Original Article

# Evaluation of Outcome in Sticking Upper Limit and Lower Limit in BIS Monitoring for Radical Cystectomy

**Nilofar Massoudi [1], Mohammad Fathi[2], Navid Nooraei [2*], Moien Daneshmand[4]**


## Abstract

**Background:** The electroencephalogram-derived bispectral index (BIS) is a promising new method to assess anesthetic adequacy. The purpose of this study was to evaluation of outcome in sticking upper limit and lower limit in BIS monitoring for radical cystectomy surgery.

**Methods and Materials:** A total of 202 patients with elective radical cystectomy were selected randomly and divided into two groups of BIS (40-50) and BIS (50-60). The patients were blinded to the study group (BIS). Initially demographic and clinical information such as age, sex, weight, recovery time, patient extubation time, awareness during surgery, mortality rate and patient stay in hospital, BIS and patient cost were included in data collection form.

**Results:** There were 197 males and 5 females and the average age of the patients were 67.12±8.1. There was significant relationship between recovery time, amount of anesthetic used, ICU stay, hospital stay, hospital cost, and BIS monitoring range ($p<0.001$). In addition, there was significant relationship between extubation time and BIS monitoring range ($p=0.001$). The relationship between PONV with BIS monitoring range is significant ($p<0.001$). But there was no significant relationship between analgesic drugs ($p=0.26$) and awareness ($p=0.175$) and mortality ($p=0.651$) with BIS monitoring range.

**Conclusion:** By increasing the BIS value, the anesthetic dose, extubation and recovery time, hospital and ICU stay were significantly reduced as well as the cost.


**Keywords:** Bispectral Index, Radical Cystectomy, Anesthesia

1. Clinical Research and Development Unit at Shahid Modarres Hospital, Department of Anesthesiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran
2. Critical Care Quality Improvement Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran
3. Critical Care Quality Improvement Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran
4. Anesthesiology Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

**Corresponding Author:** Navid Nooraei, MD; Critical Care Quality Improvement Research Center, Modarres Hospital, Saadat Abad, Tehran, Iran; Tel/Fax: (+98) 21 22074100. **Email:** navid_nooraee@yahoo.com

**Please cite this article as:** Massoudi N, Fathi M, Nooraei N, Daneshmand M. Evaluation of Outcome in Sticking Upper Limit and Lower Limit in BIS Monitoring for Radical Cystectomy. J Cell Mol Anesth. 2019;4(3):82-7.

## Introduction

Tumors that have involvement of muscle (T3), fat and structures outside the bladder (T4) are treated first with transurethral resection of bladder tumor (TURBT), and then radical cystectomy (possible prostatectomy) followed by neoadjuvant chemotherapy. Radical cystoprostatectomy (RCP) is the standard and effective treatment method for patients with invasive or superficial recurrent bladder

cancer who are in a high progression risk group (1)

Current evidence suggests that anesthesia that is either excessively deep or too light may have a negative impact on patient outcomes. While awareness during general anesthesia is associated with patient dissatisfaction and increased incidence of posttraumatic stress disorder, excessive depth has been linked to increased incidence of postoperative delirium and cognitive dysfunction. In addition, some studies have also suggested an association between excessive depth of anesthesia and postoperative mortality (2). Traditional methods of monitoring depth of anesthesia have been based on clinical signs and minimal alveolar concentration of inhalational anesthetics. Advances in technology over the last 20 years have led to the development of electroencephalography (EEG)-based depth-of-anesthesia monitors (2). Currently, there exists no effective monitor that can predict the probability of a patient being conscious during general anesthesia. The electroencephalogram-derived bispectral index (BIS) is a promising new method to assess anesthetic adequacy (3).

Low mean arterial pressure (MAP) and deep hypnosis have been associated with complications and mortality. The normal response to high minimum alveolar concentration (MAC) fraction of anesthetics is hypotension and low Bispectral Index (BIS) scores. Low MAP and/or BIS at lower MAC fractions may represent anesthetic sensitivity (4) In fact, all anesthesiologists should pay particular attention to these three parameters and reduce them during surgery. (4) Therefore, in this study we evaluated different BIS levels between 40 and 50 and 50 to 60 in patients undergoing radical cystectomy; the results will be reported in terms of overall study objectives.

# Methods

n this clinical trial study, 202 patients with elective radical cystectomy under general anesthesia referred to Shahid Modarres Hospital in 2015-2019 were selected randomly from simple random sampling.

Exclusion criteria included: patients with advanced cardiovascular problems (Class 3 and 4 American society of anesthesiology (ASA)), Duration of operation less than two hours, Discontinuation of anesthesia due to unstable hemodynamic bleeding, patients who underwent emergency surgery and over 80 or under 18 years of age. Initially demographic and clinical information such as age, sex, weight, recovery time, patient extubation time, awareness during surgery, mortality rate and patient stay in the hospital, BIS and patient cost were included in the data collection form.

Patients were randomly divided into two groups of BIS (40-50) and BIS (50-60). The patients were blinded to the study group (BIS). Anesthesiologist in the operating room was aware of the type of patients group. Prior to the induction of anesthesia, a catheter No. 18 was inserted for the administration of medications and fluids, and then a monitoring sensor was mounted on the frontal patient, and then every 5 minutes BIS and hemodynamics were recorded. Induction with propofol 2.5 mg/kg and atracurium 0.5 mg/kg, Sevoflurane with 3% MAC was used in all patients. For maintenance and, based on BIS or the hemodynamic conditions, sevoflurane changed and this decrease or increase in anesthetic will be recorded. Therefore, in operation, the anesthetic dose adjusted based on the BIS number that in the first group in range BIS (40-50) and in the second group range (50-60) and non-depolarizing muscle relaxant (NDMR) administration during the operation was done based on TOF monitoring.

At the end of the surgery, extubation time and then the time for eye-opening and response to verbal stimuli and total recovery time and the amount of analgesia required for recovery were recorded in both groups. Mortality and total cost were documented in both groups, existence or absence of awareness in the patients were noted in recovery unite when patients were awake and 72 hours after surgery. If patients require ICU, length of ICU time, as well as the length of hospital stay, is also noted.

# Results

Among 202 patients in this study, there were 197 males and 5 females and the average age of the patients were 67.12±8.1. The patients were divided into two groups (BIS range 40-50 and BIS range 50-60) that there were 101 patients in each group. The average age of group 1 (BIS range 40-50) was 65.92±8

**Table 1:** Relationship of age between two groups.

| | Mean (%) | P value |
|---|---|---|
| group 1(BIS range 40-50) | 65.92±8 | 0,017 |
| group 2(BIS range 50-60) | 68.33±8.9 | |

**Table 2:** Average of anesthetic dose, extubation time, recovery time, hospital stay, ICU stay, cost in patients and the statistical relationship between two groups.

| | group 1(BIS range 40-50) (n=101) | group 2(BIS range 50-60) (n=101) | P value |
|---|---|---|---|
| Anesthetic dose(cc) | 120.79±20.1 | 95.38±15.2 | <0.001 |
| extubation time(min) | 23.54±8.7 | 19.49±7.8 | 0.001 |
| recovery time(min) | 68.03±24.01 | 46.7±18.8 | <0.001 |
| hospital stay(day) | 13.82±2.5 | 12.62±3.47 | <0.001 |
| ICU stay(day) | 3.48±2.8 | 3.44±1.9 | <0.001 |
| Cost($) | 315±29.9 | 283.76±29.9 | <0.001 |

and the average age of group 2 (BIS range 50-60) was 68.33±8.9. There was no significant relationship in age between two groups (Table 1).

The average of recovery time, amount of anesthetic used, ICU stay, extubation time, hospital stay, hospital cost, were measured in each group.

There was significant relationship between recovery time, amount of anesthetic used, ICU stay, hospital stay, hospital cost, and BIS monitoring range ($p<0.001$).

Then the percentage of mortality, postoperative nausea and vomiting (PONV), awareness, analgesic drugs in each group. The relationship between PONV with BIS monitoring range was significant ($p<0.001$), but, there was no significant relationship between analgesic drugs ($p=0.26$) and awareness ($p=0.175$) and mortality ($p=0.651$) with BIS monitoring range (Table 3).

## Discussion

Anesthesia based on BIS ranging from 40 to 60 improves anesthesia drug delivery and recovery after surgery with a higher depth anesthesia ratio and also reduces the risk of surgery awareness in high-risk patients.

Routine use of BIS in the operating room today has improved clinical outcome, a BIS of less than 50 has not been associated with clinical benefits, and anesthesia has been associated with a BIS ranging from 50 to 65 with shorter recovery time and surgery.

The BIS, a parameter derived from the electroencephalograph (EEG), has been shown to correlate with increasing sedation and loss of consciousness (5) The use of clinical signs may not be reliable in measuring the hypnotic component of anesthesia. The use of BIS to guide the dose of anesthetic may have certain advantages over clinical signs (6)

Explicit recall (ER) is evident in approximately 0.2% of patients given general anesthesia including muscle relaxants (7). Awareness is an uncommon complication of anesthesia, affecting 0.1-0.2% of all surgical patients. Bispectral index (BIS) monitoring

**Table 3:** Number and percentage of PONV, awareness, analgesic drugs and mortality in patients and the statistical relationship between two groups.

| | | group 1(BIS range 40-50) (n=101) | | group 2(BIS range 50-60) (n=101) | | P value |
|---|---|---|---|---|---|---|
| | | number | percent | number | percent | |
| PONV | Mild | 29 | 28.7 | 59 | 58.4 | <0.001 |
| | Moderate | 53 | 52.5 | 38 | 37.6 | |
| | Sever | 19 | 18.8 | 4 | 4 | |
| awareness | Without awareness | 100 | 99 | 97 | 96 | 0.175 |
| | With awareness | 1 | 1 | 4 | 4 | |
| Analgesic drugs | Opium | 55 | 54.5 | 66 | 66.3 | 0.26 |
| | Acetaminophen | 36 | 35.6 | 21 | 20.8 | |
| | Both | 10 | 9.9 | 14 | 13.9 | |
| Mortality | Death | 3 | 3 | 2 | 2 | 0.651 |
| | Alive | 98 | 97 | 99 | 98 | |

measures the depth of anesthesia and facilitates anesthetic titration (8)

The BIS is from zero, indicating full suppression of the brain's electrical performance to 100, indicating complete level of consciousness. Significant target range is recommended to prevent awakening during anesthesia and to prescribe a minimum dose of anesthetic between 40 and 60. Given that BIS 40 to 60 is appropriate for anesthesia, the effect of BIS at its lowest the highest limit will be examined in this study (9). BIS is the most widely used DOA-monitoring system and is approved for

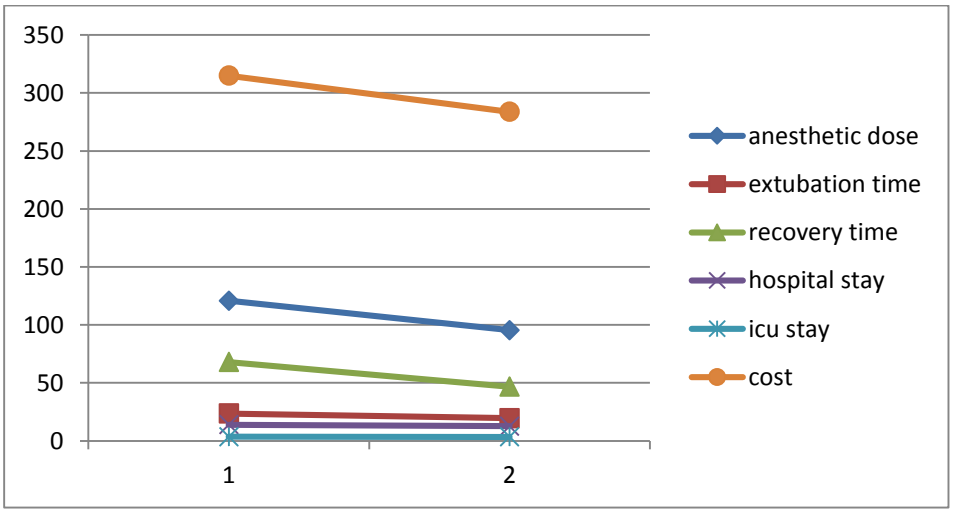


**Figure 1.** Diagram of variable differences between groups.

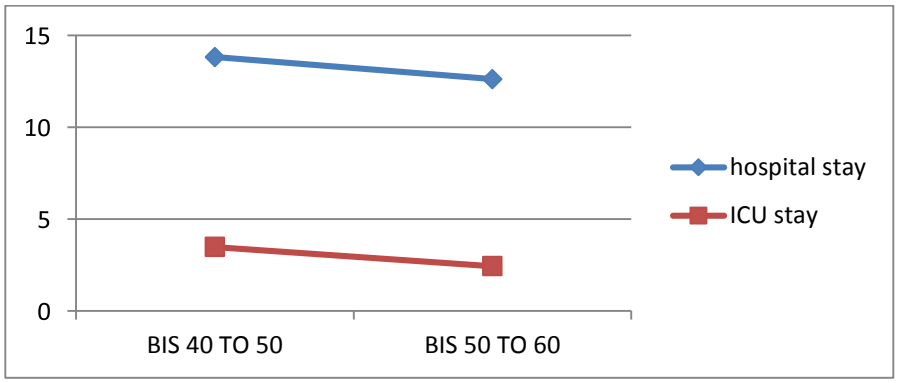


**Figure 2.** Relationship between ICU and hospital stay with BIS range.

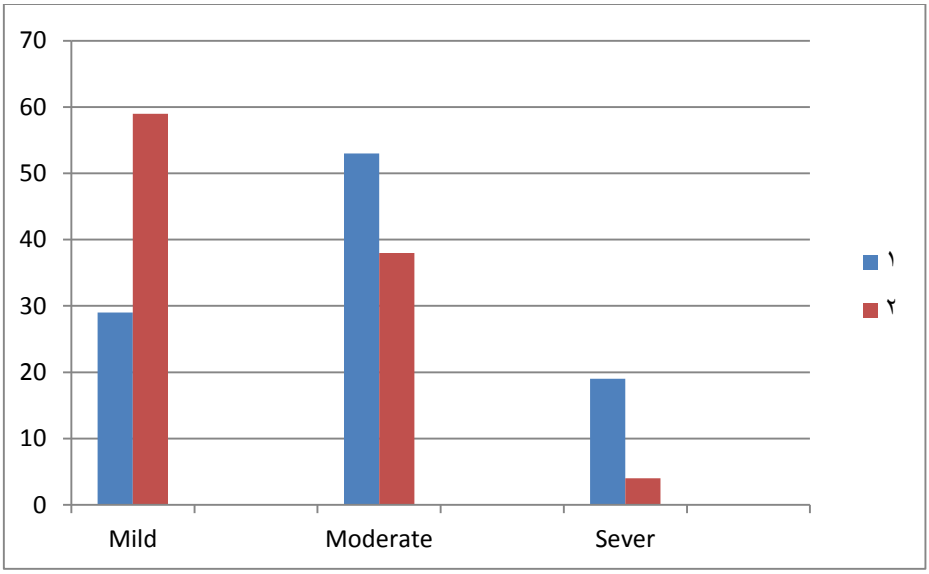


**Figure 3.** Diagram of PONV variable differences between groups.

monitoring hypnosis by the food and drug administration (FDA). It can be a useful monitoring guide for the titration of propofol (10).

In the Avidan study in 2011, BIS levels ranged from 40 to 60 complete anesthesia for surgery but awareness occurred in the BIS group, as compared within the ETAC (end-tidal anesthetic-agent concentration) group (9).

In another review by Punjasawadwong et al. In 2007, 20 studies with 4056 participants comparing BIS to clinical symptoms with anesthesia titration concluded that BIS use reduced anesthesia and shorter recovery time and intraoperative awareness. The total cost was lower in the BIS group compared to the CS group (6).

As it's shown in figure 1 by increasing the BIS value, the anesthetic dose, extubation and recovery time, were significantly reduced as well as the cost. Pavlin et al. and Hong yu et al., Nelskyla et al, the same as this study, concluded that BIS control could reduce recovery time (11-13). Wong et al achieve the same result as this study about the extubation time (6). Gan TJ, found that anesthetic dose was decreased with BIS value increasing (5).

As it is shown in figure 2 both ICU and hospital stay were significantly reduced with increasing the BIS value.

Neeru Sahni et al. were studied on the depth of anesthesia on the postoperative pain and analgesic requirements in patients undergoing laparoscopic cholecystectomy (14). They concluded that BIS to a value of 45 to 40 throughout the surgery results in

better postoperative pain relief and decreased requirement of rescue analgesic without any untoward effect.

Ketai et al. achieve to the same results that there was no significant difference between mortality and BIS value (15) Several studies such as Wong et al, Chen et al and Ekman et al shown that there is no significant difference between awareness during surgery with BIS value (2, 7, 16).

## Conclusion

It was conducted that in this study there was significant difference between PONV and BIS value. But there was no significant relationship between Analgesic, awareness and mortality with BIS value. By increasing the BIS value, the anesthetic dose, extubation and recovery time, hospital and ICU stay were significantly reduced as well as the cost.

## Conflicts of Interest

The authors declare that they have no conflict of interest.

## References

1. Farnham SB, Cookson MS, Alberts G, Smith JA Jr, Chang SS. Benefit of radical cystectomy in the elderly patient with significant co-morbidities. Urol Oncol. 2004;22(3):178-81.
2. Shepherd J, Jones J, Frampton G, Bryant J, Baxter L, Cooper K. Clinical effectiveness and cost-effectiveness of depth of anaesthesia monitoring (E-Entropy, Bispectral Index and Narcotrend): a systematic review and economic evaluation. Health Technol Assess. 2013;17(34):1-264.
3. Flaishon R, Windsor A, Sigl J, Sebel P. Recovery of Consciousness after Thiopental or PropofolBispectral Index and the Isolated Forearm Technique. Anesthesiology. 1997; 86(3):613-9.
4. Sessler DI, Sigl JC, Kelley SD, Chamoun NG, Manberg PJ, Saager L, Kurz A, Greenwald S.. Hospital stay and mortality are increased in patients having a "triple low" of low blood pressure, low bispectral index, and low minimum alveolar concentration of volatile anesthesia. Anesthesiology. 2012;116(6):1195-203.
5. Gan TJ, Glass PS, Windsor A, Payne F, Rosow C, Sebel P, Manberg P. Bispectral index monitoring allows faster emergence and improved recovery from propofol, alfentanil, and nitrous oxide anesthesia. Anesthesiology. 1997;87(4):808-15.
6. Punjasawadwong Y, Phongchiewboon A, Bunchungmongkol N. Bispectral index for improving anesthetic delivery and postoperative recovery. Cochrane Database Syst Rev. 2014;(6):CD003843.
7. Ekman A, Lindholm ML, Lennmarken C, Sandin R. Reduction in the incidence of awareness using BIS monitoring. Acta Anaesthesiol Scand. 2004;48(1):20-6.
8. Myles PS, Leslie K, McNeil J, Forbes A, Chan MT. Bispectral index monitoring to prevent awareness during anaesthesia: the B-Aware randomised controlled trial. Lancet. 2004;363(9423):1757-63.
9. Avidan MS, Jacobsohn E, Glick D, Burnside BA, Zhang L, Villafranca A, Karl L, Kamal S, Torres B, O'Connor M, Evers AS, Gradwohl S, Lin N, Palanca BJ, Mashour GA; BAG-RECALL Research Group. Prevention of intraoperative awareness in a high-risk surgical population. N Engl J Med. 2011 Aug 18;365(7):591-600.
10. Fu Y, Xu T, Xie K, Wei W, Gao P, Nie H, Deng X, Wang G, Tian M, Yan M, Dong H, Yue Y. Comparative Evaluation of a New Depth of Anesthesia Index in ConView® System and the Bispectral Index during Total Intravenous Anesthesia: A Multicenter Clinical Trial. Biomed Res Int. 2019;2019:1014825..
11. Pavlin DJ, Hong JY, Freund PR, Koerschgen ME, Bower JO, Bowdle TA. The effect of bispectral index monitoring on end-tidal gas concentration and recovery duration after outpatient anesthesia. Anesth Analg. 2001;93(3):613-9.
12. Yu H, Zhang L, Ma Y, Yu H. Early postoperative recovery in operating room after desflurane anesthesia combined with Bispectral index (BIS) monitoring and warming in lengthy abdominal surgery: a randomized controlled study. BMC anesthesiol. 2018;18(1):110.
13. Nelskylä KA, Yli-Hankala AM, Puro PH, Korttila KT. Sevoflurane titration using bispectral index decreases postoperative vomiting in phase II recovery after ambulatory surgery. Anesth Analg. 2001;93(5):1165-9.
14. Sahni N, Anand L, Gombar K, Gombar S. Effect of intraoperative depth of anesthesia on postoperative pain and analgesic requirement: A randomized prospective observer blinded study. J Anaesthesiol Clin Pharmacol. 2011 Oct;27(4):500-5.
15. Kertai MD, Palanca BJ, Pal N, Burnside BA, Zhang L, Sadiq F, et al. Bispectral index monitoring, duration of bispectral index below 45, patient risk factors, and intermediate-term mortality after noncardiac surgery in the B-Unaware Trial. Anesthesiology. 2011;114(3):545-56.
16. Nelson P, Nelson JA, Chen AJ, Kofke WA. An alternative position for the BIS-Vista montage in frontal approach neurosurgical cases. J Neurosurg Anesthesiol. 2013;25(2):135-42.