

Tracheal intubation with volatile induction and target bispectral index of 25 versus 40: A randomized clinical trial

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Abstract

Background and Aims: A target bispectral index (BIS) value of 40 is considered adequate for depth of anesthesia, but no consensus exists regarding BIS value for tracheal intubation without neuromuscular blocking drugs. The aim of this randomized, double-blinded study was to compare the total duration from sevoflurane induction to tracheal intubation at a BIS value of 25 or 40.

Material and Methods: This study was a prospective, randomized and observer-blinded clinical trial. After approval of the Institutional Ethics Committee and written informed consent, 80 patients of American Society of Anesthesiologists physical status I-II, aged 20-60 years, of either sex, requiring general anesthesia with tracheal intubation were enrolled. The patients were randomized to either Group BIS₄₀-intubation at a target BIS value of 40 ± 5 or group BIS₂₅-intubation at a target BIS value of 25 ± 5. The intubating conditions, hemodynamic, and adverse effects were observed in both the groups.

Results: This study showed that the total time required from induction to tracheal intubation was 4.9 ± 0.9 min in group BIS₄₀ as compared to 6.3 ± 0.5 min in group BIS₂₅ ($P = 0.001$) using two-tailed sample *t*-test. The mean intubation score was 6.5 ± 0.9 in group BIS₄₀, and 5.1 ± 0.7 in group BIS₂₅ ($P = 0.001$) using Mann-Whitney U-test.

Conclusion: The time to achieve target BIS value of 25 was greater as compared to target BIS value of 40 during sevoflurane induction but provided better intubating conditions in the absence of neuromuscular agents.

Key words: Bispectral index, inhalational induction, neuromuscular blockers, sevoflurane, tracheal intubation

Introduction

Intravenous (IV) induction during general anesthesia (GA) is common practice in modern anesthesia. Avoidance of neuromuscular blocking (NMB) drugs is an unusual requirement, in surgical procedures that mandates “no paralysis” (e.g., selective nerve stimulation to aid in dissection), anticipated difficult airway, or in children with difficult IV access.^[1-3]

In an earlier study by van Twest *et al.* a target bispectral index (BIS) value of 25 provided good to excellent intubating conditions over target BIS of 40 with sevoflurane induction of anesthesia without the use of NMB drugs.^[3] Studies are needed to evaluate the time required to achieve target BIS value of 25 versus 40 and tracheal intubation with sevoflurane inhalational induction as the primary outcome.

Hence we planned this study to compare the total time taken from inhalation induction to tracheal intubation at a BIS value of 25 or 40.

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Material and Methods

After approval of the Institutional Ethics Committee and written informed consent, we enrolled 80 patients of American Society of Anesthesiologists physical status I and II, 20-60 years, of either sex scheduled for elective surgical procedures requiring GA with tracheal intubation. Exclusion criteria were; History of significant systemic dysfunction, gastro-oesophageal reflux or a hiatus hernia, alcohol or substance abuse, previous or predicted difficult intubation, body mass index (BMI) $>30 \text{ kg/m}^2$, and pregnancy.

This was a prospective, randomized, and observer-blinded clinical trial. All the patients received alprazolam 0.25 mg and ranitidine 150 mg per oral at night and 2 h before surgery as premedication. Using computer generated random number table, an anesthesiologist not part of the clinical trial allocated the patients to either of the following two groups. Group BIS₄₀ ($n = 40$) - Intubation with oral cuffed tracheal tube (Portex, UK) after induction with sevoflurane to reach a target BIS value of 40 ± 5 ; Group BIS₂₅ ($n = 40$) - Intubation with oral cuffed tracheal tube (Portex, UK) after induction with sevoflurane to reach a target BIS value of 25 ± 5 .

Group allocation was concealed using opaque, coded, and sealed envelopes. On arrival of the patient in the operating room, IV access, and standard anesthesia monitoring (Aestiva S/5™ Critical Care Monitor, Datex Ohmeda, Helsinki, Finland) was started. Skin of the forehead was cleaned with an alcohol swab and dried with gauze before application of a disposable BIS - quatro sensor strip (Aspect Medical Systems Inc., Norwood, MA, USA) on the forehead in accordance to manufacturer's instructions. BIS was monitored and recorded using M-BIS module (Aestiva S/5™ Critical Care Monitor, Datex Ohmeda, Helsinki, Finland). IV midazolam 20 $\mu\text{g/kg}$, fentanyl 0.5 $\mu\text{g/kg}$, and glycopyrrolate 0.1 mg were given to all patients 5 min prior to induction of anesthesia.

The intubating anesthetist (PK) started the induction of anesthesia using semi-closed Bain coaxial circuit at an oxygen gas flow rate of 6 L/min. The supervising anesthetist (K.K.G) increased sevoflurane (Drager Vapor 2000, Abbott Lab. Pvt. Ltd., Germany) in increments of 1-2% up to a maximum of 6-8% to achieve the target BIS value as per group allocation. The patient and intubating anesthetist were blinded to sevoflurane dial setting and the target BIS value that was concealed as the supervising anesthetist (K.K.G) managed the sevoflurane dial settings and BIS as per group allocation. The end-tidal sevoflurane concentration (EtSevo) was measured using module M-CAiOV (S/5™ Critical Care Monitor, Datex Ohmeda, Helsinki, Finland).

Once the target BIS value was reached, the supervising anesthetist maintained the target BIS value for 2 min and the intubating anesthetist performed tracheal intubation. If the time to achieve target BIS value was more than 10 min or a second attempt for tracheal intubation was required, then the intubating anesthetist was allowed to proceed with technique as appropriate for the procedure. Following tracheal intubation, all patients received the standard anesthetic technique. An independent observer used a stopwatch to observe and record the time to reach the target BIS value and tracheal intubation confirmed on capnography. The intubating conditions were graded according to the intubating conditions scoring table; 3-4 = excellent, 5-6 = good, and 8-12 = poor/impossible.^[3] Hemodynamic parameters were measured every one minute during preoxygenation, intubation, and up to 5 min following intubation. The patients were postoperatively followed for 24 h to observe any complications such as nausea, vomiting, awareness, sore throat, or any other adverse effect.

Statistical analysis

The sample size was calculated based on an earlier study^[3] in which mean total time to achieve BIS 25, and tracheal intubation were 8.6 ± 2.4 , and 7.1 ± 1.6 min for BIS 40. Considering α error of 0.05 and power of 90%, the sample size required was estimated to be 38 patients per group. To compensate for possible dropouts 40 patients were enrolled per group. Data were analyzed using statistical package for the social sciences (SPSS) version 15.0 for Windows. Statistical analysis was performed using two-tailed sample *t*-test and Chi-square test. Mann-Whitney U-test was used to compare intubation score between both the groups. $P < 0.05$ was considered statistically significant.

Results

Eighty-five patients were enrolled for the study and of these five patients were excluded due to non-fulfilment of inclusion criteria; rest 80 patients completed the study. The patient's characteristics were similar in both the groups [Table 1]. The total time required from induction to tracheal intubation and mean values of Etsevo (%) was lower in group BIS₄₀ as compared to BIS₂₅ ($P = 0.001$) [Table 2]. The mean intubation score was superior in group BIS₂₅ as compared to group BIS₄₀ ($P = 0.001$) [Table 3]. On *post-hoc* analysis, it was found that patients with lower BMI ($<20 \text{ kg/m}^2$) exhibited better intubation scores and required lower EtSevo to achieve target BIS value ($P = 0.001$) [Table 3].

All the patients completed the study, and none of the patients in either group had a failure to achieve the target BIS or required alternative means for tracheal intubation. The patients did not

Table 1: Patient characteristics

Variables	Group BIS ₄₀ (n = 40)	Group BIS ₂₅ (n = 40)
Age (year)	37±11	37±10
Weight (kg)	57±6	56±5
Height (cm)	159±6	160±6
BMI (kg/m)	22±2	22±2
Male, n (%)	29 (72)	28 (70)

Data described as mean ± SD or n (%), *P < 0.05 considered statistically significant. BMI = Body mass index, SD = Standard deviation

Table 2: Induction and intubation parameters in patients

Variables	Group BIS ₄₀ (n = 40)	Group BIS ₂₅ (n = 40)	P
Time to achieve target BIS (min)	4.6±0.8	6.1±0.5	0.001*
Time from induction to intubation (min)	4.9±0.9	6.3±0.5	0.001*
Time to perform tracheal intubation (s)	18.4±3.6	14.4±1.7	0.001*
EtSevo at target BIS	3.2±0.3	4.2±0.3	0.001*
Intubation score	6.5±0.9	5.1±0.7	0.001*
Excellent (3-4)	0	9 (22)	
Good (4-5)	27 (67)	31 (78)	
Poor (8-12)	13 (33)	0	

Data described as mean ± SD, *P < 0.05 considered statistically significant, BIS = Bispectral index, EtSevo = End tidal sevoflurane concentration, SD = Standard deviation

Table 3: Intubation score, EtSevo with different BMI

Variables	Group BIS ₄₀ (n = 40)	Group BIS ₂₅ (n = 40)	P
Intubation score (kg/m ²)			
<20	6.0	4.6±0.8	0.01*
20.122	6.5±0.4	5.1±0.1	0.01*
22.125	7.2±0.0	5.27±0.7	0.01*
EtSevo (kg/m ²)			
<20	2.8±0.5	3.9±0.4	0.001*
20.122	3.0±0.7	3.99±0.6	0.001*
22.125	3.4±0.2	4.34±0.2	0.001*

Data described as mean ± SD, *P < 0.05 considered statistically significant, BIS = Bispectral index, EtSevo = End tidal sevoflurane concentration, SD = Standard deviation, BMI = Body mass index

have any significant perioperative hemodynamic instability or adverse events.

Discussion

A target BIS of 40 was considered an adequate depth of anesthesia and hence one group was BIS₄₀. We planned tracheal intubation without the use of NMB drugs so a lower BIS value of 25 was selected assuming that this may benefit in terms of tracheal intubation score. Kimura *et al.* used EtSevo concentration of 4.5 % and achieved a desirable intubating condition in 20 min without the use of BIS.^[4] So far, a study by van Twest *et al.* was the only study available to

address the issue of BIS guided intubation without the use of neuromuscular agents and there is no such study in the Indian population. van Twest *et al.* concluded that no difference existed in the time taken from induction to intubation with a target BIS 25 or 40.^[3] In this study, patient's in-group BIS₂₅ required greater time for induction to tracheal intubation possibly due to the greater time required for alveolar and the cerebral concentrations equilibration.^[5] The longer induction time in group BIS₂₅ and greater EtSevo (%) allowed for greater absorption of sevoflurane into the effect site tissues (brain, spinal cord) and provided greater relaxation of jaw muscles and obtunded airway reflexes to a greater degree.^[3] The triad of anesthesia is sedation, analgesia, and muscle relaxation and omission one of these are likely to effect the time to achieve target BIS and tracheal intubation, which is a clinical outcome.^[6] The present study proved that greater time required for induction to tracheal intubation in patients of group BIS₂₅ relates to adequate intubating conditions to allow successful intubation without increasing the incidence of hemodynamic instability or side effects as compared to group BIS₄₀.

Fentanyl when used in higher doses of 2-4 µg/kg reduces the required EtSevo and intubation response.^[7,8] In this study, patients had lower mean BMI 22.4 ± 2.2 kg/m² as compared to 26.2 ± 2.9 kg/m² in the study conducted by van Twest *et al.*^[3] Patients with BMI (<20 kg/m²) exhibited excellent intubation scores and needed lower values of EtSevo to achieve the target BIS (P = 0.001). The explanation in this regard is better jaw relaxation and lesser response to intubation in our patients due to lesser muscle mass. Therefore, BIS guided tracheal intubation during inhalational induction may be especially useful in patients with lower BMI, as it is a more accurate measurement of the depth of anesthesia and overcomes the physiological variability in these patients, which may not be alone possible with EtSevo.^[3]

This study has a few limitations. The effect of BIS on tracheal intubation in patients with BMI <20 kg/m² was underpowered and requires further randomized clinical trials. We used a low dose of fentanyl during the induction period, and the results may differ with a higher dosage of fentanyl.

Conclusion

The total time from induction to tracheal intubation was greater with sevoflurane induction at a target BIS value of 25 as compared to 40 but with better intubation score.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Conference Calendar July 2016

Name of conference	Dates	Venue	Name of organising Secretary with contact details
6 th Annual Conference of the Academy of Regional Anaesthesia (AORA) AORA INDIA 2016	September 23 rd -24 th 2016	Hyderabad	Dr. TVS Gopal Organising Chairperson Axon Anaesthesia Associates Pvt Ltd 302, Anjali Enclave, 6-3-596/24/1, Venkataramana Colony, Khairatabad, Hyderabad - 500 004 Telangana India Telefax : +91-40-66138808 Phone : 09030065456 Email : axongm@gmail.com, vinod_sagar2005@yahoo.com Telephone : 91 9030065456 Email Id : axongm@gmail.com Website : http://www.aoraindia.com/aora2016/index.html
NYSORA 15 th Annual Symposium on Regional Anesthesia, Pain and Perioperative Medicine 2016 (NYSORA 2016)	September 23 rd -25 th , 2016	Hilton Midtown, New York	http://nysorasymposium.com/ Vision Expo 2753 Broadway, Suite 183 New York, NY 10025, +44 1462 483 466 info@visionexpo.co www.nysora.com
ISACON Bihar Jarkhand – 2016 Annual State Conference of ISA Bihar Jarkhand State Chapter	September 23 rd -25 th , 2016	The Park, Jubba Sahni Park Market, Club Road, Mithanpura, Muzaffarpur	Org Secretary: Dr. Narendra Kumar Mobile No.: +91- 9431650905 / 7250514526 Email: narendrak792@gmail.com
ISACON GUJARAT – 2016 & WIZACON 2016 49 th Annual State Conference of ISA GUJARAT State Chapter & 12 th West Zone Conference	September 23 rd -25 th , 2016	Rangoli Hotel & Resorts, Vertej, Bhavnagar	Org Secretary: Dr. Fremiot J. Mascarenhas Mobile No.: +91-9428401780 Email: drfremiot@hotmail.com / isacongujarat2016@gmail.com Website: www.isacongujarat2016.com
40 th Annual State Conference of ISA Kerala State Chapter 2016 ISACON Kerala 2016	October 7 th -9 th , 2016	MAC FAST Auditorium, Tiruvalla, Pathanamthitta, India	Dr. Koshy Thomas Phone 91-9447398170 E-mail thomaskoshy59@gmail.com
9 th National Conference of Association of Obstetric Anaesthesiologists AOA-MASCON 2016	October 14 th -16 th 2016	The Renaissance, Powai, Mumbai, India	Dr. Satish Kulkarni, Dr. Manju Sinha, Dr. Vijay Shetty Organising Secretaries Dr. Mayuri Shetty The Secretariat, AOA-MASCON 2016 Vikas Paradise, Tower I, A-1402, L.B.S. Road, Mulund (W). Mumbai - 400 080. Maharashtra, INDIA. Mobile : 09820185527, E-mail: aomumbai2016@gmail.com Website : www.mumbaiana.org/ www.aoaindia.com