

Research letter

Use of ISTH bleeding assessment scale to evaluate therapy-associated bleeding risk in patients undergoing coronary revascularization

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Abstract: *Background* — Currently, there is a challenge in the dynamic prognostic assessment of haemorrhagic risks, particularly in recognising the development of bleeding in patients who have undergone cardiac surgery (CS). Bleeding frequently occurs in post-CS patients as they are receiving antithrombotic therapy (ATT), prescribed for continuous a period of 3, 6, or 12 months after surgery. This not only worsens prognosis and quality of life but also, if therapy is discontinued, increases the risk of thrombotic events.

Objective — To investigate the diagnostic value of scales for assessing bleeding and predicting bleeding outcomes in individuals who have undergone myocardial revascularisation, and to assess the applicability of the ISTH scale for evaluating bleeding in this patient group.

Methods — A total of 98 patients undergone myocardial revascularisation participated in the prospective study. An assessment of hemorrhagic risks according to the PRECISE-DAPT scale and hemorrhagic manifestations according to the ISTH scale was performed at visit 1 and 2 (0-1 month after revascularization).

Results — It was found that the assessment of bleeding risk during antithrombotic therapy (ATT) in the first month after myocardial revascularisation, when performed using the PRECISE-DAPT scale, is not comparable to the assessment using the ISTH scale. However, the ISTH scale proved to be a useful tool for evaluating haemorrhagic complications of ATT in patients following cardiac surgery (CS).

Conclusion — The use of the ISTH scale allows the assessment of early signs of bleeding during dual antiplatelet therapy (DAPT) following revascularisation, helping to foster a proactive attitude in patients towards monitoring complications of antithrombotic therapy. This approach can reduce risks of fatal haemorrhages and the development and progression of anaemia. However, the ISTH scale is not comparable to the PRECISE-DAPT scale for assessing hemorrhagic risks and cannot be recommended for dynamic prediction of hemorrhagic risks in post-CS patients.

Keywords: myocardial revascularisation, hemorrhagic risks, ISTH scale, PRECISE-DAPT scale, bleeding, myocardial stenting, myocardial bypass surgery, antithrombotic therapy.

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Introduction

Cardiac surgeons, cardiologists in the sanatorium-resort setting, and outpatient cardiologists and therapists managing patients after myocardial revascularisation frequently encounter haemorrhagic complications, which vary in severity and arise as side effects of anti-thrombotic therapy (ATT) [1-15]. ATT, subdivided into double anti-platelet therapy (DAPT), triple anti-platelet therapy (TAPT), or anticoagulant therapy (ACT), is prescribed to patients in accordance with clinical guidelines (CG) [3, 8, 11, 13]. Sufficient ATT is required in order to prevent thrombotic complications [1, 3]. However, an individualised approach to post-revascularisation care must carefully balance thrombosis prevention with bleeding risk mitigation, as bleeding significantly impacts the likelihood of adverse coronary and non-coronary events [4, 9-17].

To address haemorrhagic risks, clinical guidelines recommend the PRECISE-DAPT scale for assessments at the time of discharge

from cardiac surgery (CS) [3]. This tool aids in determining whether patients should receive ATT for six or twelve months and guides the selection of appropriate drug combinations. Nevertheless, the occurrence of haemorrhagic events during therapy often necessitates reevaluation of the prescribed medication regimen, including adjustments to drug type, dosage, and duration [8].

The clinical guidelines approved by the Ministry of Health of the Russian Federation for post-CS management, along with related methodological recommendations [3], do not address tools for assessing haemorrhagic events during therapy. Although some studies have employed the ISTH bleeding assessment scale for this purpose [4, 18], its reliability for dynamic prognostic monitoring in such patients remains unconfirmed.

This study aims to evaluate the practical use of the PRECISE-DAPT scale for haemorrhagic events and the ISTH bleeding assessment scale for personalising antithrombotic therapy in patients after myocardial revascularisation.

Table 1. Characteristics of patients included in the study

Sample characteristics	M±SD	% of the total number in the sample
Male, n	73	74.5
Female, n	25	25.5
Age (both genders), years	61.73±9.8	
Age (male), years	61.01±9.6	
Age (female), years	63.8±10.2	
Weight, kg	84.3±14.6	
Chronic coronary syndrome, n	53	54.6
Acute coronary syndrome, n	44	45.4
History of myocardial infarction, n	42	43.3
Average height, cm	170.6±8.4	
History of diabetes mellitus, n	15	15.5
Hemoglobin before surgery, g/l	136.3±16.7	
Hemoglobin after surgery, g/l	114.6±16.1	
Anemia, n	45	45.9
History of prior-ATT bleeding, n	5	5.5
Patients on DAPT at discharge, n	84	87.5
Patients on TAPT at discharge, n	1	1
Patients without DAPT/DAPT at discharge, n	11	11.5

Material and Methods

A prospective study was conducted involving 98 patients who underwent myocardial revascularisation within one month post-procedure. Haemorrhagic risks were analysed using the PRECISE-DAPT scale, and haemorrhagic manifestations were evaluated using the ISTH scale during two visits. At visit 1 (conducted within 1-3 days after revascularisation), both scales were employed, while at visit 2 (one month post-revascularisation), only the ISTH scale was used [18].

Inclusion criteria required patients to have undergone myocardial revascularisation (visit 1 occurred within 1-7 days after stenting or bypass surgery). Non-inclusion criteria encompassed patient refusal to participate or inability to establish contact after discharge. The main characteristics of the patients are summarised in [Tables 1](#) and [2](#).

At discharge, the presence of a history of bleeding was assessed in all patients, in accordance with the questions of the validated ISTH questionnaire. The results are presented in [Table 2](#).

At the inclusion visit (upon discharge) and at the follow-up visit (1 month from the index event), all cases of bleeding were recorded with details of their nature, source, severity, and treatment, as per the ISTH scale.

The ISTH score at discharge assigned 0 points to 37.2% of patients (32 out of 94). Among the remaining patients, scores ranged from 1 to 14 points, indicating that haemorrhages were identified in 42.8% of cases during hospitalization. Minor haemorrhagic signs (1 to 3 points) were noted in 37.2% of patients, while 28.7% demonstrated significant bleeding manifestations. The distribution of patients by ISTH scale scores at discharge is illustrated in [Figure 1](#).

Anaemia before surgery was present in 45% of patients. A history of myocardial infarction prior to CS was documented in 40 patients (42.1%), and diabetes mellitus was reported in 15.5%. Slightly more than half of the patients underwent surgery in a stable condition (Chronic coronary syndrome at admission – 54.6%), whereas the rest underwent revascularisation due to acute coronary syndrome. The severity of bleeding by localisation at visit 1, assessed using the ISTH scale from 0 (no signs of haemorrhages) to 4 (severe manifestations), is displayed in [Figure 2](#).

When analyzing the severity of hemorrhagic manifestations at visit 1, a mild degree was observed in most patients (score=1),

bleeding from the gastrointestinal tract or oral cavity, as well as pronounced menstrual blood loss, are most commonly noted in the group with mild hemorrhages, while severe manifestations predominantly originated from surgical sites and tooth extraction. The risks of hemorrhagic complications were assessed in all patients according to the PRECISE-DAPT scale at discharge. Based on their PRECISE-DAPT scores, patients were categorised into two groups: those recommended for 6-month ATT (41 patients; 42.7%) and those recommended for 12-month ATT (55 patients; 57.3%).

At discharge, patients reported bleeding manifestations anamnestically using the ISTH scale. This included events prior to hospitalisation (e.g., menorrhagia and labour-related bleeding) and events documented during hospitalisation ([Table 2](#)). The calculated total ISTH score ranged from 0 (no manifestations of increased bleeding) to 14 (maximum bleeding risk score). The distribution of scores is illustrated in [Figure 1](#).

Results

Prior to surgery, patients had significantly higher haemoglobin levels compared to those measured post-CS (136.3±16.7 vs. 114.6±16.1 g/l). This decrease is evidently a result of substantial blood loss during surgery. To mitigate thrombosis risk, current clinical guidelines recommend that target haemoglobin levels during erythrocyte transfusion remain below normal thresholds [5, 12].

An analysis was conducted to compare the PRECISE-DAPT score recommendations with actual antithrombotic therapy (ATT) prescriptions at discharge. Discrepancies were identified in 12% of cases. Specifically, 4% of patients, for whom 12 months of ATT would have been appropriate, were instead advised to limit therapy to six months. Conversely, 8% of patients classified in the “short-term therapy” group were prescribed extended ATT. These deviations likely reflect insufficient adherence to clinical guidelines or inadequate utilisation of the PRECISE-DAPT scale by clinicians during discharge planning. A limitation of this study that may contribute to these findings is that it was single-centered.

[Figure 1](#) illustrates that approximately one-third of patients (28.6%) showed no signs of bleeding (0 ISTH points), while another 34% exhibited minimal bleeding manifestations (scores of 1-3 points). A further 33.7% demonstrated varying degrees of haemorrhagic events (scores of 4-9 points) either prior to hospitalisation or during their stay. Severe haemorrhagic manifestations (scores of 10-14) were observed in 3% of patients. These findings underscore the ability of the ISTH scale to identify patients with diverse degrees of bleeding severity. Notably, all such patients were prescribed short-term ATT, although anticoagulants were included in two cases.

Among patients assigned to short-term therapy based on the PRECISE-DAPT scale (37.8% of the total), an increased risk of bleeding assessed by the ISTH scale was observed in 24%. Conversely, among those allocated to long-term therapy (62.1%), 73.1% had the high risk of hemorrhagic events.

In the subgroup classified as having a high risk of congenital haemorrhagic predisposition according to the ISTH scale (36.7% of the group), 72.4% were assigned to short-term ATT based on the PRECISE-DAPT score, while the remaining 27.6% were prescribed long-term ATT. Among those with no increased risk of bleeding at discharge (63.3% of the group), 44.4% were assigned to long-term ATT, while 55.6% were allocated to short-term ATT based on the PRECISE-DAPT score.

Table 2. ISTH score at discharge

ISTH scale question number	Assessment by scales and characterization of subgroups according to the "X" index – points scored on the ISTH scale	The number and % of persons with the X index
-	ISTH score "X", – calculated total score at discharge from 0 to 14 according to the graphs (Assessment of the risk of bleeding according to the recommendations of the international society for thrombosis and hemostasis – ISTH)	X=0: 28 (28.6%) X=1: 16 (16.4%) X=2: 7 (7.1%) X=3: 11 (11.2%) X=4: 7 (7.1%) X=5: 9 (9.2%) X=6: 5 (5.1%) X=7: 3 (3.1%) X=8: 5 (5.1%) X=9: 4 (4.1%) X=12: 1 (1%) X=13: 1 (1%) X=14: 1 (1%)
1	Epistaxis • No/trivial 0 • >5 /year or >10 minutes +1 • Consultation only +2 • Packing, cauterization, or antifibrinolytic agents +3 • Blood transfusion, replacement therapy, or desmopressin +4	X=0: 83 (86.5%) X=1: 10 (10.4%) X=2: 3 (3.1%) X=3: 0 X=4: 0
2	Skin hemorrhages • No/trivial 0 • 5 or more bruises (more than 1 cm) in exposed areas +1 • Examination of the patient and referral to a specialist or conducting a detailed laboratory examination +2 • Extensive +3 • Spontaneous hematoma requiring blood transfusion +4	X=0: 79 (82.3%) X=1: 10 (10.4%) X=2: 7 (7.3%) X=3: 0 X=4: 0
3	Bleeding from minor wounds • No/trivial 0 • More than 5 per year, longer than 10 min +1 • Examination of the patient and referral to a specialist or conducting a detailed laboratory examination +2 • Surgical hemostasis +3 • Transfusion of blood components, substitution therapy, desmopressin +4	X=0: 70 (73%) X=1: 25 (26%) X=2: 1 (1%) X=3: 0 X=4: 0
4	Oral cavity – bleeding at discharge • No/trivial 0 • Bleeding +1 • Examination of the patient and referral to a specialist or conducting a detailed laboratory examination +2 • Surgical hemostasis, antifibrinolytics +3 • Transfusion of blood components, substitution therapy, desmopressin +4	X=0: 70 (73%) X=1: 25 (26%) X=2: 0 X=3: 1 (1%) X=4: 0
5	Gastrointestinal bleeding • No/trivial 0 • Occur (not associated with ulcers, portal hypertension, hemorrhoids, angiodysplasia) +1 • Examination of the patient and referral to a specialist or conducting a detailed laboratory examination +2 • Surgical hemostasis, antifibrinolytics +3 • Transfusion of blood components, replacement therapy, desmopressin +4	X=0: 71 (74%) X=1: 23 (24%) X=2: 0 X=3: 2 (2%) X=4: 0
6	Hematuria • No/trivial 0 • Occurs (macrohematuria) +1 • Examination of the patient and referral to a specialist or conducting a detailed laboratory examination +2 • Surgical hemostasis, iron preparations +3 • Transfusion of blood components, substitution therapy, desmopressin +4	X=0: 81 (84.4%) X=1: 6 (6.3%) X=2: 9 (9.3%) X=3: 0 X=4: 0
7	Bleeding after tooth extraction • No/trivial 0 • Is marked in less than 25%, does not require correction +1 • It is noted in more than 25%, does not require correction +2 • Suturing (repeated), tamponing +3 • Transfusion of blood components, substitution therapy, desmopressin +4	X=0: 80 (83.3%) X=1: 8 (8.3%) X=2: 2 (2.1%) X=3: 6 (6.3%) X=4: 0
8	Surgical Bleeding • No/trivial 0 • Is marked in less than 25%, does not require correction +1 • It is noted in more than 25%, does not require correction +2 • Surgical hemostasis, antifibrinolytics +3 • Transfusion of blood components, substitution therapy, desmopressin +4	X=0: 65 (67.7%) X=1: 18 (18.8%) X=2: 0 X=3: 13 (13.5%) X=4: 0
9	History of Menorrhagia • No/trivial 0 • Examination of the patient and referral to a specialist or conducting a detailed laboratory examination, or changing pads more frequently than every 2 hours, clot and flooding, or PBAC score>100+1 • Time off work/school >2 /year, requiring antifibrinolytics, or hormonal/iron therapy +2 • Antifibrinolytics + hormonal therapy since menarche or for more than 12 months +3 • Acute blood loss requiring: hospitalization, transfusion, substitution therapy, desmopressin +4	X=0: 84 (87.5%) X=1: 8 (8.3%) X=2: 0 X=3: 3 (3.1%) X=4: 1 (1.1%)
10	A history of postpartum bleeding • No/trivial or no deliveries 0	X=0: 91 (94.8%)

ISTH scale question number	Assessment by scales and characterization of subgroups according to the "X" index – points scored on the ISTH scale	The number and % of persons with the X index
	- Examination of the patient and referral to a specialist or conducting a detailed laboratory examination or: the use of oxytocin, lochia for more than 6 weeks +1 - Antifibrinolytics, iron preparations +2 - Required: transfusion of blood components, replacement therapy, desmopressin, examination with anesthesia, uterine tamponing +3 - Required: resuscitation support, surgery (hysterectomy, uterine tube embolization, etc.) +4	X=1: 5 (5.2%) X=2: 0 X=3: 0 X=4: 0
11	Intramuscular hematomas - Never 0 - After injury, without therapy +1 - Spontaneous without therapy +2 - Spontaneous or traumatic, requiring: substitution therapy, desmopressin +3 - Spontaneous or traumatic, requiring: surgical care, transfusion +4	X=0: 87 (90.6%) X=1: 8 (8.3%) X=2: 0 X=3: 1 (1.1%) X=4: 0
12	Hemarthrosis - Never 0 - After injury, without therapy +1 - Spontaneous without therapy +2 - Spontaneous or traumatic, requiring: substitution therapy, desmopressin +3 - Spontaneous or traumatic, requiring: surgical care, transfusion +4	X=0: 91 (94.8%) X=1: 2 (2.1%) X=2: 0 X=3: 0 X=4: 3 (3.1%)
13	Hemorrhages in the central nervous system - Never 0 - Subdural, any intervention +3 - Intracerebral intervention +4	X=0: 90 (94.7%) X=1: 2 (2.1%) X=4: 3 (3.2%)
14	Other bleeding (e.g. conjunctival hemorrhage or excessive bleeding following circumcision/venipuncture) - No/trivial 0 - Present +1 - Consultation only +2 - Surgical hemostasis or antifibrinolytics +3 - Blood transfusion, replacement therapy, or desmopressin +4	X=0: 89 (93.7%) X=1: 3 (3.2%) X=2: 0 X=3: 2 (2.1%) X=4: 1 (1%)

Table 3. Comparability between ISTH scores at discharge and PRECISE-DAPT scores at discharge. One-sample Kolmogorov-Smirnov test

VAR00003			
N			66
Parameters of normal distribution ^{a,b}	Mean		3.8485
	St.deviation		3.43844
Largest absolute differences	Absolute		0.143
	Positive		0.143
	Negative		-0.132
Test statistic			0.143
Asymptotic significance (two-tailed)			0.002 ^c

^a The tested distribution is normal; ^b Computed from the data; ^c Lilliefors significance correction.

Table 4. Comparability between ISTH scores at discharge and PRECISE-DAPT scores at discharge. Ranks

	PRECISE-DAPT at discharge	N	Mean rank	Sum of the ranks
ISTH score at discharge	Long-term therapy	25	28.98	724.50
	Short-term therapy	41	36.26	1486.50
	Total	66		

Table 5. Comparability between ISTH scores at discharge and PRECISE-DAPT scores at discharge. Statistical Tests^a

	ISTH- estimated score on the date of discharge from the hospital
Mann-Whitney U Test	399.500
Wilcoxon Signed-Rank Test	724.500
Z-Value	-1.505
Asymptotic significance (two-tailed)	0.132

^a Grouping variable: PRECISE-DAPT score group at discharge.

Thus, the use of the ISTH scale, reflecting the risk of congenital increased hemorrhagic predisposition, in 72.4% of cases was supported by the recommendations to limit the duration of ATT based on the PRECISE-DAPT assessment. However, for patients classified as low risk by the ISTH scale, the PRECISE-DAPT scale

often divides them almost equally between short-term and long-term ATT groups. This supports the hypothesis that clinical indicators used in the PRECISE-DAPT calculation (e.g., haemoglobin, creatinine levels) possess significant prognostic value. Additionally, the ISTH assessment of haemorrhagic history, regardless of the timing of events, is important for understanding the development of haemorrhagic manifestations during hospitalisation, as reflected by higher ISTH scores.

A correlation analysis between the ISTH and PRECISE-DAPT scores revealed no significant relationship ([Tables 3, 4, and 5](#)). This may stem from the limited sample size and the inherent limitations of the ISTH scale in its accessible version, which does not specify the timing of haemorrhagic events. These findings suggest that applying the ISTH scale without a temporal framework may not be optimal for evaluating haemorrhagic risk in patients prescribed ATT following surgical intervention.

To evaluate the comparability of haemorrhagic manifestations recorded on the ISTH scale and haemorrhagic risks assessed by the PRECISE-DAPT scale, a comparative analysis was conducted. This assessment focused on the "long-term ATT" and "short-term ATT" groups as determined by the PRECISE-DAPT scale and the groups "no haemorrhagic manifestations on the ISTH scale" and "haemorrhagic manifestations present on the ISTH scale".

The results showed no significant correlation between these indicators at the time of discharge from the hospital ([Tables 3, 4, and 5](#)).

After analysing the data on the severity of haemorrhagic manifestations one month after discharge using the ISTH scale, it was found that 34.3% of patients exhibited no signs of haemorrhage (0 points; [Figure 1](#)). Minor haemorrhagic signs (1 to 3 points) were observed in 46.8% of patients (15 individuals), while haemorrhages with a severity ranging from 4 to 9 points were detected in 18.7% of patients.

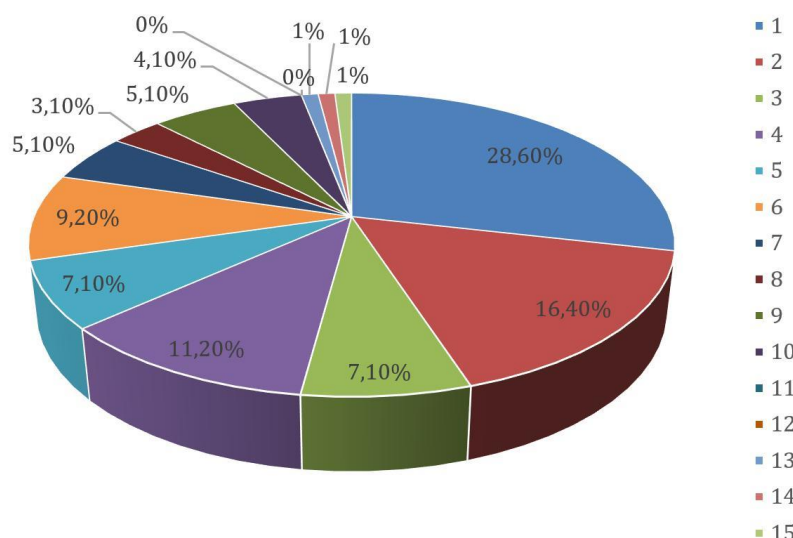


Figure 1. Distribution of patients by ISTH score at discharge (from 0 to 14 points – indicated in different colors).

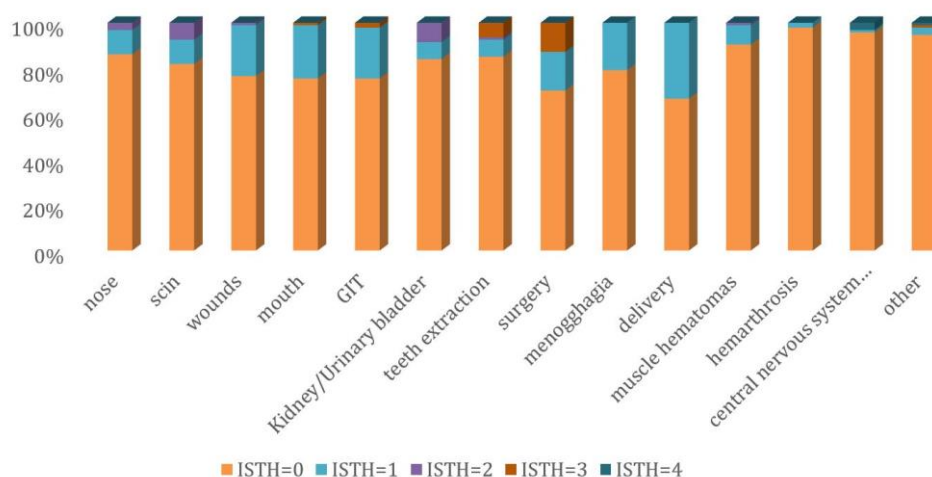


Figure 2. Manifestations of hemorrhagic events on the ISTH scale at visit 1 in patients after myocardial revascularisation.

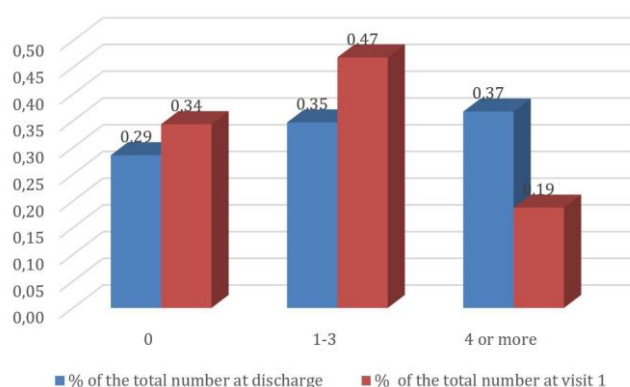


Figure 3. Dynamics of the ISTH score between visit 1 and visit 2.

Notably, when the ISTH score was assessed one month apart, it showed different evaluations of haemorrhagic event severity, likely reflecting changes in the clinical manifestation of haemorrhages as complications of ATT. These observations indicate significant dynamics in haemorrhagic manifestations during the first month post-discharge. Specifically, the proportion of patients with moderate bleeding (1 to 3 points) increased, while the proportion with more severe haemorrhages (4 or more points) decreased ([Figure 3](#)).

This pattern aligns with reports from various research groups, which describe the peak severity of haemorrhagic syndrome occurring during the inpatient postoperative period. Our findings confirm that this pattern also holds true for patients who underwent CS, who, unlike most other surgical patients, are recommended ATT after discharge [2]. Importantly, our data suggest that the incidence of severe bleeding events does not increase during the first month post-discharge in patients receiving ATT following CS.

Discussion

As our study showed, when assessing the risk of bleeding on the PRECISE-DAPT scale, long-term therapy was recommended for most patients based on the assumed low risk of bleeding. While the use of the ISTH scale, designed to assess hemorrhagic risks in the general population, does not provide additional information compared to the PRECISE-DAPT scale, it allows for the recording of hemorrhagic complications of antiplatelet therapy (ATT) during the first month of treatment. This early documentation forces doctors to make decisions regarding dosing and the duration of ATT earlier than the recommended six-month period. In practice, as our analysis demonstrates, the PRECISE-DAPT scale is not consistently implemented in some situations when prescribing therapy at discharge, requiring an evaluation of the factors leading to deviations from clinical recommendations. This may be due to the limited data or the lack of attention from inpatient doctors, who are aware of the responsibility of outpatient doctors for monitoring ATT complications. For outpatient doctors, the discharge guidelines serve as a practical framework for patient management. Thus, a disconnect exists in the continuum of responsibility for monitoring hemorrhagic manifestations in patients prescribed ATT after revascularisation. To improve such monitoring, the implementation of reliable tools is required, one of which could be the ISTH scale: it allows for monitoring of the current situation over six to twelve months of prescribed therapy.

It is important to note that in modern cardiological practice, dynamic and objectified assessment of hemorrhagic manifestations during the ATT process within the first year after revascularisation is insufficiently implemented. Available questionnaires for assessing bleeding risk consider factors that predispose to their development, but they do not serve as tools for structured self-diagnosis of hemorrhages [18]. The clinical guidelines in cardiology do not include scales for assessing hemorrhagic manifestations in the context of ATT, and scientific publications do not sufficiently address the potential use of the only validated scale for evaluating hemorrhagic symptoms, the ISTH scale.

The approaches to predicting hemorrhagic events outlined in the guidelines focus on unmodifiable risk factors such as age, diabetes, renal failure, and the placement of uncoated stents. It seems this approach fails to consider the clinical manifestations of bleeding, which are accounted for by, for example, the ISTH scale. Initially developed to identify individuals with hereditary platelet/coagulopathies [18], the ISTH scale can also be applied to individuals with a secondarily acquired hemorrhagic predisposition, such as those receiving DAPT/TAPT/ATT [4].

In patients undergoing myocardial revascularisation and receiving ATT, the use of the ISTH scale helps identify hemorrhages related to the dynamic regulation of blood rheology, which is influenced by factors such as the patient's genetic profile, vitamin K intake, and the effects of DAPT/TAPT/ATT and other medications on pharmacokinetics and blood rheology [9, 10]. The wide range of factors influencing hemorrhagic risks and manifestations often compels doctors to focus on the clinical signs of bleeding when tailoring recommendations for each patient [7, 8]. However, such approaches are not reflected in the clinical recommendations on anemia or in cardiology guidelines.

The development and implementation of a more personalized approach could improve clinical outcomes in the treatment of patients with cardiovascular diseases and anemia. Current

hemorrhagic risk scales predict major bleeding based on clinical and anamnestic unmodifiable risk factors, rather than on actual bleeding manifestations, which limits the ability to adjust risks during DAPT/TAPT/ATT therapy [17, 18].

The PRECISE-DAPT scale, which provides a calculated bleeding risk index at discharge for patients after a coronary event, includes parameters such as age, weight, smoking status, anemia at discharge, creatinine clearance, and the use of TAAT at discharge. However, it does not account for the dynamics of hemorrhagic events during treatment. According to L.I. Buryachkovskaya and colleagues [3], who presented the practical guide "Algorithms and Risk Scales for Thrombosis and Bleeding in Cardiology and Neurology" in 2018, a large number of scales have been developed to assess the prognosis of coronary artery disease endpoints associated with thrombosis. Of the 11 hemorrhagic risk scales recommended by the authors (ISTH, TIMI, GUSTO, BLEEDSCORE, BARC, HEMORR2HAGES, HAS-BLED, CRUSADE SCALE, REACH SCALE, GIT, SMOG) [1, 3-15, 17, 18], only the ISTH scale can be considered a prognostic measurement tool that reflects hemorrhagic incidents. As noted by the authors of the aforementioned guidelines, "more than half of the so-called minor bleeding events in clinical trials go unnoticed because there is no method for their quantitative assessment" [3].

The ISTH bleeding risk scale is the most suitable for assessing bleeding in patients after myocardial revascularisation in clinical practice. It is publicly available and can be used to assess the risk of bleeding in patients after cardiac surgery. However, as our data show, it cannot be used to assess the risk of hemorrhagic events and has not proven to be comparable to the PRECISE-DAPT scale in predicting bleeding.

Conclusion

In our opinion, the optimal therapeutic strategy for patients who have undergone myocardial revascularisation is to balance the prescription of antiplatelet therapy (ATT) and closely monitor signs of bleeding in order to optimise the selection of regimens and dosages. As there are currently no recommendations regarding the use of any validated questionnaire aimed at recognising the development of haemorrhagic events in patients who have undergone coronary surgery, including signs of bleeding, we consider it appropriate to use the ISTH scale for this purpose.

In clinical practice, despite the availability of validated scales for assessing bleeding risk on ATT, there is no assessment of the effectiveness of an ATT modification algorithm in case of complications. As antithrombotic therapy, which carries haemorrhagic risks, is indicated for continuous use for a period of 3-6 to 12 months following CS, there is a clear need to apply integrated approaches to the assessment of haemorrhagic manifestations throughout the entire treatment period. The ISTH scale, however, did not demonstrate predictive value when used to anticipate haemorrhagic events.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

References

1. Brazhnik VA, Minushkina LO, Averkova AO, Zubova EA, Khasanov NR, Galyavich AS, et al. Bleeding risk scales in patients with acute coronary syndrome: place of the ORACUL scale. *Cardiovascular Therapy and Prevention*. 2020; 19(5): 2333. Russian. <https://doi.org/10.15829/1728-8800-2020-2333>.
2. Morev DS, Kalyuta TYu. Assessment of the risk of postoperative bleeding in cardiac surgery patients. In: Navolokin NA, Mylnikov AM, Fedonnikov AS, Eds. *Week of Russian science (WeRuS-2023)*. Collection of materials of the XII All-Russian Science Week with international participation, dedicated to the Year of the teacher and mentor. Saratov, Russia. 2023: 1035-1036. Russian. <https://www.elibrary.ru/item.asp?id=54245689>.
3. Buryachkovskaya LI, Lomakin NV, Sumarokov AB, Shirokov EA. Algorithms and risk scales for thrombosis and bleeding in cardiology and neurology. A practical guide. Publishing house of Studio Color Box LLC. 2018; 104 p. Russian. https://www.rnmot.ru/public/uploads/RNMOT/clinical/2017/posobie_FORUM-200-150.pdf.
4. Rodeghiero F, Tosetto A, Abshire T, Arnold DM, Collier B, James P, et al; ISTH/SSC joint VWF and Perinatal/Pediatric Hemostasis Subcommittees Working Group. ISTH/SSC bleeding assessment tool: a standardized questionnaire and a proposal for a new bleeding score for inherited bleeding disorders. *J Thromb Haemost* 2010; 8(9): 2063-2065. <https://doi.org/10.1111/j.1538-7836.2010.03975.x>.
5. Rao AK, Pratt C, Berke A, Jaffe A, Ockene I, Schreiber TL, et al. Thrombolysis in Myocardial Infarction (TIMI) Trial-phase I: hemorrhagic manifestations and changes in plasma fibrinogen system and fibrinolytic system in patients treated with recombinant tissue plasminogen activator and streptokinase. *J Am Coll Cardiol* 1988; 11(1): 1-11. [https://doi.org/10.1016/0735-1097\(88\)90158-1](https://doi.org/10.1016/0735-1097(88)90158-1).
6. GUSTO investigators. An international randomized trial comparing four thrombolytic strategies for acute myocardial infarction. *N Engl J Med* 1993; 329(10): 673-682. <https://doi.org/10.1056/nejm199309023291001>.
7. Serebruany VL, Atar D. Assessment of bleeding events in clinical trials – proposal of a new classification. *Am J Cardiol* 2007; 99(2): 288-290. <https://doi.org/10.1016/j.amjcard.2006.07.091>.
8. Mehran R, Rao SV, Bhatt DL, Gibson CM, Caixeta A, Eikelboom J, et al. Standardized bleeding definitions for cardiovascular clinical trials: a consensus report from the Bleeding Academic Research Consortium. *Circulation* 2011; 123(23): 2736-2747. <https://doi.org/10.1161/circulationaha.110.009449>.
9. Gage BF, Yan Y, Milligan PE, Waterman AD, Culverhouse R, Rich MW, et al. Clinical classification schemes for predicting hemorrhage: results from the National Registry of Atrial Fibrillation (NRAF). *Am Heart J* 2006; 151(3): 713-719. <https://doi.org/10.1016/j.ahj.2005.04.017>.
10. Lip GY, Nieuwlaet R, Pisters R, Lane DA, Crijns HJ. Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: the Euro Heart Survey on atrial fibrillation. *Chest* 2010; 137(2): 263-272. <https://doi.org/10.1378/chest.09-1584>.
11. Subherwal S, Bach RG, Chen AY, Gage BF, Rao SV, Newby LK, et al. Baseline Risk of Major Bleeding in Non-ST-Segment–Elevation Myocardial Infarction: the CRUSADE (Can Rapid risk stratification of Unstable angina patients Suppress ADverse outcomes with Early

implementation of the ACC/AHA guidelines) Bleeding Score. *Circulation* 2009; 119(14): 1873-1882. <https://doi.org/10.1161/circulationaha.108.828541>.

12. Crowther MA, Cook DJ, Albert M, Williamson D, Meade M, Granton J, et al; Canadian Critical Care Trials Group. The 4Ts scoring system for heparin-induced thrombocytopenia in medical-surgical intensive care unit patients. *J Crit Care* 2010; 25(2): 287-293. <https://doi.org/10.1016/j.jcrc.2009.12.006>.
13. Rodeghiero F, Michel M, Gernsheimer T, Ruggeri M, Blanchette V, Bussel JB, et al. Standardization of bleeding assessment in immune thrombocytopenia: report from the International Working Group. *Blood* 2013; 121(14): 2596-2606. <https://doi.org/10.1182/blood-2012-07-442392>.
14. Wu C, Alotaibi GS, Alsaleh K, Sean McMurtry M. Case fatality of bleeding and recurrent venous thromboembolism during, initial therapy with direct oral anticoagulants: a systematic review. *Thromb Res* 2014; 134(3): 627-632. <https://doi.org/10.1016/j.thromres.2014.07.001>.
15. Palareti G, Antonucci E, Mastroiacovo D, Ageno W, Pengo V, Poli D, et al. The American College of Chest Physician score to assess the risk of bleeding during anticoagulation in patients with venous thromboembolism. *J Thromb Haemost* 2018; 16(10): 1994-2002. <https://doi.org/10.1111/jth.14253>.
16. Kozlova TV, Taratuta TV. Possibilities of optimizing anticoagulant therapy with Warfarin. *Russian Medical Journal* 2008; 16(11): 1532-1535. Russian. <https://www.elibrary.ru/item.asp?id=22934327>.
17. Uthoff H, Staub D, Socrates T, Meyerhans A, Bundi B, Schmid HP, et al. PROCAM-, FRAMINGHAM-, SCORE- and SMART-risk score for predicting cardiovascular morbidity and mortality in patients with overt atherosclerosis. *Vasa* 2010; 39(4): 325-333. <https://doi.org/10.1024/0301-1526/a000057>.
18. ISTH. ISTH-SCC Bleeding Assessment Tool. 2024. <https://www.mdcalc.com/calc/10580/isth-scc-bleeding-assessment-tool>.

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