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ORIGINAL ARTICLE

The safety of perioperative antiplatelet continuation without selection biases in microsurgical decompression surgery for single level lumbar spinal stenosis and lumbar disc herniotomy

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Abstract

Purpose Each institution or physician has to decide on an individual basis whether to continue or discontinue antiplatelet (AP) therapy before spinal surgery. The purpose of this study was to determine if perioperative AP continuation is safe during single-level microsurgical decompression (MSD) for treating lumbar spinal stenosis (LSS) and lumbar disc hernia (LDH) without selection bias.

Methods Patients who underwent single-level MSD for LSS and LDH between April 2018 to December 2022 at our institute were included in this retrospective study. We collected data regarding baseline characteristics, medical history/comorbidities, epidural hematoma (EDH) volume, reoperation for EDH, differences between preoperative and one-day postoperative blood cell counts (ΔRBC), hemoglobin (ΔHGB), and hematocrits (ΔHCT), and perioperative thromboembolic complications. Patients were divided into two groups: the AP continuation group received AP treatment before surgery and the control group did not receive antiplatelet medication before surgery. Propensity scores for receiving AP agents were calculated, with one-to-one matching of estimated propensity scores to adjust for patient baseline characteristics and past histories. Reoperation for EDH, EDH volume, ΔRBC, ΔHGB, ΔHCT, and perioperative thromboembolic complications were compared between the groups.

Results The 303 enrolled patients included 41 patients in the AP continuation group. After propensity score matching, the rate of reoperation for EDH, the EDH volume, ΔRBC, ΔHGB, ΔHCT, and perioperative thromboembolic complication rates were not significantly different between the groups.

Conclusion Perioperative AP continuation is safe for single-level lumbar MSD, even without biases.

Keywords Antiplatelet · Lumbar disc hernia · Lumbar spinal stenosis · Microsurgical decompression

Introduction

In the current aging society, the incidences of cardiovascular and cerebrovascular diseases are increasing. Thus, more patients with spinal disorders who require surgical intervention are taking antiplatelet (AP) or anticoagulation (AC) agents. According to an online appendix of common procedures and the associated procedural bleeding risks (revised in 2022), all spinal surgeries are classified as high bleeding risk [5]. Antithrombotic agents may need to be discontinued before spine surgeries. However, discontinuation of antithrombotic agents may increase perioperative thromboembolic complications, which lead to poor patient prognosis. Because the risks and benefits of perioperative

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AP discontinuation are unclear, surgeons must balance the risk of procedural bleeding against the increased thromboembolic risk of antithrombotic therapy interruption. Each institution or physician has to decide on an individual basis whether to continue or discontinue AP therapy before spinal surgery [3, 6, 11]. We have been performing lumbar surgery in patients without interrupting the AP medication and with no biases to prevent thrombotic complications since 2018. The purpose of this study was to investigate the safety, pros, and cons of AP continuation during microsurgical decompression (MSD). We compared the postoperative status of patients taking perioperative AP with patients not taking AP.

Materials and methods

Patient selection

We retrospectively reviewed the medical records and radiographic images of patients who underwent MSD at our hospital between April 2018 to December 2022 for LSS or LDH against conservative treatment using pharmacotherapy and physiotherapy for low back pain, intermittent claudication, and lower limb pain. Inclusion criteria were as follows: (1) underwent single-level MSD or single-level microsurgical herniotomy, (2) lumbar blood examination < 1 month before and 1 day after surgery, and (3) underwent lumbar magnetic resonance imaging (MRI) 4–10 days after surgery. Exclusion criteria were as follows: (1) previous spinal surgery, (2) medical history of spinal tuberculosis and another spinal infectious disease or tumor, and (3) medical history of coagulation disorders and platelet dysfunction or, suspicious of them with the preoperative hematological examination.

Patients who met the inclusion criteria were divided into two groups: the AP continuation group received AP before surgery, and the control group received no AP medication before surgery. Thus, all patients who received AP for cardiovascular disease underwent surgery without discontinuing AP with no biases, even if the patients received dual AP therapy. For patients in both groups who received AC preoperatively, only AC was discontinued perioperatively.

Surgical methods

All surgeries were performed under a microscope under general anesthesia in the prone position. Conventional MSD was performed with bilateral partial laminectomy for patients with LSS and unilateral laminectomy and herniotomy for patients with LDH. After resecting the ligamentum flavum, less than one-third of the medial side of the superior articular process of the vertebral body was removed using an ultrasound aspirator. The medial side of the pedicle of the vertebral arch and mobility of the root were confirmed. Epidural drainage tubes were placed, and suction drainage was continued. Drainage tubes were removed about 18 h after the surgery in all patients.

Data collection

The following patient data were collected: sex, age at surgery, preoperative American Society of Anesthesiologists physical status (ASA-PS), medical history/comorbidities (diabetes mellitus, hypertension, dyslipidemia, chronic heart failure, chronic renal failure, chronic obstructive pulmonary disease, and cancer), smoking status, and surgical procedure (MSD only or with microscopic herniotomy). In the AP continuation group, the type of AP and the reason for initiation of AP medication were collected from the electronic medical records. Preoperative parameters were recorded, including platelet count (PLT), prothrombin time (PT), and activated partial thromboplasmin time (APTT), to assess preoperative coagulation disorders and platelet dysfunction. Perioperative parameters were recorded, including red blood cell counts (RBCs), hemoglobin (HGB), and hematocrits (HCTs), and differences in preoperative and one-day postoperative parameters were determined and termed ΔRBC, ΔHGB, and ΔHCT, respectively, to assess perioperative bleeding. These preoperative hematological parameters were collected from the data examined within one month prior the operation. We also extracted data about reoperation for epidural hematoma (EDH) and thromboembolic complications up to a month after surgery.

Minimal dural sac index for indirect assessment of EDH volume

Minimal dural sac index (MDSI) was used to indirectly evaluate postoperative EDH volume at the surgical level. The cross-sectional area of the dural sac was manually outlined postoperatively (4–10 days after the operation) on the MRI T2 weighted image obtained from a Picture Archiving and Communication System (Fig. 1); the marked area was automatically calculated. The ratio of the cross-sectional area of the dural sac area was measured as the smallest area around dural sac at the surgical level divided by the cross-sectional area of the dural sac one vertebral level above the surgical site; the ratio is presented as the MDSI; the smaller the MDSI, the larger the EDH volume.

Statistical analysis

All data were analyzed using JMP pro (version 16.2 for Mac; SAS Institute Inc., NC, USA) and presented as means ± standard deviations or medians. Chi-square or

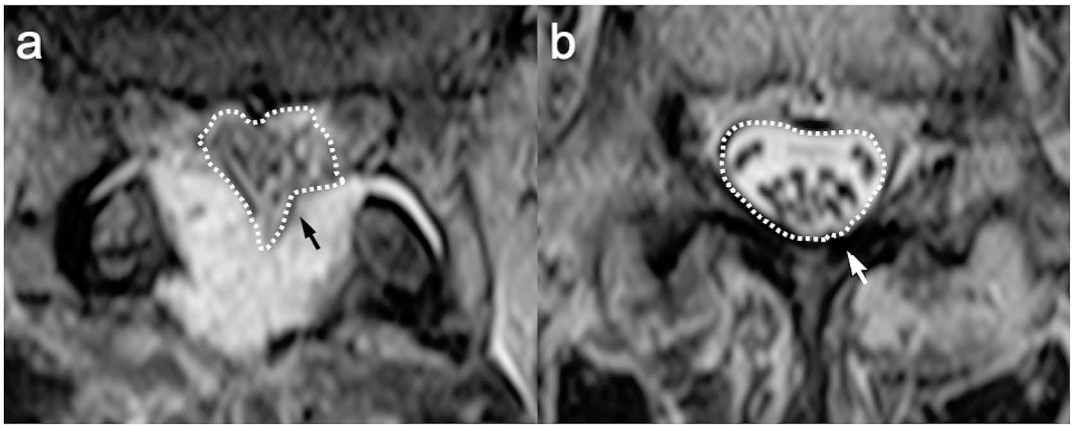

Fig. 1 Measuring minimal dural sac index (MDSI) for indirect assessment of postoperative epidural hematoma (EDH) volume. On the postoperative axial MRI T2 weighted image, the minimal cross-sectional area of the dural sac at the surgical level (a; dot circle with black arrow) was divided by the cross-sectional area of the dural sac one vertebral level above the surgical site (b; dot circle with white arrow); the ratio is referred to as the MDSI. The smaller the MDSI, the larger the EDH volume

Fisher's exact tests were used to compare categorical variables, and Mann–Whitney U tests were used to compare continuous variables. Propensity scores were calculated using a logistic regression model in which baseline characteristics and surgical details were independent variables. Propensity scores were calculated based on seven variables, including ASA-PS; medical/comorbidity history of diabetes mellitus, hypertension, dyslipidemia, chronic heart failure, and cancer; and surgical procedure. One-to-one matching was performed to adjust for baseline characteristics and surgical procedures. Reoperation for EDH, MDSI, ΔRBC, ΔHGB, ΔHCT, and perioperative thromboembolic complication rates were compared between the two groups. Differences between the groups were evaluated using Wilcoxon rank-sum tests for continuous variables and McNemar tests for categorical variables. A p-value of <0.05 was considered statistically significant.

Results

Patient demographics

Patient demographics are shown in Table 1. The 303 patients (165 males, 138 females) who underwent single-level MSD for LSS or LDH had a mean age of 68.0 ± 13.8 years. Preoperative AP was administered to 41 patients who were included in the AP continuation group, and 262 patients were included in the control group. 100 mg of aspirin (acetylsalicylic acid), 200 mg of cilostazol, 75 mg of clopidogrel (Clopidogrel Sulfate), and 3.75 mg of prasugrel (Prasugrel Hydrochloride) per day were administrated in 24, 6, 3, and 1 patients, respectively, and 7 patients received dual AP therapy in the AP continuation group. The reasons for initiation of AP medication were cerebral infarction in 7 patients, angina pectoris or myocardial infarction in 6 patients, peripheral arterial disease in 5 patients, coronary stenting in 4 patients, coil embolization for cerebral aneurysm in 2 patients, and unknown in 17 patients. No significant differences in age, sex, preoperative PLT count, preoperative PT, preoperative APTT, medical/comorbidity history of chronic heart failure, chronic renal failure, chronic obstructive pulmonary disease, and cancer, or smoking status were detected between the preoperative AP and control groups. In contrast, ASA-PS ($p<0.0001$), medical/comorbidity history of diabetes mellitus ($p<0.0001$), hypertension ($p=0.0004$), dyslipidemia ($p=0.0148$), and surgical procedure ($p=0.00520$) were significantly different between the two groups. Thus, patients in the AP continuation group exhibited worse preoperative PS and had more vascular risk factors compared with patients in the control group.

The rates of patients received AC preoperatively in the AP continuation group and in the control group was not different statistically ($p=0.618$).

Table 1 Baseline patient characteristics, medical/comorbidity history and surgical procedure of antiplatelet continuation group and control group including in present study

Group	AP continuation ($n=41$)	Control ($n=262$)	P value (OR, 95%CI)
Baseline characteristics			
Age, years	72.7 ± 6.08	67.4 ± 14.6	0.218
Female sex	18 (43.9%)	120 (45.8%)	0.820 (1.08, 0.556-2.10)
ASA PS			**< 0.0001**
1	0 (0%)	57 (21.76%)	
2	34 (82.9%)	194 (74.1%)	
3	7 (17.1%)	10 (3.82%)	
4	0 (0%)	0 (0%)	
Past history			
Diabetes mellitus	15 (36.6%)	32 (12.2%)	**< 0.0001** (4.15, 1.99–8.64)
Hypertension	32 (78.1%)	127 (48.5%)	**0.0004** (3.77, 1.74–8.23)
Dyslipidemia	19 (46.3%)	68 (26.0%)	**0.0148** (2.44, 1.24–4.78)
Chronic heart failure	4 (9.76%)	8 (3.05%)	0.0643 (3.42, 0.981–11.9)
Chronic renal failure	14 (34.2%)	83 (31.7%)	0.765 (1.11, 0.554–2.23)
Chronic obstructive pulmonary disease	5 (12.2%)	25 (9.54%)	0.5773 (1.31, 0.472–3.64)
Smoking status Current or former smoker	24 (58.5%)	114 (43.5%)	0.0793 (1.81, 0.927–3.53)
Cancer	5 (12.2%)	11 (4.20%)	0.0516 (3.13, 1.03–9.53)
Preoperative PLT count (x10^4/μl)	24.4 ± 6.13	23.1 ± 6.11	0.094
Preoperative PT (sec)	10.4 ± 0.598	10.6 ± 1.79	0.696
Preoperative APTT (sec)	29.2 ± 4.33	29.1 ± 5.25	0.452
Surgical procedure			**0.00520** (3.15, 1.34–7.36)
Microscopic Love	7 (17.1%)	103 (39.3%)	
MSD	34 (82.9%)	159 (60.7%)	

APTT: activated partial thromboplastin time, ASA PS: American society of anesthesiologists physical status, CI: confidence interval, MSD microsurgical decompression, OR: odds ratio, PLT: platelet count, PT: prothrombin time

Table 2 Crude analysis for postoperative epidural hematoma, perioperative blood loss related factor and perioperative thromboembolic complication

	AP continuation ($n=41$)	Control ($n=262$)	P value (OR, 95%CI)
Reoperation for EDH	1 (2.44%)	1 (0.381%)	**0.0494** (13.3, 1.18–150)
Minimum dural sac index	0.671 ± 0.247	0.785 ± 0.286	**0.0166**
ΔRBC (x10^4/ul)	28.71 ± 23.5	28.2 ± 24.5	0.942
ΔHGB (g/dl)	0.900 ± 0.747	0.920 ± 0.708	0.763
ΔHCT (%)	2.78 ± 2.26	2.60 ± 2.08	0.656
Perioperative thromboembolic complication	0 (0%)	0 (0%)	1.000 (NA)

CI: confidence interval, EDH: epidural hematoma, OR: odds ratio, RBC: red blood cell count, HGB: hemoglobin, HCT: hematocrit

Perioperative parameters and postoperative complications

Perioperative parameters and postoperative complications are shown in Table 2. One patient in each group underwent reoperation for EDH. These two patients underwent evacuation of an EDH due to intolerable lower back pain and lower limb weakness. The mean period between the postoperative MRI and the operation was 6.80 ± 1.23 days. Reoperation was performed significantly more frequently in the AP continuation group compared with the control group (2.44% in the AP continuation group vs. 0.381% in the control group) ($p=0.0494$), and the EDH volume indirectly measured with MDSI was significantly larger ($p=0.0166$) in the AP continuation group compared with the volume in the control group. No significant differences in ΔRBC, ΔHGB, and ΔHCT were detected between the two groups ($p=0.942$, 0.763, and 0.656 respectively). No patients in either group suffered from perioperative thromboembolic complications.

Reoperation for EDH, MDSI, ΔRBC, ΔHGB, ΔHCT, and perioperative thromboembolic complication rates were compared between the AC discontinuation group and the AC naïve group. The incidences of the reoperation and thromboembolic complication were not significantly different between the two groups ($p=0.671$ and $p=1.00$ respectively). And no differences in MDSI, ΔRBC, ΔHGB, and ΔHCT were detected between the two groups ($p=0.367$, $p=0.306$, $p=0.1612$, and $p=0.255$ respectively).

Propensity score matched analysis

One-to-one matching yielded 39 patient pairs. After propensity score matching, the baseline characteristics, medical/comorbidity history, smoking status, and surgical procedure were similar between the two groups (Table 3). Although one

Table 3 Baseline patient characteristics, medical/comorbidity history and surgical procedure of antiplatelet continuation group and control group including in present study after propensity-score matching

	AP continuation ($n=39$)	Control ($n=39$)	P value (OR, 95%CI)
Baseline characteristics			
Age	72.9 ± 6.20	74.2 ± 8.86	0.184
Female sex	16 (41.0%)	18 (43.9%)	0.648 (1.2, 0.503–3.02)
ASA PS			1.000 (1.00, 0.265–3.77)
1	0 (0%)	0 (0%)	
2	34 (87.2%)	34 (82.9%)	
3	5 (12.8%)	5 (17.1%)	
4	0 (0%)	0 (0%)	
Past history			
Diabetes mellitus	13 (33.3%)	12 (36.6%)	0.808 (1.13, 0.434–2.91)
Hypertension	30 (76.9%)	32 (78.1%)	0.575 (0.73, 0.241-2.20)
Dyslipidemia	18 (46.2%)	19 (46.3%)	0.821 (0.902, 0.371-2.20)
Chronic heart failure	3 (7.69%)	2 (9.76%)	1.00 (1.54, 0.243–9.78)
Chronic renal failure	14 (35.9%)	16 (34.2%)	0.642 (0.805, 0.323–2.01)
Chronic obstructive pulmonary disease	4 (10.3%)	5 (12.2%)	0.723 (0.777, 0.192–3.14)
Smoking status Current or former smoker	23 (59.0%)	21 (58.5%)	0.648 (1.23, 0.503–3.02)
Diabetes mellitus	5 (12.8%)	6 (12.2%)	0.745 (0.809, 0.225–2.91)
Preoperative PLT count ($x10^4/\mu l$)	24.0 ± 5.86	25.2 ± 7.60	0.895
Preoperative PT (sec)	10.4 ± 0.624	10.4 ± 0.762	0.819
Preoperative APTT (sec)	28.5 ± 3.52	30.6 ± 6.31	0.500
Surgical procedure			0.761 (0.831, 0.252–2.74)
Micro Love	7 (18.0%)	6 (17.1%)	
MSD	32 (82.1%)	33 (82.9%)	

APTT: activated partial thromboplastin time, ASA PS: American society of anesthesiologists physical status, CI: confidence interval, MSD microsurgical decompression, OR: odds ratio, PLT: platelet count, PT: prothrombin time

Table 4 Postoperative epidural hematoma, perioperative blood loss related factor and perioperative thromboembolic complication after propensity-score matching

	AP continuation ($n=39$)	Control ($n=39$)	P value (OR, 95%CI)
Reoperation for EDH	1 (2.56%)	0 (0%)	0.494 (NA)
Minimum dural sac index	0.681 ± 0.240	0.775 ± 0.342	0.287
ΔRBC ($x10^4$/ul)	30 ± 22.6	29.1 ± 22.4	0.869
ΔHGB (g/dl)	0.933 ± 0.725	0.972 ± 0.717	0.572
ΔHCT (%)	2.92 ± 2.14	2.60 ± 2.23	0.760
Perioperative thromboembolic complication	0 (0%)	0 (0%)	1.000 (NA)

CI: confidence interval, EDH: epidural hematoma, OR: odds ratio, RBC: red blood cell count, HGB: hemoglobin, HCT: hematocrit

patient in the AP continuation group underwent hematoma evacuation (2.56%), the incidence was not significantly different between the two groups ($p=0.494$). No differences in EDH volume, ΔRBC, ΔHGB, and ΔHCT were detected between the two groups ($p=0.287$, 0.869, 0.572, and 0.760, respectively) (Table 4).

Discussion

AP is an effective agent for primary and secondary prevention of acute myocardial infarction and stroke [4, 8]. AP treatment reduced mortality by almost 25% in patients with a history of coronary artery disease, and AP cessation in patients with a history of coronary artery intervention was associated with a 5–10-fold increase in mortality due to acute myocardial infarction [2]. Additionally, aspirin withdrawal syndrome is characterized by a clinical prothrombotic state due to increased thromboxane production and decreased fibrinolysis [4, 7, [21]].

In the present study, AP continuation did not increase the incidence of reoperation for EDH or postoperative EDH volume and anemia progression the day after single-level MSD for LSS and LDH. The predicted incidence of reoperation for EDH and thromboembolic complications was relatively low up to a month after surgery. Thus, these incidences alone were not appropriate endpoints for this study. Therefore, we compared EDH volumes within 10 days after surgery and changes in perioperative RBCs between the two groups. We used MDSI as an indirect assessment of EDH volume in the present study. Direct measurement of cross-sectional EDH area or minimal dural sac, which was used in a previous study [18], were not suitable for the present study. Because spinal canal area is difference in each patient, and the present study included the patients performed even though single level MSD but at various level of lumbar level. Additionally, we used ΔRBC, ΔHGB, and ΔHCT, which were

calculated as the differences between preoperative values and values measured a day after surgery, to assess perioperative hemorrhage. We irrigate with copious water to prevent heat injury and to secure a clear visual field during drilling, and we wash with copious water (about 2–3 L/operation) to prevent surgical site infection just before closure. In addition, intraoperative estimated blood loss is usually small for single-level MSDs. Therefore, the recorded estimated blood loss may not be accurate, and differences between groups may not be clinically significant. Because ΔRBC, ΔHGB, and ΔHCT also reflect postoperative hemorrhage, including EDH one day after surgery, these values are better indicators of perioperative hemorrhage compared with intraoperative estimated blood loss. Of note, at our institution, a protocol for postoperative intravenous drip infusion up to 24 h postoperatively is standard for all patients, including patients undergoing lumbar MSD.

Though effectiveness of drain usage after spine surgery remains controversial, epidural drainage tube was placed in all patients included in present study without bias. Recent systematic review revealed that the use of closed-suction drainage in elective thoracolumbar spinal surgery is not associated with any proven benefit for patients and cannot decrease postoperative complications [17]. However, Gubin et al. suggest that the frequency of postoperative direct puncture drainage may be higher without drains compared to with drains [7]. In the present study, though no patient received postoperative direct puncture drainage, if the drains are not placed, AP continuation might contribute to the occurrence of postoperative direct puncture drainage.

Previous reports about the safety of continuation or discontinuation of perioperative antithrombotic agents in spinal surgeries, except for a systematic review, are summarized in Table 5. No randomized control trials (RCTs) have been conducted, and all existing studies were retrospective. RCTs for verifying the safety of continuation or discontinuation of antithrombotic agents are difficult to design. The studies concerning the safety of AP continuation are conflicting. The merits of continuation or discontinuation of antithrombotic agents are unclear. Thus, surgeons must balance the risk of procedural bleeding against the increased thromboembolic risks.

Some of the studies included the continuation or discontinuation of both AP and AC antithrombotic agents, and some studies included various types of surgery (e.g., decompression with or without fusion, surgery for various lumbar levels, or whole spine surgeries). Thus, some reports are difficult to directly apply to clinical practice. We conceived this study to clarify the safety of AP continuation without any biases only for single-level lumbar MSD, which is the most frequent surgery.

In eight studies, the continuation or discontinuation of antithrombotic agents was compared with a control group of drug naïve patients [1, 4, 9, 10, 13, 14, 20]. In the other five studies, a direct comparison of the discontinuation and continuation groups was made, which is the next best method to a RCT [12, 15, 16, 18, 19]. However, one of these studies [19] included patients that received a heparin bridge with low molecular weight heparin for the perioperative period in the discontinuation group and another study [18] included patients who discontinued AP within three days before surgery in the continuation group. Additionally, in most of the previous reports, the method of selecting patients who continued or discontinued antithrombotic agents in the perioperative period was not described in detail. Thus, patient selection biases were difficult to determine. In only one study reported by Inoue et al., all patients who took AP (low-dose aspirin) preoperatively continued the drug before cervical laminoplasty, and these patients were compared with AP naïve patients as the control group; AP continuation did not increase hemorrhagic complications in this study [9].

The present study is the first report that revealed the safety of AP continuation for single-level lumbar MSD without any biases in selecting the AP continuation group. We unified the surgical procedure to single-level MSD; thus, the results of the present study can be applied to clinical settings.

Recently, Wagner et al. reported that preoperative extended coagulatory screening (for factor XIII, von-Willebrand-factor, and platelet function) may allow to reduce the risk for postoperative hemorrhage in adult cranial neurosurgeries [22]. The value of expanded preoperative coagulation screening may be more important than discontinuation of antiplatelet medication in preventing bleeding complications, even after spine surgeries. Because ordinary preoperative laboratory diagnostics may fail to identify yet unknown coagulopathies in patients, which may manifest during or after a surgery.

Study limitations

Several limitations of this study should be acknowledged. First, the present study was retrospective and performed at a single institution. The retrospective nature of the cross-sectional dural sac area measurement may have introduced observer bias. To minimize this bias, patient outcomes were blinded when we measured the cross-sectional area of the dural sac. Second, the surgeries were performed without utilizing the double-blind method. Thus, the surgeons might control bleeding more carefully during surgeries for the AP continuation group compared with the control group. However, even in a real clinical setting, the surgeons will always carefully control hemostasis in patients with known risk

Table 5 Previous studies except systematic reviews which described about discontinuation or continuation of antithrombotic agents including antiplatelet perioperatively for spinal surgeries including present study

Author	Publication year	Surgical site	Procedures	Patient number	Antithrombotic agent	Patient group	Main results
Kang et al. [10]	2011	lumbar	fusion	76	AP	Discontinuation vs. Control	No difference in blood loss Greater drainage volume and transfusion requirement under discontinuation
Park et al. [15]	2013	lumbar	fusion	182	AP	Short term discontinuation vs. Long term discontinuation vs. Control	Greater drained volume with short term discontinuation
Park et al. [16]	2014	lumbar	Single level decompression, fusion	106	AP	Continuation vs. Discontinuation vs. Control	No difference in blood loss under continuation and under discontinuation but higher than control
Cuellar et al. [4]	2015	whole spine	decompression, fusion	200	AP	Continuation vs. Control	No difference in hemorrhagic complication
Soleman et al. [19]	2016	lumbar	decompression, discectomy	102	AP	Continuation vs. Discontinuation*	No difference in blood loss, reoperation for EDH and other complication rate
Shin et al. [18]	2018	thoracolumbar	decompression, fusion	113	AP	Continuation vs. Discontinuation** vs. Control	No difference in blood loss and EDH volume
Lee et al. [13]	2018	whole spine	fusion	65	AP	Discontinuation vs. Control	No difference in blood loss and complications
Kulkarni et al. [12]	2020	lumbar	decompression, fusion, discectomy, MISS	1587	AP	Continuation vs. Discontinuation vs. Control	No difference in hemorrhagic and thromboembolic complication
Banat et al. [1]	2021	whole spine	dorsal instrumentation	217	AP or AC	Continuation vs. Control	No difference in thromboembolic and other complication
Okamoto et al. [14]	2022	whole spine	fusion, decompression, endoscope	9853	AP or AC	Discontinuation vs. Control	No difference blood loss and thromboembolic complication
Uehara et al. [20]	2022	cervical	fusion for spinal cord injury	776	AP or AC	Continuation vs. Control	No difference in blood loss and operation time
Inoue et al. [9]	2022	cervical	laminoplasty	399	AP	Continuation vs. Control	No difference in blood loss and hemorrhagic complication
Present study	2023	lumbar	Single level decompression, discectomy	303	AP	Continuation vs. Control	No difference in reoperation rate and EDH volume, thromboembolic complication, and perioperative change in RBC related laboratory data

AC: anticoagulant, AP: antiplatelet, EDH: epidural hematoma, MISS: minimum invasive spinal surgery, RBC: red blood cell

* All patient received heparin bridge with low molecular weight heparin for perioperative period

** Continuation group included patients discontinued antithrombotic agents within three days before operation

factors for perioperative bleeding. Third, all patients continued to receive AP, so we could not compare this group with patients who discontinued AP. However, our data show that continued AP was not inferior to the AP naïve group. Thus, discontinuing AP is not necessary before surgery. Finally, due to the retrospective nature of the study, the reason for AP initiation was not in the electronic medical records of about 40% of patients in the AP continuation group. AP may have been unnecessary in these patients (e.g., for lacunar infarction). However, this fact may not affect the safety of AP continuation in patients undergoing single-level MSD for LSS and LHD.

Conclusions

Perioperative AP continuation is safe for single-level lumbar MSD, even without biases, and is especially safe for patients who are vulnerable to cardiovascular and cerebrovascular events.

Comments: The authors present us an interesting study on an important question in daily neurosurgical practice. Their results suggest that antiplatelet therapy can be widely safe continued perioperatively at least in low invasive single-level microsurgical lumbar decompressions. This conclusion relativizes not only the risk associated with interruption

of the medication but also facilitates the administration management before, during and after the operation. Since the optimal timepoint for postoperative reuptake of antiplatelet substances is often multifactorial and unclear, this difficult question would also be omitted. Additionally, I would generally recommend critically questioning the indication for platelet aggregation inhibition and other drugs before every surgery and the need for readministration afterwards to avoid needless intake and its associated risks and side effects. In this way, it is often possible that one can dispense with medications that are not or no longer, or that may never have been necessary. I congratulate the authors on this relevant work, which has helped to easier answer a frequent question in spine surgery.

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Zurich, Switzerland.

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Data availability The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval The study protocol was approved by the institutional review board and the Ethics Committee of Ijinkai Takeda General Hospital (approval number: 2,022,012).

Conflict of interest The authors declare that they have no conflict of interest.

Consent to participate Informed consent was deemed unnecessary (retrospective cohort study).

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