A RANDOMIZED CONTROLLED PROSPECTIVE STUDY OF AWARENESS UNDER GENERAL ANAESTHESIA COMPARING TWO DIFFERENT MAC VALUES OF DESFLURANE

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ABSTRACT

Background and Aim: Several studies have been conducted on awareness and the MAC required to prevent awareness during anesthesia. Our aim is to study the depth of anesthesia with 0.7 MAC and 1 MAC and assess awareness post operatively using BRICE questionnaire. **Methodology**: A prospective randomized controlled study was conducted for three years in a tertiary care hospital. A total of 256 patients who were scheduled for undergoing laparoscopy surgeries with duration limited to less than 2 hours were selected and divided them equally into two groups, the first and second groups were administered 0.7 and 1 MAC respectively and depth of anesthesia monitored with BIS Quatro sensor monitor (Covidien medical systems).
Group A(N=136) with MAC of desflurane 0.7 and BIS 40-60
Group B(N=120) with MAC of desflurane 1 and BIS 40-60.
Post-op awareness was assessed using the BRICE questionnaire.
Results: There were no observed statistical differences in both the groups regarding age, sex, body weight, height and comorbidities. No statistical difference in basal heart rate, SBP, DBP, MAP, SPO2. No awareness was seen in patients of both the groups. Volume of desflurane consumed in first hour was 25+/- 3 ml for group A with 0.7 MAC and 40+/- 5 ml in group B with 1 MAC which was statistically significant. The baseline BIS value for both groups is 92-99. The minimum BIS value attained was 40 in group A, 24 in group B. **Conclusion**: No awareness seen in either of the groups. No statistically significant differences in HR, SBP, DBP, MAP, SPO2. Volume of desflurane consumed in first hour was significantly lesser in 0.7 MAC Group and BIS value levels were maintaining between 40-60.

KEYWORDS: 0.7 MAC, awareness, BIS, BRICE questionnaire, desflurane.
-**Question**: Is 0.7 MAC good enough to prevent awareness?
-**Findings**: Yes. It prevents awareness and provides hemodynamic stability like 1 MAC.
-**Meaning**: Lesser MAC is enough to prevent awareness during general anesthesia.

INTRODUCTION

General anesthesia comprises a combination of four major components: analgesia, hypnosis, and immobility and amnesia.

Unconsciousness is the sine qua non of general anesthesia. Though Loss of response to verbal commands is used to assess the onset of unconsciousness, loss of responsiveness does not equate with loss of consciousness. The patients can remain conscious but unresponsive and they can recall events during this conscious phase leading to intraoperative awareness.[1]

Any unintentional or accidental return of consciousness during general anesthesia represents a failure to achieve its primary aim which is a serious complication of general anesthesia.

American Society of Anesthesiologists (ASA) in year 2000 defined awareness as "the un-intended postoperative explicit recall of sensory perceptions during general anaesthesia". This recall may occur immediate postoperatively or may be delayed. It does not include the phenomenon of intra-operative dreaming which is more commonly reported than awareness and is not an early interpretation of delayed awareness.[2] [3]

Explicit memory is the conscious recollection of previous experiences. Implicit memory refers to changes in performance or behaviour that are produced by previous experiences, without any conscious recollection

of those experiences. The term awareness is used for explicit memory only.

According to older studies the incidence of awareness has been reported to be around 0.1% and 0.2% in the general population undergoing surgery.[4] [5] According to NAP5 report 2014 the overall incidence of awareness was very low, approximately 1 in 19,000 general anesthetics.[6] This recall may be spontaneous, or it may be only elicited in a structured interview or questionnaire. One preferred modality for assessing intraoperative awareness with explicit recall is the modified BRICE questionnaire.

Depth of anesthesia monitors were invented because of the ability to objectively determine whether the patient is unconscious or not, and to avoid intra operative complications like awareness. General anaesthetics cause changes in the brain electrical activity which is registered as raw EEG waveforms. Depth of anesthesia can be monitored processing these raw EEG waveforms. These include

- BIS Monitor (most widely used)
- Narcotrend
- M-Entropy (GE Healthcare, Helsinki, Finland)
- aepEX

Bispectral index (BIS) is the most used method for cerebral monitoring. BIS is composed of a combination of time domain, frequency domain, and higher order spectral components that is derived from clinical data. BIS values range from 0 to 100; wherein 0 signifies no detectable brain activity, while a value of 100 signifies a fully awake state.[8]

In our study we have used desflurane considering the advantage of rapid elimination and early recovery from anesthesia. Until now most studies have shown that MAC 1.0 is needed for anesthesia maintenance inorder to prevent awareness. There is paucity in literature about use of 0.7 MAC of desflurane for awareness. In our study we are trying to compare and see if lesser MAC value of desflurane is sufficient to avoid intraoperative awareness Using BIS monitor intraoperatively for assessing adequate depth of anesthesia in both groups helps us alert in case the patient is in lighter planes of anesthesia especially in 0.7 MAC group. Through this we are trying to use less amount of inhalational agent and also by using minimal-flow (FGF < 500 ml/minute) anesthesia, less operation theatre pollution, cost reduction, less global warming could be an added benefit.

1.1.1 Risk Factors For Awareness
Awareness during general anaesthesia is due to an imbalance between the depth of anesthesia and the stimulus to which the patient is exposed.[1] It can be due to:

- Intentional provision of light anaesthesia – in patients who are perceived to not tolerate conventional anaesthetic doses, like high risk ASA IV and V, those with hypovolemia, decreased cardiopulmonary reserve (EF < 30 %), severe aortic stenosis, patients undergoing caesarian section, cardiac surgery.
- Inadvertent provision of light anaesthesia – can happen during prolonged attempts of laryngoscopy and intubation, during patient transport from induction room to operating room, malfunction of anaesthetic delivery system such as vaporizer, infusion pumps, indiscriminate use of NMBs, etc.
- Increased anaesthetic requirements –this can occur in tolerance to anaesthetic agents, for example in patients with pyrexia, hyperthyroidism, obesity, anxiety, smoking, chronic heavy alcoholism, addiction to opioids and use of amphetamines.

Additional risk factors for Intraoperative Awareness:
- Female sex
- Age (younger adults, but not children)
- Emergencies
- Type of surgery (obstetric, cardiac, thoracic)
- Anaesthetist seniority (junior trainees)
- Previous h/o awareness
- Use of NMB
  Factors that were not risk factors for accidental awareness:
- Race
- Use or omission of nitrous oxide.

1.2 Aim
To conduct a randomized controlled prospective study of awareness under general anaesthesia comparing two different MAC values of desflurane.

1.3 Primary Objective
To compare incidence of awareness in two groups of different MAC values of desflurane.

1.4 Secondary Objective
To evaluate:
- The hemodynamic variability in both the groups.
- The amount of inhalational agent consumed in both groups.
- BIS value variation in both groups.

1.4.1 METHODOLOGY
Ethical committee approval
The study was conducted at a tertiary care centre after institutional ethical committee and scientific committee approval. The study population included 256 ASA I and II patients undergoing laparoscopic gastrointestinal procedures. These patients were randomly divided into two groups; group A and group B as mentioned before.
- Group A – desflurane MAC 0.7
- Group B – desflurane MAC 1.0

Pre-Aneasthetic Evaluation

All the patients underwent thorough pre-anaesthetic evaluation one day prior to the procedure. All systems were examined including airway, and the procedure to be carried out was explained to the patients. Patients were reassured to alleviate their anxieties. All patients were kept nil per oral as per fasting guidelines. Written informed consent of patients was taken.

1.4.2 Investigations
The following investigations were done on all patients:
- Blood investigations: Hb%, BT, CT, random blood sugar, blood group and cross matching.
- ECG and Chest X-Ray PA view, 2D Echo depending on the age and associated co-morbidities.

1.4.3 Preliminaries
- Written informed consent
- Intravenous access – starting of an intravenous line with 20G intravenous cannula under aseptic conditions.

1.4.4 Pre-Medication
Tablet Ranitidine 150 mg would be given 2 hours before induction time.

1.4.5 Monitoring
The following monitors would be affixed to each patient:
- Pulse oximeter
- Non-invasive blood pressure monitor
- Respiratory rate
- Electrocardiograph
- A BIS Quatro sensor (Covidien Medical Systems)

1.4.6 Procedure
After obtaining informed written consent and institutional approval, patients of both genders, between age of 18 – 60 years, ASA grade I and II were selected. History of each patient was taken, and then physical exams and routine investigations were conducted. Before performing the surgery, all routine monitors mentioned in the Monitoring section above were connected to the patient. BIS monitor was applied on the patient's forehead. All observations were carried out by single investigator.

Patients were preoxygenated with 100% oxygen at 10 Liters/Minute for 3 minutes. Patients in both groups were induced with Fentanyl 100 mcg IV injection, Propofol 1.5 mg/Kg IV injection, muscle relaxant atracurium 0.5 mg/Kg would be given to facilitate endotracheal intubation. Post intubation, desflurane was started at 6% on the vaporizer dial with fresh gas flow rate of 6 Liters/minute of air: O_2 in 1:1 ratio until 0.7 MAC in group A or 1.0 MAC in group B is achieved respectively. $ETCO_2$ was targeted to be maintained between 30 to 40 mm hg, after MAC target value was achieved, flow rate was reduced to 0.5 litres/minute and maintained until extubation. Opioid analgesia with Morphine 0.1 mg/Kg injection, and crystalloids at the rate of 1 ml/kg/hour were given. Atracurium at 0.1 mg/Kg top up was given

every 20 minutes. The inhaled desflurane concentration is continuously adjusted to maintain the value of MAC between 0.7 in Group A and 1.0 in Group B. BIS was recorded every 5 minutes from monitor.

When hypotension (MBP < 20% of baseline) occurred, volume replacement was first conducted, followed by the administration of 6 mg of ephedrine or 100 μg of phenylephrine. Bradycardia (heart rate < 45 beats/min) was treated with 0.6 mg of atropine. Mechanical ventilation was initiated with a tidal volume of 8 ml/kg, and the ventilatory rate was adjusted to maintain end-tidal CO_2 tension of 30-40 mmHg. At no point was MAC allowed to fall below 0.6.

Intraoperative hypertension (MBP > 20% baseline) was treated with rescue analgesics like NSAIDS injection, Paracetamol 1gm IV ± Diclofenac injection IV and 25 mcg IV Fentanyl injection. If hypertension persisted beta blockers eg: 1-2 mg IV Metoprolol injection was given.

Throughout the surgery all parameters (heart rate, mean BP, $ETCO_2$, ET-Des, BIS value) were noted every 10 minutes. Observed values were noted as follows:
1. Pre-induction i.e baseline value as 0, for example heart rate was noted as HR0.
2. Similarly, other values were noted as HR5, HR10, HR20, HR30 etc, which corresponded to heart rate values at 5, 10, 20 and 30 minutes.

Note, the above notation was followed for all the variables measured.

In all cases, 15 minutes before extubation, ondansetron 8 mg IV was administered for nausea, vomiting prophylactically. Desflurane was discontinued when the laparoscope was removed. The flow rates were maintained at 0.5 liters/minute until the last suture. In order to minimize the risk of residual neuromuscular blockade, IV neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg was administered. After extubation, total desflurane consumed during surgery was noted and BIS value at exit from operation theatre.

Post operatively, patients were assessed for awareness using modified BRICE questionnaire at 3 intervals – within 2-12 hours post extubation, at 24 hours and day of discharge or post-operative day 7, whichever was earlier. Evaluation of awareness was based upon these 3 interviews. Primary outcome measure was incidence of confirmed awareness, which was defined by patient's recollection of intraoperative events during any of the interviews using the BRICE questionnaire. All patients who were suspected to have awareness as per interview, were to be re-interviewed by an independent reviewer to confirm the diagnosis of awareness.

1.4.6.1 BRICE Questionnaire
Questionnaire for post-operative recall:
1. What was the last thing you remember before you went to sleep?

2. What was the first thing you remember after your operation?
3. Can you remember anything in between?
4. Did you dream during your operation?
5. What was the worst thing about your operation?
6. Did you hear any musical songs during surgery?

Based on the data obtained from these interviews, any reports suggestive of awareness will be reported and classified as:
1. No awareness.
2. Possible awareness: when patient is unable to recall any event definitively indicative of awareness.

2 Statistical Methodology
Descriptive and inferential statistical analysis has been carried out in our study. Results on continuous measurements are presented on Mean ± SD (minimum – maximum) and categorical measurements are presented as percentages. In the above experimental study, heart rate, mean BP, BIS values, ETDes values, $ETCO_2$ and

MAC values have been recorded to draw statistical inferences.

The data was entered into MS-Excel and statistical analysis was done by using IBM SPSS version 25.0. The data values were expressed as number and percentages for categorical variables and to test the association between the groups, Chi-square test was used. For continuous variables, the data values were represented as mean and standard deviation and to test the mean difference between two groups, student's t-test was used. All the p-values less than 0.05 are considered as statistically significant.

3 RESULTS AND OBSERVATIONS
The present study was conducted in the Department of Anaesthesiology, Yashoda Superspecialty Hospital, Somajiguda, Hyderabad with the objective to compare awareness under general anaesthesia in two different MAC values of desflurane. A total of 256 patients were included in the study.

Table 1: Descriptive Statistics for Demographic data.

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Age	Group-A	136	41.82	16.407	2.814	36.10	47.55
	Group-B	120	47.53	12.596	2.300	42.83	52.24
	Total	256	44.50	14.909	1.864	40.78	48.22
Weight	Group-A	136	69.88	12.519	2.147	65.51	74.25
	Group-B	120	74.40	12.263	2.239	69.82	78.98
	Total	256	72.00	12.509	1.564	68.88	75.12
Height	Group-A	136	162.97	2.037	.349	162.26	163.68
	Group-B	120	162.93	4.346	.794	161.31	164.56
	Total	256	162.95	3.297	.412	162.13	163.78

Table 2: Independent Samples Test for Demographic data.

		t-test for Equality of Means						
		t	df	P Value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Age	Equal variances assumed	**-1.546**	**62**	**0.127 NOT SIG**	**-5.710**	**3.694**	**-13.094**	**1.675**
	Equal variances not assumed	-1.571	60.894	.121	-5.710	3.634	-12.977	1.557
Weight	Equal variances assumed	**-1.454**	**62**	**0.151 NOT SIG**	**-4.518**	**3.106**	**-10.726**	**1.691**
	Equal variances not assumed	-1.456	61.302	.150	-4.518	3.102	-10.720	1.684
Height	Equal variances assumed	.045	62	.964	.037	.833	-1.627	1.701
	Equal variances not assumed	**.043**	**40.012**	**0.966 NOT SIG**	**.037**	**.867**	**-1.715**	**1.790**

Table **1**, show the distribution of demographic profile across both groups. It was observed that the two groups

Table **2** and

are statistically not significant in terms of age, weight and height of patients. P value >0.05 ie p value.

Table 3: Sex/Gender spread.

		Group-A	Group-B	Total
Female	Count	68	48	116
	% within SEX	58.6%	41.4%	100.0%
	% within GROUP	50.0%	40.0%	45.3%
Male	Count	68	72	140
	% within SEX	48.6%	51.4%	100.0%
	% within GROUP	50.0%	60.0%	54.7%
Total	Count	136	120	256
	% within SEX	53.1%	46.9%	100.0%
	% within GROUP	100.0%	100.0%	100.0%
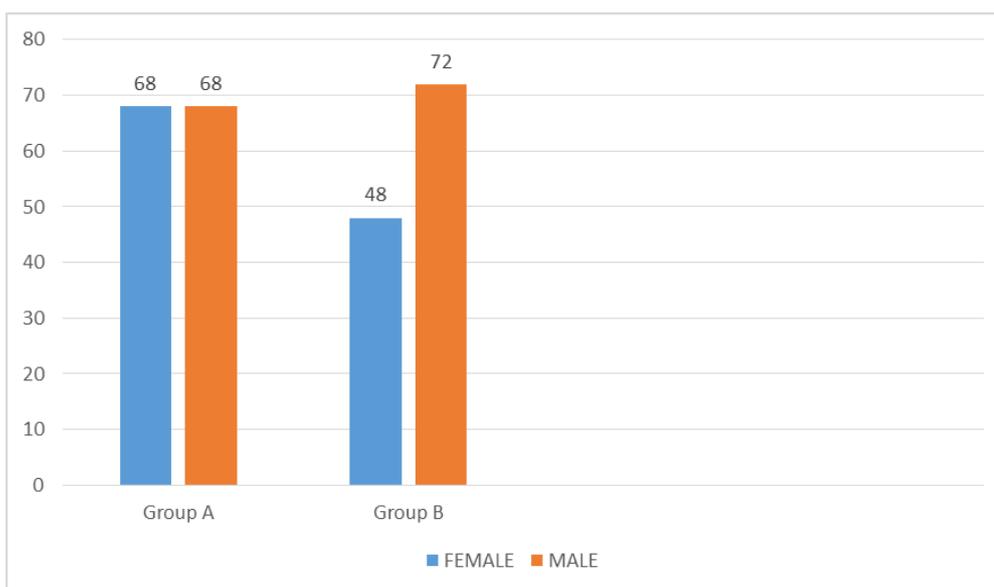
Figure 1 – Sex /Gender spread.

Table 3 and Figure 1, show the distribution of gender across both groups. It was observed that the two groups are statistically not significant in terms of number of female and male patients. The p-value was 0.423, inferring that samples are gender matched.

Table 4: ASA Group spread.

		Group A	Group B	Total
ASA I	Count	68	40	108
	% within ASA	63.0%	37.0%	100.0%
	% within GROUP	50.0%	33.3%	42.2%
ASA II	Count	68	80	148
	% within ASA	45.9%	54.1%	100.0%
	% within GROUP	50.0%	66.7%	57.8%
Total	Count	136	120	256
	% within ASA	53.1%	46.9%	100.0%
	% within GROUP	100.0%	100.0%	100.0%
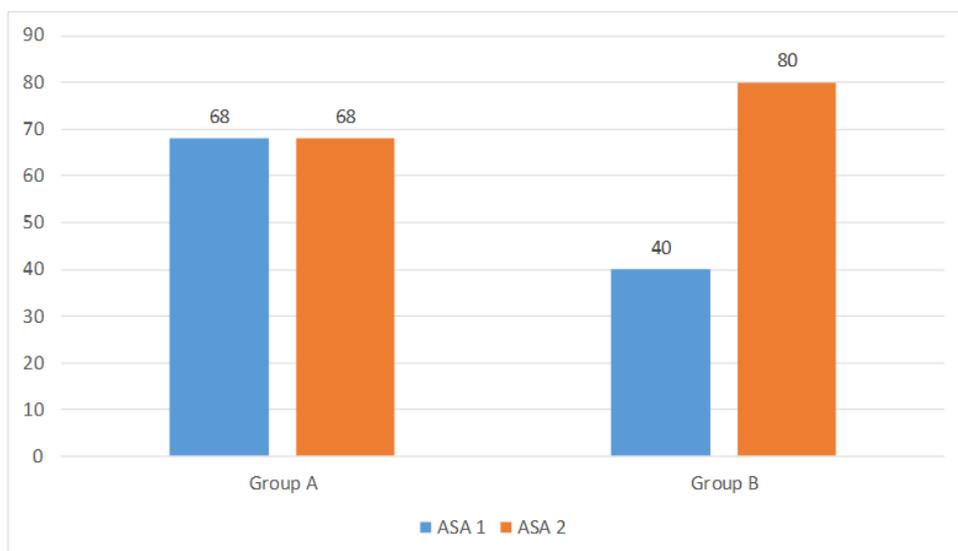
Figure 2 - ASA Group spread.

From the

 and Figure 2 above, ASA groups are statistically similar in both groups.

Table 5: Co-morbidities spread.

		Group A	Group B	Total
DM	Count	0	12	12
	% within Co-morbidities	0.0%	100.0%	100.0%
	% within GROUP	0.0%	10.0%	4.7%
DM, POST PTCA	Count	0	4	4
	% within Co-morbidities	0.0%	100.0%	100.0%
	% within GROUP	0.0%	3.3%	1.6%
HTN	Count	8	12	20
	% within Co-morbidities	40.0%	60.0%	100.0%
	% within GROUP	5.9%	10.0%	7.8%
HTN, DM	Count	4	20	24
	% within Co-morbidities	16.7%	83.3%	100.0%
	% within GROUP	2.9%	16.7%	9.4%
HTN, DM, HYPOTHYROID	Count	4	0	4
	% within Co-morbidities	100.0%	0.0%	100.0%
	% within GROUP	2.9%	0.0%	1.6%
HTN, HYPOTHYROID	Count	4	4	8
	% within Co-morbidities	50.0%	50.0%	100.0%
	% within GROUP	2.9%	3.3%	3.1%
HYPOTHYROID	Count	4	4	8
	% within Co-morbidities	50.0%	50.0%	100.0%
	% within GROUP	2.9%	3.3%	3.1%
NIL	Count	112	64	176
	% within Co-morbidities	63.6%	36.4%	100.0%
	% within GROUP	82.4%	53.3%	68.8%
TOTAL	Count	136	120	256
	% within Co-morbidities	53.1%	46.9%	100%
	% within GROUP	100%	100%	100%

The Figure 3 and Table 5 shows that both group A and B have statistically similar spread of co-morbidities. This ensures that there is no unintended bias.

Figure 3 – Co-morbidities spread.

Table 6: Heart Rate Descriptive statistics.

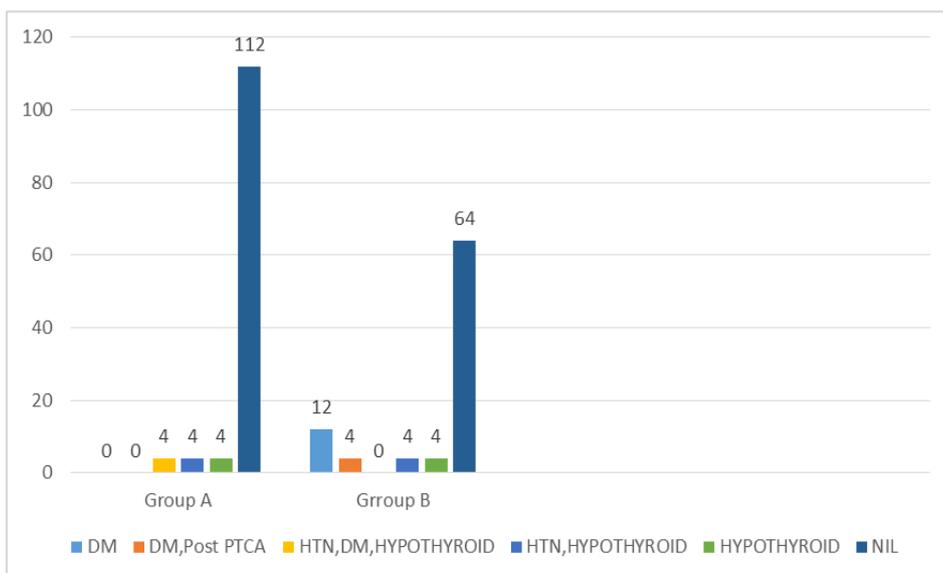|	GROUP									
	Group-A					Group-B				
	Count	Mean	Standard Deviation	Minimum	Maximum	Count	Mean	Standard Deviation	Minimum	Maximum
HR_0	136	79.59	13.20	60.00	106.00	120	86.53	21.38	55.00	169.00
HR_5	136	74.56	11.42	57.00	99.00	120	74.77	12.04	50.00	104.00
HR_10	136	72.38	12.86	44.00	96.00	120	73.30	12.77	50.00	100.00
HR_15	136	72.29	11.32	44.00	96.00	120	73.23	12.40	52.00	96.00
HR_20	136	70.74	13.32	44.00	96.00	120	72.07	11.95	50.00	96.00
HR_25	136	71.06	13.53	44.00	100.00	120	72.60	12.48	50.00	96.00
HR_30	136	73.18	12.27	50.00	100.00	120	70.50	10.03	53.00	90.00
HR_40	136	74.94	12.98	51.00	104.00	120	71.70	9.95	56.00	90.00
HR_50	136	75.75	12.50	52.00	103.00	120	71.41	11.00	51.00	92.00
HR_60	136	77.30	13.53	55.00	98.00	120	74.26	12.56	51.00	96.00
HR_70	136	72.06	10.79	54.00	92.00	120	67.17	8.09	56.00	84.00
HR_80	136	73.14	11.09	57.00	90.00	120	71.07	10.79	58.00	96.00
HR_90	136	77.73	12.19	55.00	99.00	120	69.70	7.66	60.00	84.00
HR_100	136	78.78	17.96	53.00	110.00	120	70.22	4.84	60.00	78.00
HR_110	136	78.29	13.98	55.00	100.00	120	76.17	12.21	65.00	100.00
HR_120	136	79.83	13.69	60.00	95.00	120	81.40	14.10	65.00	96.00

Table 7: Heart Rate Independent Samples Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
HR_0	Equal variances assumed	**-1.584**	**62**	**.118 NOT SIG**	**-6.945**	**4.385**	**-15.711**	**1.821**
	Equal variances not assumed	-1.539	47.111	.130	-6.945	4.512	-16.021	2.131
HR_5	Equal variances assumed	**-.071**	**62**	**.944 NOT SIG**	**-.208**	**2.935**	**-6.075**	**5.659**
	Equal variances not assumed	-.071	60.060	.944	-.208	2.945	-6.098	5.683
HR_10	Equal variances assumed	**-.286**	**62**	**.776 NOT SIG**	**-.918**	**3.211**	**-7.336**	**5.500**
	Equal variances not assumed	-.286	61.124	.776	-.918	3.209	-7.335	5.499

HR_15	Equal variances assumed	**-.317**	**62**	**.753 NOT SIG**	**-.939**	**2.966**	**-6.867**	**4.989**
	Equal variances not assumed	-.315	59.195	.754	-.939	2.983	-6.907	5.029
HR_20	Equal variances assumed	**-.419**	**62**	**.677 NOT SIG**	**-1.331**	**3.181**	**-7.689**	**5.027**
	Equal variances not assumed	-.421	61.979	.675	-1.331	3.159	-7.646	4.983
HR_25	Equal variances assumed	**-.472**	**62**	**.639 NOT SIG**	**-1.541**	**3.269**	**-8.075**	**4.993**
	Equal variances not assumed	-.474	61.870	.637	-1.541	3.252	-8.042	4.959
HR_30	Equal variances assumed	**.948**	**62**	**.347 NOT SIG**	**2.676**	**2.825**	**-2.970**	**8.323**
	Equal variances not assumed	.960	61.671	.341	2.676	2.789	-2.900	8.253
HR_40	Equal variances assumed	**1.110**	**62**	**.271 NOT SIG**	**3.241**	**2.921**	**-2.598**	**9.080**
	Equal variances not assumed	1.128	60.868	.264	3.241	2.873	-2.504	8.986
HR_50	Equal variances assumed	**1.432**	**59**	**.157 NOT SIG**	**4.336**	**3.028**	**-1.723**	**10.395**
	Equal variances not assumed	1.441	58.955	.155	4.336	3.009	-1.684	10.357
HR_60	Equal variances assumed	**.876**	**55**	**.385 NOT SIG**	**3.041**	**3.470**	**-3.914**	**9.995**
	Equal variances not assumed	.880	54.941	.383	3.041	3.456	-3.886	9.967
HR_70	Equal variances assumed	**1.538**	**34**	**.133 NOT SIG**	**4.889**	**3.178**	**-1.571**	**11.348**
	Equal variances not assumed	1.538	31.524	.134	4.889	3.178	-1.589	11.367
HR_80	Equal variances assumed	**.501**	**26**	**.621 NOT SIG**	**2.071**	**4.136**	**-6.429**	**10.572**
	Equal variances not assumed	.501	25.980	.621	2.071	4.136	-6.430	10.572
HR_90	Equal variances assumed	**1.784**	**19**	**.090 NOT SIG**	**8.027**	**4.499**	**-1.389**	**17.443**
	Equal variances not assumed	1.824	17.008	.086	8.027	4.402	-1.260	17.315
HR_100	Equal variances assumed	1.380	16	.187	8.556	6.199	-4.587	21.698
	Equal variances not assumed	**1.380**	**9.157**	**.200 NOT SIG**	**8.556**	**6.199**	**-5.432**	**22.543**
HR_110	Equal variances assumed	**.288**	**11**	**.778 NOT SIG**	**2.119**	**7.347**	**-14.051**	**18.289**
	Equal variances not assumed	.292	10.989	.776	2.119	7.264	-13.871	18.109
HR_120	Equal variances assumed	**-.187**	**9**	**.856 NOT SIG**	**-1.567**	**8.400**	**-20.569**	**17.436**
	Equal variances not assumed	-.186	8.538	.857	-1.567	8.425	-20.785	17.652
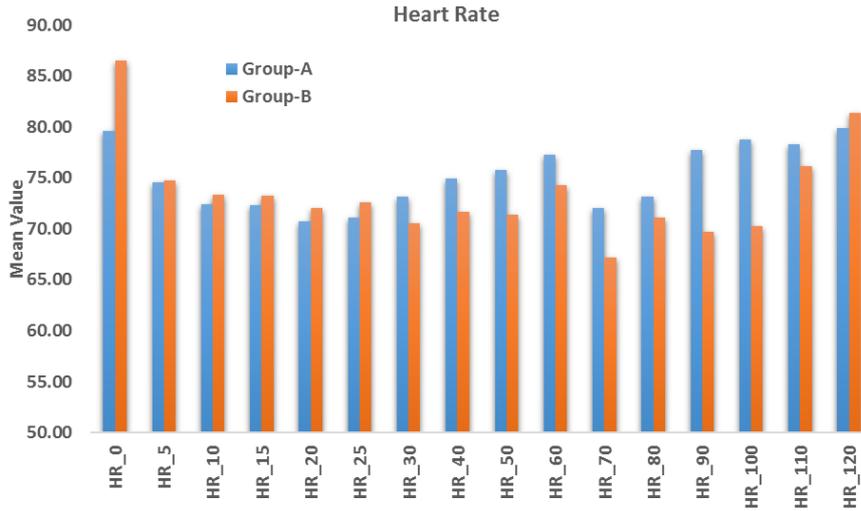
Figure 4 – Heart Rate Mean Value.

Table 8: Mean BP Descriptive Statistics.

|	Group A				Group B			
	Mean	**Standard Deviation**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
MBP_0	93.65	14.93	70.00	129.00	99.70	13.65	73.00	138.00
MBP_5	88.32	14.22	65.00	130.00	91.47	13.72	70.00	125.00
MBP_10	87.29	14.39	63.00	130.00	87.57	14.81	63.00	120.00
MBP_15	87.59	13.51	65.00	120.00	86.37	15.68	62.00	115.00
MBP_20	85.59	13.82	67.00	120.00	85.53	16.29	62.00	117.00
MBP_25	85.50	14.34	67.00	120.00	86.23	15.45	62.00	110.00
MBP_30	87.74	16.30	67.00	120.00	89.93	20.36	62.00	150.00
MBP_40	88.44	14.73	60.00	120.00	91.87	21.91	62.00	163.00
MBP_50	91.06	16.19	68.00	128.00	90.86	18.94	62.00	130.00
MBP_60	93.23	16.26	65.00	120.00	93.37	14.28	64.00	122.00
MBP_70	86.83	15.12	64.00	114.00	85.22	13.17	61.00	107.00
MBP_80	88.07	16.10	65.00	114.00	90.64	10.95	72.00	111.00
MBP_90	92.73	17.98	60.00	112.00	89.70	11.18	70.00	106.00
MBP_100	94.44	15.49	74.00	120.00	90.67	14.04	68.00	110.00
MBP_110	91.43	21.22	50.00	112.00	86.83	11.77	79.00	110.00
MBP_120	91.67	18.88	60.00	110.00	92.80	16.93	71.00	115.00
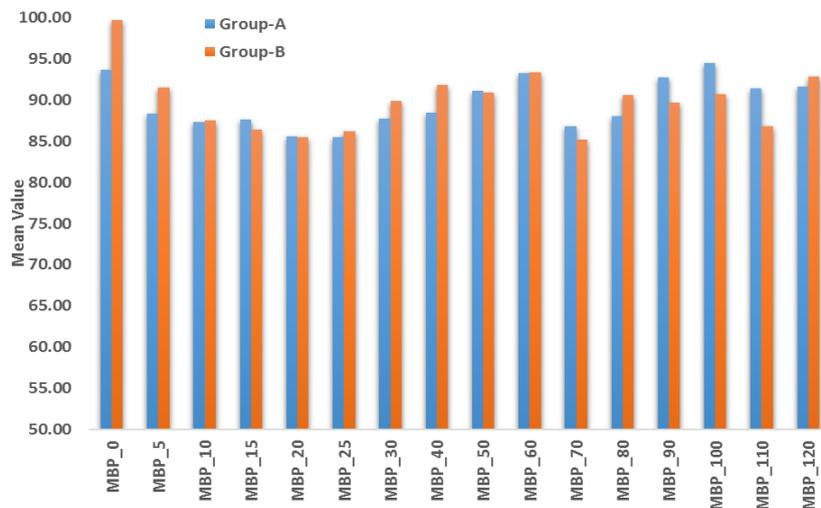
Figure 5 – Mean BP Descriptive Statistics.

Table 9: Mean BP Independent Samples Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
MBP_0	Equal variances assumed	**-1.685**	**62**	**.097 NOT SIG**	**-6.053**	**3.593**	**-13.235**	**1.129**
	Equal variances not assumed	-1.694	61.912	.095	-6.053	3.572	-13.194	1.088
MBP_5	Equal variances assumed	**-.897**	**62**	**.373 NOT SIG**	**-3.143**	**3.504**	**-10.148**	**3.862**
	Equal variances not assumed	-.899	61.483	.372	-3.143	3.496	-10.134	3.847
MBP_10	Equal variances assumed	**-.075**	**62**	**.941 NOT SIG**	**-.273**	**3.654**	**-7.578**	**7.033**
	Equal variances not assumed	-.074	60.530	.941	-.273	3.661	-7.595	7.049
MBP_15	Equal variances assumed	**.335**	**62**	**.739 NOT SIG**	**1.222**	**3.649**	**-6.072**	**8.515**
	Equal variances not assumed	.332	57.685	.741	1.222	3.683	-6.152	8.595
MBP_20	Equal variances assumed	**.015**	**62**	**.988 NOT SIG**	**.055**	**3.765**	**-7.470**	**7.580**
	Equal variances not assumed	.014	57.246	.989	.055	3.804	-7.561	7.671
MBP_25	Equal variances assumed	**-.197**	**62**	**.845 NOT SIG**	**-.733**	**3.725**	**-8.179**	**6.713**
	Equal variances not assumed	-.196	59.587	.845	-.733	3.743	-8.221	6.754
MBP_30	Equal variances assumed	**-.479**	**62**	**.633 NOT SIG**	**-2.198**	**4.586**	**-11.366**	**6.969**
	Equal variances not assumed	-.473	55.481	.638	-2.198	4.650	-11.516	7.120
MBP_40	Equal variances assumed	**-.742**	**62**	**.461 NOT SIG**	**-3.425**	**4.618**	**-12.657**	**5.806**
	Equal variances not assumed	-.724	49.785	.472	-3.425	4.730	-12.928	6.077
MBP_50	Equal variances assumed	**.045**	**59**	**.965 NOT SIG**	**.200**	**4.500**	**-8.804**	**9.205**
	Equal variances not assumed	.044	55.413	.965	.200	4.535	-8.887	9.287
MBP_60	Equal variances assumed	**-.034**	**55**	**.973 NOT SIG**	**-.137**	**4.073**	**-8.300**	**8.026**
	Equal variances not assumed	-.034	54.971	.973	-.137	4.045	-8.244	7.970
MBP_70	Equal variances assumed	**.341**	**34**	**.735 NOT SIG**	**1.611**	**4.725**	**-7.991**	**11.213**
	Equal variances not assumed	.341	33.372	.735	1.611	4.725	-7.998	11.220
MBP_80	Equal variances assumed	-.494	26	.625	-2.571	5.204	-13.268	8.125
	Equal variances not assumed	**-.494**	**22.911**	**.626 NOT SIG**	**-2.571**	**5.204**	**-13.338**	**8.195**
MBP_90	Equal variances assumed	.458	19	.652	3.027	6.616	-10.820	16.875
	Equal variances not assumed	**.468**	**16.913**	**.646 NOT SIG**	**3.027**	**6.471**	**-10.631**	**16.685**
MBP_100	Equal variances assumed	**.542**	**16**	**.595 NOT SIG**	**3.778**	**6.968**	**-10.995**	**18.550**

	Equal variances not assumed	.542	15.846	.595	3.778	6.968	-11.006	18.562
MBP_110	Equal variances assumed	**.470**	**11**	**.647 NOT SIG**	**4.595**	**9.773**	**-16.916**	**26.106**
	Equal variances not assumed	.491	9.597	.634	4.595	9.350	-16.357	25.547
MBP_120	Equal variances assumed	**-.104**	**9**	**.920 NOT SIG**	**-1.133**	**10.922**	**-25.841**	**23.574**
	Equal variances not assumed	**-1.685**	**62**	**.097 NOT SIG**	**-6.053**	**3.593**	**-13.235**	**1.129**

From the tables and figures (
Table **6**, Table 7,

Table **8**, Table 9,

Figure **4** and Figure 5) above its observed that the heart rate readings across the duration of surgery for both groups is statistically similar. Hence, it can be said that reducing the value of MAC to 0.7 is sufficient for hemodynamic stability.

- The difference in mean arterial blood pressures at 0 mins of two groups was statistically not significant in group 1 and group 2 respectively. (p >0.05).
- The difference at 90 minutes mean arterial blood pressures of two groups was statistically not significant (p >0.05).

There was no statistically significant difference in mean arterial blood pressure of the two groups at all respective intervals. (P > 0.05).

Table 10: BIS Value Descriptive Statistics.

|	Group A				Group B			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
BIS_0	97.24	1.48	92.00	99.00	97.13	1.41	94.00	98.00
BIS_5	49.94	10.48	40.00	91.00	45.57	7.38	32.00	64.00
BIS_10	49.94	7.15	48.00	77.00	42.80	6.78	31.00	56.00
BIS_15	50.09	6.46	48.00	62.00	41.27	7.09	29.00	56.00
BIS_20	49.76	6.15	40.00	64.00	41.17	6.32	30.00	52.00
BIS_25	49.44	5.91	40.00	62.00	40.60	6.48	30.00	60.00
BIS_30	48.79	6.50	42.00	62.00	42.67	7.06	30.00	60.00
BIS_40	52.03	11.59	40.00	92.00	42.97	7.93	24.00	60.00
BIS_50	52.94	11.68	40.00	91.00	44.90	9.00	32.00	80.00
BIS_60	65.47	21.42	40.00	94.00	46.74	15.05	25.00	88.00
BIS_70	57.33	16.64	40.00	92.00	43.89	11.47	31.00	84.00
BIS_80	58.14	18.86	42.00	92.00	54.93	22.26	30.00	90.00
BIS_90	57.45	19.85	40.00	94.00	46.60	15.81	35.00	90.00
BIS_100	59.78	17.00	42.00	88.00	51.00	21.81	33.00	90.00
BIS_110	58.14	15.12	44.00	90.00	41.33	3.14	37.00	46.00
BIS_120	91.00	.89	90.00	92.00	82.80	5.22	74.00	88.00
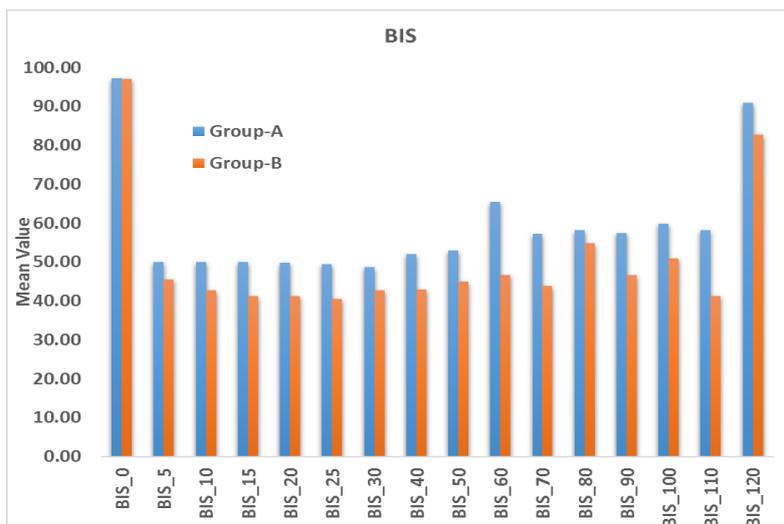
Figure 6 – BIS Value Descriptive Statistics.

Table 11: BIS Values Independent T Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
BIS_0	Equal variances assumed	**.282**	**62**	**.779 NOT SIG**	**.102**	**.362**	**-.622**	**.826**
	Equal variances not assumed	.282	61.622	.779	.102	.361	-.620	.824
BIS_5	Equal variances assumed	**1.906**	**62**	**.061 NOT SIG**	**4.375**	**2.295**	**-.213**	**8.962**
	Equal variances not assumed	1.948	59.229	.056	4.375	2.246	-.120	8.869
BIS_10	Equal variances assumed	**4.084**	**62**	**<0.0001 VHS**	**7.141**	**1.748**	**3.646**	**10.636**
	Equal variances not assumed	4.098	61.652	.000	7.141	1.743	3.657	10.625
BIS_15	Equal variances assumed	**5.210**	**62**	**<0.0001 VHS**	**8.822**	**1.693**	**5.437**	**12.206**
	Equal variances not assumed	5.180	59.166	.000	8.822	1.703	5.414	12.229
BIS_20	Equal variances assumed	**5.507**	**62**	**<0.0001 VHS**	**8.598**	**1.561**	**5.477**	**11.719**
	Equal variances not assumed	5.498	60.571	.000	8.598	1.564	5.471	11.725
BIS_25	Equal variances assumed	**5.707**	**62**	**<0.0001 VHS**	**8.841**	**1.549**	**5.744**	**11.938**
	Equal variances not assumed	5.673	59.160	.000	8.841	1.558	5.723	11.959
BIS_30	Equal variances assumed	**3.615**	**62**	**.001 SIG**	**6.127**	**1.695**	**2.740**	**9.515**
	Equal variances not assumed	3.597	59.402	.001	6.127	1.704	2.719	9.536
BIS_40	Equal variances assumed	**3.602**	**62**	**.001 SIG**	**9.063**	**2.516**	**4.033**	**14.093**
	Equal variances not assumed	3.685	58.565	.001	9.063	2.459	4.141	13.984
BIS_50	Equal variances assumed	**2.990**	**59**	**.004 SIG**	**8.041**	**2.690**	**2.659**	**13.423**
	Equal variances not assumed	3.028	57.570	.004	8.041	2.655	2.725	13.357

BIS_60	Equal variances assumed	3.779	55	.000	18.726	4.955	8.795	28.657
	Equal variances not assumed	**3.848**	**52.074**	**<0.0001 VHS**	**18.726**	**4.866**	**8.961**	**28.491**
BIS_70	Equal variances assumed	**2.822**	**34**	**.008 SIG**	**13.444**	**4.764**	**3.764**	**23.125**
	Equal variances not assumed	2.822	30.175	.008	13.444	4.764	3.718	23.171
BIS_80	Equal variances assumed	**.412**	**26**	**.684 NOT SIG**	**3.214**	**7.798**	**-12.814**	**19.243**
	Equal variances not assumed	.412	25.319	.684	3.214	7.798	-12.835	19.264
BIS_90	Equal variances assumed	**1.376**	**19**	**.185 NOT SIG**	**10.855**	**7.886**	**-5.651**	**27.360**
	Equal variances not assumed	1.392	18.704	.180	10.855	7.798	-5.484	27.193
BIS_100	Equal variances assumed	**.952**	**16**	**.355 NOT SG**	**8.778**	**9.216**	**-10.760**	**28.315**
	Equal variances not assumed	.952	15.101	.356	8.778	9.216	-10.855	28.410
BIS_110	Equal variances assumed	**2.659**	**11**	**.022 SIG**	**16.810**	**6.322**	**2.896**	**30.723**
	Equal variances not assumed	2.871	6.600	.026	16.810	5.855	2.792	30.827
BIS_120	Equal variances assumed	**3.825**	**9**	**.004 SIG**	**8.200**	**2.144**	**3.351**	**13.049**
	Equal variances not assumed	3.473	4.196	.024	8.200	2.361	1.765	14.635

From the tables (

Table **10** and Table 11) and figure above (Figure 6), it can be noted that the BIS values across the duration of surgery (recorded every 10 minutes) are statistically dissimilar.

1. The baseline BIS values recorded in our group of the patients ranged between 92 to 99.
2. The BIS values decreased after induction of anaesthesia.
3. The minimum BIS value in Group A was 40 and in Group B was 24.

Table 12: ETCO$_2$ Descriptive Statistics.

	Group A				Group B			
	Mean	**Standard Deviation**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
ETCO2_0	30.94	3.18	25.00	35.00	31.60	3.22	25.00	40.00
ETCO2_5	31.06	2.96	25.00	36.00	30.83	3.38	22.00	38.00
ETCO2_10	31.15	2.89	26.00	37.00	31.03	3.60	22.00	38.00
ETCO2_15	30.88	2.96	24.00	35.00	31.10	3.84	22.00	38.00
ETCO2_20	30.79	2.85	24.00	35.00	30.60	3.93	20.00	38.00
ETCO2_25	31.47	3.74	24.00	42.00	30.47	3.71	20.00	38.00
ETCO2_30	40.88	51.55	28.00	33.00	30.73	3.79	21.00	38.00
ETCO2_40	32.15	3.07	27.00	41.00	31.17	3.42	23.00	38.00
ETCO2_50	32.09	2.52	28.00	40.00	31.17	3.86	23.00	39.00
ETCO2_60	31.87	3.03	25.00	41.00	31.48	3.59	23.00	39.00
ETCO2_70	32.22	2.44	28.00	35.00	31.94	3.44	26.00	39.00
ETCO2_80	32.07	2.79	27.00	37.00	32.43	4.16	28.00	40.00
ETCO2_90	33.00	2.45	29.00	38.00	32.60	3.60	28.00	39.00
ETCO2_100	33.67	2.92	30.00	38.00	33.11	3.69	28.00	40.00
ETCO2_110	32.71	3.20	28.00	38.00	34.00	3.95	28.00	40.00
ETCO2_120	33.33	3.72	30.00	40.00	31.00	2.65	28.00	35.00

Table 13: ETCO$_2$ Independent Samples Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
ETCO2_0	Equal variances assumed	**-.822**	**62**	**.414 NOT SIG**	**-.659**	**.802**	**-2.261**	**.944**
	Equal variances not assumed	-.821	60.802	.415	-.659	.802	-2.263	.946
ETCO2_5	Equal variances assumed	**.284**	**62**	**.777 NOT SIG**	**.225**	**.793**	**-1.361**	**1.812**
	Equal variances not assumed	.282	58.134	.779	.225	.800	-1.376	1.827
ETCO2_10	Equal variances assumed	**.140**	**62**	**.889 NOT SIG**	**.114**	**.812**	**-1.509**	**1.737**
	Equal variances not assumed	.138	55.641	.891	.114	.823	-1.535	1.762
ETCO2_15	Equal variances assumed	**-.256**	**62**	**.799 NOT SIG**	**-.218**	**.851**	**-1.920**	**1.484**
	Equal variances not assumed	-.252	54.328	.802	-.218	.865	-1.952	1.517
ETCO2_20	Equal variances assumed	**.228**	**62**	**.820 NOT SIG**	**.194**	**.850**	**-1.506**	**1.894**
	Equal variances not assumed	.224	52.264	.824	.194	.867	-1.546	1.935
ETCO2_25	Equal variances assumed	**1.076**	**62**	**.286 NOT SIG**	**1.004**	**.933**	**-.861**	**2.869**
	Equal variances not assumed	1.077	61.108	.286	1.004	.933	-.861	2.869
ETCO2_30	Equal variances assumed	**1.075**	**62**	**.287 NOT SIG**	**10.149**	**9.443**	**-8.728**	**29.026**
	Equal variances not assumed	1.144	33.403	.261	10.149	8.868	-7.885	28.183
ETCO2_40	Equal variances assumed	**1.208**	**62**	**.231 NOT SIG**	**.980**	**.811**	**-.641**	**2.602**
	Equal variances not assumed	1.200	58.716	.235	.980	.817	-.655	2.615
ETCO2_50	Equal variances assumed	1.113	59	.270	.921	.828	-.735	2.577
	Equal variances not assumed	**1.091**	**47.372**	**.281 NOT SIG**	**.921**	**.845**	**-.777**	**2.620**
ETCO2_60	Equal variances assumed	**.440**	**55**	**.662 NOT SIG**	**.385**	**.876**	**-1.371**	**2.141**
	Equal variances not assumed	.436	51.145	.665	.385	.884	-1.390	2.160
ETCO2_70	Equal variances assumed	**.280**	**34**	**.781 NOT SIG**	**.278**	**.994**	**-1.741**	**2.297**
	Equal variances not assumed	.280	30.652	.782	.278	.994	-1.749	2.305
ETCO2_80	Equal variances assumed	**-.267**	**26**	**.792 NOT SIG**	**-.357**	**1.339**	**-3.110**	**2.395**
	Equal variances not assumed	-.267	22.697	.792	-.357	1.339	-3.129	2.415
ETCO2_90	Equal variances assumed	**.300**	**19**	**.767 NOT SIG**	**.400**	**1.331**	**-2.387**	**3.187**
	Equal variances not assumed	.295	15.682	.772	.400	1.356	-2.479	3.279
ETCO2_100	Equal variances assumed	**.354**	**16**	**.728 NOT SIG**	**.556**	**1.567**	**-2.767**	**3.878**

	Equal variances not assumed	.354	15.188	.728	.556	1.567	-2.782	3.893
ETCO2_110	Equal variances assumed	**-.649**	**11**	**.530 NOT SIG**	**-1.286**	**1.981**	**-5.645**	**3.074**
	Equal variances not assumed	-.638	9.660	.538	-1.286	2.016	-5.798	3.227
ETCO2_120	Equal variances assumed	**1.172**	**9**	**.271 NOT SIG**	**2.333**	**1.991**	**-2.171**	**6.838**
	Equal variances not assumed	1.211	8.838	.257	2.333	1.926	-2.037	6.703
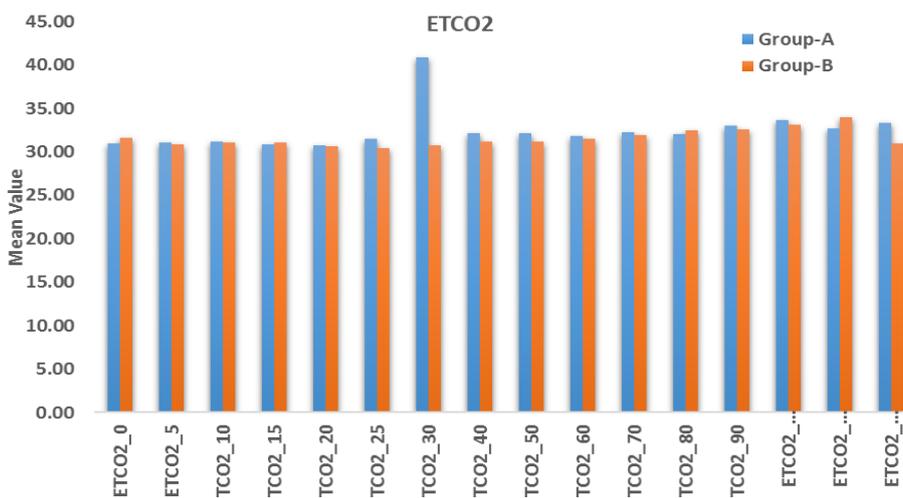
Figure 7 – ETCO$_2$

Table 14: MAC Values Descriptive Statistics.

|	Group A				Group B			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
MAC_0	.00	.00	.00	.00	.00	.00	.00	.00
MAC_5	.66	.12	.20	.90	.79	.13	.50	1.00
MAC_10	.70	.02	.70	.80	.89	.12	.70	1.00
MAC_15	.69	.05	.40	.70	.95	.07	.80	1.00
MAC_20	.69	.05	.40	.70	.98	.05	.80	1.00
MAC_25	.69	.05	.40	.70	.98	.05	.80	1.00
MAC_30	.69	.02	.60	.70	1.00	.02	.90	1.00
MAC_40	.69	.04	.50	.70	1.00	.00	1.00	1.00
MAC_50	.70	.02	.60	.70	1.00	.02	.90	1.00
MAC_60	.70	.00	.70	.70	.98	.05	.80	1.00
MAC_70	.71	.03	.70	.80	.99	.05	.80	1.00
MAC_80	.67	.09	.40	.70	1.00	.00	1.00	1.00
MAC_90	.70	.00	.70	.70	1.00	.00	1.00	1.00
MAC_100	.70	.00	.70	.70	1.00	.00	1.00	1.00
MAC_110	.70	.00	.70	.70	.83	.41	.00	1.00
MAC_120	.70	.	.70	.70	.	.	.	.
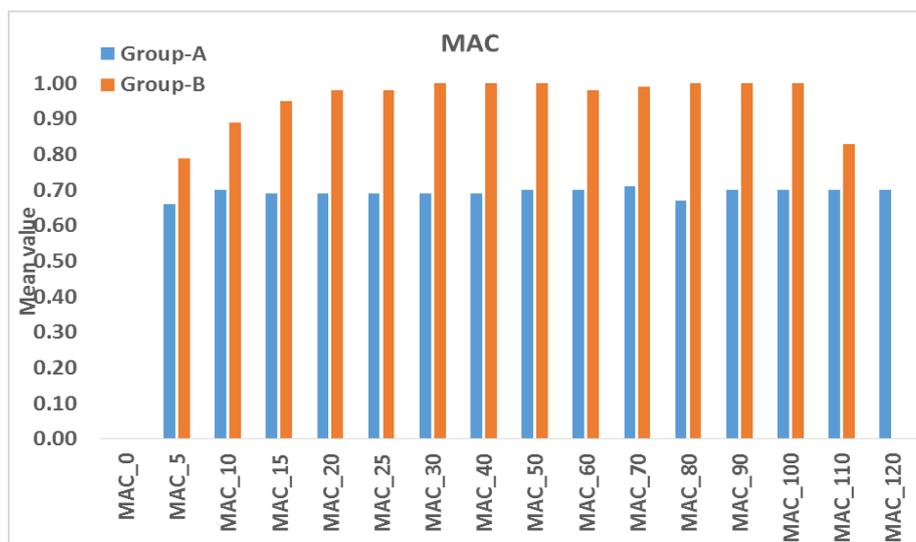
Figure 8 – MAC Values.

Table 15: MAC Values Independent T Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
MAC_0	Equal variances assumed	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Equal variances not assumed	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MAC_5	Equal variances assumed	**.284**	**62**	**.777 NOT SIG**	**.225**	**.793**	**-1.361**	**1.812**
	Equal variances not assumed	.282	58.134	.779	.225	.800	-1.376	1.827
MAC_10	Equal variances assumed	**.140**	**62**	**.889 NOT SIG**	**.114**	**.812**	**-1.509**	**1.737**
	Equal variances not assumed	.138	55.641	.891	.114	.823	-1.535	1.762
MAC_15	Equal variances assumed	**-.256**	**62**	**.799 NOT SIG**	**-.218**	**.851**	**-1.920**	**1.484**
	Equal variances not assumed	-.252	54.328	.802	-.218	.865	-1.952	1.517
MAC_20	Equal variances assumed	**.228**	**62**	**.820 NOT SIG**	**.194**	**.850**	**-1.506**	**1.894**
	Equal variances not assumed	.224	52.264	.824	.194	.867	-1.546	1.935
MAC_25	Equal variances assumed	**1.076**	**62**	**.286 NOT SIG**	**1.004**	**.933**	**-.861**	**2.869**
	Equal variances not assumed	1.077	61.108	.286	1.004	.933	-.861	2.869
MAC_30	Equal variances assumed	**1.075**	**62**	**.287 NOT SIG**	**10.149**	**9.443**	**-8.728**	**29.026**
	Equal variances not assumed	1.144	33.403	.261	10.149	8.868	-7.885	28.183
MAC_40	Equal variances assumed	**1.208**	**62**	**.231 NOT SIG**	**.980**	**.811**	**-.641**	**2.602**
	Equal variances not assumed	1.200	58.716	.235	.980	.817	-.655	2.615
MAC_50	Equal variances assumed	1.113	59	.270	.921	.828	-.735	2.577
	Equal variances not assumed	**1.091**	**47.372**	**.281 NOT SIG**	**.921**	**.845**	**-.777**	**2.620**

MAC_60	Equal variances assumed	**.440**	**55**	**.662 NOT SIG**	**.385**	**.876**	**-1.371**	**2.141**
	Equal variances not assumed	.436	51.145	.665	.385	.884	-1.390	2.160
MAC_70	Equal variances assumed	**.280**	**34**	**.781 NOT SIG**	**.278**	**.994**	**-1.741**	**2.297**
	Equal variances not assumed	.280	30.652	.782	.278	.994	-1.749	2.305
MAC_80	Equal variances assumed	**-.267**	**26**	**.792 NOT SIG**	**-.357**	**1.339**	**-3.110**	**2.395**
	Equal variances not assumed	-.267	22.697	.792	-.357	1.339	-3.129	2.415
MAC_90	Equal variances assumed	**.300**	**19**	**.767 NOT SIG**	**.400**	**1.331**	**-2.387**	**3.187**
	Equal variances not assumed	.295	15.682	.772	.400	1.356	-2.479	3.279
MAC_100	Equal variances assumed	**.354**	**16**	**.728 NOT SIG**	**.556**	**1.567**	**-2.767**	**3.878**
	Equal variances not assumed	.354	15.188	.728	.556	1.567	-2.782	3.893
MAC_110	Equal variances assumed	**-.649**	**11**	**.530 NOT SIG**	**-1.286**	**1.981**	**-5.645**	**3.074**
	Equal variances not assumed	-.638	9.660	.538	-1.286	2.016	-5.798	3.227
MAC_120	Equal variances assumed	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	Equal variances not assumed	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Table 16: ET-Des Values Descriptive Statistics.

	Group A				Group B			
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
EtDes_0	.00	.00	.00	.00	.00	.00	.00	.00
EtDes_5	4.10	.89	1.20	5.20	4.89	.48	4.10	5.90
EtDes_10	4.00	.65	2.40	5.50	5.24	.71	4.20	7.80
EtDes_15	4.07	.51	3.20	5.40	5.35	.46	4.20	6.10
EtDes_20	4.08	.47	3.20	5.20	5.40	.48	4.70	6.70
EtDes_25	4.10	.47	3.20	5.50	5.42	.51	4.80	6.40
EtDes_30	4.08	.45	3.20	5.20	5.41	.45	4.90	6.40
EtDes_40	4.05	.48	2.90	4.90	5.43	.51	4.80	6.60
EtDes_50	4.07	.47	2.90	4.80	5.47	.51	4.80	6.70
EtDes_60	4.07	.48	3.40	4.90	5.27	.39	4.60	6.20
EtDes_70	3.94	.69	2.00	4.80	5.24	.31	4.90	5.80
EtDes_80	4.05	.36	3.70	4.80	5.21	.31	4.80	5.80
EtDes_90	4.12	.37	3.70	4.80	5.28	.41	4.50	5.80
EtDes_100	4.07	.32	3.60	4.50	5.35	.29	5.00	5.80
EtDes_110	4.18	.27	3.90	4.60	5.47	.42	5.00	5.80
EtDes_120	.	.	.	.	5.30	.	5.30	5.30

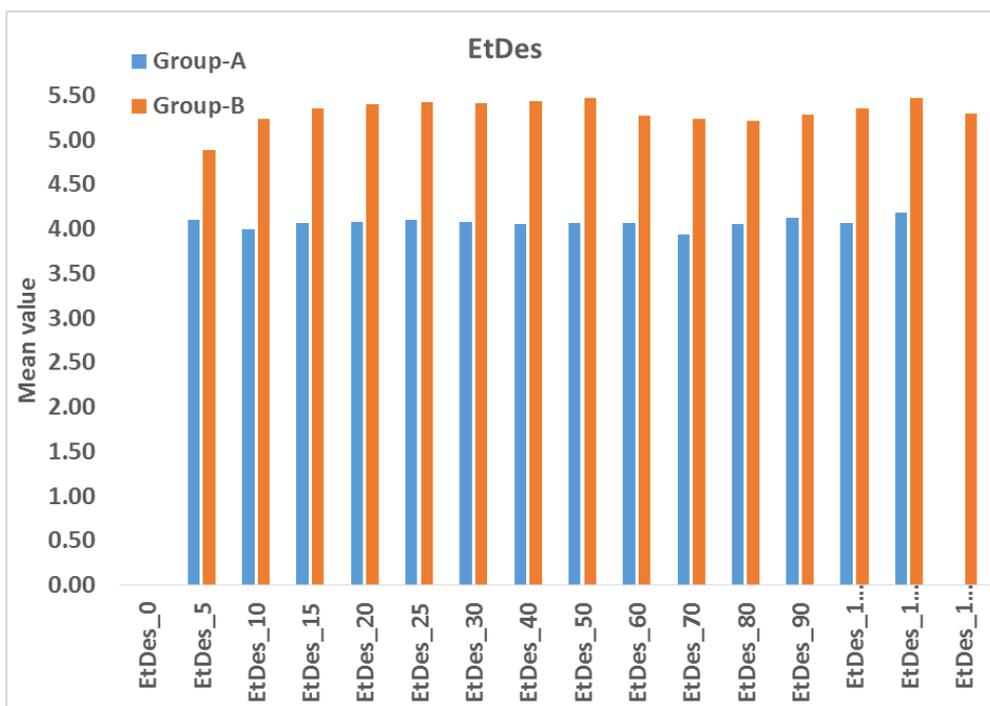**Figure 9 – ET-Des Values.**

Table 17: ET-Des Values Independent Samples Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
EtDes _0	Equal variances assumed	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Equal variances not assumed	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EtDes_5	Equal variances assumed	**-4.186**	**58**	**<0.0001 VHS**	**-.7888**	**.1885**	**-1.1661**	**-.4116**
	Equal variances not assumed	-4.347	48.503	.000	-.7888	.1815	-1.1536	-.4241
EtDes_10	Equal variances assumed	**-7.268**	**61**	**<0.0001 VHS**	**-1.2433**	**.1711**	**-1.5854**	**-.9013**
	Equal variances not assumed	-7.235	58.873	.000	-1.2433	.1719	-1.5872	-.8994
EtDes_15	Equal variances assumed	**-10.538**	**62**	**<0.0001 VHS**	**-1.2794**	**.1214**	**-1.5221**	**-1.0367**
	Equal variances not assumed	-10.609	61.971	.000	-1.2794	.1206	-1.5205	-1.0383
EtDes_20	Equal variances assumed	**-11.176**	**62**	**<0.0001 VHS**	**-1.3239**	**.1185**	**-1.5607**	**-1.0871**
	Equal variances not assumed	-11.156	60.514	.000	-1.3239	.1187	-1.5613	-1.0866
EtDes_25	Equal variances assumed	**-10.686**	**62**	**<0.0001 VHS**	**-1.3167**	**.1232**	**-1.5630**	**-1.0704**
	Equal variances not assumed	-10.630	59.384	.000	-1.3167	.1239	-1.5645	-1.0688
EtDes_30	Equal variances assumed	**-11.832**	**62**	**<0.0001 VHS**	**-1.3273**	**.1122**	**-1.5515**	**-1.1030**
	Equal variances not assumed	-11.839	61.148	.000	-1.3273	.1121	-1.5514	-1.1031

EtDes_40	Equal variances assumed	**-10.893**	**59**	**<0.0001 VHS**	**-1.3779**	**.1265**	**-1.6310**	**-1.1248**
	Equal variances not assumed	-10.861	57.541	.000	-1.3779	.1269	-1.6319	-1.1239
EtDes_50	Equal variances assumed	**-10.735**	**55**	**<0.0001 VHS**	**-1.4004**	**.1304**	**-1.6618**	**-1.1390**
	Equal variances not assumed	-10.695	53.320	.000	-1.4004	.1309	-1.6630	-1.1378
EtDes_60	Equal variances assumed	**-8.313**	**35**	**<0.0001 VHS**	**-1.1982**	**.1441**	**-1.4909**	**-.9056**
	Equal variances not assumed	-8.362	34.162	.000	-1.1982	.1433	-1.4894	-.9071
EtDes_70	Equal variances assumed	**-6.480**	**26**	**<0.0001 VHS**	**-1.3071**	**.2017**	**-1.7218**	**-.8925**
	Equal variances not assumed	-6.480	17.999	.000	-1.3071	.2017	-1.7310	-.8833
EtDes_80	Equal variances assumed	**-7.743**	**19**	**<0.0001 VHS**	**-1.1555**	**.1492**	**-1.4678**	**-.8431**
	Equal variances not assumed	-7.800	18.958	.000	-1.1555	.1481	-1.4656	-.8454
EtDes_90	Equal variances assumed	**-6.238**	**16**	**<0.0001 VHS**	**-1.1556**	**.1853**	**-1.5483**	**-.7628**
	Equal variances not assumed	-6.238	15.797	.000	-1.1556	.1853	-1.5487	-.7624
EtDes_100	Equal variances assumed	**-7.441**	**11**	**<0.0001 VHS**	**-1.2786**	**.1718**	**-1.6568**	**-.9004**
	Equal variances not assumed	-7.492	10.917	.000	-1.2786	.1707	-1.6545	-.9026
EtDes_110	Equal variances assumed	**-5.679**	**7**	**.001 SIG**	**-1.2833**	**.2260**	**-1.8177**	**-.7490**
	Equal variances not assumed	-4.849	2.888	.018	-1.2833	.2647	-2.1444	-.4222
EtDes _120	Equal variances assumed	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	Equal variances not assumed	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Table 18: Surgery Duration spread.

Surgery Duration		Group-A	Group-B	Total
SX_DUR <= 1 Hour	Count	64	48	112
	% within SX_DUR	57.1%	42.9%	100.0%
	% within GROUP	47.1%	40.0%	43.8%
1 - 2 Hours	Count	72	72	144
	% within SX_DUR	50.0%	50.0%	100.0%
	% within GROUP	52.9%	60.0%	56.3%
Total	Count	136	120	256
	% within SX_DUR	53.1%	46.9%	100.0%
	% within GROUP	100.0%	100.0%	100.0%

Chi-square value = 0.323, P-value = 0.570 (Not Significant)
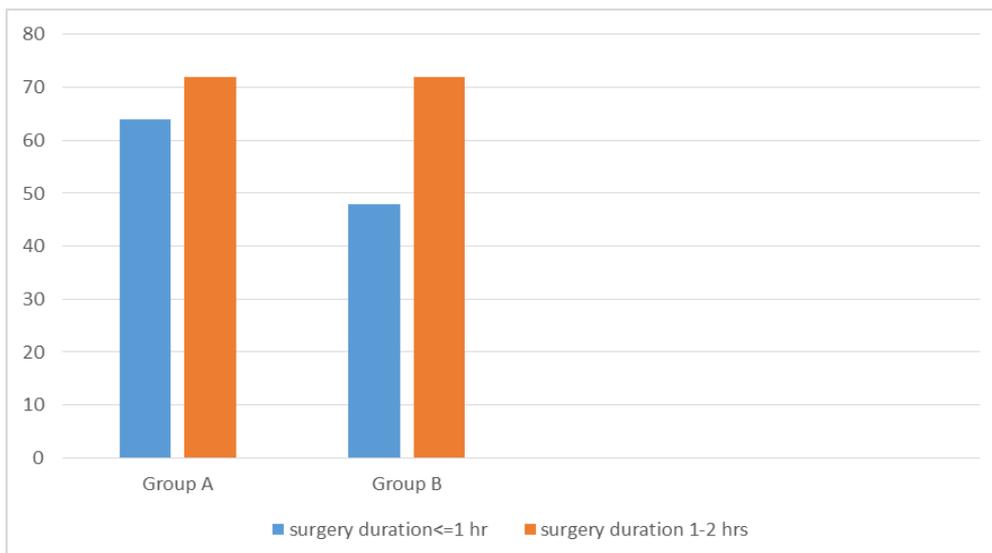
Figure 10 – Surgery Duration spread.

Table 19: Total Desflurane consumed & BIS value at exit from OT.

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Desflurane Total	Group-A	136	27.38	10.617	1.821	23.68	31.09
	Group-B	120	43.10	13.532	2.471	38.05	48.15
	Total	256	34.75	14.347	1.793	31.17	38.33
BIS at Exit	Group-A	136	93.38	1.477	.253	92.87	93.90
	Group-B	120	93.30	2.020	.369	92.55	94.05
	Total	256	93.34	1.739	.217	92.91	93.78
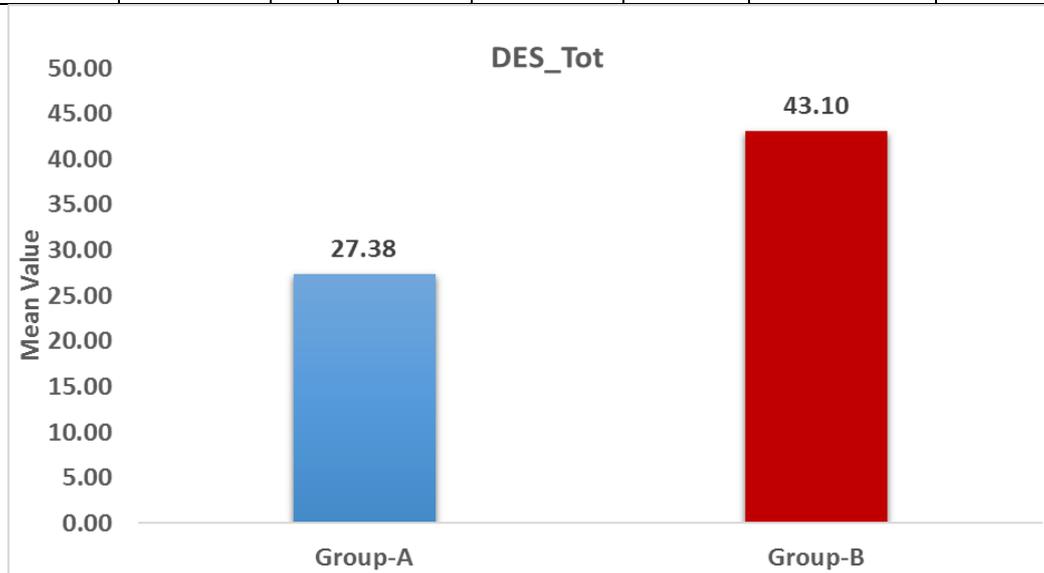
Figure 11 – Total Desflurane consumed.
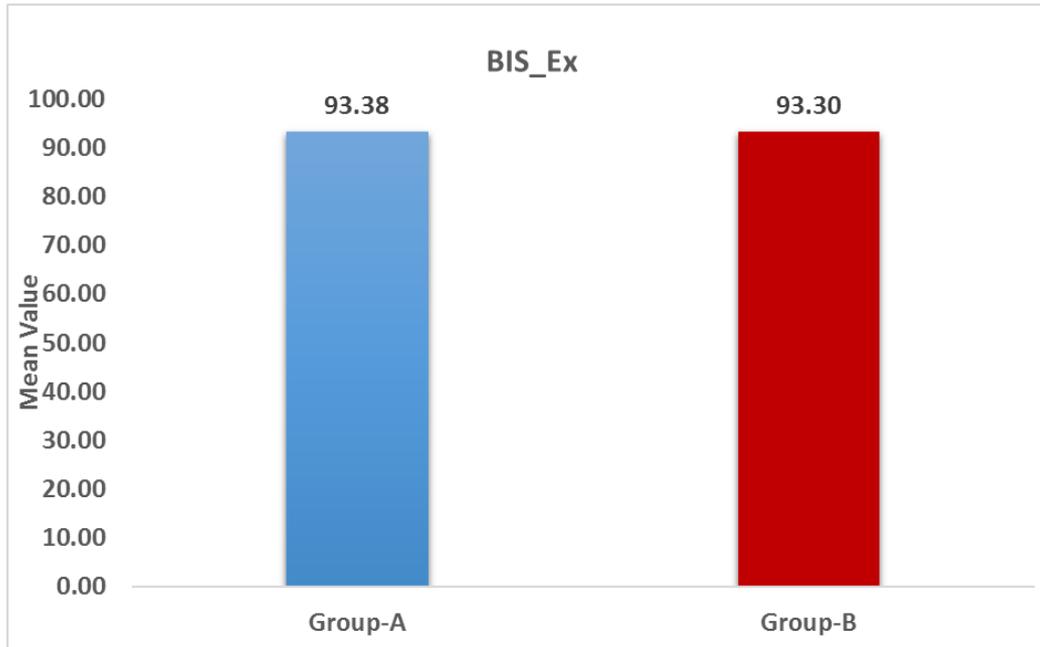
Figure 12 – BIS value at exit from OT.

Table 20: Total Desflurane consumed & BIS value at exit from OT – Independent Sample Test.

		t	df	P Value	Mean Difference	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
BIS_0	Equal variances assumed	**-5.199**	**62**	**<0.0001 VHS**	**-15.718**	**3.023**	**-21.761**	**-9.675**
	Equal variances not assumed	-5.121	54.841	.000	-15.718	3.069	-21.869	-9.566
BIS_5	Equal variances assumed	**.188**	**62**	**.852 NOT SIG**	**.082**	**.439**	**-.795**	**.960**
	Equal variances not assumed	.184	52.553	.855	.082	.447	-.815	.980
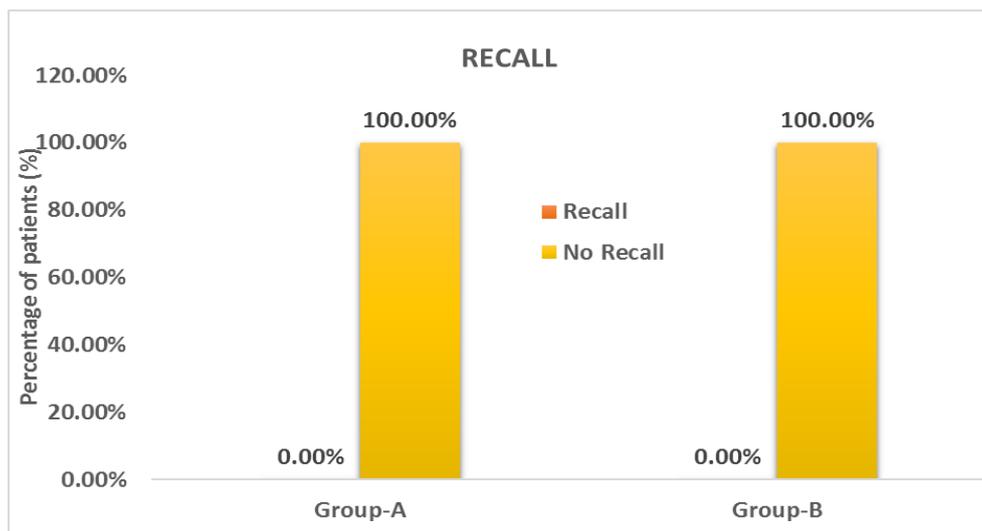
Figure 13 – Recall Graph.

4   DISCUSSION

Although incidence of intra-operative awareness with explicit recall in the Western world has been reported around 0.1% and 0.2% in the general population undergoing surgery and up to 1-2% of patients at high risk for this complication. In a study by **Reshma** et al[36] in 900 Indian cancer patients at high risk for intra-

operative awareness suggested that awareness is an uncommon occurrence in Indian population.

Minimum alveolar concentration (MAC) is traditionally being used to compare the potency of volatile anesthetics. However, it reflects the spinal mechanism of immobility rather than the cerebral mechanism of analgesia and hypnosis. MAC-Awake is approximately one third of MAC and 50% of subjects don't respond to oral command at ETAC equivalent to 0.33 MAC (MAC-Awake), and distressing (auditory) stimuli is not internalized till twice MAC-awake (about 0.7 MAC). MAC-awake is important for two reasons. Firstly, patients will not awaken after cessation of administration of anaesthetic agent until the cerebral partial pressure decreases below equivalent MAC-awake. Lower ratio of MAC-awake to MAC results in longer recovery time. Secondly, MAC-awake is also the concentration that is enough for amnesia.

Until now most studies were done using MAC 1.0 for anesthesia maintenance to prevent awareness. In our study, we have compared awareness between two groups of 0.7 and 1.0 MAC. Basic principle behind this is based on MAC definition i.e, the concentration of volatile anaesthetic needed to prevent explicit memory from developing, and to produce unconsciousness, is usually much lower than the concentration required to prevent movement in response to surgery. Desflurane was used as it has advantage of lower blood and tissue solubilities, thereby promoting rapid equilibration and rapid elimination following cessation of administration at the end of anaesthesia.

4.1 Demographic Variables
In our study the two groups were comparable with respect to age, weight, sex distribution, ASA status and duration of procedure and the procedure itself.

The mean age in group A was 41 ± 16.4 years and in group B was 47 ± 12.5 years. Statistically, the difference between two groups was not significant (p>0.05).

The mean weight of patients was 69.8 ± 12.5 kg and 74.4 ± 12.2 kg in group A and B respectively. The difference in body weights between the two groups was statistically not significant (p >0.05).

In group A, there were 48.6% males and 58.6% females and in group B, there were 48.6% males and 51.4% females. The difference in gender distribution between two groups was statistically not significant (p> 0.05).

The mean heights of patients were 162 ± 2.07 cm and 162 ± 4.3 cm in group A and B respectively. The difference in body heights between the two groups was statistically not significant (p >0.05).

In group A, 63% patients were ASA I, 45.9% were ASA II while in group B, 37%, 53.4% and 54% patients were

ASA I and ASA II respectively. There was no statistically significant difference between two groups with respect to ASA grading. (p>0.05).

The duration of procedure ranged from 45 minutes to 2 hours. The mean duration of surgery in group A, for ≤1hour was 57% and for 1-2hours was 50%. In group B 42.9% and 50% respectively for ≤1 hour and 1-2 hours duration surgeries. There was no statistically significant difference between two groups with respect to duration of procedure (p >0.05.).

In our study there was no statistically significant difference with respect to age, weight, height, gender, ASA grade, and duration of procedure.

4.2 Incidence of Awareness
In both group A and B patients were asked postoperative BRICE Questionnaire at three intervals
1. < 2 hours post extubation in recovery room
2. 24 hours post extubation
3. Postoperative day 3 or at time of discharge whichever was earlier

There was no recall in both groups A & B in all three intervals.so we can infer that 0.7 MAC can be used for general anesthesia to avoid awareness.

4.3 Hemodynamics
4.3.1 Heart rate
The mean heart rate at 0 mins was 74.59 ± 5.59 bpm in group A and $88.53 \pm$ bpm in group B and this difference was statistically not significant. (P > 0.05).

The mean heart rate was maintained throughout the surgery in both the groups. None of the patients developed bradycardia (heart rate < 50 bpm). The mean heart rate at the extubation was 79 ± 13.69 in group A and 81.40 ± 14.10 in group B and this difference was statistically not significant (p > 0.05).

The difference between the mean heart rate of two groups was statistically not significant at all the respective intervals. (p > 0.05).

4.3.2 MBP
The difference in mean arterial blood pressures at 0 mins of two groups was statistically not significant ie; 93 ± 14.93 mm of Hg in group A and 99 ± 13.15 mm of Hg in group B (p >0.05).

The mean blood pressure was maintained throughout the surgery in both the groups. None of the patients developed hypotension (mbp fall to less than 20% of baseline). The difference at end of surgery mean arterial blood pressures of two groups was statistically not significant i.e 91 ± 18.8, mmHg and 92.80 ± 16.93 mmHg in group A and group B respectively (p >0.05).

There was no statistically significant difference in mean arterial blood pressure of the two groups at all respective

intervals. ($p > 0.05$).

4.3.3 ETCO$_2$
Baseline values in group A was 30.94 ± 3.18 and in group B were 31.60 ± 3.22, thus being statistically not significant($p > 0.05$).

The difference in EtCO$_2$ at extubation was 33.33 ± 3.72 and 31 ± 2.65 mm of Hg in group A & B respectively. Thus, statistically both groups were not significant.

Studies on desflurane have demonstrated that it controls hemodynamic stability much better than other inhaled anesthestics. Most studies were done using 1.0 MAC, in our study we found that in both 0.7 and 1.0 MAC groups hemodynamic stability was well maintained and both were statistically not significant with p value >0.05.

4.4 BIS Values
Bis values at baseline i.e. Pre-induction in group A was 97.2 ± 1.48 and in group B was 97.1 ± 1.41.
After induction BIS values decreased and ranged between 40-60 in group A and in group B it even decreased to < 40 which was undesired.
Throughout the surgery BIS values where higher in Group A in comparison to that of group B.
The minimum BIS value in group A was 40 and in group B was 24.
BIS value at Extubation in Group A was 91 ± 0.89, and in Group B was 82.80 ± 5.2.
We know that for maintenance of anethesia BIS value between 40-60 is adequate. In group B, it was observed that BIS values were decreasing to < 40 which is not ideal, we can infer that MAC1.0 is not required for preventing awareness.

Even in group A minimum BIS value was around 40, which is also considered to be deeper level of anesthesia, we can try if MAC <0.7 (0.5) is adequate for preventing intraoperative awareness.

4.5 MAC Values
In group A MACvalues were maintained at 0.7 while in group B at 1.0 MAC.
Approximate time taken to achieve 0.7 MAC with desflurane 6% on vaporizer for 6 minutes with FGF of 6 liters/minute was around 6 minutes in group A and to achieve 1.0 MAC was around 10 minutes in group B.
Thus, more the time taken for achieving MAC 1.0 more is the wastage of inhalation agent.

4.6 ETDes Values
In group A, ET Des mean was around 4.21 ± 0.47, while in group B it was around 5.35 ± 0.46. The difference in both groups shows that they are Very Highly Significant (VHS) with p-value< 0.0001.

4.7 Total Desflurane Consumed Values
In group A mean value of total DES consumed at end of surgery was 27.38 ± 10.617 and in group B it was 43.10 ± 13.53.
Thus, statistically both groups were Very Highly Significant (VHS) with p-value < 0.0001.

4.8 BIS At Exit From Operation Theatre Values
At the time of exit mean of BIS values in group A was 93.38 ± 1.47 and in group B was 93.30 ± 2.02.

4.9 Limitations
- Small sample size
- Single institutional study
- Follow up was limited to hospital stay
- Long term consequences could not be followed up
- Discussion on laparoscopy was beyond the scope of this study

5 SUMMARY AND CONCLUSION
5.1 Background & Objectives
The present study was done to compare incidence of awareness under general anaesthesia in 2 groups of 0.7 and 1.0 MAC of Desflurane. Awareness was evaluated using BRICE questionnaire. Other parameters which were observed were hemodynamic variability, amount of inhalational agent consumed and BIS value variation.

5.2 Methods
Study was conducted on 256 ASA I or II patients of age group 18 to 60 years patients undergoing short duration elective laparoscopic surgeries were selected, limiting to duration of 2 hours. The study sample was divided into two groups of 136 and 120 respectively. The first and second groups of patients were administered 0.7 and 1.0 MAC of Desflurane respectively. General anaesthesia was administered with standard anaesthesia technique. Post intubation, desflurane was started at 6% on the vaporizer dial with fresh gas flow rate of 6 Liters/minute of air: O$_2$ in 1:1 ratio until 0.7 MAC in group A or 1.0 MAC in group B is achieved respectively. ETCO$_2$ was targeted to be maintained between 30 to 40 mm hg, after MAC target value was achieved, flow rate was reduced to 0.5 liters/minute and maintained until extubation. Throughout the surgery all parameters (heart rate, mean BP, ETCO$_2$, ET-Des, BIS value) were noted every 10 minutes.

Post operatively, patients were assessed for awareness using modified BRICE questionnaire at 3 intervals – within 2 hours post extubation, at 24 hours and day of discharge or post-operative day 7, whichever was earlier. Evaluation of awareness was based upon these 3 interviews.

5.3 Results
- In our study the two groups were comparable with respect to age, weight, sex distribution, ASA status and duration of procedure and the procedure itself.

- Patient in both groups A & B had no recall in all three interviews, so we can infer that 0.7 MAC will be adequate to prevent awareness.
- There was no statistically significant difference in heart rate, mean BP, $ETCO_2$ between both groups across time periods.
- BIS values in group A (0.7 MAC) ranged from 40 – 60, with minimum value being 40, while in group B minimum BIS value was 24. In group B, it was observed that BIS values were decreasing to < 40 which is not ideal, we can infer that MAC1.0 is not required for preventing awareness.
- Approximate time taken to achieve 0.7 MAC with desflurane 6% on vaporizer for 6 minutes with FGF of 6 liters/minute was around 6 minutes in group A and to achieve 1.0 MAC was around 10 minutes in group B.
- In group A, ETDes mean was around 4.21 ± 0.47, while in group B it was around 5.35 ± 0.46.
- In group A mean value of total DES consumed at end of surgery was (27.38 ± 10.617) lesser than group B (43.10 ± 13.53).

5.4 CONCLUSION
In our study of small group of patients, we found that there was no incidence of awareness, which implies that 0.7 MAC is sufficient to prevent intraoperative awareness. Volume of desflurane consumed in first hour was 25+/- 3 ml for group A with 0.7 MAC and 40+/- 5 ml in group B with 1 MAC which was statistically significant. The baseline BIS value for both groups are 92-99. The minimum BIS value attained was 40 in group A, 24 in group B.

Given the volume of desflurane consumed is significantly lesser with 0.7 MAC, advantages of less operation theatre and atmospheric pollution and cost reduction can be considered.

Conflicts of interest and disclosures: NONE.

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