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A PROSPECTIVE COMPARATIVE STUDY OF CARDIOVASCULAR RESPONSE TO LMA INSERTION AND ENDOTRACHEAL TUBE INTUBATION

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Abstract

Introduction: Airway management is a fundamental and the most important aspect of anaesthetic practice and of emergency and critical care medicine. Endotracheal tube intubation (ETI) is the gold standard procedure for airway management.

Materials and Methods: This study was done to evaluate the cardiovascular response to intubation following insertion of LMA and ETT. This is a prospective, non-randomised clinical study of 220 patients admitted to Department of Anaesthesia, Rangaraya Medical College, Kakinada from November 2022 to April 2023 to undergo elective surgical procedures. The patients were in the age group of 14-70 years. Preoperative evaluation was done in all patients including assessment of the airway. Investigations include Urine albumin, Sugar, Hb, Blood urea, serum Creatinine, X-Ray chest and ECG.

Results: The heart increased by 15.54% following endotracheal intubation and by 9.91% following laryngeal mask insertion. The systolic blood pressure showed an increase of 14.13% in endotracheal group and 4.88% in laryngeal mask group. The diastolic blood pressure increased by 17.73% in endotracheal group and 27.27% in laryngeal mask group. The rate pressure product increased by 31.26% following endotracheal intubation and 14.20% following laryngeal mask insertion. The incidence of premature ventricular contraction is 9.09% following endotracheal intubation and 3.64% following laryngeal mask airway insertion.

Conclusion: This study shows that a considerably less cardiovascular response is produced by insertion of the laryngeal mask airway compared with direct Laryngoscopy and Endotracheal intubation. The laryngeal mask airway may be useful in situations where the pressor response to Endotracheal intubation should be avoided, for example during induction of anaesthesia in a hypertensive patient.

Key Words: Airway management, Endotracheal intubation, laryngeal mask insertion.

INTRODUCTION

Airway management is a fundamental and the most important aspect of anaesthetic practice and of emergency and critical care medicine. Endotracheal tube intubation (ETI) is the gold standard procedure for airway management.[1]

General anaesthesia with endotracheal intubation is a time tested procedure practiced all over the world. Direct laryngoscopy and intubation of trachea was considered safe until the hemodynamic stress response to airway manipulation, laryngoscopy and intubation was demonstrated by King et al. in 1951, which is characterized by an increase in HR and rise in BP.[2] This is transient and insignificance in healthy individuals, but may be harmful in high risk patients such as patient with h/o hypertension or Ischaemic Heart Disease (IHD) and cerebrovascular diseases.[3]

Tracheal intubation is performed routinely during general anaesthesia to secure the airway, to facilitate ventilation of the lungs, for control of partial pressures of oxygen and carbon dioxide in arterial blood. Laryngoscopy and intubation are associated with tachycardia, hypertension and arrhythmias.[4]

Placement of LMA is effective in securing the airway. Its insertion does not require Laryngoscopy and its placement is less stimulating and less catecholamine release; hence, there is no tachycardia, hypertension and arrhythmias.[5] The aim of the study is to analyse the cardiovascular response to LMA and ETT insertion.

MATERIALS AND METHODS

This study was done to evaluate the cardiovascular response to intubation following insertion of LMA and ETT. This is a prospective, non-randomised clinical study of 220 patients admitted to Department of Anaesthesia, Rangaraya Medical College, Kakinada from November 2022 to April 2023 to undergo elective surgical procedures. The patients were in the age group of 14-70 years. Preoperative evaluation was done in all patients including assessment of the airway. Investigations include Urine albumin, Sugar, Hb, Blood urea, serum Creatinine, X-Ray chest and ECG.

Exclusion criteria: hypertension, bronchial asthma, cerebrovascular disease, cardiovascular disease and blood pressure > than 140/90 mmHg, Hb < 8 gm%, patients with ECG showing evidence of ischaemic heart disease and rhythm disturbance.

The estimated sample size was found to be 208 (104 in each group) by using a study done by N Braude et al, where the mean (SD) systolic Blood Pressure was found to be 114.5(2.54) and 116.0 (2.88) in Tracheal tube group and Laryngeal mask group respectively at 5 minutes. Finally, 220 patients were found to have the satisfying criteria and they were all included in the study and alternatively allotted to each group.

All the patients included for the study were advised nil oral after 10 pm the night before study. Premedication in the ward include T. Diazepam 0.2 mg/kg orally, T. Ranitidine 3 mg/kg orally, T. Metoclopramide 0.2 mg/kg orally at 10 pm the night before surgery. All patients were given premedication of Inj. fentanyl 2 mg/kg and atropine 10 μg/kg (not exceeding 0.6 mg total dose) intramuscularly 45 minutes to 70 minutes before induction of anaesthesia.

Intravenous access was established on arrival in the operation theatre with continuous monitoring of ECG, Blood pressure and SpO2. Patients were randomly allocated to either ETT group or LMA group. Appropriate size ETT or LMA was kept ready for that patient. Patients were reassured and a stabilisation period of 5 minutes was allowed. Pre-induction baseline heart rate and blood pressure were recorded. Preoxygenation was done with 100% oxygen for 3 minutes. Anaesthesia was induced with fentanyl 2 mg/kg and 2.5% Thiopentone sodium 4 – 5 mg/kg until eyelash reflex was lost. This was followed by muscle paralysis with 1.5 mg/kg Succinylcholine and patients were ventilated with 100% O2 using facemask. After complete paralysis was achieved, Laryngoscopy was performed with standard intubating pillow. Endotracheal intubation was done with Lignocaine jelly smeared to cuff of appropriate size ET tube with cuff inflated to achieve a seal. Positive pressure ventilation was commenced with nitrous oxide and oxygen using Bain's circuit.

In LMA group patients, the fully deflated Lignocaine smeared LMA was inserted after complete paralysis with Succinylcholine as per the technique described by Brain. The neck was flexed with a pillow under the head with a slightly extended head, the laryngeal mask was held like a pen and inserted by pressing it against the hard palate and was advanced into the oral cavity with the help of gloved hand and was guided into the posterior pharyngeal wall as deeply as possible till a resistance was felt. The cuff was inflated with appropriate amount of air as recommended to produce a complete seal. Positive pressure ventilation was commenced with nitrous oxide and oxygen using Bain's circuit. Vecuronium 0.1 mg/kg was administered intravenously.

Patients in whom more than one attempt was made to intubate the trachea or insert an LMA were excluded from the study. No other medications were administered or procedures performed during the 10 minutes data collection period. The study parameters monitored were Heart rate, Systolic blood pressure and Diastolic blood pressure at 0-minute and every minute thereafter up to 5 minutes and on the 10th minute. Reversal was done at the end of surgery with Neostigmine 40 μg/kg and atropine 20 μg/kg.

Statistical Analysis

The data were entered in Excel Sheet and checked for any errors. Analysis was done using Frequencies; Proportions were calculated for qualitative variables. Mean and standard deviation used for quantitative variables. Independent sample 't' test and paired 't' tests were performed to compare the means of two groups. A probability value (p) < 0.05 was regarded as statistically significant.

RESULTS

There was no significant difference in heart rates in baseline (pre-induction) values between the two groups. Heart rate increased above the baseline values in both the groups after induction (post-induction), but there was no significant difference between the two groups.

In the laryngeal mask group, heart rate values were significantly higher ($P < 0.05$) than the baseline values at 0 minute and 1 minute. The highest heart rate values were seen at 0 minute. The heart rate began to fall below the baseline values from 3 minutes.

In the Endotracheal tube group, the heart rate remained significantly elevated ($P < 0.05$) above the baseline values up to 4 minutes from the time of intubation and maximum increase in heart rate was seen at 1 minute. There was no significant difference in heart rate between the two groups at 0 minute and 1 minute. At all other times, the heart rate remained significantly higher ($P < 0.05$) in the Endotracheal group.

Age in years	LMA group (N=110)	ETT group (N=110)
11-20	22	8
21-30	46	42
31-40	22	20
41-50	12	28
51-60	4	10
61-70	4	2
Mean	30.16	36.10
SD	11.08	7.24

Table 1: Age distribution

	LMA group (N=110)	ETT group (N=110)
Male	72	80
Female	38	30

Table 2: Gender distribution

	LMA group (N=110)	ETT group (N=110)
Mean	47.80	46.50
SD	7.20	7.60

Table 3: Weight in KG

Time	LMA group Mean±SD	ETT group Mean±SD	P Value
Baseline (Pre-Induction)	98.61 ± 2.50	98.16 ± 2.50	>0.05
Post-Induction	100.5 ± 2.29	99.70 ± 2.30	>0.05
Immediately after Intubation or Insertion	108.5± 2.16	109.0 ± 2.19	>0.05

(Zero Minute)			
1 Minute	107.4 ± 2.32	113.4 ± 2.71	>0.05
2 Minute	102.2 ± 2.24	113.0 ± 2.50	<0.05
3 Minute	97.71± 2.20	109.8 ± 2.51	<0.05
4 Minute	95.65± 2.18	105.4 ± 2.24	<0.05
5 Minute	93.45 ± 2.12	101.3 ± 2.09	<0.05
10 Minute	89.22 ± 1.85	94.47 ± 1.89	<0.05

Table 4: Changes in Heart Rate at Various Time Intervals following Endotracheal Intubation and Laryngeal Mask

Time	LMA group %	ETT group %
Post-Induction	+1.61	+1.48
Immediately after Intubation Insertion (Zero Minute)	+9.91	+11.05
1 Minute	+8.80	+15.54
2 Minute	+3.54	+15.13
3 Minute	-1.01	+11.87
4 Minute	-3.09	+7.39
5 Minute	-5.33	+3.21
10 Minute	-9.61	-3.75

Table 5: Percentage Change in Heart Rate from Baseline at various Time Intervals Insertion

Time	LMA group Mean±SD	ETT group Mean±SD
Baseline (Pre-Induction)	127.0 ± 1.54	128.8 ± 1.82
Post-Induction	114.5 ± 1.84	116.6 ± 1.72
Immediately after Intubation or Insertion (Zero Minute)	132.0 ± 1.84	142.5 ± 2.18
1 Minute	133.2 ± 2.01	147.0 ± 2.16
2 Minute	127.9 ± 2.12+	145.9 ± 2.32*
3 Minute	123.7 ± 1.94+	138.8 ± 2.41*
4 Minute	120.0 ± 1.54+	135.7 ± 2.17*
5 Minute	119.3 ± 1.44+	130.6 ± 1.99
10 Minute	117.8 ± 1.41+	126.4 ± 1.46

Table 6: Changes in Systolic Blood Pressure at various Time Intervals following Endotracheal Intubation and Laryngeal Mask Insertion

Time	LMA group %	ETT group %

Post-Induction	-9.84	-9.47
Immediately after Intubation or Insertion (Zero Minute)	+3.94	+10.64
1 Minute	+4.88	+14.13
2 Minute	+0.71	+13.28
3 Minute	-2.60	+7.76
4 Minute	-5.51	+5.36
5 Minute	-6.06	+1.40
10 Minute	-7.24	-1.86

Table 7: Percentage Change in Systolic Blood Pressure from Baseline at various Time Intervals

Time	**LMA group %**	**ETT group %**
Post-Induction	-6.82	-7.78
Immediately after Intubation or Insertion (Zero Minute)	+10.47	+11.8
1 Minute	+27.27	+17.73
2 Minute	+9.42	+14.43
3 Minute	+3.65	+9.58
4 Minute	+1.52	+5.84
5 Minute	+0.31	+2.39
10 Minute	-0.05	-1.49

Table 8: Percentage Change in Diastolic Blood Pressure from Baseline at various Time Intervals

Time	**LMA group Mean±SD**	**ETT group Mean±SD**
Baseline (Pre-Induction)	12577.02±04.8	12732.87±430.2
Post-Induction	11448.16±307.5	11651.82±336.1
Immediately after Intubation or Insertion (Zero Minute)	14358.98±383.5 +	15568.25±424.1
1 Minute	14363.31±425.2 +	16713.96±491.5
2 Minute	13121.02±396.0 +	16526.69±470.7
3 Minute	12106.36±355.2 +	15270.91±447.8
4 Minute	11454.05±275.8 +	14329.75±402.8
5 Minute	11114.44±257.8 +	13268.00±386.7
10 Minute	10488.84±235.9 +	11983.85±317.1

Table 9: Changes in Rate Pressure Product at various Time Intervals following Endotracheal Intubation and Laryngeal Mask Insertion

Time	LMA group %	ETT group %
Post-Induction	-8.98	-8.49
Immediately after Intubation or Insertion (Zero Minute)	+14.17	+22.27
1 Minute	+14.20	+31.26
2 Minute	+4.33	+29.80
3 Minute	-3.74	+19.93
4 Minute	-8.93	+12.54
5 Minute	-11.63	+4.20
10 Minute	-16.60	-5.89

Table 10: Percentage Change in Rate Pressure Product from Baseline at various Time Intervals

DISCUSSION

This hypertension and tachycardia have far reaching consequences on cardiovascular system. Myocardial oxygen consumption has been correlated with the product of heart rate and peak systolic pressure. This has been termed as the rate pressure product. The left ventricular wall tension is directly related to the myocardial oxygen consumption.[6]

The present study shows that there is an increase in heart rate following laryngeal mask insertion or endotracheal intubation. The heart rate remained significantly elevated ($P < 0.05$) up to 1 minute following laryngeal mask insertion in contrast to 4 minutes following endotracheal intubation and these heart rate values are significantly greater than the laryngeal mask group ($P < 0.05$) through this 4 minutes period.[7]

Our study shows that there is an increase in systolic blood pressure following laryngeal mask insertion (4.88%) or endotracheal intubation (14.13%). The systolic blood pressure remained significantly elevated ($P < 0.05$) up to 1 minute following laryngeal mask insertion. Following laryngoscopy and intubation, the significant rise ($P < 0.05$) in systolic blood pressure persisted up to 4 minutes and these are significantly higher than the corresponding values of laryngeal mask group.[8]

This study has shown that there is an increase in diastolic blood pressure at one minute following laryngeal mask insertion (27.27%) or endotracheal intubation (17.73%). Statistically, there is no significant difference between these two values.[9] At all other times, the diastolic blood pressure in the laryngeal mask group remained significantly lower than the endotracheal group. The rise in diastolic blood pressure above the baseline was significant ($P < 0.05$) up to one minute

following laryngeal mask insertion values and up to 4 minutes following endotracheal intubation. Wilson et al have shown that diastolic blood pressure following endotracheal intubation raised by 53.2% versus 27.7% following laryngeal mask insertion.[10]

CONCLUSION

This study shows that a considerably less cardiovascular response is produced by insertion of the laryngeal mask airway compared with direct Laryngoscopy and Endotracheal intubation. The laryngeal mask airway may be useful in situations where the pressor response to Endotracheal intubation should be avoided, for example during induction of anaesthesia in a hypertensive patient.

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