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**Research Article**

# Macintosh laryngoscope versus Bonfils Intubation Endoscopes in endotracheal intubation: Hemodynamic, intra-ocular pressure and serum catecholamine responses

**Sameh H. Ghoneim** [a,*], **Mohamad M. Sadek** [b]

[a] *Anesthesia Department, Al-Azhar University (for Girls), Egypt*
[b] *Clinical Pathology, Al-Azhar University, Egypt*

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**KEYWORDS**

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**Abstract** *Objective:* One of the alternative methods in managing patients for endo-tracheal intubation is the Bonfils fiberscope. We studied the efficacy of Bonfils fiberscope in comparison to the classical laryngoscope with Macintosh blade inhemodynamic, serum catecholamine and intra-ocular pressure responses.
*Methods:* In a prospective, randomized trial 40 patients ASA I or II aged ⩾18 years scheduled for gynecological, urinary and lower abdominal procedures in supine position were randomly allocated to one of two groups; 20 patients each; according to intubating device by using either Macintosh laryngoscope (L) group or Bonfils Intubation Endoscopes (B) group. Pre-induction (baseline) and pre-insertion values of HR, MAP, IOP and blood samples for catecholamine level were recorded and repeated at 1, 3, and 5 min after intubation.
*Results:* There was significant increase in HR, MAP, IOP and catecholamine level in L group at 1, 3, and 5 min after intubation.
*Conclusion:* Bonfils laryngoscope had superiority over Macintosh as a method of intubation in situations where minimal changes in hemodynamic, catecholamine level and intraocular pressure are desirable.



## 1. Introduction

There were many devices suitable for tracheal intubation if indicated. Endotracheal (ET) tube is standard method for maintaining a patent airway during anesthesia, however it needs direct laryngoscopy for insertion which may causes hemodynamic changes and increases intraocular pressure [1]. These changes have been observed to be associated with rise of plasma epinepherine level confirming a predominantly

* Corresponding author at: Anesthesia Department, Al-Azhar University (for Girls), Egypt. Tel./fax: +20 1006611462.
E-mail address: dr_sameh66@hotmail.com (S.H. Ghoneim).
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sympathetic response [2]. The rise of intraocular pressure may also be secondary to increase sympathetic activity. While the Bonfils Intubation Endoscopes (riged fibroscope) was alternative to traditional laryngoscopes which has attracted the attention of several workers as regard to minimal hemodynamic and intraocular pressure changes. It obviates the need for traditional laryngoscopy for endotracheal intubation [3].

The aim of this study was to compare the hemodynamic, serum catecholamine and the intraocular pressure changes to endotracheal intubation by Macintosh laryngoscope versus Bonfils Intubation Endoscopes.

## 2. Materials and methods

This prospective double-blind study was approved by our institutional ethics committee. Forty patients ASA physical status I, II, aged $\geqslant$18 years with body mass index $\leqslant$35 kg/m$^2$ undergoing gynecological, urinary and lower abdominal procedures were randomly allocated to one of two groups according to device of intubation used; 20 patients each, Macintosh laryngoscope group and Bonfils Intubation Endoscopes (Figure 1) group. Patients with history of difficult intubation, suspicion of difficult intubation, respiratory, cardiac or esophageal diseases, coagulation disorders, preexisting raised intraocular pressure and Malapatti score >2 were excluded.

Intra-ocular pressure (IOP), mean arterial blood pressure (MAB), and heart rate (HR) recorded before induction of anesthesia (baseline). Also intravenous blood sample was collected for serum epinephrine and nor-epinephrine levels (baseline). IOP was measured in both eyes using Schiotz tenometer after instilling two drops of lidocaine 4% in each eyes and average of IOP in the two eyes was taken as baseline reading pre-operative. The blood sample were collected in pre-cooled 2–8 °C tube containing EDTA and reduced glutathione, the samples were analyzed in duplicate using high performance liquid chromatography and electro-chemical detection (Beckman, Palo Alto, CA). Inter-assay variation was 5.4% for epinephrine and 6.4% for nor-epinephrine.

All patients were monitored by standard monitoring (ECG, NIBP, $SPO_2$, $ETCO_2$) plus EMG to monitor; train of four; using nerve stimulator, and peak airway pressure. After pre-medication with midazolam 0.02 mg/kg i.v. anesthesia was induced by Fentanyl 2 μg/kg and propofol 2 mg/kg i.v. until loss of eyes lash reflex and anesthesia was maintained by $O_2$ + Sevoflurane 2% and Rocuronium 0.6 mg/kg was administrated to facilitate endotracheal intubation by Macintosh laryngoscope or Bonfils Intubation Endoscopes. Trachea was intubated by using ET size 7 for women and 8 for men. Controlled ventilation was settled to keep $ETCO_2$ around 35 mmHg.

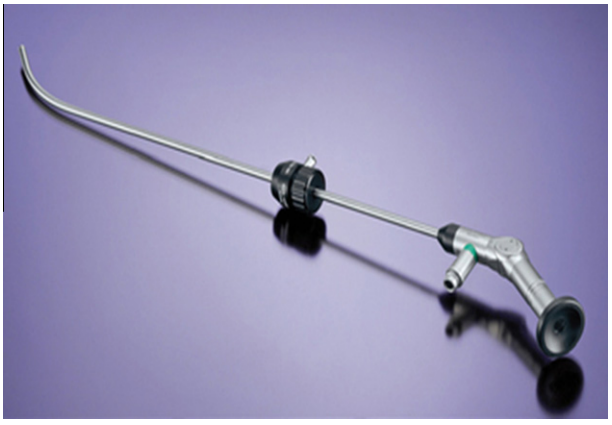

**Figure 1** Bonfils intubation endoscopes.

Intra-ocular pressure (IOP), Mean arterial pressure (MAP) and heart rate (HR) recorded immediately before pre-intubation, 1, 3, 5 min after intubation. Venous blood sample for determination of epinephrine and norepinepherine levels were collected and recorded at the same times.

### 2.1. Statistical analysis

Data are expressed as mean ± SD where applicable. Continuous data were tested for normal distribution and analyzed by Student's *t*-test. Nonparametric data analyzed using Mann–Whitney *U*-test and Chi-square test. $P < 0.05$ was considered statistically significant.

## 3. Results

Patients characteristics and Malapatti score were comparable between the two groups (Table 1).

There was significant increase in HR in both groups after intubation compared to baseline in all recording intervals. HR was significantly increased in L group compared to B group in all recording intervals after insertion of endotracheal tube (Table 2).

There was significant increase in MAP in both groups after intubation compared to baseline in all recording intervals. MAP was significantly increased in L group compared to B group in all recording intervals after insertion of endotracheal tube (Table 3).

There were significant increase in both epinephrine and nor-epnepherine levels compared to baseline measurement in both groups, also there were significant increase in both epinephrine and nor-epnepherine levels in group L compared to group B only at 5 min after intubation ($p < 0.05$) (Tables 4 and 5).

IOP was significantly decreased immediately after induction of anesthesia in both groups, however the values were comparable in both groups in other measuring intervals compared to baseline measurement. However there was significant increase in IOP in L group at 1, 3, and 5 min after intubation compared to B group (Table 6).

## 4. Discussion

The hemodynamic responses, manifesting as increase in heart rate and blood pressure, are due to reflex sympatho-adrenal discharge provoked by epilaryngeal and laryngotracheal

**Table 1** Patients characteristics.

| | Macintosh | Bonfils |
|---|---|---|
| Age (year) | 43 ± 16 | 48 ± 12 |
| Male/female | 9/11 | 8/12 |
| Weight (kg) | 61 ± 19 | 57 ± 31 |
| BMI% | 27.7 ± 3.8 | 25.9 ± 3.5 |
| Malapatti score | 1.1 (1–2) | 1.2 (1–2) |

**Table 2** Changes in HR (beat/min).

| Groups | Baseline | Before intubation | 1 (min) | 3 (min) | 5 (min) |
|---|---|---|---|---|---|
| L | 70 ± 14[NS] | 80 ± 16.1[*,†] | 97 ± 7.0[*,†] | 94 ± 11.2[*,†] | 114 ± 18.9[*] |
| B | 68 ± 11 | 73 ± 13.1[*] | 80 ± 14.1[*] | 80 ± 14.7[*] | 90 ± 17.1[*] |

Mean ± standard deviation.
[*] Significant in compared to the same group.
[†] Significant in compared to the other group.
[NS] Nonsignificant in compared to the other group.

**Table 3** Changes in MAP (mmHg).

| Groups | Baseline | Before intubation | 1 (min) | 3 (min) | 5 (min) |
|---|---|---|---|---|---|
| L | 69 ± 20.6[NS] | 81 ± 23.7[*,†] | 93 ± 11.5[*,†] | 92 ± 12.1[*,†] | 100 ± 17.1[*] |
| B | 70 ± 18.9 | 77 ± 23.1[*] | 77 ± 20.1[*] | 76 ± 20.2[*] | 90 ± 13.0[*] |

Mean ± standard deviation.
[*] Significant in compared to the same group.
[†] Significant in compared to the other group.
[NS] Nonsignificant in compared to the other group.

**Table 4** Changes in epinephrine concentration (Pg/dl).

| Groups | Baseline | Before intubation | 1 (min) | 3 (min) | 5 (min) |
|---|---|---|---|---|---|
| L | 29.5 ± 34[NS] | 33.8 ± 67.7[ns,NS] | 32 ± 87.8[ns,NS] | 31 ± 70[ns,NS] | 84 ± 61.3[*] |
| B | 27.9 ± 8.7 | 31.1 ± 12.6[ns] | 31.4 ± 8.7[ns] | 30.2 ± 8.4[ns] | 59 ± 34.3[*] |

Mean ± standard deviation.
[*] Significant in compared to the same group.
[NS] Nonsignificant in compared to the other group.
[ns] Nonsignificant in compared to the same group.

**Table 5** Changes in nor-epinephrine concentration (Pg/dl).

| Groups | Baseline | Before intubation | 1 (min) | 3 (min) | 5 (min) |
|---|---|---|---|---|---|
| L | 180 ± 65[NS] | 192 ± 45[ns] | 190 ± 58[ns,†] | 195 ± 54[ns] | 287 ± 169[*,†] |
| B | 165 ± 83 | 162 ± 70[ns] | 162 ± 87[ns,†] | 164 ± 58[ns] | 234 ± 109[*,†] |

Mean ± standard deviation.
[*] Significant in compared to the same group.
[†] Significant in compared to the other group.
[ns] Nonsignificant in compared to the same group.
[NS] Nonsignificant in compared to the other group.

**Table 6** Changes in intraocular pressure.

| Groups | Baseline | Before intubation | 1 (min) | 3 (min) | 5 (min) |
|---|---|---|---|---|---|
| L | 15.93 ± 3.41 | 9.51 ± 1.94[*] | 13.71 ± 4.16 | 13.49 ± 2.85 | 15.41 ± 1.94 |
| B | 16.13 ± 2.54[NS] | 9.17 ± 2.21[*] | 12.62 ± 2.53[*] | 11.24 ± 2.44 | 12.09 ± 2.52 |

Mean ± standard deviation.
[*] Significant in compared to the same group.
[NS] Nonsignificant in compared to the other group.

stimulation subsequent to laryngoscopy and tracheal intubation [4,5]. Use of Bonfils for endotracheal intubation had also been shown to have less hemodynamic responses after intubation [6].

Our study was designed to evaluate the hemodynamic responses, catecholamine level, and IOP following intubation by Macintosh direct laryngoscope or Bonfils rigid fibroscope. We observed increase in HR, MAP, and catecholamine level

with intubation in all patient but with more increase in Macintosh intubated patients. The result correlate with Hirabayashi et al. [7] who reported that BP and HR changes after tracheal intubation differed between the Laryngoscope and Bonfils (49 mmHg and 25 bpm versus 44 mmHg and 18 bpm, respectively), and he explained that the Bonfils retromolar intubation fiberscope is a rigid endoscope designed to enable glottic visualization and facilitate intubation under endoscopic vision. Theoretically, avoiding direct-vision laryngoscopy and thus could produce less stimulation during intubation than the conventional direct laryngoscopic procedure. Also Nishkawa et al. [8] showed that light wand technique using 2 μg/kg Fentanyl i.v. before intubation, attenuated hemodynamic changes after intubation in comparison with laryngoscopic technique. The HR and BP were measured at 1 min intervals. Although the light wand technique needed more frequent attempts and a longer duration for intubation than the laryngoscopic technique, the light wand technique was accompanied by smaller increase in SBP after tracheal intubation than the laryngoscopic technique. Previous study Dahlgren and Messter [9] and Ko et al. [10] showed that differences in anesthetic technique might affect the hemodynamic responses to tracheal intubation in addition the method of recording hemodynamic variables. Shribman et al. [5] studied 24 adult patients and found similar increase in BP and circulating catecholamine level after laryngoscope with and without intubation. However intubation was associated with significant increase in HR; this did not occur in the laryngoscope without intubation in their study. Also BP were increase in the intubation patients at one and two minutes after laryngoscopy, although the increase were statistically insignificants possibly, therefore, a relatively small number in sample size might cause a β error statistically. In addition, intermittent BP measurement might miss the maximum changes.

As regard to IOP we found that both groups were associated with decrease of IOP just before intubation, however there was increase in IOP in Macintosh compared to Bonfils intubated patients. The mechanisms of aIOP rise using Macintosh is secondary to increased sympathetic activity. Adrenergic stimulation causes vaso- venoconstriction, and an increase central venous pressure, which has close relationship with IOP [11]. In addition adrenergic stimulation can also produce an increase in IOP, by increasing the resistance to the outflow of aqueous humour in trabecular meshwork between anterior chamber and Schemm's canal [12]. This explains the close relationship between hemodynamic and IOP response recorded in our study.Our results are in accordance with Kitamura et al. [13], and Halligan and Charters [14], While Rudolph et al. [15] using Alfentanil and propofol for total intravenous anesthesia reported neither intubation by Macintosh or Bonfils being associated with increase in IOP.

## 5. Conclusion

Bonfils is superior to Macintosh as an airway insertion device in decreasing hemodynamic, catecholamine level and intraocular pressure changes in response to endotracheal intubation.

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