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Is pharmacological anticoagulant prophylaxis necessary for adolescent idiopathic scoliosis surgery?

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Abstract

We report the outcomes of mechanical prophylaxis and chemoprophylaxis in patients who underwent elective surgery for idiopathic adolescent scoliosis (AIS).

We retrospectively studied the patients who underwent posterior spinal instrumentation for AIS. The patients were divided into three groups: Group A low-molecular-weight heparin (LMWH) started at 8 hours after surgery; Group B LMWH started at 24 hr after surgery; Group C did not receive chemoprophylaxis. The data about wound oozing, need for transfusion, preoperative and postoperative hemoglobin level, length of stay in hospital, interval from the surgery to removal of closed suction drainage tube, postoperative blood loss from closed suction drain, deep venous thrombosis (DVT), and pulmonary embolism (PE) were investigated.

The mean age and Lenke classification for all the groups were similar. No DVT or PE was detected in any group. The mean blood loss from the drain was higher in Group A (400 mL) and Group B (450 mL) when compared to Group C (150 mL) ($P = .001$). There were more wound oozing in Groups A (5) and B (6) than in Group C (3) ($P = .585$). Three patients in Group B, 3 patients in Group A, and no patient in Group C had superficial infections. However, there was no statistical difference between the groups ($P = .182$). Postoperative hospital stay was significantly longer in Groups A (6 days) and B (6 days) then in Group C (5 days) ($P = .001$).

Our current study claims that chemoprophylaxis is not necessary for the patients without risk factors after AIS surgery. Early mobilization and mechanoprophylaxis represents adequate prophylaxis in addition to pain management and well hydration in patients' routine treatment. The complications of chemoprophylaxis are not correlated to the initiation time of prophylaxis.

Abbreviation: AIS = adolescent idiopathic scoliosis, CS = compression stockings, CT = computed tomography, DVT = deep venous thrombosis, EDH = epidural hematoma, gr/dl = gram/deciliter, Hb = hemoglobin, LMWH = low-molecular-weight Heparin, ml = milliliter, PE = pulmonary embolism, ROM = Range of motion, SCDs = pneumatic compression devices, VTE = venous thromboembolism.

Keywords: adolescent idiopathic scoliosis, chemoprophylaxis, deep venous thrombosis, mechanical prophylaxis, pulmonary embolism

1. Introduction

There are many risk factors for thromboembolism regarding elective spine surgery, including age, malignancy, type of surgery, and trauma.[1] Prophylaxis for venous thromboembolism (VTE) involves mechanical, pharmacological, and physical modalities, and the studies stated that multimodal therapy is most beneficial.[2,3] Although the methods of mechanical prophylaxis with compression stockings (CS) or pneumatic compression devices (SCDs) and early mobilization after spine surgery are generally accepted as effective and safe,[4,5] chemical agents are not found to be as innocent as mechanical prophylaxis. Anticoagulation therapy is known to reduce thrombotic events, yet the safety and time of initiating these agents remains controversial. Starting anticoagulation chemoprophylaxis early may lead to bleeding complications, specifically, acute postoperative formation of epidural hematoma (EDH) with significant neurological deficits.[2,6] Mclynn et al[7] stated that the potential benefit of prophylactic anticoagulation in spine surgery patients must be carefully weighed against the potential risk of EDH, which can be associated with neurologic deficits and wound oozing that can predispose to infection.[5,8,9] Also, guidelines from the North American Spine Society and the American College of Chest Physicians note that the balance of benefit and risk is unclear, and this merits further investigation. The current approach often urges surgeons to make a decision about chemical prophylaxis without strong evidence to guide them in terms of patient selection or choice of medication.[5,8] Overall, the guidelines state that the decision is largely based on clinical judgment. Current guidelines necessitate a need for further studies to evaluate the efficacy of

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chemoprophylaxis and the optimal agent, particularly in low-risk patients or elective surgeries.[8]

Chemoprophylaxis agents are known to reduce thrombotic and thromboembolic events. However, the timing for initial dose of thromboprophylaxis and safety of these agents are discussed controversially. We report the outcomes of mechanical prophylaxis and chemoprophylaxis in patients who underwent elective surgery for idiopathic adolescent scoliosis (AIS). All patients were given antiembolic CS perioperatively, SCDs peroperatively, and they were mobilized early. However, they were separated into 3 groups: Group A patients had their low-molecular-weight heparin (LMWH) 8 hours after operation; Group B patients received LMWH 24 hours after operation; Group C patients did not receive any chemoprophylaxis. We hypothesized that starting LMWH early increases wound oozing, blood transfusion, hospital stay, and closed suction drain tube removal time.

2. Patients and method

We retrospectively studied the patients who underwent posterior spinal instrumentation for adolescent idiopathic scoliosis from January 2012 to June 2017. In our daily practice, depending on the surgeon's preference, some patients obtained their LMWH at 8 hours, some patients at 24 hours, and others received no LMWH. The data of 90 patients were collected from the hospital records and patients' files. The following criteria were excluded for this study: being younger than 14 and older than 19 years, thrombophilia or any kind of coagulopathy, spinal anterior column osteotomy, postoperative neurological deficit, postoperative need of intensive care unit, inadequate follow-up, and lack of hospital records. After exclusion of patients, we included 73 teenagers in our study with no underlying chronic diseases or thrombotic risk factors.

The patients were divided into 3 groups (Groups A, B, and C). Group A (21 patients) had their LMWH started at 8 hours after surgery; Group B (28 patients) had their LMWH started at 24 hours after surgery; and Group C (24 patients) received no chemoprophylaxis. We applied SCDs peroperatively. All patients had compressive stockings after surgery for 4 weeks and started their ankle and knee ROM exercises after surgery. All patients were mobilized during the first 24 hours after surgery.

One subfascial drain was intraoperatively performed. All the drains were removed once drainage was <50 mL/day or stopped flowing.

We collected the data on wound oozing, need for transfusion, preoperative and postoperative hemoglobin level, length of stay in hospital, interval from the surgery to removal of close section drainage tube, and postoperative blood loss from closed suction drain. The data related to other complications, such as deep venous thrombosis (DVT) and pulmonary embolism (PE), were obtained from later admissions, outpatient clinic records, and the results from radiological investigations, computed tomography (CT) venography, and duplex ultrasonography. All the patients were classified according to the Lenke scoliosis classification. Data related to instrumentation status and level were also collected from the records.

Our clinic guidelines for transfusion of red blood cells were to give only 1 unit at a time to maintain the hemoglobin concentration at ≥8.5 g/dL. No fresh frozen plasma or platelets were given to any patient.

3. Statistical analysis

Descriptive analyses were performed to provide information on general characteristics of the study population. The Kolmogorov-Smirnov test was used to evaluate whether the distribution of variables were normal. The one-way analysis of variance and Kruskal-Wallis analysis of variance were used for the comparison of the continuous data among groups. For multiple comparisons, the Tukey HSD test and Dunn test were used. Normally distributed continuous data were expressed as mean ± standard deviation (SD); non-normally distributed continuous variables were presented as the median and interquartile range (quartile l–quartile 3). The χ^2 test compared categorical variables. Categorical variables were presented as a count and percentage. A P value <.05 was considered significant. Analyses were performed using commercial software (IBM SPSS Statistics, Version 23.0, IBM Corp., Armonk, NY.[10]

Ethical approval obtained from local ethical committee (University of Sakarya Medical Faculty Ethical Committee). Number/date of approval: 71522473/050.01.04/205 27 June 2018.

4. Results

Details of demographic data for all groups (Groups A, B, and C) are shown in Table 1. The mean age for all the groups was similar. There were 42 females and 31 males with relatively fewer males in Group C. Distributions according to the Lenke classification were similar in each group ($P=.735$).

4.1. Length of hospital stay

Postoperative hospital stay was significantly longer in Groups A and B then in Group C. Most of the longer hospital stays were because of wound oozing (if persistent, fluid oozing from the wound during healing may be a superficial or deep infection risk). The median hospital stays were 6 days for Groups A and B and 5 days for Group C ($P=.001$) (Table 1).

4.2. Drain

The median blood loss from the drain was higher in Groups A (450 mL) and B (400 mL) but less in Group C (150 mL). Drain time was shortest in Group C ($P=.001$) (Table 1).

4.3. Hemoglobin level

The mean postoperative hemoglobin level was lower in Groups A and B compared to Group C. Mean hemoglobin of Group C was 9.4 g/dL, whereas it was 8.46 g/dL and 8.00 g/dL for Groups B and C, respectively. Hb drop from pre-op values to post-op values showed a similar trend (Table 1).

4.4. Blood transfusion

Groups A and B patients received more transfusions than Group C patients. The median blood transfusion was 0 (0–1 U) for Group C, 2 (1–2 U) for Group A, and 2 (0.5–2 U) for Group B ($P=.001$).

Table 1

Comparisons of the patient characteristics among groups.

		First 8 h Group A (n=21)	After 24 h Group B (n=28)	Non-used Group C (n=24)	*P*
Age, y		14 (14–16)	15 (14–16)	14.5 (14–16)	.780
Follow-up		40 (30–44)	43.5 (27–60.5)	23 (16–38.5)	.030
Blood loss from the drain, mL		450 (400–500)	400 (350–500)	150 (125–200)	<.001*
Drain time		72 (48–72)	48 (48–48)	24 (24–24)	<.001**
Length of hospital stay		6 (6–8)	6 (6–7)	5 (5–5)	<.001***
Instrumentation levels		11 (10–12)	11 (10–12))	11 (11–12)	.724
Transfusion, U		2 (1–2)	2 (0.5–2)	0 (0–1)	<.001***
Pre-Op hemoglobin, g/dL		14 (13–14)	13 (12–14)	12.5 (12–14)	.090
Post-op hemoglobin		8 (7.6–8.3)	8.2 (7.8–8.85)	10 (8.2–10.15)	<.001***
Hemoglobin differences		5.47±1.14	4.83±1.27	3.51±1.47	<.001***
Sex	Female	10 (47.6)	15 (53.6)	17 (70.8)	.251
	Male	11 (52.4)	13 (46.4)	7 (29.2)	
Wound oozing	Positive	5 (23.8)	6 (21.4)	3 (12.5)	.585
	Negative	16 (76.2)	22 (78.6)	21 (87.5)	
Lenke classification	Type 1	12 (57.1)	12 (42.9)	13 (54.2)	.735
	Type 2	5 (23.8)	10 (35.7)	5 (20.8)	
	Type 3	1 (4.8)	3 (10.7)	4 (16.7)	
	Type 5	3 (14.3)	3 (10.7)	2 (8.3)	
Infection	Positive	3 (14.3)	3 (10.7)	0 (0)	.182
	Negative	18 (85.7)	25 (89.3)	24 (100)	

Data were shown as median (interquartile range) or mean±standard deviation and n (%). Group C was significantly different when compared to Group A and group B. Wound oozing: Fluid oozes from wounds during healing. If persistent, it may be risk for superficial or deep infection.
* Group C was significantly different than group B.
** All the groups were significantly different.
*** Group C was significantly different when compared to Group A and group B.

4.5. Infection

None of the patients in Group C had a superficial or deep infection. Three cases in Group B and 3 cases in Group A had superficial infections in the surgical site. However, there was no statistical difference between the groups ($P=.182$). They required local wound debridement. After debridement, the wound healed with wound dressing. The wound culture was negative for all the cases.

There was neither deep infection nor hematoma during hospitalization or during follow-up in all 3 groups.

There was more wound oozing in Groups A and B (5 and 6 patients, respectively) than in Group C (3 patients) without any statistical significance ($P=.585$).

No DVT or PE was detected in any group.

5. Discussion

There was no DVT or PE documented in any of the 3 groups in our study. In the literature, several studies stated that without any predisposing factor, venous thrombosis and PE are uncommon in children.[11–14] However, elective spine surgery itself is a minimal risk factor for thrombosis.[11–13]

Owing to low risk of fatal PE in elective surgery, expert opinion leans against using chemical prophylaxis routinely to prevent thromboembolic disease.[15] The use of thromboembolic stockings and mechanical compression devices is recommended on a case-by-case basis. Chemical prophylaxis should be considered in patients with significant neurologic dysfunction or who require prolonged bed rest, although this scenario was not evaluated in this study.[15] If heparin is used, then careful observation of the wound and neurologic functions should be performed. Chemical prophylaxis should be considered for spinal trauma patients and those with spinal cord injuries.[15] The lack of documentation of DVT or PE in our study could be because of the exclusion of all predisposing factors, neurological dysfunctions, and need for the intensive care unit as well as postoperative early mobilization and mechanical prophylaxis.

A study with 2181 cases in a tertiary referral center revealed that antiembolic stockings, adequate hydration, and early mobilization are effective in reducing VTE and DVT rates to a significantly low level. This will be the safe protocol for most elective spinal surgery.[15] Similarly, in another large retrospective study of 1229 cases with scoliosis, only 8 cases had clinically suspected and objectively documented venous thrombosis (<1%).[16]

A meta-analysis of 28 studies showed no statistically significant differences in the rate of VTE in patients who underwent spinal surgery and either received no prophylaxis or received mechanoprophylaxis and/or chemoprophylaxis. They recommend chemoprophylaxis for patients with higher risks, such as trauma, malignancy, combined anterior, and posterior surgery, and patients with a history of VTE.[17] A prospective study aimed to screen DVT in patients with AIS who underwent surgery. They performed Doppler ultrasonography on the day before surgery as well as on the 3rd, 7th, and 15th day after the surgery. They concluded that active screening of DVT and prophylactic prophylaxis might not be recommended for AIS.[18]

The above article supports our study. We recommend that mechanical compression devices and thromboembolic stocks with early mobilization are adequate for thromboprophylaxis, which also avoids the risk of chemoprophylaxis.

5.1. Complications of using chemoprophylaxis

The studies showed different results regarding wound complications and use of chemoprophylaxis. Bono et al [8] reported that there is no correlation between the use of chemoprophylaxis and wound complications after spinal surgery. Whereas, in a retrospective study of 1281 patients, a superficial surgical site infection (SSI) occurred in 1.66% of the patients in the control group (only mechanoprophylaxis was used) and 0.29% of the patients in the LMWH group ($P=.004$). All were treated with antibiotics. Eight patients in the control group and 3 in the LMWH group had a deep SSI which required wound debridement and antibiotics for at least 6 weeks. There were not any significant statistical differences in the 2 groups.[19] In the present study, although there was no statistical difference between the groups for superficial SSI, there was no superficial or deep infection in Group C of our study. However, 3 patients in Group B and 3 patients in Group A presented with superficial SSI. They were all treated with local wound debridement and antibiotics.

A study by McLynn et al[7] revealed that prophylaxis with unfractionated heparin after elective spine surgery was not associated with a significant reduction in VTE, but there was a significant increase in postoperative wound complication and hematoma. Kaabachi et al[18] stated that prophylaxis for venous thrombosis and routine screening of DVT should not be recommended in idiopathic scoliosis surgery. The patients with thrombotic risk factors must be carefully managed.

In a comparative study of LMWH used and not used, the volume of drainage from the drain and number of bleeding complications were higher in the group treated with LMWH. The incidence of symptomatic spinal EDH was also higher in groups treated with LMWH.[20] Zeng and Peng's study[20] showed that LMWH significantly decreases the incidence of thrombosis and thromboembolic events but increases the risks of incision bleeding, blood transfusion need, and symptomatic spinal EDH. Similarly, our study showed a greater drop in postoperative hemoglobin and an increased need for transfusion for Groups A and B compared to Group C.

To our knowledge, there is no study in the literature concerning hospital stay and anticoagulant use for spinal surgery. Our study showed that the hospital stay for the group of patients treated with anticoagulants was higher than the length of the hospital stay for the patients not treated with anticoagulant agents. There might be a contribution of higher wound complications in the length of hospital stay in the patients who received chemoprophylaxis. The need for transfusion, wound complication, hospital stay, and the volume of blood loss was high in the chemoprophylaxis group (Groups A and B) in our study, but these parameters were similar on comparison of group A with group B.

6. Limitation

First, this study did not address whether the patients in all 3 groups had different recovery experiences or less pain in the earlier weeks post-surgery because there were no weekly follow-up appointments after hospital discharge. Second, this study was retrospective in nature and involved a small number of patients.

7. Conclusion

The present study claims that chemoprophylaxis is not necessary for patients without risk factors after AIS surgery. Early mobilization and mechanoprophylaxis is adequate prophylaxis to prevent VTE and DVT in addition to pain management and well hydration in patients' routine treatment. The complications of chemoprophylaxis are not correlated to the initiation time of prophylaxis.

Author contributions

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