy group took almost 6.02 minutes to result to baseline

Study by Fazia et al<sup>14</sup> compared the haemodynamic responses to intubation with Macintosh, McCoy & C-MAC<sup>(R)</sup> and found that HR was significantly higher in C-MAC<sup>(R)</sup> group at 3 minutes whereas SBP, DBP and MAP were significantly higher at 1 min. These observations are in contrast to our study where we found haemodynamic responses to both McCoy and C-MAC<sup>(R)</sup>; that too significantly higher (>20% baseline) in McCoy group. The variation may be because our study populations were cases of difficult intubation and more pressure was needed in both the groups to visualize the larynx (N5 in IDS score)

Observation by Fu-Shan Xue<sup>7</sup> in his review on current evidence on the use of video laryngoscopes also observed that C-MAC<sup>(R)</sup> video laryngoscopes does not offer any benefit with regard to hemodynamic response

In our study we could intubate all the patients enrolled in both the groups. The use of bougie, the external laryngeal manipulation and the Intubation difficulty score (IDS 2) was comparable in both the groups.

## Conclusion

We found McCoy almost equally efficient when compared to C-MAC(R) with 100% success rate in intubating all patients in the first attempt. Although it took a little lesser time to intubate with McCoy, there was a definite rise in PR & BP with the use of McCoy; and a significant one when compared to C-MAC<sup>(R)</sup>. Considering all these facts we believe that C-MAC<sup>(R)</sup> is the best choice available and should be the first choice for intubating patients with cervical immobilization.

The limitation in our study is that we selected non obese patients having no difficulty in intubation. Probably the same results could not be translated to obese, in patients with already restricted mouth opening, or in those with short neck or receding or protruding mandible. Further research is warranted in these lines.

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## Abbreviations

IDS: Intubation difficulty score, BURP: Backwards, Upwards, Right, Posterior,

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