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Comparison of Air-Q® Masked Laryngeal Airway and Standard Endotracheal Tube during Gynecological Laparoscopic Surgery

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Abstract

Background: In laparoscopic surgical procedures, many clinicians recommend extra glottic airway devices as good alternatives to intubation. We compared the air-Q® and standard Endotracheal tube (ETT) during laparoscopic gynecological surgery regarding hemodynamics changes and respiratory parameters before, during, and after pneumoperitoneum.

Methods: Following Institutional Review Board approval and written informed consent, 60 patients were randomly allocated into the air-Q group (n=30) or ETT group (n=30). The hemodynamic parameters and peak inspiratory pressure, lung compliance, were measured before, during, and after pneumoperitoneum.

Results: There were no significant differences between the two groups regarding demographic data, hemodynamic parameters ware significantly changed in EET group, Peak inspiratory pressure and lung compliance were not significantly changed following carbon dioxide pneumoperitoneum in both groups.

Conclusions: Air-Q can be a good alternative to intubation in selected groups of patients in laparoscopic gynecological procedures, especially where the avoidance of the presser response is of particular concern, and in an emergency unexpected difficult airway.

Keywords: Air-Q; Laparoscopic gynecological surgery; Pneumoperitoneum

Introduction

Airway management has become more refined with the introduction of many airway devices. In the past several decades, a variety of extra-glottic airway devices have been introduced with the goal of a more convenient replacement of tracheal intubation. The advantages of extra-glottic include easy insertion, favorable respiratory mechanics, stable hemodynamics, and decreased airway morbidity [1]. The use of the Laryngeal mask airway (LMA) in laparoscopic surgery remains controversial due to the increased risk of aspiration and difficulties encountered when trying to maintain effective gas transfer while delivering the higher airway pressures required during pneumoperitoneum. Despite these concerns, there have been several randomized controlled trials assessing the use of Proseal LMA (PS-LMA) vs. cuffed endotracheal tube with data advocating the PS-LMA as effective and efficient for pulmonary ventilation in laparoscopic surgery [2]. The Air-Q Intubating laryngeal airway (Cook gas LLC, Mercury Medical, Clearwater, FL) is an extra-glottic airway which is used as a primary airway and as an aid for intubation in situations of anticipated or unanticipated difficult airways. The Air-Q special features make it superior to the classical LMA. Therefore, it has the potential to overcome the limitations of the classical LMA [3].

The primary goal of the present study was to compare the Air-Q device with conventional endotracheal tube for patients undergoing elective laparoscopic gynecological surgery regarding the hemodynamics and respiratory mechanics before, during, and after pneumoperitoneum.

Materials and Methods

After receiving the hospital local ethical committee's approval and informed written consent; this study was conducted on 60 adult female patients, with American Society of Anesthesiologists (ASA) physical status I or II, who underwent elective laparoscopic gynecological surgery under general anesthesia. The study was done at Saudi German hospital in Dubai from November 2014 to November 2015. Patients with a history of obstructive sleep apnea, patients with potentially full stomach (trauma; morbid obesity; pregnancy; history of gastric regurgitation; and heart burn), those with esophageal reflux (hiatus hernia), and those with coagulation disorders were excluded from the study. Patients were assessed preoperatively by El-Ganzouri airway score [4] to assess the expected difficulty of intubation. Patients with airway scores ≥ 5 were excluded from the study.

As per the standard recommended dosages, all patients were pre-medicated with atropine sulfate (0.4 mg) and ranitidine intravenously. Standard monitoring devices (ECG; pulse oximeter; non-invasive blood pressure) were attached before the induction of anesthesia. Patients were pre-oxygenated for 3 min. Induction drugs included fentanyl 1 μg/kg; propofol 2.5 mg/kg; and rocuronium 0.6 mg/kg. Manually assisted ventilation, with 3% sevoflurane, was carried out till the patient became completely relaxed. Insertions of the supraglottic device or tracheal intubation were performed once the patient becomes completely relaxed. Patients were placed into 2 equal groups.

Air- Q group (30 patients)

Insertion of the proper size of the Air-Q was carried out. Proper placement was confirmed by listening for signs of a leak; observing the chest rising; and noting, under manually assisted ventilation, the presence of a normal capnograph tracing. Our goal was to achieve a minimum leak (seal pressure or oropharyngeal leak pressure) at less than 40 cm H_2O. Leak pressures could be assessed by auscultation over the anterior neck and chest whilst observing the ventilator manometer during positive pressure ventilation. It could be measured by closing the expiratory valve, of the circle system, at a fixed gas flow of 3 l/min and noting the airway pressure.

EET group (30 patients)

Size 7 and 7.5 mm ID conventional oral Endotracheal tubes (ETT) were used for intubation. Successful tracheal intubation was confirmed with auscultation of bilateral breath sounds and end tidal carbon dioxide. Heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure were recorded at baseline (T1), 1 min after insertion of Air Q or EET (T2), 5 min before CO_2 pneumoperitoneum (T3), 5 min after the start of CO_2 pneumoperitoneum (T4), and 5 min after the removal of pneumoperitoneum (T5). The Peak inspiratory pressure (PIP) and pulmonary compliance were recorded and compared between the groups at T1-5 using the spirometer of a Primus Drager anesthesia ventilator (Drager Medical GmbH, Lubeck, Germany). The peritoneal insufflation pressure was set at 15 mmHg [5], and the Trendelenburg position was limited to 30 degrees. The patient was extubated or device removed when the patient started responding to verbal commands. Complications were investigated, such as blood on the device or a postoperative sore throat at 1 h.

Statistical analysis

Data were recorded using a data collection sheet and analyzed using a Microsoft Excel spreadsheet and SPSS version 18 (SPSS, Chicago, IL, USA). Statistical comparisons between the supraglutic device and endotracheal tube were made using Student's t-test or Mann-Whitney's U test for continuous data and the chi-squared or Fisher's exact test for categorical data. Data are presented as the mean ± SD or number of patients (%). AP value <0.05 was considered statistically significant.

Results

Age, height, weight, anesthesia time, and pneumoperitoneum time were not statistically significant between the two groups (Table 1).

	Air Q group (n=30)	EET group (n=30)
Age	53.8 ± 12.1	55.9 ± 14.9
Height(cm)	163.6 ± 7.4	162.7 ± 7.6
Weight(kg)	64.3 ± 8.9	64.1 ± 11.1
Anesthesia Time (min)	77.0 ± 17.9	72.0 ± 17.0
Pneumoperitoneum time (min)	36.1 ± 14.6	32.3 ± 15.3

Table 1: Patients' Demographic Characteristics and Anesthetic Properties.

The values of heart rate, systolic BP, diastolic BP, and MAP were recorded, at base line (T1), 1 min after insertion of Air Q or EET (T2), 5 min before CO_2 pneumoperitoneum (T3), 5 min after the start of CO_2 pneumoperitoneum (T4) and 5 min after the removal of pneumoperitoneum (T5) (Table2).

	Mean Heart Rate	Mean Systolic Blood Pressure	Mean Diastolic Blood Pressure	Mean Arterial Blood Pressure
Air Q group Baseline (T1)	72.07 ± 9.11	121.67 ± 11.33	73.13 ± 7.43	89.30 ± 7.67
Post Insertion Immediate (T2)	102.80 ± 12.80***	159.37 ± 19.12***+	87.37 ± 11.18***	1l6.35 ± 11.75***
T3	98.40 ± 11.52***	153.03 ± 13.16***+	85.17 ± 8.35***+	107.35 ± 10.11***+
T4	91.50 ± 8.7 ***	135.67 ± 10.80***++	80.67 ± 6.32+	96.99 ± 6.61**++
T5	86.93 ± 8.55***	126.86 ± 13.51*++	74.96 ± 8.39	92.25 ± 9.41+
EET group Baseline (T1)	70.53 ± 6.23	126.03 ± 8.10	74.90 ± 5.38	92.27 ± 4.47
Post insertion Immediate (T2)	111.00 ± 17.19***	170.23 ± 14.62***	88.97 ± 10.40***	121.05 ± 10.23***
T3	101.10 ± 16.35***	160.33 ± 14.31***	87.07 ± 9.00***	112.52 ± 9.02***
T4	94.67 ± 13.50***	143.93 ± 11.13***	82.33 ± 7.72***	101.53 ± 7.77***
T5	86.70 ± 11.41***	135.05 ± 8.68***	75.70 ± 5.00	96.13 ± 5.09***

Table 2: Comparison between heart rate, systolic, diastolic and mean Arterial Blood Pressure. **p<0.01 Highly Significant (vs. Base line), ***p<0.001 Very Highly Significant (vs. Base line), +p<0.05 Significant (Group I vs. II). ++p<0.01 Highly Significant (Air Q group vs. EET group).

The heart rate, diastolic blood pressure and mean arterial blood pressure values increased in both the groups. The values remained elevated for up to 5 minutes in EET group. The values were significantly lower in Air Q group at T2, T3 and T4 compared to EET group (Figures 1-4).

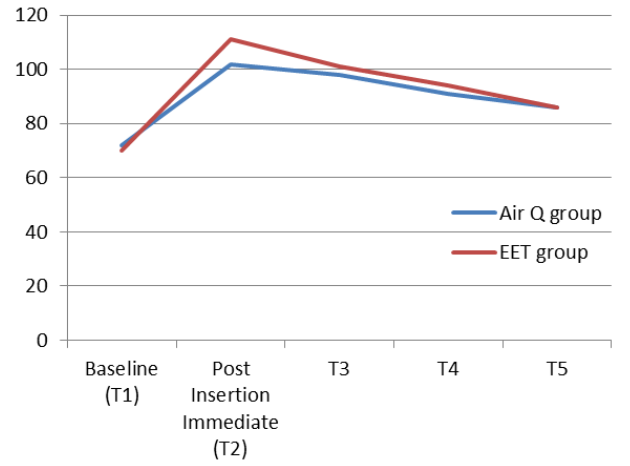

Figure 1: changes in heart rate between Air Q group and EET group.

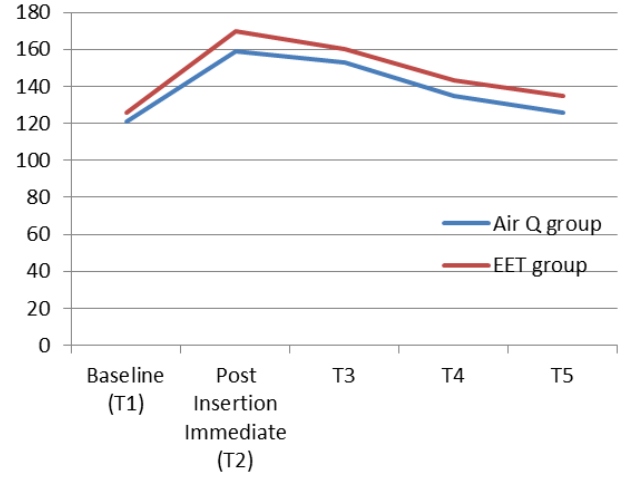

Figure 2: changes in systolic blood pressure between Air Q group and EET group.

In both groups, the PIP was higher and pulmonary compliance was significantly lower during pneumoperitoneum (T3, T4) than before pneumoperitoneum (T2). However, the PIP was not significantly higher and pulmonary compliance was lower in Air Q group especially after Trendelenburg position and CO_2 insufflation (Figure 5 and 6).

There was no significant difference in the incidence of postoperative complications between the groups. Blood on the device was observed concerning two patients in the Air Q group. Four patients in the Air Q group and two patients in the EET group developed a postoperative sore throat.

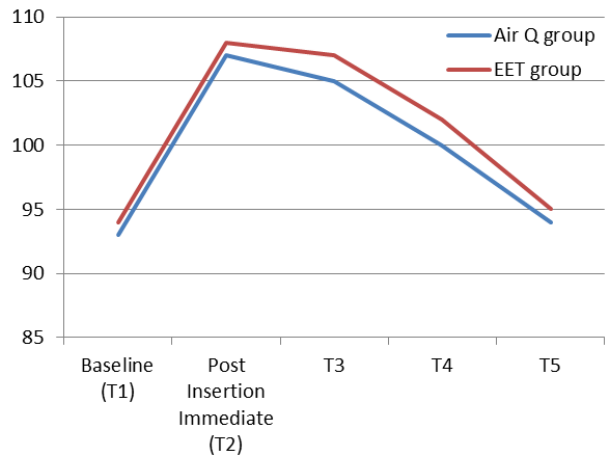

Figure 3: Changes in diastolic blood pressure between Air Q group and EET group.

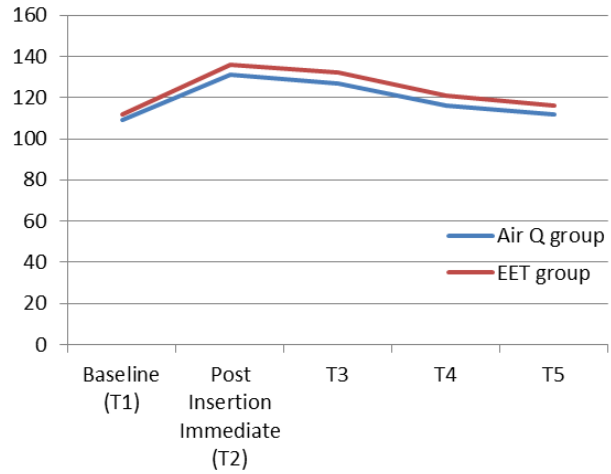

Figure 4: changes in mean blood pressure between Air Q group and EET group.

Discussion

The hemodynamic responses to tracheal intubation reflect the increase in response to oropharyngeal and tracheal stimulation. The possible complications include transient hypertension, tachycardia and arrhythmias. Although these complications are of little significance in normotensive subjects they may be harmful to patients with hypertension, ischemic heart disease or cerebrovascular disease [6,7].

In our study there was no difference in the baseline values of hemodynamic variables between the two groups. The heart rate increased after endotracheal intubation more than after insertion of Air Q and values remained elevated for up to 5 minutes when compared with the baseline. These results were very similar to that study by Yoshitaka Fujii [7] and colleagues who found that the hemodynamic changes were greater after intubation than after laryngeal mask airway insertion.

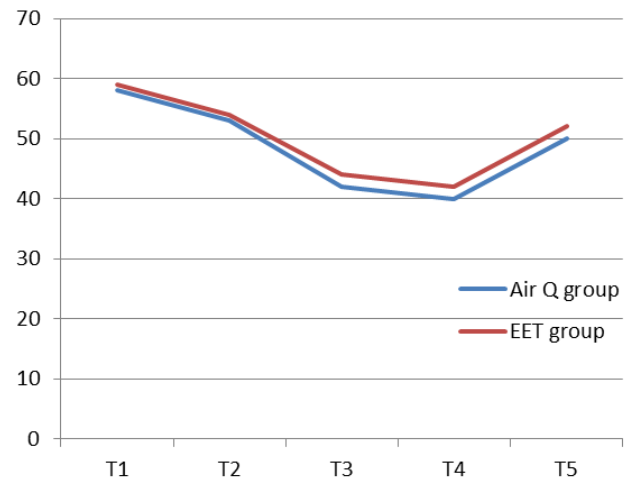

Figure 5: changes in pulmonary compliance between Air Q group and EET group.

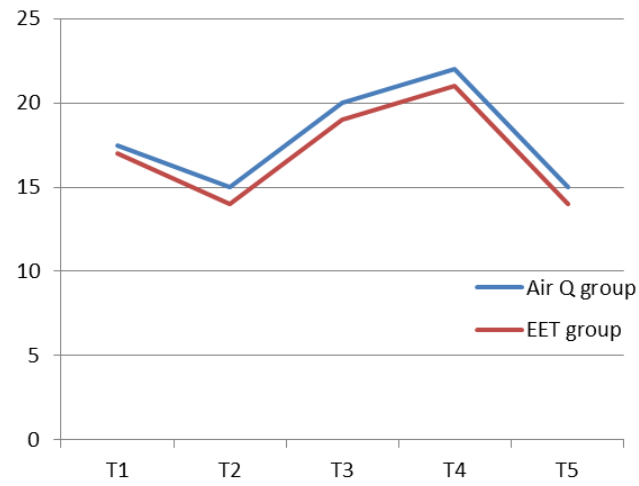

Figure 6: changes in peak airway pressure between Air Q group and EET group.

In this study the increase in mean heart rate were similar when the two groups were compared, the mean peak increase in heart rate was 59.2% in group EET and 36% in group Air Q with $p<0.001$ which is very highly significant. This difference may be because insertion of Air Q or similar extra glottis device produced a balanced stimulation of vagal and cardiac accelerator fibers but intubation of trachea produced lesser vagal stimulus. There was an elevation of both systolic and diastolic BP after airway manipulation in both the groups of our study. However the values in group Air Q were significantly lower compared to EET group.

The results of our study match the findings of Wilson et al. [8] who found that insertion of the laryngeal mask airway produced a small but not significant increase in both systolic and diastolic arterial pressure.

The mean arterial pressure (MAP) values in our study increased after tracheal intubation or insertion of Air Q. Similar to other hemodynamic variables the MAP in group Air Q was significantly lower than group EET. The results of our study were similar to the study of Yoshitaka Fujii [7] and colleagues who found that MAP values increased after airway instrumentation in both the groups with an attenuated response in group LMA.

In our study the insertion of Air Q was associated with a less hemodynamic response comparable to endotracheal intubation. Shribman [9] and colleagues concluded that stimulation of the supragrottic region by tissue tension is the major cause of the sympathoadrenal response.

Intraoperative pulmonary mechanics are affected by Laparoscopic surgery thus providing the most severe test of the efficacy of an airway device [10]. It can also create gastric distension, which may be a cause of nausea and vomiting. In laparoscopic surgery pulmonary compliance is decreased, and the resistance is increased, thereby leading to high airway pressure [11]. Laparoscopic surgery leads to increased intra-abdominal pressure, typically 15 mmHg [12]. This is associated with an increased peak airway pressure of approximately 50%, which decreases pulmonary compliance by 25% [13]. Consistently, this study observed decreased compliance and increased peak airway pressure during pneumoperitoneum in both groups, but there were no significant differences in the extent of the changes between the groups.

There are several important limitations to this study. First the sample size were small (60 patients), secondly data were collected by an un blinded single investigator, thus, it's not sure that there would not be an element of bias, thirdly the Trendelenburg position was limited to 30 degree which need good laparoscopic surgeon which may be not feasible in every procedure.

However in spite of limitation the results of this study suggest that use of Air Q is associated with attenuated hemodynamic during insertion, maintenance and removal compared with tracheal intubation in laparoscopic gynecological procedures in selected group of patients with normal pulmonary compliance. However laparoscopic procedures without a definitive airway security with an Endo-tracheal tube (ETT) are definitely not recommended especially when the incidence of regurgitation and aspiration is high and in complex surgical procedure. Air Q may be good alternative in in an emergency unexpected difficult airway for laparoscopic gynecological surgery.

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