e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.2.88

International Journal of Pharmaceutical Quality Assurance 2025; 16(2); 556-562

Original Research Article

A Comparative Study of Dexmedetomidine-Fentanyl Versus Dexmedetomidine-Pentazocine for Monitored Anesthesia Care in Tympanoplasty

Ambuj[1], Jyoti Kumar Singh[2]

[1]Associate Professor, Department of Anesthesiology, Netaji Subhas Medical College, and Hospital, Bihta, Patna, Bihar, India

[2]Assistant Professor, Department of Anesthesiology, Netaji Subhas Medical College, and Hospital, Bihta, Patna, Bihar, India

Received: 06-12-2024 / Revised: 19-01-2025 / Accepted: 24-02-2025

Corresponding Author: Dr. Jyoti Kumar Singh

Conflict of interest: Nil

Abstract:

Background: Monitored anesthesia care (MAC) is increasingly being used in various surgical procedures due to its safety and effectiveness. Tympanoplasty, a common otological procedure, requires careful anesthesia management to provide adequate analgesia while maintaining stable hemodynamics. The combination of dexmedetomidine with either fentanyl or pentazocine has been explored in this context, but there is limited data directly comparing the efficacy of these combinations. This study aims to compare the effects of dexmedetomidine-fentanyl and dexmedetomidine-pentazocine for monitored anesthesia care during tympanoplasty surgery.

Objectives:

1. To compare the efficacy of dexmedetomidine-fentanyl versus dexmedetomidine-pentazocine in providing adequate sedation and analgesia during tympanoplasty surgery.
2. To assess the hemodynamic stability, including blood pressure and heart rate, in both groups.
3. To evaluate the incidence of perioperative complications, including respiratory depression, nausea, and vomiting.
4. To compare the postoperative pain scores and the requirement for additional analgesics in the two groups.

Methods: This randomized controlled trial was conducted at Department of Anesthesiology, Netaji Subhas Medical College, and Hospital, Bihta, Patna, Bihar, India, over a period of 18 months. A total of 100 patients undergoing tympanoplasty surgery were randomly assigned to two groups: the dexmedetomidine-fentanyl group (Group DF) and the dexmedetomidine-pentazocine group (Group DP). The primary outcome measures included sedation level, intraoperative analgesia, hemodynamic stability, and the incidence of complications. Secondary outcomes included postoperative pain scores, time to recovery, and patient satisfaction.

Results: Group DF demonstrated significantly better sedation scores and more stable intraoperative hemodynamics compared to Group DP. The incidence of postoperative nausea and vomiting was lower in Group DF, while postoperative pain scores were significantly lower in Group DP, although both groups had comparable analgesic efficacy. Both groups had similar safety profiles, with no significant differences in respiratory depression or other complications.

Conclusion: Both dexmedetomidine-fentanyl and dexmedetomidine-pentazocine are effective combinations for providing monitored anesthesia care during tympanoplasty. However, dexmedetomidine-fentanyl provides superior sedation and hemodynamic stability, making it a more preferable option for this procedure.

Keywords: Dexmedetomidine, Fentanyl, Pentazocine, Monitored Anesthesia Care, Tympanoplasty, Sedation, Analgesia, Hemodynamics, Postoperative Pain

Introduction

Tympanoplasty is a commonly performed surgical procedure to treat middle ear pathology, specifically to repair a perforated tympanic membrane, often associated with chronic otitis media. The procedure aims to restore hearing function and prevent further complications such as recurrent infections [1]. Adequate anesthesia management is essential for the successful completion of tympanoplasty while ensuring the patient's comfort and safety. Monitored anesthesia care (MAC) has become increasingly popular in otolaryngologic procedures, including tympanoplasty, as it provides sedation and analgesia while allowing the patient to remain cooperative and responsive during the surgery [2].

Monitored anesthesia care, while effective, requires careful selection of anesthetic agents to provide the desired level of sedation and analgesia without compromising the patient's physiological stability. Among the various agents used in MAC, dexmedetomidine, an alpha-2 adrenergic agonist, has gained popularity due to its sedative, analgesic, and anxiolytic properties without causing significant respiratory depression. Dexmedetomidine provides excellent sedation and analgesia, allowing for optimal conditions during surgery while minimizing the need for additional opioids [3,4].

Fentanyl, a potent opioid analgesic, is frequently combined with dexmedetomidine to enhance the analgesic effect during surgeries requiring MAC. Fentanyl provides fast onset and strong analgesic effects, which are beneficial in surgical settings. However, opioid use is often associated with side effects such as nausea, vomiting, and respiratory depression, which can complicate recovery and prolong hospital stays [5,6].

An alternative to fentanyl is pentazocine, a mixed agonist-antagonist opioid, which provides analgesia with a lower incidence of respiratory depression compared to traditional opioids. Pentazocine, when combined with dexmedetomidine, has the potential to provide effective sedation and analgesia while reducing some of the side effects associated with fentanyl, such as postoperative nausea and vomiting [7]. Despite the widespread use of dexmedetomidine with either fentanyl or pentazocine in various surgical procedures, there is limited research directly comparing the two combinations for MAC during tympanoplasty. The choice of anesthetic agents can significantly affect intraoperative hemodynamics, postoperative recovery time, and the incidence of complications such as respiratory depression, nausea, and vomiting [8].

This study aims to compare the efficacy and safety of dexmedetomidine-fentanyl and dexmedetomidine-pentazocine combinations for providing adequate sedation and analgesia during tympanoplasty surgery. The study will assess the primary outcomes of sedation quality, hemodynamic stability, and intraoperative analgesia, as well as secondary outcomes including postoperative pain management, recovery times, and patient satisfaction.

By evaluating these two drug combinations, this study seeks to identify which combination provides the optimal balance of sedation, analgesia, hemodynamic stability, and minimal side effects, offering a more tailored approach to anesthetic care during tympanoplasty procedures.

Materials and Methods

This randomized controlled trial was conducted at Department of Anesthesiology, Netaji Subhas Medical College, and Hospital, Bihta, Patna, Bihar, India, over a period of 18 months. A total of 100 patients undergoing elective tympanoplasty surgery under general anesthesia were enrolled in the study. The patients were randomly assigned to two groups: the dexmedetomidine-fentanyl group (Group DF) and the dexmedetomidine-pentazocine group (Group DP).

Inclusion Criteria

Patients aged 18 to 60 years, ASA physical status I or II, scheduled for elective tympanoplasty surgery, and who had no contraindications to the use of dexmedetomidine, fentanyl, or pentazocine were included in the study.

Exclusion Criteria

Patients with a history of chronic pain, substance abuse, cardiovascular diseases, respiratory disorders, allergies to study medications, or those requiring emergency surgery were excluded from the study.

Randomization and Group Allocation

The patients were randomly assigned to one of two groups using a computer-generated randomization table.

- **Group DF**: Received 0.6 µg/kg of intravenous dexmedetomidine over 10 minutes, followed by 1-2 µg/kg/hour infusion of dexmedetomidine and 1 µg/kg fentanyl intravenously before the induction of anesthesia.
- **Group DP**: Received 0.6 µg/kg of intravenous dexmedetomidine over 10 minutes, followed by 1-2 µg/kg/hour infusion of dexmedetomidine and 0.1 mg/kg pentazocine intravenously before the induction of anesthesia.

The medications were administered by the anesthesiologist who was blinded to the group allocation. Both groups also received standard anesthesia induction and maintenance with propofol and sevoflurane.

Anesthesia Protocol

Anesthesia was induced with intravenous propofol (2 mg/kg), followed by endotracheal intubation facilitated by rocuronium (0.6 mg/kg). The patients were mechanically ventilated with 100% oxygen, and anesthesia was maintained with sevoflurane in a mixture of oxygen and nitrous oxide (60:40). Intraoperative analgesia was maintained with the study drug (fentanyl or pentazocine) as per group allocation, and additional doses of fentanyl (50 µg) were administered for supplemental analgesia if required during the surgery.

Monitoring

The following parameters were monitored throughout the perioperative period:

- Electrocardiogram (ECG)

- Non-invasive blood pressure (BP)
- Heart rate (HR)
- Oxygen saturation (SpO2)
- End-tidal carbon dioxide (EtCO2)
- Bispectral index (BIS) for monitoring depth of anesthesia

Outcome Measures

The primary outcome measures included:

1. **Sedation Level**: Assessed using the Ramsay Sedation Score (RSS) immediately before the surgical incision, during the surgery, and after the procedure. A score of 4-5 was considered adequate sedation.
2. **Hemodynamic Stability**: Measured by monitoring heart rate and blood pressure during the procedure. Significant changes in heart rate and blood pressure were defined as a 20% deviation from baseline values.
3. **Intraoperative Analgesia**: The total amount of fentanyl or pentazocine administered and any requirement for additional analgesia during surgery.
4. **Incidence of Complications**: This included the incidence of respiratory depression (defined as SpO2 <90% requiring intervention), nausea, and vomiting.

Secondary outcome measures included:

1. **Postoperative Pain Scores**: Assessed at 2-, 6-, and 24-hours post-surgery using the Visual Analog Scale (VAS), with scores ranging from 0 (no pain) to 10 (worst pain imaginable).
2. **Postoperative Analgesic Requirement**: Recorded the total amount of supplemental analgesics required in the first 24 hours after surgery.
3. **Time to Recovery**: Time taken for patients to achieve the Modified Aldrete Score of 9 or more, indicating readiness for discharge from the recovery room.
4. **Patient Satisfaction**: Assessed using a 5-point scale from 1 (very dissatisfied) to 5 (very satisfied).

Statistical Analysis

The sample size was calculated based on the primary outcome of intraoperative sedation level. A total of 100 patients (50 per group) were needed to achieve 80% power to detect a significant difference at a 5% significance level. Data were analyzed using SPSS version 26.0 (IBM Corp, Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and compared using the independent t-test. Categorical variables were expressed as percentages and compared using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 100 patients were included in this study, with 50 patients in each group: Group DF (dexmedetomidine-fentanyl) and Group DP (dexmedetomidine-pentazocine). The primary outcomes assessed were sedation levels, intraoperative analgesia, hemodynamic stability, and the incidence of complications. Secondary outcomes included postoperative pain scores, analgesic requirements, and patient satisfaction. The findings show that Group DF demonstrated superior sedation and hemodynamic stability compared to Group DP, while both groups provided effective analgesia. However, Group DF showed better long-term postoperative pain control and a lower incidence of complications such as nausea and vomiting.

Table 1: **Sedation Levels in Group DF and Group DP**

Group	Ramsay Sedation Score 4 or 5 (%)
Group DF	80%
Group DP	60%

Table 2: **Hemodynamic Stability in Group DF and Group DP**

Group	Mean Heart Rate Change (bpm)	Mean Blood Pressure Change (mmHg)
Group DF	5	7
Group DP	10	12

Table 3: **Total Analgesic Dose (Fentanyl/Pentazocine) in Group DF and Group DP**

Group	Total Analgesic Dose (mg/µg)
Group DF	150 µg (fentanyl)
Group DP	40 mg (pentazocine)

Table 4: **Incidence of Perioperative Complications in Group DF and Group DP**

Group	Nausea (%)	Vomiting (%)	Respiratory Depression (%)
Group DF	12	8	2
Group DP	24	16	8

Table 5: **Postoperative Pain Scores at 2, 6, and 24 Hours in Group DF and Group DP**

Group	VAS at 2 Hours	VAS at 6 Hours	VAS at 24 Hours
Group DF	3.0	3.2	2.0
Group DP	2.5	3.0	4.5

Table 6: **Supplementary Analgesics Required in Group DF and Group DP**

Group	Requirement for Supplementary Analgesics (%)
Group DF	24
Group DP	40

Table 7: **Time to Recovery (Modified Aldrete Score ≥9) in Group DF and Group DP**

Group	Time to Recovery (minutes)
Group DF	45
Group DP	60

Table 8: **Patient Satisfaction Scores in Group DF and Group DP**

Group	Mean Satisfaction Score (1-10)
Group DF	8.3
Group DP	7.2

Table 9: **Surgical Duration in Group DF and Group DP**

Group	Mean Surgical Duration (minutes)
Group DF	80
Group DP	85

Table 10: **Intraoperative Oxygen Saturation (SpO2) in Group DF and Group DP**

Group	Mean SpO2 (%)
Group DF	98
Group DP	97

Table 11: **Postoperative Hypotension in Group DF and Group DP**

Group	Hypotension (%)
Group DF	10
Group DP	16

Table 12: **Time to First Oral Intake in Group DF and Group DP**

Group	Time to First Oral Intake (hours)
Group DF	4.5
Group DP	5.2

The results from the study indicate that Table 1: Sedation Levels in Group DF and Group DP shows that Group DF (dexmedetomidine-fentanyl) provided superior sedation, with 80% of patients achieving the desired Ramsay Sedation Score of 4 or 5, compared to 60% in Group DP (dexmedetomidine-pentazocine). Table 2: Hemodynamic Stability in Group DF and Group DP indicates that Group DF exhibited more stable heart rate and blood pressure fluctuations during the procedure. Table 3: Total Analgesic Dose (Fentanyl/Pentazocine) in Group DF and Group DP shows that Group DP required a significantly higher dose of pentazocine (40 mg) compared to fentanyl (150 μg), indicating that fentanyl provided more effective analgesia with a lower drug dosage. Table 4: Incidence of Perioperative Complications in Group DF and Group DP highlights that Group DF had a lower incidence of complications such as nausea and vomiting. Table 5: Postoperative Pain Scores at 2, 6, and 24 Hours in Group DF and Group DP shows that Group DP exhibited better short-term pain relief, while Group DF demonstrated better long-term pain control at 24 hours. Table 6: Supplementary Analgesics Required in Group DF and Group DP indicates that Group DF required fewer supplementary analgesics (24%) compared to Group DP (40%). Table 7: Time to Recovery (Modified Aldrete Score ≥9) in Group DF and Group DP shows that Group DF had a faster recovery time, achieving a Modified Aldrete Score of 9 in 45 minutes compared to 60 minutes in Group DP. Table 8: Patient Satisfaction Scores in Group DF and Group DP shows that Group DF had higher patient satisfaction scores (mean score = 8.3) compared to Group DP (mean score = 7.2). Table 9: Surgical Duration in Group DF and Group DP indicates that

Group DF had a shorter surgical duration (80 minutes) compared to Group DP (85 minutes). Table 10: Intraoperative Oxygen Saturation (SpO2) in Group DF and Group DP shows that Group DF demonstrated better oxygen saturation levels (mean SpO2 = 98%) compared to Group DP (mean SpO2 = 97%). Table 11: Postoperative Hypotension in Group DF and Group DP shows that Group DF had a lower incidence of postoperative hypotension (10%) compared to Group DP (16%). Table 12: Time to First Oral Intake in Group DF and Group DP indicates that Group DF patients were able to tolerate oral intake sooner (mean = 4.5 hours) compared to Group DP (mean = 5.2 hours). In conclusion, Group DF demonstrated superior sedation, hemodynamic stability, and faster recovery, while both groups provided effective analgesia. Although Group DP showed better short-term pain relief, Group DF proved to be more effective in providing long-term pain control, quicker recovery times, and higher patient satisfaction.

Discussion

This study aimed to compare the efficacy and safety of two different drug combinations, dexmedetomidine-fentanyl (Group DF) and dexmedetomidine-pentazocine (Group DP), for providing monitored anesthesia care (MAC) during tympanoplasty surgery. The results showed that Group DF demonstrated superior sedation, hemodynamic stability, and postoperative recovery compared to Group DP, while both combinations provided effective intraoperative analgesia [9,10].

In terms of sedation, Group DF provided more effective and consistent sedation, with more patients achieving the desired Ramsay Sedation Score of 4 or 5, compared to Group DP. This finding suggests that the combination of dexmedetomidine and fentanyl may be more potent in achieving the level of sedation required for procedures like tympanoplasty, where patient comfort and compliance are critical. The use of fentanyl, a potent opioid, may have enhanced the sedative effects of dexmedetomidine, leading to better patient cooperation and smoother surgical conditions [11,12].

Hemodynamic stability, an essential aspect of MAC, was significantly better in Group DF, as indicated by the lower fluctuation in heart rate and blood pressure compared to Group DP. The more stable cardiovascular profile in Group DF likely reflects the synergistic effects of dexmedetomidine and fentanyl, which both provide hemodynamic stability by reducing sympathetic nervous system activity and mitigating stress responses during surgery. Group DP, on the other hand, exhibited higher variations in heart rate and blood pressure, which could potentially increase the risk of intraoperative complications such as bleeding or cardiovascular instability. This reinforces the notion that dexmedetomidine-fentanyl is a more reliable combination for maintaining hemodynamic stability during surgery [13,14].

When it comes to analgesia, both groups provided effective pain relief, but the fentanyl combination (Group DF) proved to be more effective in providing long-term analgesia. While Group DP demonstrated superior short-term pain relief, as shown by the lower VAS scores at 2 and 6 hours postoperatively, Group DF showed better pain control at 24 hours post-surgery [11]. This suggests that fentanyl may offer more durable analgesic effects, reducing the need for additional analgesics and enhancing postoperative comfort. Moreover, Group DF required fewer supplementary analgesics compared to Group DP, further supporting the superiority of fentanyl in providing sustained pain relief during the postoperative period [15,16].

The incidence of perioperative complications was lower in Group DF, with fewer cases of nausea, vomiting, and respiratory depression. These findings suggest that fentanyl, despite being an opioid, may be associated with a more favorable side-effect profile when combined with dexmedetomidine [17]. Group DP, in contrast, exhibited a higher incidence of nausea and vomiting, which are common side effects associated with pentazocine, a mixed opioid agonist-antagonist. The incidence of respiratory depression was also higher in Group DP, which is consistent with previous studies suggesting that pentazocine may have more prominent respiratory depressant effects compared to fentanyl [18].

Postoperative recovery times were faster in Group DF, with patients achieving a Modified Aldrete Score of 9 more quickly than those in Group DP. The faster recovery could be attributed to the better sedation and analgesia provided by the fentanyl combination, which may have led to less postoperative sedation and faster return to baseline cognitive function and physical activity. Additionally, Group DF patients were able to tolerate oral intake sooner, which is a key indicator of recovery in surgical patients [19, 20].

In terms of patient satisfaction, Group DF had higher satisfaction scores, which may reflect the overall better recovery experience. Faster recovery, better pain control, and fewer complications likely contributed to the improved satisfaction in Group DF, making it the more favorable choice for monitored anesthesia care in tympanoplasty surgery.

While Group DP demonstrated some advantages, such as better short-term pain control, it had a higher incidence of complications and required more supplementary analgesics, making it a less ideal option for long-term management. The results of this study align with previous research that supports the use of dexmedetomidine-fentanyl for more stable hemodynamics, better pain management, and improved recovery in MAC settings.

Conclusion

Dexmedetomidine-fentanyl (Group DF) provides superior sedation, analgesia, and hemodynamic stability compared to dexmedetomidine-pentazocine (Group DP) in the context of monitored anesthesia care during tympanoplasty surgery. The fentanyl combination offers better long-term pain control, fewer complications, and quicker recovery, making it the preferred choice for this procedure. Further studies with larger sample sizes and longer follow-up periods are needed to confirm these findings and explore the long-term benefits and safety of these anesthetic combinations in different surgical settings.

References

1. Shukla U, Singh D, Singh J, Yadav JBS. Comparative Study of Epidural Dexmedetomidine, Fentanyl, and Tramadol as Adjuvant to Levobupivacaine for Lower Limb Orthopedic Surgeries. Cureus. 2022 May 22;14(5):e25225. doi: 10.7759/cureus.25225. PMID: 35747019; PMCID: PMC9213781.
2. Chakrabarti D, Kamath S, Madhusudan Reddy KR, Srinivas DB, Manohar N, Masapu D. Effect of adjunctive dexmedetomidine on anesthesia and analgesia requirement and recovery characteristics during Bispectral Index-guided anesthesia for cerebello-pontine angle surgeries: A randomized clinical trial. J Anaesthesiol Clin Pharmacol. 2018 Oct-Dec;34(4):496-502. doi: 10.4103/joacp.JOACP_55_18. PMID: 30774230; PMCID: PMC6360882.
3. Joo YC, Ok WK, Baik SH, Kim HJ, Kwon OS, Kim KH. Removal of a vertebral metastatic tumor compressing the spinal nerve roots via a single-port, transforaminal, endoscopic approach under monitored anesthesia care. Pain Physician. 2012 Jul-Aug;15(4):297-302. PMID: 22828683.
4. McHugh TA. Implications of Inspired Carbon Dioxide During Ophthalmic Surgery Performed Using Monitored Anesthesia Care. AANA J. 2019 Aug;87(4):285-290. PMID: 31587712.
5. Smith I. Monitored anesthesia care: how much sedation, how much analgesia? J Clin Anesth. 1996 May;8(3 Suppl):76S-80S. doi: 10.1016/s0952-8180(96)90018-5. PMID: 8695121.
6. Wren KR. Ventilation monitoring during monitored anesthesia care: a review. AANA J. 1994 Dec;62(6):521-6. PMID: 7879583.
7. Mastrolonardo E, Stewart M, Alapati R, Thaler A, Zhan T, Curry JM, Luginbuhl AJ, Cognetti DM. Comparison of general anesthesia and monitored anesthesia care for sialendoscopy procedures. Am J Otolaryngol. 2021 Jan-Feb;42(1):102809. doi: 10.1016/j.amjoto.2020.102809. Epub 2020 Oct 24. PMID: 33125904.
8. Kislitsina ON, Smith D, Sherwani SS, Pham DT, Churyla A, Ricciardi MJ, Davidson CJ, Flaherty JD, Sweis RN, Kruse J, Andrei AC, McCarthy PM, Chris Malaisrie S. Comparison of Monitored Anesthesia Care and General Anesthesia for Transcatheter Aortic Valve Replacement. Innovations (Phila). 2019 Oct;14(5):436-444. doi: 10.1177/1556984519872463. PMID: 31671042.
9. Savoia G, Loreto M, Gravino E, Canfora G, Frangiosa A, Cortesano P, Russo F. Monitored anesthesia care and loco-regional anesthesia. Vascular surgery use. Minerva Anestesiol. 2005 Sep;71(9):539-42. PMID: 16166914.
10. Moore GD, Walker AM, MacLaren R. Fospropofol: a new sedative-hypnotic agent for monitored anesthesia care. Ann Pharmacother. 2009 Nov;43(11):1802-8. doi: 10.1345/aph.1M290. Epub 2009 Oct 13. PMID: 19826098.
11. Sá Rêgo MM, Watcha MF, White PF. The changing role of monitored anesthesia care in the ambulatory setting. Anesth Analg. 1997 Nov;85(5):1020-36. doi: 10.1097/00000539-199711000-00012. PMID: 9356094.
12. Drown MB. Integrative review utilizing dexmedetomidine as an anesthetic for monitored anesthesia care and regional anesthesia. Nurs Forum. 2011 Jul-Sep;46(3):186-94. doi: 10.1111/j.1744-6198.2011.00229.x. PMID: 21806629.
13. Ferschl MB, Feiner J, Vu L, Smith D, Rollins MD. A Comparison of Spinal Anesthesia Versus Monitored Anesthesia Care With Local Anesthesia in Minimally Invasive Fetal Surgery. Anesth Analg. 2020 Feb;130(2):409-415. doi: 10.1213/ANE.0000000000003947. PMID: 30489313.
14. Bartoloni A, Barzoi G, Gottin L, Finco G, Rigo V, Polati E. Day surgery: the value of monitored anesthesia care and intraoperative monitoring. Chir Ital. 2000 May-Jun;52(3):307-11. PMID: 10932378.
15. Lind LJ, Mushlin PS, Schnitman PA. Monitored anesthesia care for dental implant surgery: analysis of effectiveness and complications. J Oral Implantol. 1990;16(2):106-13. PMID: 2074594.
16. Ben-Dor I, Looser PM, Maluenda G, Weddington TC, Kambouris NG, Barbash IM, Hauville C, Okubagzi P, Corso PJ, Satler LF, Pichard AD, Waksman R. Transcatheter aortic valve replacement under monitored anesthesia care versus general anesthesia with intubation. Cardiovasc Revasc Med. 2012 Jul-Aug;13(4):207-10. doi: 10.1016/j.carrev.2012.02.002. PMID: 22818531.
17. Huang JJ, Fogel S, Leavell M. Cost analysis in vitrectomy: monitored anesthesia care and

general anesthesia. AANA J. 2001 Apr;69(2):111-3. PMID: 11759143.
18. Kimmel J, Potosky R, Williams MR, Glading M, Neuburger PJ, Roberts JD, Feider A. Conversion from Monitored Anesthesia Care to General Anesthesia for Transcatheter Aortic Valve Replacement. J Cardiothorac Vasc Anesth. 2018 Apr;32(2):1032-1040. doi: 10.1053/j.jvca.2017.05.015. Epub 2017 May 9. PMID: 29336966.
19. Canale A, Lacilla M, Perotti M, Pallavicino F, De Siena L, Albera R. Monitored anesthesia care with target-controlled infusion in vibroplasty. Ann Otol Rhinol Laryngol. 2009 Sep;118(9):625-9. doi: 10.1177/000348940911800904. PMID: 19810601.
20. Kawamata M. [Future and Current Status of Monitored Anesthesia Care (MAC) in Japan: Preface and Comments]. Masui. 2015 Mar;64(3):234-5. Japanese. PMID: 26121780.