



The Influence of Preoperative Antiplatelet and Anticoagulant Agents on Outcomes in Patients Undergoing Anterior Cervical Discectomy

Wei-Han Kao^{1,2}, Yung-Hsiao Chiang^{1,3}, Wen-Cheng Lo^{1,3}, Shu-Mei Chen^{1,3}, Jiann-Her Lin^{1,3}, Chung-Che Wu^{1,3}

¹Department of Neurosurgery, Taipei Medical University Hospital, ²Taipei Neuroscience Institute, Taipei Medical University, ³Department of Surgery, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan

Background: Anterior cervical discectomy and fusion (ACDF) and cervical disc replacement (CDR) are surgical procedures performed to treat degenerative conditions of the cervical spine. Anticoagulants and antiplatelets are medications that are commonly used to prevent the formation of blood clots and are often taken by patients before surgery to reduce the risk of thrombotic complications. However, the use of these medications can also increase the risk of bleeding during and after surgery. **Aim:** There is limited information about the risk of antiplatelet and anticoagulant usage for patients undergoing ACDF and CDR. Consequently, there is no obvious consensus regarding the duration or necessity of discontinuing these medications during the perioperative period. The purpose of this paper is to review the current evidence to see the clinical outcomes of the discontinuation or continuation of antithrombotic agents before ACDF and CDR at Taipei Medical University Hospital. **Methods:** The retrospective observational study is done in Taipei Medical University Hospital. A total of 348 patients undergoing CDR or ACDF between January 2021 and December 2022 are enrolled. The patients are divided into two groups based on the discontinuation of their antiplatelet or anticoagulant therapy (d-APT or d-ACT) before an operation. The criteria of d-APT patients in this group are to stop taking their antiplatelet medication for a minimum of 4 days before the operation and d-ACT patients in this group are to discontinue their anticoagulant medication for at least 3 days before the operation. The analysis of continuous variables is conducted using the Mann–Whitney *U* test. For the analysis of categorical variables, the Chi-square test or Fisher's exact test is used. $P < 0.05$ is considered statistically significant. **Results:** A total of 348 patients have undergone CDR or ACDF between January 2021 and December 2022. Twenty-seven patients have received APTACT preoperatively. Twenty-one patients have undergone surgery under the continuation of antiplatelet or anticoagulant (c-APT-ACT), and five patients have undergone surgery under d-APT-ACT before surgery. The percentage of patients with diabetes mellitus in the c-APT-ACT group is significantly greater than that in the d-APT-ACT group (12/21 [57.1%] and 0/5 [0%], $P = 0.043$). There are no significant differences in age, sex, body mass index, smoking habits, hypertension, dyslipidemia, chronic kidney disease, cancer, hemoglobin level, platelet count, international normalized ratio, and activated partial thromboplastin time. There are no significant differences in indication of APT and ACT including coronary artery disease, cerebrovascular accident (CVA), and atrial fibrillation. There are no significant differences in intraoperative blood loss (<10 c.c is 4 [80%] in d-APT-ACT and 13 [61.9%] in c-APT-ACT, $P = 0.628$; between 30 and 69 c.c is 0 in d-APT-ACT and 5 [23.8%] in c-APT-ACT, $P = 0.545$; and between 70 and 99 c.c is 0 in d-APT-ACT and 2 [9.5%] in c-APT-ACT, $P = 0.354$). There are no patients receiving intraoperative blood transfusion, and no acute myocardial infarction (AMI)/CVA within 1 year after surgery nor use of postoperative drainage in both groups. Length of postoperative stay is 5.6 days in d-APT-ACT and 3.76 days in c-APT-ACT ($P = 0.493$). **Conclusion:** According to our results, for patients with APT or ACT usage receiving ACDF or CDR, continuing antiplatelet or anticoagulant therapy has a minimal difference in surgical outcome and length of postoperative stay difference, so continuing antiplatelet or anticoagulant therapy should be considered in selected cases.

Key words: Anterior cervical discectomy and fusion, cervical disc replacement, anticoagulants, antiplatelet, APT, ACT, non-Vitamin K oral anticoagulant

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Corresponding Author: Dr. Chung-Che Wu, Department of Neurosurgery, Taipei Medical University Hospital, No. 252, Wuxing St., Taipei 11031, Taiwan. Tel.: +886-988-178-889. E-mail: johnwu@tmu.edu.tw

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INTRODUCTION

Anterior cervical discectomy and fusion (ACDF) and cervical disc replacement (CDR) are surgeries for the treatment of degenerative conditions in the cervical spine.¹ These procedures often involve the removal of intervertebral discs and the fusion of adjacent vertebrae, or the replacement of damaged discs with artificial ones, aiming to alleviate neurological symptoms and restore spinal stability. Anticoagulants and antiplatelets prevent the formation of blood clots and reduce the risk of thrombotic complications. However, the use of these medications can also increase the risk of bleeding during and after surgery.

Regarding the continuation or discontinuation of anticoagulant and antiplatelet in the perioperative period of noncardiac surgery, the risks and benefits differ according to the patients and their past and present history.² There is limited information about the risk of antiplatelet and anticoagulant usage for patients undergoing ACDF and CDR. Consequently, there is no obvious consensus regarding the duration or necessity of discontinuing these medications during the perioperative period.

The purpose of this paper is to review the current evidence on the discontinuation of anticoagulants and antiplatelets before ACDF and CDR at Taipei Medical University Hospital. The paper will examine the clinical outcomes of discontinuing these medications in the perioperative period and provide options for patients undergoing these procedures. Furthermore, shared decision-making is beneficial when deciding to discontinue anticoagulants and antiplatelets for patients undergoing ACDF and CDR. Factors that may influence this decision include the patient's underlying medical conditions, the type and severity of the surgical procedure, and the potential risks and benefits of continuing or discontinuing these medications.

MATERIALS AND METHODS

A retrospective observational study is conducted at Taipei Medical University Hospital in Taiwan, involving a total of 348 patients who have undergone either CDR or ACDF procedures between January 2021 and December 2022. The study is conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of TMU-JIRB with IRB number N202311087 and approved on 03/01/2024. Informed written consent is waived by the IRB. Inclusion criteria encompass adult patients diagnosed with cervical spine neurological disorders necessitating ACDF or CDR following evaluation by physicians. Exclusion criteria include patients with primary and secondary coagulopathies, individuals with malignant tumors, hepatic or renal dysfunction, and those with incomplete clinical data.

The patients are categorized into two groups based on their duration of discontinuation of antiplatelet or anticoagulant

therapy before the operation. Those who cease their antiplatelet medication for a minimum of 4 days before the operation are assigned to the “d-APT” group, whereas those in the “d-ACT” group discontinue their anticoagulant medication for at least 3 days before the operation^{3,4} The purpose of dividing the patients into these groups is likely to assess the impact of discontinuing antiplatelet or anticoagulant therapy before an operation on various outcomes including intraoperative blood loss, intraoperative blood transfusion, postoperative drainage tube insertion, and length of postoperative stay. The analysis of continuous variables is conducted using the Mann–Whitney *U* test. For the analysis of categorical variables, the Chi-square test or Fisher's exact test is used. $P < 0.05$ is considered statistically significant.

Anterior cervical discectomy operation steps are described below. Before the surgery, we engage in shared decision-making with the patient to discuss the benefits and risks of continuing or discontinuing Antiplatelet therapy (APT) and Anticoagulant therapy (ACT). During operation under general anesthesia and supine position, the surgical site is sterilized and skin draped. Surgeons identify the level of surgery through fluoroscopy and make a transverse wound at the anterior neck. Surgeons open platysma and identify sternocleidomastoid muscle (SCM) at the lateral side, and dissect layers of deep cervical fascia along the medial side of SCM to identify carotid artery at lateral side and under SCM, dissect middle layer of deep neck fascia along medial side of carotid artery to identify and dissect prevertebral fascia and alar fascia. Surgeons then confirm disc space by fluoroscopy and extend the surgical field bilaterally to the longus colli muscle. Neck retractors are then inserted to expose disc space, and the anterior longitudinal ligament is cut open. Anterior discectomy is done by curette and 3 mm cutting burr; then, the posterior longitudinal ligament is opened to ensure a lack of disc fragments between the ligament and dura. After checking the decompression of the foramen and dura sac, surgeons insert an artificial disc or cage into the disc space. Gelatin–thrombin matrix sealant and gelatin are used for enhancing hemostasis in operation. Finally, the anterior longitudinal ligament is stripped by monopolar, and the wound is closed by 2-0 vicryl, 4-0 vicryl, and finally with either strips or application of 2-octyl cyanoacrylate.

RESULTS

A total of 348 patients have undergone CDR or ACDF between January 2021 and December 2022. Among the patients, 27 patients have received antiplatelet (APT) or anticoagulant (ACT) preoperatively. One of the 27 patients is eliminated from our dataset due to insufficient information on his medication from other hospitals after an uneventful surgery.

Of the 26 patients included in our study, 21 patients have undergone surgery with the continuation of antiplatelet or anticoagulant (c-APT-ACT), and five patients discontinued antiplatelet or anticoagulant (d-APT-ACT) before surgery, as shown in Figure 1. The patients' characteristics are summarized in Table 1. The percentage of patients with diabetes mellitus in the c-APT-ACT group is significantly greater than that in the d-APT-ACT group (0/5 [0%] in the d-APT-ACT group and 12/21 [57.1%] in the c-APT-ACT group; $P = 0.043$). There are no significant differences in age, sex, body mass index, smoking habits, presence of hypertension, dyslipidemia, chronic kidney disease, cancer, hemoglobin level, platelet (PLT) count, international normalized ratio, and activated partial thromboplastin time. The differences in surgery and medication between the d-APT-ACT and c-APT-ACT groups are insignificant.

Table 2 outlines the operative methods utilized in the study. Within the d-APT-ACT group, four patients received ACDF, whereas one patient underwent CDR. In the c-APT-ACT group, 11 patients underwent ACDF, 3 received CDR, and seven patients opted for a combination of ACDF and CDR.

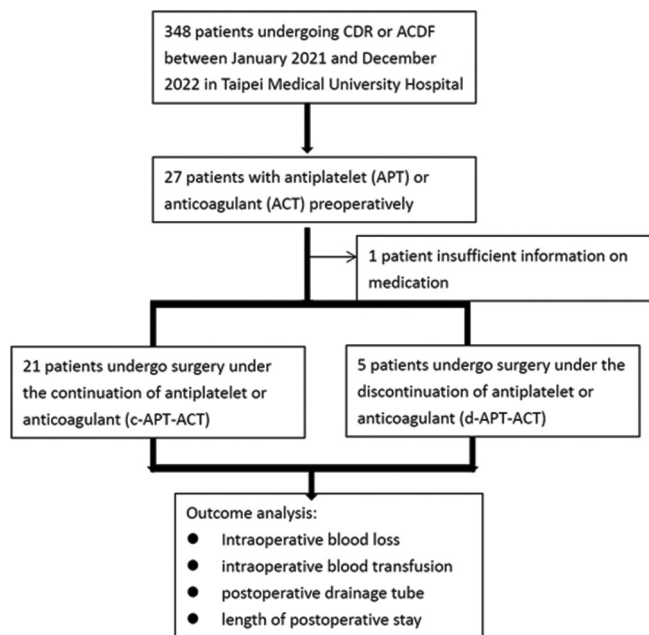


Figure 1: Diagram of patient enrollment. A total of 348 patients have undergone cervical disc replacement or anterior cervical discectomy and fusion between January 2021 and December 2022. Among the patients, 27 patients have received antiplatelet (APT) or anticoagulant (ACT) preoperatively. One of the 27 patients is eliminated from our dataset due to insufficient information on his medication from other hospitals after an uneventful surgery. Of the 26 patients included in our study, 21 patients have undergone surgery with the continuation of antiplatelet or anticoagulant (c-APT-ACT), and five patients discontinued antiplatelet or anticoagulant (d-APT-ACT) before surgery. ACDF = Anterior cervical discectomy and fusion, CDR = Cervical disc replacement, APT = Antiplatelet, ACT = Anticoagulant

Further specifics regarding the use of APT and ACT are detailed in Table 3. There are no significant differences in indication of APT and ACT use including coronary artery disease (CAD), cerebrovascular accident (CVA), and atrial fibrillation. Aspirin is the most common medication used in the c-APT-ACT group (61.9%). However, clopidogrel is the most administered agent in the d-APT-ACT group (40%).

There are no significant differences between the two groups in intraoperative blood loss [Table 4]. Intraoperative blood loss <10c.c in four patients (80%) in the d-APT-ACT group and 13 patients (61.9%) in the c-APT-ACT group ($P = 0.63$). Intraoperative blood loss between 30 and 69c.c is absent in the d-APT-ACT group and five patients (23.8%) in the c-APT-ACT group ($P = 0.55$). Intraoperative blood loss between 70 and 99c.c is absent in the d-APT-ACT group and two patients (9.5%) in the c-APT-ACT group ($P = 0.35$). There are no patients receiving intraoperative blood transfusion, and no acute myocardial infarction (AMI)/CVA within 1 year after surgery nor use of postoperative drainage in both groups.

Table 1: Characteristics of the two groups

	d-APT-ACT (n=5)	c-APT-ACT (n=21)	P
Age	67.8±5.5	70.3±3.2	0.46
Female sex - n (%)	2 (40)	8 (38.1)	0.88
Type 2 DM	0 (0)	12 (57.1)	0.04
HTN	4 (80)	18 (85.7)	1
Dyslipidemia	3 (60)	10 (47.6)	1
Smoke	0 (0)	2 (10.0)	1
Cancer	1 (20)	3 (14.3)	1
BMI	24.7±2.1	26.3±1.7	1
Hb (g/dL)	12.9±1.2 (11.7-14.1)	12.9±0.8 (12.1-13.7)	0.98
Platelet (×10 ³ /uL)	180±50 (130-230)	234±36 (198-270)	0.19
PT-INR _a	1.13±0.23	1.05±0.06	0.28
aPTT (sec)	34.2±1.3	34±0.4	0.70
CKD	1 (20.0)	9 (42.9)	0.62

Type 2 DM: Type 2 Diabetes Mellitus, HTN: Hypertension, BMI: Body Mass Index, Hb: Hemoglobin, PT-INR: Prothrombin. Time-International Normalized Ratio, aPTT: Activated Partial Thromboplastin Time, CKD: Chronic Kidney Disease

Table 2: Operation methods of the two groups

	d-APT-ACT (n=5)	c-APT-ACT (n=21)
ACDF	4 (80)	11 (52.4)
1 level	1 (20)	5 (23.8)
2 level	3 (60)	6 (28.6)
CDR	1 (20)	3 (14.3)
1 level	1 (20)	2 (9.5)
2 level	0	1 (4.8)
ACDF + CDR	0	7 (33.3)

Table 3: Details about antiplatelet and anticoagulant use of the two groups

	d-APT-ACT (n=5)	c-APT-ACT (n=21)	P
Pre op antiplatelet use	3	20	
Aspirin	1	13	
Clopidogrel	2	5	
Cilostazol	0	0	
DAPT	0	2	
Pre op anticoagulant use	2	1	
Warfarin	1	0	
DOAC	1	1	
Preoperative discontinuation period (days)	6.8±0.73 (6.07 to 7.53)	1.33±0.37 (0.96-1.70)	<0.00001
Indication of APT or ACT			
CAD	4	13	0.63
Atrial Fibrillation/Arrhythmia	1	1	0.35
CVA	0	3	1

DAPT: Dual Antiplatelet Therapy, DOAC: Direct Oral Anticoagulant, CAD: Coronary Artery Disease, CVA: Cerebrovascular Accident

Table 4: Outcomes of the two groups

	d-APT-ACT (n=5)	c-APT-ACT (n=21)	P
Drain insertion	0	0	
Length of postoperative stay (days)	5.6±5.56	3.76±2.03	0.49
Blood transfusion	0	0	
AMI/CVA in 1 year	0	0	
Blood loss (c.c)			0.97
<10	4	13	0.63
10~29	0	0	
30-69	0	5	0.55
70-99	0	2	1
100	1	1	0.35

The length of postoperative stay (days) is 5.6 ± 5.56 in the d-APT-ACT group and 3.76 ± 2.03 in c-APT-ACT ($P = 0.49$). According to our results above, we conclude that there is no difference in surgical outcome and postoperative stay duration between both groups.

DISCUSSION

Discontinuing antiplatelet and anticoagulant therapy before surgery is a common medical practice as these drugs significantly impact the safety of the surgery. On the one hand, discontinuing antiplatelet and anticoagulant therapy may increase the risk of thrombotic or embolic events, whereas continuing these drugs may increase the risk of intra- and postoperative bleeding. For example, ASA continuation is associated with an increased risk of major bleeding and a lower risk of thromboembolism in patients with long-term

antiplatelet therapy undergoing elective noncardiac surgery compared with patients who receive placebo perioperatively.⁵

Regarding this issue, the following aspects should be focused including individual differences of patients, type and risk of surgery, type and dosage of antiplatelet drugs, preoperative evaluation, and management. Some surgeries, such as cardiac and neurosurgical operations, require better PLT aggregation and coagulation function. Therefore, discontinuing antiplatelet and anticoagulant therapy may be needed before these operations. For example, a study revealed that average drain output and length of stay in cervical spine operations are higher in patients on clopidogrel therapy than patients who are not on clopidogrel.⁶ Preoperative dual antiplatelet therapy use leads to more postoperative bleeding in patients with acute type A aortic dissection undergoing total arch replacement and frozen elephant trunk.⁷ However, there is a study showing that preoperative APT use appears to be safe and has no significant effect on early postoperative hematoma formation in intracerebral hemorrhage patients undergoing surgery treatment (craniotomy, endoscopic, or minimally invasive surgery for hematoma removal) within 7 days after the onset of symptoms.⁸

As for other noncardiac and nonneurosurgical operations, patients may not require stopping APT and ACT drugs. For example, no significant differences are found in surgical outcomes or postoperative complications between colorectal cancer patients who continue antiplatelet therapy during laparoscopic resection and those who discontinue it in the perioperative period.⁹ For patients undergoing hip fracture surgery, neither preoperative non-Vitamin K oral anticoagulant (NOAC) nor Vitamin K antagonist treatments are associated with an increased risk of 30-day postoperative

mortality. However, NOAC is associated with a slightly increased risk of transfusion, and preoperative use of antiplatelet drugs is associated with an increased risk of transfusion and mortality.¹⁰ Besides, different types of antiplatelet and anticoagulant drugs have different mechanisms and dosages, so the decision to discontinue the medication and the duration of stopping should be based on these factors.

Surgeons also need to conduct a comprehensive evaluation of patients, including medical history, physical examination, and laboratory tests, to decide whether to stop antiplatelet therapy. In summary, discontinuing antiplatelet therapy before surgery is a complex issue that requires consideration of various factors such as the history of patients, type and bleeding risk of surgery, and the type and dosage of antiplatelet or anticoagulant drugs. During this process, surgeons should communicate fully with patients, explain the related risks and benefits, and help patients make wise decisions.

According to the current medical reports, there is still controversy regarding the necessity of discontinuing antiplatelets and anticoagulants before ACDF or CDR. The overall morbidity rates for ACDF range from 13.2% to 19.3%. The rate of postoperative hematoma is between 0.4% and 5.6%, with surgical intervention required in 2.4% of cases within this range. The risk of postoperative epidural hematoma is approximately 0.9%.¹¹ The incidence of significant intraoperative blood loss defined as intraoperative blood loss of 500 mL or more during ACDF is 3.3%.¹² Some studies have shown that even if antiplatelet drugs are continued before spine surgery, there is no significant increase in postoperative bleeding risk and no adverse effects on postoperative recovery.¹³ Therefore, some surgeons believe that there is no need to discontinue the use of antiplatelet and anticoagulant drugs before surgery to avoid the risk of thrombosis and other complications. However, other studies as shown above have concluded an association between the use of antiplatelet drugs and an increased risk of postoperative drainage;⁶ as a result, some surgeons advocate discontinuing these drugs before surgeries. Conflict use of antiplatelet and anticoagulant for ACDF and CDR necessitated this review.

One of the significant complications associated with ACDF is the development of postoperative hematoma. Postoperative hematoma can lead to severe consequences, including airway obstruction, neurological deficits, and even mortality if not promptly recognized and managed. The risk of hematoma formation is particularly concerning in patients on antiplatelet or anticoagulant therapy due to their impaired hemostasis. Studies have shown that the incidence of postoperative hematoma in ACDF can range from 0.4% to 5.6%,¹¹ with some cases requiring surgical intervention. The presence of hematoma necessitates immediate medical attention and may lead to reoperation, prolonged hospital stay, and

increased health-care costs.¹⁴ Therefore, careful consideration and monitoring are crucial for patients at risk of bleeding, especially those who continue antiplatelet or anticoagulant therapy during the perioperative period.

In addition, the severity of postoperative hematoma can vary based on the type of antiplatelet or anticoagulant medication used. For instance, aspirin and clopidogrel, commonly used antiplatelet agents, have been associated with different bleeding risks.¹⁵ While aspirin is often continued perioperatively in some settings due to its relatively lower bleeding risk, clopidogrel poses a higher risk and is usually discontinued. However, even with these precautions, there remains a risk of hematoma formation. This emphasizes the need for individualized patient assessment and shared decision-making regarding the continuation or discontinuation of these medications.¹⁶ Surgeons must weigh the thrombotic risks against the potential for significant bleeding and make informed decisions to optimize patient outcomes.

To mitigate the risks of bleeding and enhance hemostasis during ACDF, the use of gelatin granules with thrombin has proven effective. Gelatin granules, combined with thrombin, create a hemostatic matrix that promotes clot formation and stabilizes the surgical site. This combination acts rapidly to control bleeding by providing a scaffold for PLT aggregation and fibrin formation.¹⁷ In our study, the application of gelatin–thrombin matrix sealant during ACDF contributed to reducing intraoperative blood loss and preventing postoperative hematoma. The matrix is particularly beneficial in patients who cannot discontinue antiplatelet or anticoagulant therapy, as it offers an additional layer of hemostatic support. Clinical evidence supports the efficacy of gelatin–thrombin sealants in various surgical settings, highlighting their role in enhancing hemostasis and reducing the risk of complications related to bleeding.

Finally, the continuation of antiplatelet or anticoagulant therapy in patients undergoing ACDF requires careful evaluation and management to balance the risks of thrombotic and bleeding events. The use of gelatin–thrombin matrix sealants provides a valuable tool in controlling intraoperative bleeding and minimizing postoperative hematoma formation. Further research and larger randomized trials are necessary to establish standardized guidelines and optimize the perioperative management of these patients.

This study has limitations, notably its retrospective nature and limited sample size. In addition, the absence of routine postoperative cardiac catheterizations might lead to undetected CAD. Moreover, the relatively low number of postoperative outcomes observed underscores the need for larger randomized prospective trials to confirm the efficacy of continuing antiplatelet and anticoagulant therapy in ACDF and CDR.

CONCLUSION

According to our results, for patients with APT or ACT usage receiving ACDF or CDR, continuing antiplatelet or anticoagulant therapy has minimal difference in surgical outcome and length of postoperative stay difference; hence, continuing antiplatelet or anticoagulant therapy should be considered in selected cases.

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Data availability statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

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Conflicts of interest

There are no conflicts of interest.

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