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ORGINAL ARTICLE

Additive Value of Syntax-ii to Syntax-i Score in Assessment of Infarct Size in Patients with st Elevation Myocardial Infarction Managed with Primary Percutaneous Coronary Intervention

Deyaa Mohamed Kamal[(1)], Mahmoud Hassan Shah [(2)], Manar Mostafa Al-Zaky[(2)], Islam Elsayed Mohamed Shehata [(2)]*

1. Nasr City Insurance Hospital, Cairo, Egypt.

2. Cardiology Department, Zagazig University, Zagazig, Egypt

***Corresponding author:**
Deyaa Mohamed Kamal Elshenawy.
Department of Cardiology, Nasr City Insurance Hospital, Cairo, Egypt
Email: Deyaakamal2017@yahoo.com.

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ABSTRACT

Background: The purpose of this study is to investigate the additive benefit of Syntax II to Syntax I score in assessment of infarct size in patients with STEMI managed with primary PCI. **Methods :** This is a cross sectional study; enrolled 150 patients with acute STEMI who did primary PCI from June 2018 till January 2020 in the Catheterization laboratory of Cardiology department, Zagazig university Hospitals and Nasr City Insurance Hospital. History, physical examination, laboratory investigation, ECG, and transthoracic echocardiography were made for all cases. Infarct size was estimated from ECG, peak CK, CK MB, troponin, systolic function, and wall motion score index. Coronary angiography has been done then Syntax II and Syntax I scores were calculated. **Results:** Syntax II and Syntax I scores were calculated, and infarct size was predicted then compared to each other's and compared to many variables including DM, HTN, smoking, COPD, smoking and peripheral arterial disease. There was positive relationship between infarct size and high Syntax I and high Syntax II score with p <0.001 with more sensitivity and specificity with Syntax II score, also there was positive relationship between infarct size and DM , HTN and peripheral vascular disease with significant p value. **Conclusion:** In patients with STEMI who did primary PCI, Syntax II score was more predictive than Syntax I for evaluation of infarct size.

Key words: Syntax II score, Syntax I score, infarct size, Primary PCI.

INTRODUCTION

One of the most critical causes of death at the current time is acute myocardial infarction (AMI). [1]

The Syntax I score is a coronary angiogram-based anatomical scoring system that quantitatively defines the coronary vasculature in terms of the number, location, complexity, and functional impact of stenotic lesions. Syntax I calculation is done to assess the complexity of the coronary artery and allows patients undergoing PCI to be prospectively risk stratified .[2]

Syntax score II (figure 1) is used to estimate mortality for patients who have complex lesions after PCI and coronary artery by-pass graft (CABG). Six clinical variables [age, gender, creatinine clearance, peripheral vascular disease, chronic obstructive pulmonary disease (COPD), and left ventricular ejection fraction] and two anatomical variables [anatomical SS and unprotected left main coronary artery disease] are the main components of the Syntax score II. [3].

In this study, we planned to evaluate the additive benefit of Syntax II to Syntax I score in prediction of infarct size, which was evaluated by ECG with calculation of modified Selvester score, echocardiography by calculating of ejection fraction by Simpson's method and wall motion score index, and laboratory investigations in the form of peak CK, CKMB and troponin in STEMI patients managed with primary PCI.

METHODS

This is a retrospective cross-sectional study enrolled 150 patients with acute STEMI and was conducted in Zagazig University Hospitals and Nasr City Insurance Hospital, Cairo, Egypt, from

June 2018 to January 2020. Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans**.**

Inclusion Criteria:

Patients admitted with STEMI defined as > 30 minutes of persistent typical angina pain and ST-segment elevation > 1 mm in two contiguous limb leads or > 2 mm in two contiguous precordial leads and positive cardiac biomarkers, prepared for primary percutaneous coronary intervention [4]. Syntax I and Syntax II scores were calculated and compared to many variables. Syntax I is a coronary angiogram-based anatomical scoring system that quantitatively characterizes the coronary vasculature in terms of the number, location, complexity, and functional influence of angiographically stenotic lesions. Syntax I is estimated to characterize the complexity of the coronary artery and enables prospective risk stratification of patients undergoing PCI [2]. Six clinical variables [age, gender, creatinine clearance, peripheral vascular disease, chronic obstructive pulmonary disease (COPD), and left ventricular ejection fraction] and two anatomical variables [anatomical SS and left main coronary artery disease (ULMCA)] are included in the Syntax II score [3].

Exclusion Criteria: Patients with NSTEMI, unstable angina, malignancy, intolerance to dual antiplatelet therapy, advanced liver disease, advanced kidney disease and coagulopathy were excluded from the study.

Study Methodology:

One hundred and fifty (150) STEMI subjects who were candidates for PPCI and fulfilled inclusion criteria had been enrolled in this retrospective study. History taking and physical examination with analysis of the chest pain and revision of the risk factors such as diabetes mellitus (DM) defined as glycosylated haemoglobin (HbA1C) more than 6.5 and fasting blood glucose (FBG) >126 mg/dl, hypertension (HTN) defined as measured systolic blood pressure is more than or equals 140 and or diastolic BP more than or equal 90 mmHg, peripheral vascular disease (PVD) defined as exercise induced claudication, weak peripheral pulsations, previous revascularization therapy or angiographic narrowing more than 50 % or combination of these features, COPD defined as prolonged use of corticosteroids or bronchodilators for pulmonary disease [5,6].

ECG as soon as possible to confirm diagnosis of STEMI. Philips machine has been used for recording the twelve lead surface ECGs with speed of 25 mm/ second and a 10 mm/mv calibration. ECG presenting site of infarction was as follow: Antroseptal MI: ST rise more than two mm in (V1, V2,). Anterior MI: ST rise more than two mm in (V1 to V4). Extensive anterior: ST rise more than two mm in leads from (V1 to V6). Lateral MI: ST rise more than two mm in (V5 and V6). Inferior wall MI: ST rise more than one mm in (LII, LIII, and AVF). High lateral MI: ST rise more than one mm in (L1 and AVL).

Modified Selvester score was used to estimate infarct size and was calculated from ECG. It is a simplified version of Selvester QRS score including only 37 criteria instead of 57 criteria with total 32 points. Each point represents 3 % of LV. Based on Q or R wave duration, R or S wave amplitude and R/Q or R/S amplitude ratios, both scoring systems were determined [7].

Transthoracic echocardiography was performed during hospital admission by using the Vivid 9 system with the following measurements had been done:

Ejection fraction (EF): The modified Simpson biplane technique from the apical four chambers and apical 2-chamber view was used to estimate the systolic function .Normally it ranges from 50-70 % [8].

Wall motion score index (WMSI): Using a standard transthoracic echocardiography views parasternal long axis view (PLAX), parasternal short axis view (PSAX), apical 4 chamber and apical 2 chamber views; each myocardial segment is assigned a score from 1 to 4 is given to each myocardial segment. The 16-segment model of myocardial segmentation is more preferred, as the apical cap of the 17-segment model is acontractile and therefore more appropriate for perfusion imaging. The left ventricle divided as follows [9].

Basal segments

Six segments, each encompassing 60 degrees of the left ventricular short axis.

Basal anterior, basal anterolateral, basal inferolateral, basal inferior, basal inferoseptal. And basal antroseptal.

Mid segments

In a similar manner to the base, divided into six segments

Apical segments

Divided into 4 90-degree segments.

Apical anterior, apical lateral, apical inferior, apical septum.

Each myocardial segment is then scored, using the following criteria: Normokinesia (1 point): normal thickening with normal endocardial excursion.

Hypokinesia (2 points): reduced thickening with reduced endocardial excursion. Akinesia (3 points): absent either wall thickening or endocardial excursion. Dyskinesia (4 points): systolic thinning or outward stretching including "aneurysmal" wall motion, with eccentric bulge during both systole and diastole.

Coronary angiography done in standard angiographic views followed by primary PCI to the culprit vessel.

Lab investigation for analysis of CK, CKMB, troponin and kidney function.

Calculation of Syntax I and Syntax II scores: A computer program consisting of serial and interactive self-guided questions calculates the Syntax I score (figure 2, 3). Twelve main questions are the components of the algorithm. They can be categorized in two groups:

Dominance, total number of lesions and the vessel segments involved per lesion are determined by the first three, and they appear one time. The extreme number of lesions allowed is twelve and each lesion is given a number, from one to 12. In the numerical order inserted in question 3, the lesions will be scored. Each lesion can encompass more than one segment. In this case, each vessel segment involved shares in the lesion scoring. The number of segments involved in each lesion is not limited. The last nine issues relate to the features of adverse lesions and are repeated with each lesion. The first question is referring to a total occlusion. If a complete occlusion is chosen, answers to detailed sub questions must be replied. The last of these sub questions asks about the status of side branches if they are present or absent and their size. If no side branches are encountered or if their size is <1.5 mm then the questions related to the trifurcation and bifurcation lesions will be automatically ignored since vessels <1.5 mm are considered not suitable for treatment either with PCI or CABG. For side branches diameters more than or equal 1.5 mm, then the lesion is considered to continue with all the questions of the algorithm. For non-occlusive lesions, we do the same steps. All the other questions of the algorithm can be answered by selecting “yes” or “no”, with the exception of the selection of the type in case of a bifurcation or a trifurcation lesion” [10].

Six clinical variables [age, sex, creatinine clearance, peripheral vascular disease, chronic obstructive pulmonary disease COPD, and left ventricular ejection fraction] and two anatomical variables [anatomical SS and ULMCA] are the main components of Syntax score II (figure 1) that is calculated by computed nomogram [3].

STATISTICAL ANALYSIS

The data were coded, entered and processed on computer using SPSS (version 18).The results were represented in tabular and diagrammatic forms. Mean, standard deviation, range, frequency and percentage were used as descriptive statistics. The following tests were done: Student's t-test was used to assess the statistical significance of the difference between two population means in a study involving independent samples. Student's paired t-test was used to assess the statistical significance of the difference between two population means in a study involving paired samples. ANOVA (F test) for normally quantitative variables, to compare between more than two groups. Value was considered significant as the following: $P > 0.05$: Non- significant. $P \le 0.05$: Significant

RESULTS

This cross section study was conducted in the period from June 2018 to January 2020 at catheterization Laboratory of Cardiology Department, Zagazig University hospitals and Nasr City insurance hospital. Study included 150 patients presented with acute STEMI managed with primary PCI, Syntax I and Syntax II scores were calculated and compared to many variables as will be shown.

Demographic data of the study group (table 1):
The study group mean age was 59.7± 10.6 years. Regarding the gender, there were 101 males with the percentage of (67.3 %) and 49 females with the percentage of (32.7 %).

Cardiovascular risk factors of the study group:
81 patients of our study group had hypertension with the percentage of 54 % **,** 80 patients of our study group were diabetic with the percentage of 53.3 % **,** 96 patients were smokers with the percentage of 64 % **,** 29 patients had COPD making percentage of 19.3 % and 25 patients had PAD with the percentage of 16.7 %

Myocardial infarction localization of the study group:
58 patients had inferior MI with the percentage of 38.7 %, 74 patients had anterior MI with the percentage of 49.3%, 10 patients had lateral MI with the percentage of 6.7%, 8 patients had inferoposterolateral MI with the percentage of 4%.

Laboratory investigations:
CKMB mean was 380±375.9.Troponin I mean was 20.3±14.1. Cr Cl mean was 86.9±26.1

Ejection fraction (EF) and wall motion score index (WMSI):
EF mean was 42 ±10.3. WMSI mean was 1.71±0.72.

No of coronary vessels with lesions

75 patients had single vessel disease (SVD) with the percentage of 50 %. 36 patients had two vessel diseases (2VD) with the percentage of 24 %. 39 patients had multivessel disease (MVD) with the percentage of 26 %.

Syntax I and Syntax II scores:

Syntax I score ranged from 3-39.5. Mean was 17.0±8.7 .Syntax II score ranged from 12-77. Mean was 33.9±16.6.

Relationship between modified Selvester score and age :

There was significant correlation between old age and high modified Selvester score more than 4 with approximately infarct size 12 %.

Relationship between different variables and Modified Selvester score :

There was significant correlation between high modified Selvester score more than 4 which correspond to infarction size 12 % and high CKMB, CK, troponin and WMSI and negative correlation between high modified Selvester score and ejection fraction.

Correlation between Sx I, and Sx II scores with modified Selvester score (table 2):

From our study, we found that high modified Selvester score more than 4 which represents infarct size 12 % correlates with Sx 1 score 24_+6 while correlates with Sx II score 46_+15

Relationship between infarction size and diabetes mellitus(table 3):

Patients were separated into 2 groups: diabetic group (80) and non-diabetics group (70). There was positive relationship between diabetes mellitus (DM) and infarct size with p value <0.001.

Relationship between infarction size and hypertension (table 4) :

Patients were allocated into 2 groups: hypertensive group (81) and normotensives group (69). There was positive relationship between HTN and infarct size all parameters with p value <0. 001.

Relationship between infarction size and peripheral arterial disease (PAD) :

Patients were allocated into 2 groups: patients with PAD (25) and patients without PAD (125).There was positive relationship between peripheral artery disease (PAD) and infarct size all parameters. p value <0.001.

Relationship between infarction size and smoking :

Patients were allocated into 2 groups: smokers (96) and non-smokers (54). There was no significant relationship between smoking and infarct size regarding all parameters except with EF where p value was 0.02.

Relationship between Sx II score and infarction site :

There was strong correlation between anterior STEMI and high Syntax II score (p value = 0.001 and F test =10.4.

Relation between Syntax I score and infarction site :

There was strong correlation between anterior STEMI and high Syntax I score (p value = 0.001 and F test = 24.8).

Relationship between Syntax II score and mortality:

There was strong correlation between mortality and Syntax II scores (p value < 0.001 and t test 7.5).

Relationship between Sx I score and mortality:

We found positive relationship between mortality and Syntax I score (p value < 0.001 and t test 7.3).

Relationship between Syntax II score and number of affected coronary vessels :

We found positive relationship between high Syntax II score and number of affected coronaries (p = 0.001 and F = 146.8).

Additive value of Syntax II to Syntax I in prediction of infarct size (table 5) :

After statistical analysis of all previous data regarding Syntax I and Syntax II score; it was found that Syntax II score was more sensitive (88.3)% and more specific (78.6) than S x I which has sensitivity 56.4 % and specificity 76.8 % in prediction of infarct size with accuracy 84.7 % for Syntax II and 64 % for S x I .Positive predictive value for Syntax II score was 87.4 compared to 80.3 for Syntax I while negative predictive value for Syntax II score was 80 compared to 51.2 for Syntax I .

Table (1) Demographic data of study Group

ITEM			
Age	**Mean ±SD**	59.7±10.6 years	
	Range	36 – 78 years	
Gender	**Male**	No	101
		Percentage	67.3%
	Female	No	49
		Percentage	32.3%

Table (2) Correlation between modified Selvester score with Sx1 and Sx II scores

Modified Selvester score		S x I	Sx II
<4	$\overline{X}$ ±SD	11.2927_+5.84467	23.914_+9.6009
≥4	$\overline{X}$ ±SD	24.0735+_6.74552	46.485_+15.446

Table (3) Relationship between DM and infarct size

		Non diabetic 70 patients	Diabetic 80 patients		
CK (mean)		3790±3029	6080±4782	t 3.4	P<0.001
CKMB	mean	189	289	MW 5.6	P< 0.017
	Range	85-787	69-2152		
EF(mean)		46±.6.7	38.5±11.5	t 4.7	p<0.001
WMSI(mean)		1.45±0.5	1.94±0.8	t 4.4	<0.001

abbreviations ?

Table (4) Relationship between HTN and infarct size

		Normotensives (69 patients)	Hypertensives (81 patients)	Test	P-value
CK (mean)		3183±2683	6569±4634	t 5.3	P<0.001
CK-MB	mean	175	387	MW 21.8	P<0.001
	Range	82-787	69-2152		
EF(mean)		47±.6.8	37.8±10.8	t 6.1	<0.001
WMSI(mean)		1.42±0.5	1.96±0.8	t 4.89	<0.001

abbreviations ?

Table (5) Relationship between Syntax I and Syntax II score regarding infarct size

	Sensitivity	specificity	Predictive value		accuracy
			positive	negative	
Sx I	56.4%	76.8%	80.3	51.2	64 %
Sx II	88.3%	78.6%	87.4	80.0	84.7

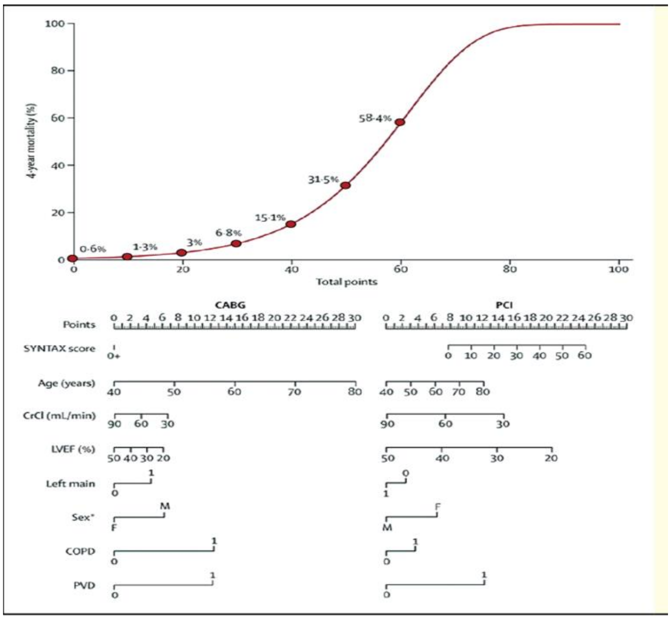

Figure (1) showing Syntax II nomogram

Table 1. The SYNTAX score algorithm

1. Dominance
2. Number of lesions
3. Segments involved per lesion, with lesion characteristics
4. Total occlusions with subtotal occlusions:
   a. Number of segments
   b. Age of total occlusions
   c. Blunt stumps
   d. Bridging collaterals
   e. First segment beyond occlusion visible by antegrade or retrograde filling
   f. Side branch involvement
5. Trifurcation, number of segments diseased
6. Bifurcation type and angulation
7. Aorto-ostial lesion
8. Severe tortuosity
9. Lesion length
10. Heavy calcification
11. Thrombus
12. Diffuse disease, with number of segments

Figure (2) showing Syntax I score algorithm

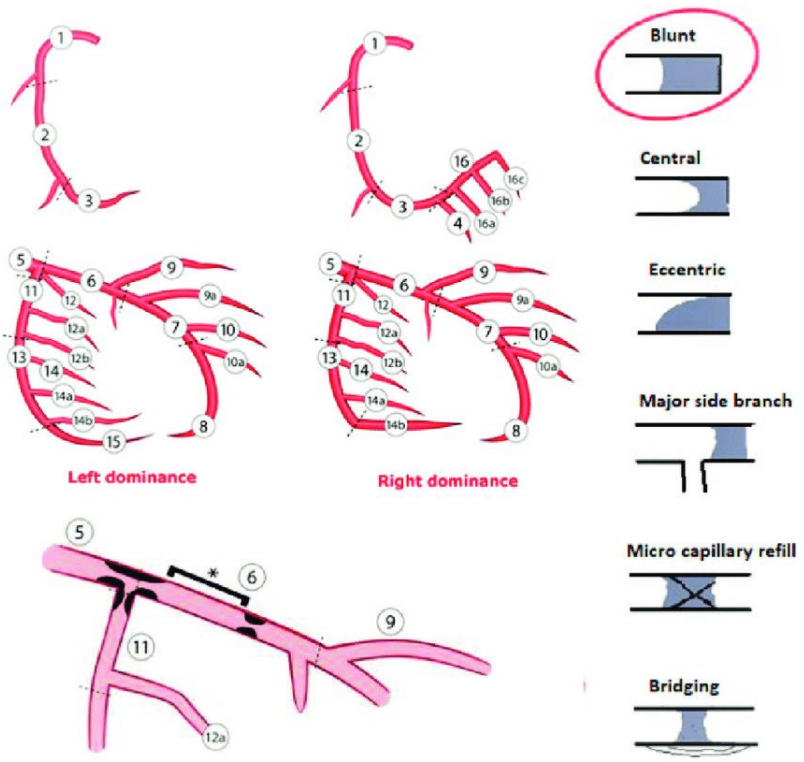

Figure (3) showing Syntax I score simulation

DISCUSSION

In the current study, It was found patients enrolled in our study were relatively younger than those patients participated in the national registry of myocardial infarction (NRMI) with mean age (59.9 versus 76.9) respectively [11].

Most of our study patients were males (67.3 %) while in the NRMI the male gender constituted 50.3% only. females were lower compared to the Euro Heart survey (EHS) patients in which females were represented by 73% versus 32.7 % in our study [11].

We also found that in our study, smoking presented the highest predominant risk factor which was present among 64 % of patients, followed by HTN (54 %) and DM was present in 53% of patients. In the EHS on PCI registry, smoking was present in 60% of patients, DM was found in 25% of patients. This might be explained by poor dietary habits and sedentary life style among Egyptian population as this may increase the overall prevalence of HTN and DM [11].

In our study, there was strong relationship between DM and infarct size when compared to non-diabetic group regarding ejection fraction EF, CK, CKMB and WMSI with p <0.001. Mather et al. showed in their study that included 93 patients who had acute MI that diabetic patients had greater infarct sizes than non-diabetic patients with CMR at baseline LV scar (mean (SD)) percentage was 23.0 percent (10.9), 25.6 percent (12.9) and 15.8 percent (10.3) respectively (p = 0.001) [12].

Lehto et al. also showed that the poor outcome of myocardial infarction in diabetic patients seems to be explained not just by the greater scale of the infarction, but also probably by the adverse effects on myocardial function of the diabetic condition itself. [13].

In our study, there was positive relationship between HTN and infarct size when compared to normotensive group regarding EF, CK, CKMB and WMSI with p < 0.001. Mehdipoo et al. showed in their study which included more than 2000 patients (1196 patients had HTN) with STEMI from 7 randomized trials that there was no association between hypertension and greater infarct size. [14].

De Luca et al. showed also STEMI patients who underwent primary PCI, \ infarct size assessed by MPI, was not affected by hypertension [15].

In a study done by Dallenbach et al. on 253 patients with acute STEMI, Syntax I score was an extra tool in anticipation of infarction size in patients managed with primary PCI and identifying high-risk group. [16].

Another study done by Choudhary showed that Syntax score was calculated in 90 sequential patients (mean age 54.2 ± 11.6) of STEMI managed with primary PCI. Outcomes were arranged according to syntax score groups: Syntax low ≤15 (n = 33), Syntax mid 16–22 (n = 30), and Syntax high ≥23 (n = 27). All-cause mortality at 30 days was the primary endpoint. the Syntax high group showed the higher mortality at 30 days compared to the Syntax mid and Syntax low group (18.5% vs 3.3% p = 0.011)] [17].

In our study, there was strong positive correlation between mortality and Syntax I score that showed high mortality with mean Syntax score I (30±8.3). Mortality was high mainly due to very poor ejection fraction and very large size of ischemic myocardium.

In a study done by Yang et al. which was done on total number of 9443 participants for this study. Results of this research showed that the risk of mortality in patients with a high SYNTAX Score II > 17 was significantly higher (p=0.04) than patients with a low SYNTAX Score II <17. Even when participants with a low SYNTAX Score II < 20 were compared with patients who were assigned to a higher SYNTAX Score II > 20, a significantly higher risk of mortality was associated with a high SYNTAX Score II (p=0.0001) [18].

In our study, there was strong positive correlation between mortality and Syntax II score where mean value of Syntax score II was 59 ± 13.7 and range from 19 to 77. Mortality was due to many factors mainly poor ejection fraction, very large ischemia and associated renal impairment.

Actually very limited data about the correlation between Syntax II score and infarct size, In our study, After statistical analysis of all previous data regarding Sx I and Sx II score; it was found that Sx II score was more sensitive (88.3%) and more specific (78.6%) than Sx I which has sensitivity 56.4 % and specificity 76.8 % in prediction of infarct size with accuracy 84.7 % for Sx II and 64 % for Sx I. positive predictive value for Sx II score was 87.4 compared to 80.3 for Sx I while negative predictive value for Sx II score was 80 compared to 51.2 for Sx I .

CONCLUSION

In ST elevation myocardial infarction patients, who were managed with primary PCI, Syntax II score was more sensitive and specific than Syntax I for prediction of infarct size.

Conflict of interest

The authors declared that they have no conflicts of interest with respect to the authorship and/ or publication of this article.

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