

Comparative Study between Bonfils Intubation Fiberscopy, Fiberoptic Bronchoscopy and Direct Laryngoscopy in Difficult Airway Patients

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ABSTRACT

Background: Airway management has progressed since the first orotracheal intubation using a blind digital technique. The Macintosh laryngoscope has allowed tracheal intubation under direct vision.

Objective: The present study was designed to compare the effect of fiberoptic intubation, bonfils intubation and direct laryngoscope on the hemodynamics, time taken for intubation, stress response hormones (glucose, cortisol and C-peptide) in difficult airway patients.

Subjects and Methods: This Prospective, randomized, controlled study included a total of 90 adult patients aged 21-50 years with physical status (ASA) I or II of both sexes undergoing general anesthesia for elective surgical procedures. Patients were subjected to clinical examination and full investigations and assessment of the patients' airway by El-Ganzori score. Patients were randomly allocated into three equal groups, 30 patients each: Group A: direct laryngoscope, Group B: fiberoptic bronchoscope and Group C: bonfils fiberscope.

Results: Fiberoptic has significant hemodynamic stability after one min of intubation than bonfils and direct laryngoscope. While bonfils has significant hemodynamic stability after five minute and ten minutes after intubation and had highly significant short time of intubation than fiberoptic and direct laryngoscope. As regard to number of attempts, most patients were successfully intubated on the first attempt in group B, while on the second attempt in groups A, and group C which was statistically non-significant between three groups.

Conclusions: It could be concluded that bonfils has hemodynamic stability after five minute and ten minutes after intubation and also had the shortest time of intubation than fiberoptic and direct laryngoscope.

Keywords: Fiberoptic bronchoscope, Bonfils, Direct laryngoscope, General anesthesia, Hemodynamic responses

INTRODUCTION

Airway management is a vital skill that is relevant to the practice of all medical specialties, especially anesthesiology, critical care, emergency medicine and surgery. Inappropriate airway management may result in adverse outcomes ⁽¹⁾.

Pre-operative airway assessment to be routinely performed to identify factors leading to difficult facemask ventilation, supraglottic airway device (SAD) insertion, tracheal intubation and emergency surgical access. This may help to identify potential problems before surgery leading to proper planning and preparation to reduce the risk of complications ⁽²⁾.

Pre-operative sedation should be used with caution in patients with an anticipated difficult airway ⁽³⁾. Fiberoptic intubation (FOI) is an effective technique for establishing airway access in patients with both anticipated and unanticipated difficult airways ⁽⁴⁾.

Bonfils intubation endoscope is a semi-rigid optical stylet, 40 cm in length, with a fixed anterior curvature of its tip of 40 degrees. Difficult orotracheal intubations can be safely performed with its use. One major limitation is that it has an immobile tip and cannot be used for nasotracheal intubation ⁽⁵⁾.

The present study was designed to compare the effect of fiberoptic intubation, bonfils intubation and direct laryngoscope on the hemodynamics, time taken

for intubation, stress response substances (glucose, cortisol and C-peptide) in difficult airway patients.

PATIENTS AND METHODS

This Prospective, randomized, controlled study included a total of 90 adult patients aged 21-50 years with physical status (ASA) I or II of both sexes assessed by El Ganzouri risk index test (EGRI) score of three and higher, undergoing general anesthesia for elective surgical procedures. Patients were investigated at Al-Zahraa University Hospital from September 2016 to March 2019.

Ethical approval:

Written informed consent of all the subjects was obtained. **Approval of the Hospital Ethics Committee was obtained.**

Exclusion Criteria:

Patients with ASA physical status III or more, age less than 21years or more than 50 years, patients with BMI > 35%.

Patients were subjected to clinical examination and full investigations and assessment of the patients' airway by El-Ganzori score. Patients were randomly allocated with closed envelope method into three equal groups, 30 patients each: Group A: direct laryngoscope,



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Group B: fiberoptic bronchoscope and Group C: bonfils fiberoscope.

On arrival to preoperative room: an 18-gauge intravenous cannula was inserted and preoperative blood sample was taken for estimation of plasma glucose, cortisol and C-peptide. Atropine 1 mg was given intravenously as antisialagogue. Ondansetron 8 mg was given as antiemetic. On operating room monitoring was inserting, in the form of Electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximeter, and end tidal CO₂ (Drager Vista 120) were applied to all patients and their baseline vital signs were measured.

Induction of Anesthesia: After pre-oxygenation via a facemask for 5 min, anesthesia was induced with 1-2 ug/kg fentanyl, 1-2 mg/kg propofol. After adequate mask ventilation with 100% oxygen and 3 vol% sevoflurane was ensured, 0.6 mg/kg rocuronium was administered to facilitate tracheal intubation. Ringer infusion was running during induction. Tracheal intubation was done by either the direct laryngoscope (Group A), fiberoptic bronchoscope (Group B) or bonfils fiberoscope (Group C). Two attempts are allowed for intubation, if second attempt failed, the third attempt was done with senior staff. Second line plane should be available by supraglottic airway device (SAD) then surgical airway and patient was excluded from study.

In all groups: well lubricated cuffed ETTs with 2% lidocaine gel with I.D. 7 mm and 7.5 mm respectively.

In Group A: In the sniffing position; intubation was done under direct vision using a Macintosh laryngoscope (size 3 or 4).

In Group B: In the sniffing position; intubation was done by fiberoptic bronchoscope (Fiberoptic 11301BNX, Karl Storz Endoscopy, D-78532, Tuttlingen, Germany) with an outer diameter of 5.1 mm. The lens was adjusted, the insertion cord was lubricated with lidocaine gel 2% together with the outer surface of an ordinary 7 mm or 7.5 mm I.D. ETT. The light source and suction were checked. The bronchoscope with the tube over it was advanced through a specialized intubating oral airway (Ovassapian airway).

In Group C: The tip of the Bonfils intubation fiberoscope (Bonfils™ 10331 B, Karl Storz Endoscopy Ltd GmbH, Tuttlingen, Germany) was positioned just proximal to the tip of the attached tracheal tube and an antifogging agent was applied to the lens. After positioning the patient's head in a neutral position, the mouth was opened and the Bonfils intubation fiberoscope was inserted in the mid sagittal plane. After insertion of the device, the anesthetist performed a jaw thrust maneuver with his left hand to increase the size of the retropharyngeal space. Then, guided by the right hand, the Bonfils intubation fiberoscope was advanced into the

glottic aperture and the tracheal tube inserted into the trachea under direct vision.

In all groups: confirmation of ETT position was done by bilateral breath sounds auscultation and by capnography waveform. Ventilation was continued with mixture of O₂:Air flow of 3 L/min and IPPV to keep ET-CO₂ between 35-40 mmHg. Anesthesia was maintained with 2% sevoflurane, top-up doses of rocuronium 0.1 mg/kg and fentanyl 0.5 mg/kg.

Assessment parameters:

Hemodynamic parameters: which include HR, MABP, O₂ saturation at preoperative, 1min, 5min and 10 min after intubation. **Intubation time:** was recorded by anesthesiologist not included in the study protocol from the moment of insertion of the instrument into the mouth till its removal: **(T1)** time required for visualization of the vocal cord and **(T2)** placement of the endotracheal tube from insertion of instrument during the last successful attempt, and duration of scope manipulation during all attempts **(T total)** were recorded. **Number of attempts:** Two attempt was allowed. If a third attempt was needed, the patient was excluded from the study. **Laboratory studies:** Preoperative samples for blood glucose, cortisol and C-peptide were taken. Other samples for blood glucose, cortisol and c-peptide were taken 10 min after intubation and before surgical incision.

Sample size calculation:

The sample size was calculated using Open Epi program for sample size calculation version 3 and according to a previous study done by **Mohamed *et al.***⁽⁶⁾ who mentioned that the mean ± SD of C-peptide level in fiberoptic group pre induction 2.33 ± 0.61 while in Laryngoscope group 2.8 ± 0.49 and by adjusting the confidence interval to 95%, margin of error accepted to 5%; power of the test to 90% and the ratio between groups to 1:1; the total sample size was found to be 60 patients divided into two equal groups each group 30 and a 30 healthy matched controls with a total sample size of 90 subjects.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Independent-samples t-test of significance was used when comparing between two means. Chi-square (χ²) test of significance was used in order to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following: P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant & P-value >0.05 was considered insignificant.

RESULTS

Demographic variables:

There was no statistically significant difference between the three groups as regard the demographic data (age, BMI, type of operation) p-value >0.05.

As regard to HR: The preoperative mean HR showed no statistically significant difference among

three groups. The mean HR recorded at 1min after intubation, there were significant decrease in HR in group B than group A and C. The mean HR recorded at 5 min and 10 min after intubation there were decrease in HR in group C than group A and B Table (1).

Table (1): Comparison of heart rate among the three groups.

Heart Rate/min Mean±SD	Group A	Group B	Group C	ANOVA	p-value
Preoperative	83.27±10.31	86.80±10.47	85.13±17.28	0.547	0.581
After 1min.	97.20±11.75	91.67±11.13	94.87±10.53	3.510	0.023
After 5min.	92.20±11.77	88.40±13.31	87.27±17.56	4.935	0.015
After 10min.	85.47±12.56	84.67±10.20	83.40±18.06	1.350	0.265

P-value <0.05 was considered significant.

P-value >0. was considered insignificant 05.

As regard to MABP: the preoperative MABP showed no statistically significant difference among three groups. The MABP recorded at 1min after intubation, there were highly significant decrease in MABP in group B than C and A. The MABP recorded at 5 and 10 min after intubation, there were significant decrease in MABP in group C than group A and B Table (2).

Table (2): Comparison between groups according to MABP.

MABP mmHg Mean±SD	Group A	Group B	Group C	ANOVA	p-value
Preoperative	90.60±17.16	88.93±10.26	87.33±15.40	1.447	0.249
After 1min.	103.00±14.27	84.80±12.43	90.20±7.23	15.914	<0.001
After 5 min.	93.27±15.96	84.60±6.92	82.33±14.94	6.260	0.003
After 10min.	87.73±11.94	81.20±13.25	79.53±12.43	3.619	0.031

P-value <0.05 was considered significant.

P-value <0.001 was considered as highly significant.

P-value >0.05 was considered non-significant.

As regard O2 saturation: The preoperative O2 saturation, 1 min, 5 min and 10 min after intubation show no statistically significant difference between three groups(P-value>0.2) which means non-significant figure (1).

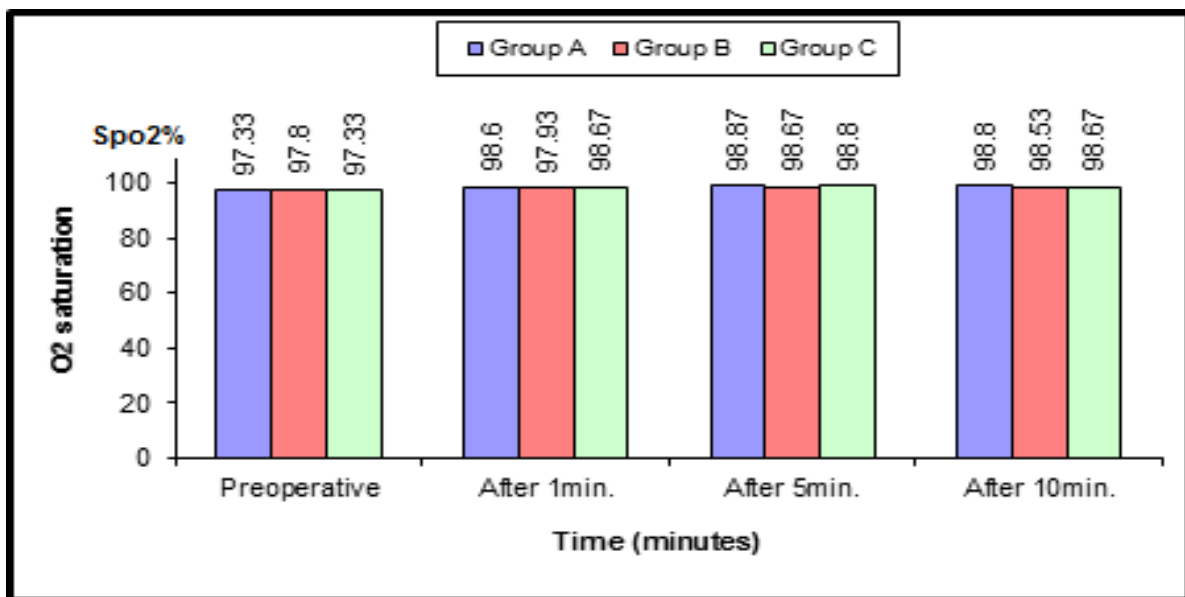


Fig (1): Bar chart between groups according to oxygen saturation.

As regard intubation time: This table shows the measured (T1) show significant decrease in group A than B and C. The measured (T2) show significant decrease in group C than A and B. The measured (T-total) shows highly significant decrease in group C in comparison to group A and B Table (3).

Table (3): Comparison between groups according to intubation time.

Intubation time (sec) Mean±SD	Group A	Group B	Group C	F/x ^{2#}	p-value
T1 Sec.	15.80±9.53	22.33±6.59	17.93±11.93	4.266	0.011
T2 Sec.	8.97±4.77	11.47±3.52	5.33±2.87	5.454	0.006
T Total Sec.	28.27±14.03	33.00±11.42	19.27±11.64	9.462	0.000

P-value <0.05 was considered significant.

P-value <0.001 was considered as highly significant.

As regard to number of attempts: Only 22 patients were successfully intubated on the first attempt in group A, 25 patients in group B and 22 patients in group C, While 8 patients on the second attempt in group A, 5 in group B and 8 in group C which was statistically non-significant Table (4).

Table (4): Comparison between groups according to Number of attempt.

No of attempt	Group A	Group B	Group C	x ²	p-value
First attempt	22 (70.0%)	25 (80.0%)	22 (73.3%)	1.118	0.572
Second attempt	8(30.0%)	5(20.0%)	8 (26.7%)		

P-Value>.05 was considered non-significant.

As regard to laboratory studies: there were no statistically significant difference between groups according to preoperative and 10 min after intubation hormones levels Table (5).

Table (5): Comparison between groups according to laboratory studies.

Hormones Mean±SD	Group A	Group B	Group C	ANOVA	p-value
C-peptide(ng/ml)					
Preoperative	3.64 ± 1.33	3.33 ± 1.46	3.39 ± 1.04	0.243	0.786
10 min after intubation	3.50±1.24	3.25±1.31	3.52±1.04	0.490	0.614
Cortisol (ng/ml)					
Preoperative	369.93 ± 246.82	276.02 ± 201.33	284.86 ± 188.07	0.884	0.420
10 min after intubation	304.11±211.93	245.41±173.10	285.61±251.66	0.587	0.558
Glucose (mg/dl)					
Preoperative	141.60 ± 65.26	124.07 ± 52.35	117.73 ± 51.32	0.714	0.496
10 min after intubation	131.53±48.48	119.30±39.97	116.23±38.43	1.088	0.342

P-value >0.05 was considered non-significant.

DISCUSSION

The current study was designed to investigate the effect of direct laryngoscope, fiberoptic bronchoscope and bonfils intubation on the hemodynamics, time taken for intubation, number of attempts and laboratory studies (glucose, cortisol and C-peptide) in difficult airway patients.

As regards hemodynamic measurements (HR and MAP), the results of the current study showed that there was no statistically significant difference found between the three studied groups at preoperative values.

The mean HR and MABP recorded at 1min after intubation showed significant decrease in HR and MAP in group B than group C and group A.

The mean HR and MABP recorded at 5min and 10 min after intubation showed significant decrease in HR and MAP in group C than B and group A respectively.

These differences may arise because of the combined effects of differences in airway stimulation and differences in the duration of laryngoscopy between the three techniques. The fiberoptic may produce less mechanical pressure on the tissues of the anterior pharynx, which may therefore induce less reflex sympathetic activity.

Supporting to the current study, **Hosdurg et al.** (7) who compared hemodynamic responses to endotracheal intubation between bonfils intubation fiberscope and direct laryngoscope. They found that there was no statistically significant difference between

the two groups with respect to MBP and HR changes throughout the study period. But there was a statistically significant difference in MBP between the groups for the first 10 min after intubation. This can be explained that bonfils group would cause less hemodynamic response to tracheal intubation due to reduced oropharyngeal stimulus.

The results also run in parallel to the study done by **Gupta et al.** ⁽⁸⁾ who compared hemodynamic responses to intubation between Flexible fibreoptic bronchoscope versus Bonfils. They found after the induction of anaesthesia, HR and MAP decreased significantly compared with the preoperative values in both the groups. After endotracheal intubation, there was a significant increase in HR and MAP in bonfils group compared with the fiberoptic group especially after 1 min of intubation.

Against this study was **Sabra** ⁽⁹⁾ who compared hemodynamic changes between Bonfils and fiberoptic bronchoscope. He found that there were no significant differences between both groups in HR and MAP changes at preoperative value, 1 and 5 min after intubation.

As regard oxygen saturation the results of the current study show that the baseline O₂ saturation, 1 min, 5 min and 10 min after intubation show no statistically significant difference between three groups.

The results were in accordance with a study done by **Bhavar et al.** ⁽¹⁰⁾ who compared hemodynamic response to tracheal intubation under general anaesthesia between fiberoptic bronchoscope (FOB) and direct laryngoscope (DLS). They show that Spo₂ was continuously monitored during intubation using either technique and it was found that patients maintained 100% saturation during induction, at the time of insertion of FOB/DLS, at 3min, 5min and 10 min in both Groups.

Supporting to the current study, **Najafi et al.** ⁽¹¹⁾ who compared hemodynamic changes between Bonfils and direct laryngoscope. They show that Pulse oximetry values did not decrease below 92% in either group.

As regard to intubation time the results of this current study show significant short intubation time in bonfils group in comparison to direct laryngoscope and fiberoptic which shows significant long intubation time than other groups.

In agreement of our study **Sabra** ⁽⁹⁾ compared intubation time between Bonfils (BF) and fiberoptic bronchoscope (FOB) he found that the intubation time was significantly longer in FOB group compared with BF group.

In agreement with our study was **Dong Ko et al.** ⁽¹²⁾ who compared success rate of the first intubation attempt between the bonfils and the conventional laryngoscope. They found that Success rate of the first intubation attempt was equal in both groups.

Against the current study **Hosdurg et al.** ⁽⁷⁾ who compared intubation time between Bonfils and direct laryngoscope. They found that the time required for intubation was significantly longer in the bonfils group compared to the direct laryngoscope group.

As regard to number of attempt to intubation the results of this current study shows no statistically significant difference between three groups, Most of patients were intubated in the first attempt with higher success rate in FOB group and second intubation attempt the number of patients were equal in bonfils and direct laryngoscope groups. In our study we exclude any patient after failed second attempt of intubation or oxygen saturation decreased below 95%.

In agreement of our current study **Sabra** ⁽⁹⁾ who compared success rate of intubation attempt between bonfils and fiberoptic bronchoscope he found that all patients were successfully intubated on the first attempt in bonfils group, while intubation was successful on the first attempt in most of patients in fiberoptic group, and only one patient on the second attempt, which was statistically non-significant.

Against our current study **Amir et al.** ⁽¹³⁾ compared Success rate of intubation attempt between the bonfils and the FOB. They found that three patients required a second attempt for successful intubation in FOB group compared to eight in bonfils group; however, the difference was not statistically significant. They explain Failures in the bonfils group may be numerically higher first, due to the preformed shape of stylet that could not be manipulated after insertion in mouth. This was not the case with FOB, as it has a lever to manipulate the direction of tip of insertion cord. Second, the image quality display of bonfils is inferior, and third, with the bonfils, there is no provision for suctioning of oral secretions during intubation causing blurring of vision.

As regard to laboratory studies response to intubation our current study showed that no statistically significant difference preoperative and 10 min post intubation between three groups according to stress response (plasma glucose, cortisol and C- peptide levels).

In agreement with our current study **Mohamed et al.** ⁽⁶⁾ who compared effect of fiberoptic intubation and direct laryngoscope on hormonal stress response in diabetics with ischemic heart disease patients. They found that there were no statistically significant differences regarding glucose, c-peptide and cortisol levels between the study groups pre and post-induction. This may be explained in this study by the use of the modified oral airways that facilitate fiberoptic intubation with no need for jaw thrust maneuver which is expect to be the cause for most of the stress response accompanied fiberoptic intubation.

Also in agreement with our study **Barak et al.** ⁽¹⁴⁾ had compared stress hormones blood levels between

direct laryngoscopy and fiberoptic groups of patients after intubation. They concluded that no significant difference between the two study groups in the hormones levels. They suggested that general anesthesia of sufficient depth could inhibit the hemodynamic response to intubation and may result in similar results in both groups.

Against our current study **Jakushenko *et al.*** ⁽¹⁵⁾ had studied the comparison between direct laryngoscopy and fiberoptic intubation. They concluded that stress hormones were higher in fiberoptic group than in direct laryngoscopy group. They explain that, although fibreoptic intubation has been recognised as a golden standard in difficult airways, it is also well known to be a comparatively longer process and causes greater irritation and, consequently, much greater stress.

CONCLUSIONS

It could be concluded that fiberoptic has the most hemodynamic stability after one min of intubation than bonfils and direct laryngoscope. While bonfils has hemodynamic stability after five minute and ten minutes after intubation and also had the shortest time of intubation than fiberoptic and direct laryngoscope.

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