Am J Transl Res 2025;17(5):3530-3537
www.ajtr.org /ISSN:1943-8141/AJTR0159848

Original Article

Feasibility and efficacy of remimazolam for anesthesia monitoring in transcatheter aortic valve implantation via femoral artery access

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Received August 15, 2024; Accepted January 2, 2025; Epub May 15, 2025; Published May 30, 2025

Abstract: Objective: To evaluate the effect of remimazolam during anesthesia monitoring in transcatheter aortic valve implantation (TAVI) via femoral artery catheter (FAC). Methods: We reviewed the medical records of 50 patients who underwent TAVI via FAC from July 2022 to September 2023. Patients were divided into two groups: a control group (receiving propofol, n=25) and a remimazolam group (receiving remimazolam, n=25). Pulse oxygen saturation (SpO_2), heart rate (HR), mean arterial pressure (MAP) and Bispectral Index (BIS) were recorded at various time points: 5 min before anesthesia (T0), 0 (T1), 5 (T2), 10 (T3), 15 (T4), and 20 min (T5) after infusion. Operation time, blood loss, awakening time, quality of recovery (QoR-15) scores before operation and 1 and 3 days after operation were recorded and compared between the two groups. Additionally, the incidence of delirium at 1-day post-operation was compared between the two groups. The incidence of adverse reactions and patient satisfaction were compared between the groups. Results: At T2, T3, T4 and T5, the remimazolam group exhibited significantly higher SpO_2, HR and MAP than the control group ($P<0.05$); BIS values and modified observer's assessment of alertness/sedation (MOAA/S) scores showed no significant differences ($P>0.05$). The remimazolam group also had significantly earlier awakening times ($P<0.05$), without differences in operation time or blood loss ($P<0.05$). QoR-15 scores at 1 and 3 days post-operation were higher in the remimazolam group ($P<0.05$). The incidence of postoperative delirium was slightly lower in the remimazolam group ($P>0.05$). The control group had a higher total incidence of adverse reactions and lower satisfaction compared to the remimazolam group ($P<0.05$). Conclusion: Remimazolam is an effective sedative for TAVI anesthesia, associated with lower postoperative adverse reactions, thus facilitating better recovery.

Keywords: Remimazolam, transcatheter aortic valve implantation via femoral artery catheter, anesthesia monitoring, postoperative delirium

Introduction

Severe aortic stenosis (AS) is a prevalent form of valvular heart disease characterized by the narrowing of the aortic valve leaflets, which restricts their ability to fully open and close [1, 2]. This condition often progresses silently; however, in severe conditions, patients typically present with a classic triad of symptoms: dyspnea, chest pain, and syncope. These symptoms are closely associated with the deterioration of cardiac function and significantly affect patient prognosis [3]. AS predominantly affects the elderly population, with an incidence of approximately 5% among older adults, and it carries a high mortality risk if left untreated [4, 5]. Surgical intervention is crucial for managing severe AS, with options including surgical aortic valve replacement (SAVR) and, more recently, transcatheter aortic valve implantation (TAVI), which has revolutionized treatment approaches [6].

The development of minimally invasive techniques has made TAVI a viable alternative to traditional surgery, particularly for high-risk patients [7]. TAVI effectively restores valve function and normalizes blood flow with minimal surgical trauma, facilitating enhanced postoperative recovery [8]. The procedure typically

https://doi.org/10.62347/QUMD4078

involves accessing the aortic valve via the femoral artery, allowing for a less invasive approach. Local anesthesia near the femoral artery can effectively manage pain while having minimal impact on the patient's overall condition [9]. Furthermore, combining local anesthesia with anesthesia monitoring can shorten operation times and reduce the need for vasopressor medications, thereby mitigating the physiological stress during surgical intervention [10].

Currently, propofol remains the standard agent for sedation during TAVI due to its favorable pharmacokinetic profile. However, remimazolam, a new ultra-short-acting benzodiazepine, offers advantages such as rapid onset, quick recovery, alongside a favorable safety profile [11, 12]. This study aims to evaluate the feasibility of using remimazolam for sedation during TAVI, providing insights into alternative anesthesia strategies that may enhance patient outcomes and recovery in this high-risk population.

Methods and data

General data

This study was approved by the Medical Ethics Committee of Zhanjiang Central People's Hospital. Medical records of 50 patients who received TAVI via femoral artery catheter (FAC) between July 2022 and September 2023 were selected and reviewed. Of these, 25 patients who received propofol during anesthesia monitoring were assigned to the control group, including 18 males and 7 females (mean age: (78.61±3.24) years). The remaining 25 patients who received remimazolam during anesthesia monitoring were assigned to the remimazolam group, including 15 males and 10 females (mean age: (78.61±3.24) years).

Inclusion and exclusion criteria

Inclusion criteria: 1) patients diagnosed with AS with indications for TAVI; 2) patients classified as American Society of Anesthesiologists classification class II-III; 3) patients aged between 70 and 85 years old; 4) patients with a body mass index (BMI) ranging from 19 to 24 kg/m^2; 5) procedure duration between 1 to 3 hours; 6) availability of complete medical records.

Exclusion criteria: 1) presence of pronounced respiratory symptoms, circulatory disorders, or suspected difficult airway; 2) severe neuropsychiatric disorders or myasthenia gravis; 3) prior use of intermittent benzodiazepines, anesthesia failure, or need for changes in anesthesia plan due to surgical requirements; 4) significant liver, kidney, or blood coagulation abnormalities; 5) procedure duration of less than 1 hour or more than 3 hours; 6) drug allergies to any of the medications used in the study.

Anesthesia and monitoring scheme

After confirming the patient's identity, oxygen was administered via a nasal catheter at 3 L/h. Following confirmation of the correct operation site, the patient was connected to the ECG monitor for continuous tracking of blood pressure (BP), heart rate (HR), respiratory rate (RR), pulse oxygen saturation (SpO_2) and Bispectral Index (BIS). Under local anesthesia, a radial artery puncture was performed for pressure measurement, and an internal jugular vein catheter was placed for infusion and prevention of surgical complications. The radial artery was used for blood pressure monitoring, and arterial blood samples were drawn during the procedure.

Remimazolam group: Each patient was intravenously administered with remimazolam (diluted to 1 mg/mL with normal saline) at 5 mg/min. After the initial dose was given within 1 min, the infusion continued to maintain the ED90 dose of 0.40 mg/kg/h (diluted to 2 mg/mL with normal saline). Control group: Propofol was administered at 5 ml/min for the first minute, followed by a continuous infusion of 2.5 mg/kg/h.

The procedure began 10 minutes after anesthesia induction, with local anesthesia applied to both the left and right groin areas. If intraoperative blood pressure fluctuation exceeded ±20% from baseline, and after ruling out other factors, noradrenaline or nitroglycerin was administered intravenously to maintain hemodynamic stability. For patients experiencing respiratory depression (SpO_2<90% for 10 seconds), interventions such as jaw lifting or mask oxygen inhalation were employed.

Outcome measures

(1) SpO_2, HR and MAP: These parameters were recorded at baseline (5 minutes before infusion

of remimazolam or propofol, T0) and at 0 (T1), 5 (T2), 10 (T3), 15 (T4), and 20 min (T5) after the infusion.

(2) BIS and Modified Observer's Assessment of Alertness/Sedation (MOAA/S) scores: BIS and MOAA/S scores were recorded at 5 min before infusion (T0) and at 0 (T1), 5 (T2), 10 (T3), 15 (T4), and 20 min (T5) after infusion.

(3) Operation-related indices: Operation time, blood loss, and awakening time were recorded for each patient.

(4) Quality of recovery-15 scale (QoR-15) [13]: The QoR-15 scale was used to evaluate patients one day before the operation, and one and three days post-operation. The QoR-15 scale consists of 15 questions, each rated on a 0-10 scale, evaluating postoperative recovery across five domains: emotional state, physical comfort, psychological support, self-care ability, and pain. The CAM Delirium Scale was used to assess patients for delirium one and three days after the procedure. Delirium was diagnosed based on the following criteria: ① Acute onset and fluctuating condition; ② Inattention; ③ Thinking disorder; ④ Change in consciousness level. A diagnosis of delirium was made if criteria 1 and 2 were met, or if either criterion 3 or 4 was present.

(5) Incidence of adverse reactions: The occurrence of adverse reactions such as hypotension, respiratory depression, and injection site pain was recorded for both groups.

(6) Patient Satisfaction: Three days post-operation, patient satisfaction was assessed using a self-developed questionnaire, recording the total number of patients satisfied with the entire anesthesia process. Satisfaction was categorized as highly satisfied, satisfied and dissatisfied. The total satisfaction rate was calculated by summing the rates of high satisfaction and satisfaction.

Statistical analyses

Data analysis was performed using SPSS 26.0. Count data were presented as cases (%), and the χ^2 test was employed for analysis. Normally distributed measurement data were described as $\bar{x} \pm s$, with inter-group comparisons made using the independent t-test. Comparisons among three or more groups at multiple time points were conducted using repeated measures analysis of variance, and post-hoc analysis was conducted using the Bonferroni method. Measurement data that were not normally distributed were expressed as median (quartile) [M (P25, P75)], with intra-group comparisons performed using the Friedman test and inter-group comparisons conducted using the Kruskal-Wallis H test. A *P*-value of less than 0.05 was considered statistically significant.

Results

Comparison of baseline data between the two groups

The two groups did not differ significantly in terms of age, sex, BMI, American Society of Anesthesiologists (ASA) classification, New York Heart Association (NYHA) classification, comorbid hypertension, comorbid coronary heart disease, comorbid arrhythmia, and interventional therapy (all P>0.05, **Table 1**).

Comparison of SpO_2, HR and MAP between the two groups

At T0 and T1, the two groups did not differ significantly in terms of SpO_2, HR or MAP (P>0.05). However, significant differences were observed at subsequent time points. At T2, T3, T4 and T5, the remimazolam group exhibited higher SpO2 levels (T2: P<0.001, T3: P<0.001, T4: P<0.001, T5: P<0.001), HR (T2: P<0.001, T3: P<0.001, T4: P<0.001, T5: P=0.004), and MAP (T2: P=0.006, T3: P<0.001, T4: P<0.001, T5: P=0.019) compared to the control group (all P<0.05, **Table 2**).

Comparison of BIS value and MOAA/S score between the two groups

Analysis of the BIS values and MOAA/S scores revealed no significant differences between the two groups across all time points (T0, T1, T2, T3, T4 and T5; P>0.05). This indicates that both groups maintained similar levels of sedation depth throughout the procedure (**Table 3**).

Comparison of operating room-related indices in the two groups

The remimazolam group experienced significantly earlier awakening time than the control group (P<0.05). However, there were no significant differences between the two groups in

Table 1. Comparison of baseline data between the two groups

	Control group (n=25)	Remimazolam group (n=25)	χ^2/t	P
Age (years)	78.61±3.24	79.14±3.08	0.593	0.556
Sex			0.802	0.371
Male	18 (72.00)	15 (60.00)		
Female	7 (28.00)	10 (40.00)		
BMI (kg/m^2)	22.06±0.94	22.24±1.04	0.642	0.524
ASA classification			0.739	0.390
II	16 (64.00)	13 (52.00)		
III	9 (36.00)	12 (48.00)		
NYHA classification			0.850	0.653
II	4 (16.00)	6 (24.00)		
III	13 (52.00)	10 (40.00)		
IV	8 (32.00)	9 (36.00)		
Comorbid hypertension			0.857	0.355
Yes	16 (64.00)	19 (76.00)		
No	9 (36.00)	6 (24.00)		
Comorbid coronary heart disease			0.642	0.423
Yes	5 (20.00)	8 (29.63)		
No	20 (80.00)	19 (70.37)		
Comorbid arrhythmia			2.122	0.145
Yes	7 (28.00)	12 (48.00)		
No	18 (72.00)	13 (52.00)		
History of interventional therapy			1.471	0.225
Yes	6 (24.00)	10 (40.00)		
No	19 (76.00)	15 (60.00)		

Note: BMI, body mass index; ASA, American standards association; NYHA, New York Heart Association.

Table 2. Comparison of SpO_2, HR and MAP between the two groups at different time points

	SpO_2 (%)		HR (times/min)		MAP (mmHg)	
	Control group (n=25)	Remimazolam group (n=25)	Control group (n=25)	Remimazolam group (n=25)	Control group (n=25)	Remimazolam group (n=25)
T0	98.45±0.84	98.44±0.36	91.94±7.53	92.08±7.34	87.55±5.27	86.94±5.30
T1	97.25±1.10^{a}	97.08±1.11^{a}	85.45±5.03^{a}	85.50±5.05^{a}	85.95±7.70^{a}	85.88±7.84^{a}
T2	95.25±0.73^{a,b}	96.32±0.80^{a,b,*}	65.46±7.04^{a,b}	73.04±5.73^{a,b,*}	71.78±7.84^{a,b}	77.46±5.91^{a,b,*}
T3	95.72±0.54^{a,b,c}	96.96±0.33^{a,b,c,*}	64.64±5.93^{a,b,c}	73.66±5.36^{a,b,c,*}	75.05±3.70^{a,b,c}	79.74±3.51^{a,b,c,*}
T4	92.21±0.50^{a,b,c,d}	95.35±0.54^{a,b,c,d,*}	65.28±5.13^{a,b,c,d}	71.08±5.10^{a,b,c,d,*}	75.04±3.54^{a,b,c}	78.91±3.01^{a,b,c,*}
T5	93.64±0.27^{a,b,c,d,e}	95.05±0.26^{a,b,c,d,e,*}	73.97±5.90^{a,b,c,d,e}	78.66±5.16^{a,b,c,d,e,*}	80.25±4.10^{a,b,c,d,e}	83.05±4.07^{a,b,c,d,e,*}

Notes: ^{a}P<0.05 *vs.* T0; ^{b}P<0.05 *vs.* T1; ^{c}P<0.05 *vs.* T2; ^{d}P<0.05 *vs.* T3; ^{e}P<0.05 *vs.* T4; *P<0.05 *vs.* control group. SpO_2, Pulse oxygen saturation; HR, Heart rate; MAP, Mean arterial pressure.

terms of operation time and blood loss (P>0.05, **Figure 1**).

Comparison of QoR-15 score and incidence of postoperative delirium between the two groups

At 1 d and 3 d after operation, the remimazolam group showed significantly higher QoR-15 score (1 day after operation: P<0.001; 3 days after operation: P<0.001) than the control group (all P<0.05). Regarding the incidence of postoperative delirium, the remimazolam group had a slightly lower incidence than the control group at 1 d and 3 d after operation (all P> 0.05, **Table 4**).

Table 3. Comparison of BIS value and MOAA/S score between the two groups at different time points

	BIS value		MOAA/S score	
	Control group (n=25)	Remimazolam group (n=25)	Control group (n=25)	Remimazolam group (n=25)
T0	89.40±4.31	88.36±4.26	5 (5, 5)	5 (5, 5)
T1	52.15±5.90[a]	54.00±5.76[a]	4 (4, 4)[a]	4 (4, 5)
T2	55.88±3.41[a,b]	56.01±3.73[a,b]	4 (3, 4)[a]	4 (4, 4)[a]
T3	56.84±2.23[a,b]	57.12±3.06[a,b]	3 (3, 4)[a,b,c]	3 (3, 4)[a,b]
T4	58.04±3.20[a,b,c,d]	59.10±3.23[a,b,c,d]	3 (3, 4)[a,b,c]	3 (3, 4)[a,b,c,d]
T5	60.86±2.44[a,b,c,d,e]	62.02±2.57[a,b,c,d,e]	3 (2, 3)[a,b,c,d,e]	3 (3, 3)[a,b,c,d]

Notes: [a]P<0.05 *vs.* T0; [b]P<0.05 *vs.* T1; [c]P<0.05 *vs.* T2; [d]P<0.05 *vs.* T3; [e]P<0.05 *vs.* T4. BIS, Bispectral index; MOAA/S, Modified Observer's Assessment of Alertness/Sedation.

Comparison of the incidence of postoperative adverse reactions between the two groups

The total incidence of adverse reactions was significantly higher in the control group (44%) than in the remimazolam group (16%) (P<0.05, **Table 5**).

Comparison of patient satisfaction between the two groups

The overall satisfaction rate was significantly higher in the remimazolam group (92.00%) compared to the control group (64.00%) (P< 0.05, **Table 6**).

Discussion

The commonly used approaches for TAVI are the transfemoral artery approach and transapical approach [14]. The apical approach is primarily employed for patients with lesions of the femoral artery and abdominal aorta. It generally requires general anesthesia, making it more invasive compared to the transfemoral artery approach [15, 16]. The transfemoral artery approach, on the other hand, is less traumatic and can be performed under local anesthesia. However, local anesthesia alone is insufficient for this procedure, as rapid ventricular pacing is required during valve placement. During this phase, the heart is in a state of no contraction. Although the duration is brief, it can still significantly affect the patient psychologically. In such cases, anesthetic monitoring plays a crucial role in ensuring a safe and comfortable environment for both patients and operators. The transfemoral approach offers rapid recovery and minimal physical impact, making it particularly suitable for TAVI via the femoral artery approach [17]. Remimazolam, an ultra-short-acting intravenous anesthetic, is rapidly metabolized by non-specific plasma esterase, preventing accumulate in the body, and its metabolite, zolam propionic acid, is mainly excreted through the kidneys [18].

In our study, the remimazolam group demonstrated more stable hemodynamic parameters, with higher SpO_2, HR, and MAP levels compared to the propofol group. This stability is likely due to remimazolam's pharmacological properties, including minimal inhibition of the autonomic nervous system, which contributes to improved oxygenation and cardiovascular stability. Our findings align with previous studies showing that remimazolam offers superior hemodynamic stability compared to propofol during procedures [19]. For instance, Tang et al. [20] compared the sedative effects of remimazolam and propofol in patients undergoing hysteroscopy and found better hemodynamic stability under remimazolam than under propofol. Similarly, Kleiman et al. [21] observed no significant prolongation of cardiac repolarization with remimazolam, indicating reduced cardiovascular burden. In addition, the remimazolam group experienced significantly earlier awakening times than the control group, but no significant differences were observed in terms of operation time and blood loss between the two groups. This faster awakening could be attributed to remimazolam's rapid metabolism and clearance, leading to a quicker reversal of its effects and faster recovery from anesthesia.

In our study, the remimazolam group achieved significantly higher QoR-15 scores than the control group at 1 d and 3 d after operation. A higher QoR-15 score means better recovery and higher quality of life after surgery [22]. This improvement may be due to remimazolam's ability to promote a faster and smoother recovery, reducing discomfort post-surgery. Moreover, remimazolam likely provides a more effective sedative effect, helping patients feel more comfortable and relaxed, which can alle-

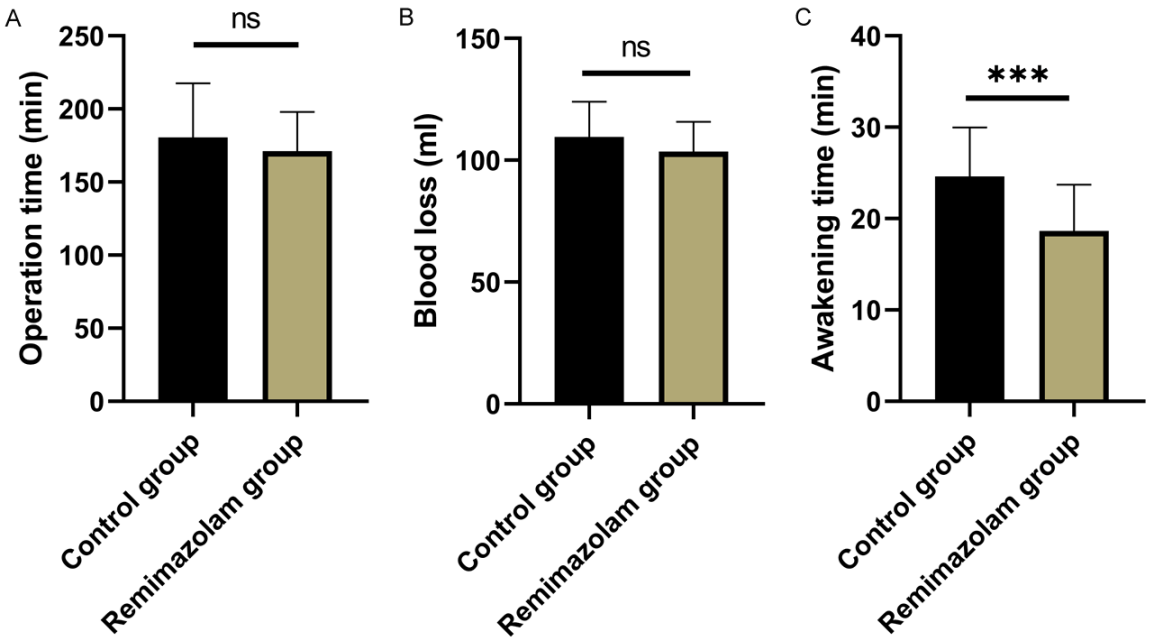

Figure 1. Comparison of operating room-related indices. A: Comparison of operation time. B: Comparison of blood loss. C: Comparison of awakening time. Note: ***P<0.001; ns, not significant.

Table 4. Comparison of QoR-15 score and postoperative delirium rate between the two groups

	QoR-15 score		Postoperative delirium	
	Control group (n=25)	Remimazolam group (n=25)	Control group (n=25)	Remimazolam group (n=25)
1 day before operation	141.57±4.77	142.08±4.59		
1 day after operation	66.28±4.16[a]	78.65±5.73[a,*]	9 (36.00)	6 (24.00)
3 days after operation	72.41±4.21[a,b]	86.09±4.33[a,b,*]	5 (20.00)	2 (8.00)

Notes: [a]P<0.05 *vs.* 1 d before operation; [b]P<0.05 *vs.* 1 day after operation; [*]P<0.05 *vs.* the control group.

Table 5. Comparison of adverse reactions between the two groups

	Control group (n=25)	Remimazolam group (n=25)	χ^2	P
Hypotension	4 (16.00)	2 (8.00)	0.758	0.384
Respiratory depression	3 (12.00)	2 (8.00)	0.222	0.637
Injection pain	4 (16.00)	0 (0.00)	4.348	0.037
Total adverse reaction	11 (44.00)	4 (16.00)	4.667	0.031

Table 6. Comparison of patient satisfaction between the two groups

	Control group (n=25)	Remimazolam group (n=25)	χ^2	P
Highly satisfied	6 (24.00)	11 (44.00)	2.228	0.136
Satisfied	10 (40.00)	12 (48.00)	0.325	0.569
Dissatisfied	9 (36.00)	2 (8.00)	5.711	0.017
Total satisfaction	16 (64.00)	23 (92.00)	5.711	0.017

viate anxiety and stress, ultimately improving both their psychological and physical state after operation. The accumulation of benzodiazepines is a crucial risk factor for postoperative delirium [23]. Remimazolam has rapid metabolism and no accumulation, which contributes to the protection of perioperative cognitive function in elderly patients. In the current study, the incidence of postoperative delirium was evaluated by the CAM delirium scale. The incidence of postoperative delirium in the remimazolam group was 24.00% at 1 day after operation and 8.00% at 3 d after operation, which was comparable

to the control group. A similar study by Kaneko et al. [24] showed a significantly lower incidence of postoperative delirium in patients given remimazolam than in patients given propofol. The difference in findings may be attributed to variations in sample size, age, and other factors. Finally, the remimazolam group exhibited significantly fewer postoperative adverse reactions and greater overall satisfaction, supporting the notion that remimazolam provides a safer anesthetic alternative. Prior research also indicates a lower incidence of respiratory depression associated with remimazolam [25]. The results imply that remimazolam can reduce the incidence of postoperative adverse reactions and contribute to better patient satisfaction.

Although this study evaluated the effects of remimazolam during anesthesia monitoring in TAVI via FAC, it still has some limitations. First, the small sample size of this retrospective study may introduce unavoidable bias, which could affect the statistical power of the results. To strengthen the findings and improve the reliability of the conclusions, larger sample sizes and multi-center studies should be conducted in future research. Second, the patients included in this study were predominantly older, and while the study focused on short-term outcomes, it did not address long-term prognosis or quality of life after surgery. As this study was limited by the short duration of follow-up, future research should aim to observe and evaluate the long-term outcomes of these patients to provide a more comprehensive understanding of the benefits of remimazolam in the perioperative setting.

Conclusion

Remimazolam provides good sedative effect during anesthesia monitoring of TAVI, with a low incidence of postoperative adverse reactions. These characteristics contribute to improved postoperative rehabilitation and overall patient outcomes, making remimazolam a promising anesthetic option for TAVI procedures.

Disclosure of conflict of interest

None.

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References

[1] Di Fusco SA, Borrelli N, Poli S, Bernelli C, Perone F, Aquilani S, Maggioni AP, Di Pasquale G, Gabrielli D, Oliva F and Colivicchi F. Degenerative aortic valve stenosis: looking for a pharmacological prevention. G Ital Cardiol (Rome) 2023; 24: 293-304.

[2] Rivera FB, Cu MVV, Cua SJ, De Luna DV, Lerma EV, McCullough PA, Kazory A and Collado FMS. Aortic stenosis and aortic valve replacement among patients with chronic kidney disease: a narrative review. Cardiorenal Med 2023; 13: 74-90.

[3] Lee G, Chikwe J, Milojevic M, Wijeysundera HC, Biondi-Zoccai G, Flather M, Gaudino MFL, Fremes SE and Tam DY. ESC/EACTS vs. ACC/AHA guidelines for the management of severe aortic stenosis. Eur Heart J 2023; 44: 796-812.

[4] Coisne A, Scotti A, Latib A, Montaigne D, Ho EC, Ludwig S, Modine T, Genereux P, Bax JJ, Leon MB, Bauters C and Granada JF. Impact of moderate aortic stenosis on long-term clinical outcomes: a systematic review and meta-analysis. JACC Cardiovasc Interv 2022; 15: 1664-1674.

[5] Rouleau SG, Brady WJ, Koyfman A and Long B. Transcatheter aortic valve replacement complications: a narrative review for emergency clinicians. Am J Emerg Med 2022; 56: 77-86.

[6] Sanchez-Cena J, Asmarats L, Li CHP, Millan X, Fernandez-Peregrina E, Menduina I, Masso van Roessel A and Arzamendi D. Redo transcatheter aortic valve replacement in degenerated transcatheter bioprosthesis (TAV-in-TAV). Expert Rev Cardiovasc Ther 2023; 21: 703-712.

[7] Mazur P, Marin-Cuartas M, Arghami A, Noack T, Crestanello JA and Borger MA. Operative management after transcatheter aortic valve replacement. Kardiol Pol 2023; 81: 107-114.

[8] Guedeney P and Collet JP. Aortic stenosis: an update. Rev Med Interne 2022; 43: 145-151.

[9] Zhao CB, Yu J, Kong M, Han J, Du H and Huang J. Ketamine for monitored anesthesia care during transcatheter aortic valve replacement. J Perianesth Nurs 2022; 37: 234-237.

[10] Shimura T and Yamamoto M; OCEAN-SHD family. Transcatheter aortic valve implantation and frailty. Cardiovasc Interv Ther 2022; 37: 626-634.

[11] Desai PV, Goel SS, Kleiman NS and Reardon MJ. Transcatheter aortic valve implantation:

long-term outcomes and durability. Methodist Debakey Cardiovasc J 2023; 19: 15-25.
[12] Hu Q, Liu X, Wen C, Li D and Lei X. Remimazolam: an updated review of a new sedative and anaesthetic. Drug Des Devel Ther 2022; 16: 3957-3974.
[13] Kara U, Şimşek F, Kamburoğlu H, Özhan M, Alakuş Ü, İnce ME, Eksert S, Özkan G, Eşkin MB and Şenkal S. Linguistic validation of a widely used recovery score: quality of recovery-15 (QoR-15). Turk J Med Sci 2022; 52: 427-435.
[14] Corcione N, Ferraro P, Morello A, Cimmino M, Albanese M, Pepe M, Giordano S, Biondi-Zoccai G and Giordano A. Transcatheter aortic valve implantation with Allegra: procedural and mid-term outcomes according to experience phase in a high-volume center. Minerva Cardiol Angiol 2022; 70: 677-685.
[15] Tiyerili V, Sotemann D, Grothusen C, Eckel C, Becher MU, Blumenstein J, Nef H and Mollmann H. Latest advances in transcatheter aortic valve implantation (2022). Surg Technol Int 2022; 40: 221-225.
[16] Costa G, Reddavid C, Dipietro E and Barbanti M. Managing complications after transcatheter aortic valve implantation. Expert Rev Med Devices 2022; 19: 599-612.
[17] Wang L, Liu Y, Gao H, Zhang B, Zhou S, Xie M and Sun X. Comparison of safety and effectiveness of local or general anesthesia after transcatheter aortic valve implantation: a systematic review and meta-analysis. J Clin Med 2023; 12: 508.
[18] Fechner J, El-Boghdadly K, Spahn DR, Motsch J, Struys MMRF, Duranteau O, Ganter MT, Richter T, Hollmann MW, Rossaint R, Bercker S, Rex S, Drexler B, Schippers F, Morley A, Ihmsen H and Kochs E; Surgery Under Remimazolam - Total IntraVenous Anaesthesia (SURE-TIVA) Trial Group. Anaesthetic efficacy and postinduction hypotension with remimazolam compared with propofol: a multicentre randomised controlled trial. Anaesthesia 2024; 79: 410-422.
[19] Kim KM. Remimazolam: pharmacological characteristics and clinical applications in anesthesiology. Anesth Pain Med (Seoul) 2022; 17: 1-11.
[20] Tang S, Lu J, Xu C, Wei L, Mei S, Chen R and Meng QT. Feasibility and safety of remazolam versus propofol when inserting laryngeal masks without muscle relaxants during hysteroscopy. Drug Des Devel Ther 2023; 17: 1313-1322.
[21] Kleiman RB, Darpo B, Thorn M, Stoehr T and Schippers F. Potential strategy for assessing QT/QTc interval for drugs that produce rapid changes in heart rate: electrocardiographic assessment of the effects of intravenous remimazolam on cardiac repolarization. Br J Clin Pharmacol 2020; 86: 1600-1609.
[22] Myles PS, Shulman MA, Reilly J, Kasza J and Romero L. Measurement of quality of recovery after surgery using the 15-item quality of recovery scale: a systematic review and meta-analysis. Br J Anaesth 2022; 128: 1029-1039.
[23] Swarbrick CJ and Partridge JSL. Evidence-based strategies to reduce the incidence of postoperative delirium: a narrative review. Anaesthesia 2022; 77 Suppl 1: 92-101.
[24] Kaneko S, Morimoto T, Ichinomiya T, Murata H, Yoshitomi O and Hara T. Effect of remimazolam on the incidence of delirium after transcatheter aortic valve implantation under general anesthesia: a retrospective exploratory study. J Anesth 2023; 37: 210-218.
[25] Song X, Wang F, Dong R, Zhu K and Wang C. Efficacy and safety of remimazolam tosilate combined with esketamine for analgesic sedation in mechanically ventilated ICU patients: a single-arm clinical study protocol. Front Med (Lausanne) 2022; 9: 832105.