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Original Article

Investigating and Comparing the Relationship between the SYNTAX Score and Short-Term and Long-Term Consequences of Patients with STEMI under Thrombolytic Treatment and then Angiography in the Years 2018-2020

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Abstract

Background: The SYNTAX score is a strong predictor of adverse cardiovascular events such as cardiac death, myocardial infarction, and lesions with revascularization. This rating was also confirmed for patients with left ventricular problems and all the patients referred for percutaneous coronary interventions Percutaneous Coronary Interventions (PCI).

Methods: This study was conducted on 107 patients with ST-Elevation Myocardial Infarction (STEMI) who underwent thrombolytic treatment and then angiography. SYNTAX score was calculated in all the patients. Finally, the short-term and long-term prognoses were examined. Finally, the STR values were compared in two groups of people with high syntax and low syntax.

Results: Eighteen patients (16.8%) suffered Congestive Heart Failure (CHF), one (0.9%) experienced GI bleeding, and one (0.9%) suffered ReMI. The patients' mean±standard deviation, maximum, and minimum SYNTAX scores were 12.82±7.19, 35, and 3, respectively. Twelve patients (11.2%) had SYNTAX scores higher than 22 (high risk), and 95 (88.8%) had scores lower than 22 (low risk).

Conclusion: Results of the present study indicated that patients with SYNTEX scores >22 had STR lower than 50. CHF incidence rate in patients with SYNTAX scores higher than 22 (high risk) was higher. There was also a significant relationship between the patients' prognosis and SYNTAX scores.

Keywords: Angiography, Heart failure, Myocardial infarction, Percutaneous coronary intervention, ST elevation myocardial infarction

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Introduction

ST-Elevation Myocardial Infarction (STEMI) most often occurs after a complete occlusion of a coronary artery resulting from a sudden decrease of the blood flow following a thrombotic occlusion of a coronary artery caused by atherosclerosis. Chest pain typically felt in the substernal area or sometimes in the epigastrium, is the main clinical symptom of STEMI (1).

Coronary artery blood supply disorder and its disproportionality with the myocardium's requirement usually causes ischemia and hypoxia and eventually leads to myocardial necrosis. In almost all vascular pathology patients, atherosclerosis is often accompanied by thrombosis and occlusion of one of the coronary arteries (2). Reperfusion therapy in acute myocardial infarction attempts to reduce the mortality rate (3).

Despite the substantial advances in the diagnosis and treatment of STEMI within the last four decades, it remains one of the major health concerns (4). Primary angioplasty has significant advantages compared with thrombolytic therapy, including restoration of excellent blood flow, anatomical determination of the lesion site, and reduction of the mechanical complications of infarction. Delays in reopening the occluded artery using one of the mentioned methods can cause extensive myocardium injury and increase the mortality rate (5-8).

The SYNTAX scoring system is a tool for grading coronary artery stenosis severity. It can also determine the prognosis of the candidates for revascularization operations, especially Percutaneous Coronary Interventions (PCI). This scoring system is a proven effective tool for classifying the patients with complex coronary artery diseases for treatment with PCI, pharmacotherapy, or Coronary Artery Bypass Grafting (CABG) (9).

SYNTAX score is also a repeatable angiography tool to determine the extent of coronary artery diseases based on the condition and complexity of each injury and a strong predictor for adverse cardiovascular events, including cardiac arrest, myocardial infarction, and revascularization of lesions (10-13).

Considering the results and various findings of different studies, we tried to investigate and compare the relationship between the SYNTAX score and the short-term and long-term consequences of the thrombolytic treatment group and then the angiography of individuals with STEMI in the present study.

Materials and Methods

This cross-sectional study investigated 107 STEMI patients with SYNTAX scores for hospitalization at Shahid Madani Hospital of Tabriz City between 2018 and 2020. Sampling was in the form of a census. The target population included 107 STEMI patients under thrombolytic treatment and then angiography with high and low SYNTAX who were residents of Tabriz City and visited the cardiology ward of the Shahid Madani Hospital of Tabriz University of Medical Sciences between 2018 and 2020. Patients with a history of infarction, unregistered time of the visit or reteplase administration, and those not indicating increased cardiac markers were excluded from the study. The first stage of the study included reviewing the patients' files, and in the second stage, after obtaining the written consent from the patients, the ECG and cardiac markers were investigated. The medical triage team and the internal medicine assistant of the center diagnosed STEMI, and if needed, consulted with the on-duty cardiologist and injected reteplase fibrinolytic drug at the emergency ward.

The thrombolytic therapy criteria included the patient's clinical symptoms and the results of the ECG. The time of the first visit to the physician at triage was recorded in the medical form or order sheet. The on-duty internal medicine emergency intern reported the patient's vital signs every five minutes in the chart for patients treated with reteplase, and the time of fibrinolysis was extracted from this chart. The time between the triage physician's visit and the therapy initiation was considered the Door-to-Needle time (DTN). The time between the onset of myocardial infarction symptoms and visiting the hospital (reported in the patient's medical form) was also considered the Symptom-to-Door Time (STDT). Generally, the DTN and STDT were considered as the delay in reperfusion therapy or ischemia time.

Study inclusion criteria were the completeness of the angiography sheet, the presence of angiography and angioplasty film, and the exclusion criteria

included illegibility and incomplete information of the angiography sheet or lack of access to the report and film of angiography and rescue PCI cases.

SYNTAX score

This scoring system is an accurate and unique tool for scoring the level of complexity of coronary artery diseases. Since proper use of this scoring tool is critical, the related specialists were fully trained before practicing it.

The total SYNTAX score is the sum of an individual's scores for each lesion (for instance, defined as 50% stenosis in a 1.5 *mm* vein). Two of the three experienced cardiologists who were completely aware of the data and the clinical results of the patients' angiography reviewed every angiography variable related to the SYNTAX score. In cases of disagreement between the two cardiologists, the third supervisor made the final decision.

A checklist, including demographic information (*i.e.,* age, sex, blood pressure, history of diabetes mellitus, triglyceride level, smoking at the moment, Marfan syndrome, history of chronic obstructive diseases, renal failure, history of smoking, history of cardiac surgery) and information obtained from imaging and during the treatment, and laboratory information was prepared. The data was collected through clinical examination, condition reports, and acquired questionnaires after the patients' visits.

Statistical analysis

All data were analyzed using SPSS software (version 20; IBM Corp., Armonk, NY, USA). The results are expressed as Mean±standard deviation or percentage. Kolmogorov-Smirnov test was used to assess the normal distribution of data. A student t-test was utilized to compare the quantitative data, and a chi-squared test was used to compare qualitative and frequency data. Fisher's test was used to check the dependence between two groups of unpaired qualitative data. p-values of less than 0.05 were considered statistically significant.

Ethical considerations

Carrying out the project required obtaining a code of ethics from the ethics committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1400.530). Ethical principles mentioned in the Helsinki Convention regarding working with human samples were observed.

Results

In this study, 107 patients with STEMI who underwent thrombolytic therapy and then angiography, were reviewed. Table 1 presents the demographic data of the patients. A total of 54 patients (50.5%) suffered an anterior Myocardial Infarction (MI), and 53 patients experienced a non-anterior MI (49.5%). Figure 1 shows the patients' Thrombolysis in Myocardial Infarction (TIMI) score and Killip class. Mean, maximum, and minimum DTN were 50.41±27.17,

Table 1. Demographic data of the patients

Variables		Frequency
Age (year)		57.06±9.38 (35-82)
Sex	Male	88(82.2%)
	Female	19(17.8%)
Weight (*kg*)		77.54±13.64 (40-128)
Systolic pressure (SBP) (*mmHg*)		135.14±23.39 (70-230)
Diastolic pressure (DBP) (*mmHg*)		83.64±15.39 (50-120)
Heartrate (HR)		80.30±16.03 (36-117)
Hypertension (HTN)	Yes	48(44.9%)
	No	59(55.1%)
Diabetes mellitus (DM)	Yes	22(20.6%)
	No	85(79.4%)
Hyperlipidemia (HLP)	Yes	27(25.2%)
	No	80(74.8%)
Family history (FH)	Yes	8(7.5%)
	No	99(92.5%)
Smoking	Yes	67(62.6%)
	No	40(37.4%)
History of stroke	Yes	0
	No	107(100%)
History of CABG	Yes	1(0.9%)
	No	106(99.1%)
PCI	Yes	4(3.7%)
	No	103(96.3%)
IHD	Yes	4(3.7%)
	No	103(96.3%)

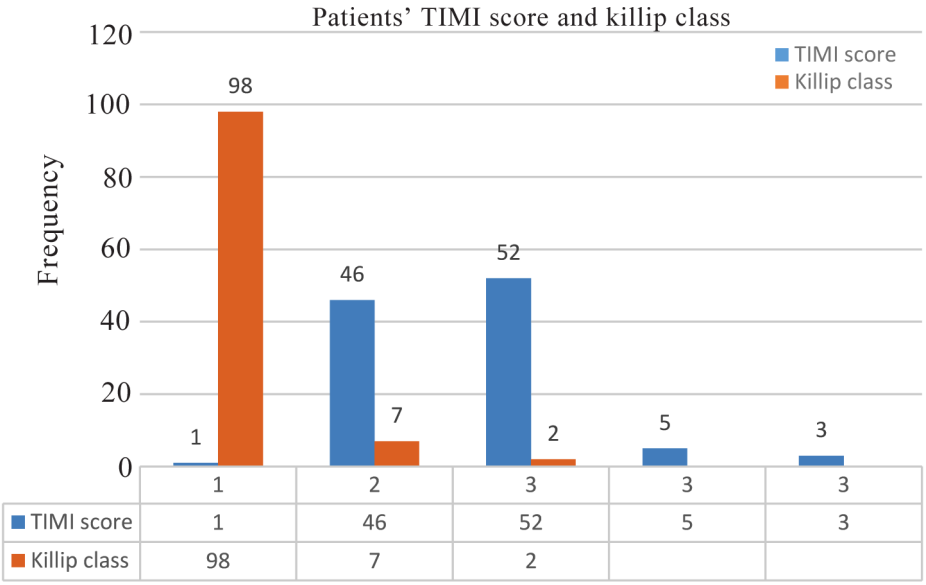

Figure 1. Patients' TIMI score and Killip class.

360, and 10 *min*, respectively. Mean, maximum, and minimum Total Ischemic Time were 9.1±84.74, 96, and 1 *hr*, respectively. Reteplase was the administered thrombolytic drug for all the patients.

The mean, maximum, and minimum interval between the thrombolytic therapy and angiography of the patients were 38.10±37.44, 240, and 2 *hr*, respectively. Table 2 presents the data regarding the ST elevation of the patients. Fifty-four patients (50.5%) indicated STRs higher than 50 percent. Also, in 47 patients (43.9%), the R wave in lead III was positive. Table 3 shows the angiography findings of the patients. Table 4 presents the severity of thrombosis and TIMI before and after the PCI. The mean, maximum, and minimum used contrast agent were 141.12±79.59, 500, and 40, respectively.

Twenty-five patients (23.4%) underwent CABG and 11 (10.3%) underwent staged PCI. In 31 patients, no stent was used. Fifty-two patients (48.6%) used one stent, 20 patients (18.7%) used two stents, two patients (1.9%) used three stents, and two patients (1.9%) used four stents. Tables 5 and 6 show the length and diameter of the stents, respectively. Percutaneous Old Balloon Angioplasty (POBA) was not used in 43 patients (40.2%). In 32 patients (29.9%), cardiologists used one; in 20 patients (18.7%) two; 10 patients (9.3%) three; one patient (0.9%) four; and in one patient (0.9%), five POBA were used.

The patients' mean±standard deviation, maximum, and minimum SYNTAX scores I were 12.82±7.19, 35, and 3, respectively. Twelve patients (11.2%) had SYNTAX scores I higher than 22 (high risk), and 95 (88.8%) had scores lower than 22 (low risk). None of the patients received thrombosuction. Figure 2 illustrates the drugs administered to the patients. None of the patients under treatment at the hospital expired. The mean, maximum, and minimum

Table 2. Data regarding the ST elevation of the patients

Variables		Frequency
Most STEMI	II	1(0.9%)
	III	50(46.7%)
	V2	15(14%)
	V3	34(31.8%)
	V4	4(3.7%)
	V5	3(2.8%)
Initial STE		2.36±4.29 (1-14)
Post thrombolysis STE		1.67±2.15 (0-9)
Lead number		1.59±4.60 (2-8)
Overall initial STE		8.26±12.31 (2-44)
Overall post thrombolysis STE		5.47±6.58 (0-25)
STEAVR	Yes	41(38.3%)
	No	66(61.7%)

Table 3. Angiography findings of the patients

Angiography findings		Frequency
Vascular disease (VD)	1VD	51(47.6%)
	2VD	31(29%)
	3 VD	25(23.4%)
Minimal CAD	Yes	1(0.9%)
	No	106(99.1%)
LM lesion	Yes	4(3.7%)
	No	103(96.3%)
Aneurysm	Yes	2(1.9%)
	No	105(98.1%)
Infarct related artery	LAD	56(52.3%)
	LCX	7(6.5%)
	RCA	44(41.1%)

Table 4. Severity of thrombosis and TIMI before and after the PCI

Variables		Frequency	
Thrombosis severity	0	2(1.9%)	
	2	15(14%)	
	3	28(26.2%)	
	4	39(36.4%)	
	5	23(21.5%)	
		After	Before
TIMI	0	23(21.5%)	4(3.7%)
	1	63(58.9%)	25(23.4%)
	2	19(17.8%)	25(23.4%)
	3	2(1.9%)	53(49.5%)

duration of patient hospitalization were 6.5±4.36, 24, and 2 days, respectively. No stroke, ICH, hematoma, hematuria, hemoptysis, or epistaxis occurred in the patients under treatment.

Eighteen patients (16.8%) suffered CHF, one (0.9%) experienced GI bleeding, and one (0.9%) suffered ReMI. Fifteen patients (14%) needed a blood transfusion. Six patients (5.6%) suffered Ventricular Fibrillation (VF) or Ventricular Tachycardia (VT), while none received cardiogenic shock. Three patients (2.8%) indicated Atrial Fibrillation (AF) rhythm and eight patients (7.5%) suffered Atrioventricular (AV) block. Left Bundle Branch Block (LBBB) occurred in three patients (2.8%), and one (0.9%) indicated Ventricular Septal Defect (VSD). PE and Right Bundle Branch Block (RBBB) occurred in no patient. Mild-to-moderate Mitral valve Regurgitation (MR) was diagnosed in 84 patients (78.5%); 13 patients (12.1%) demonstrated severe MR, and 13 patients (12.1%) showed no MR. The mean±standard deviation, maximum, and minimum EF of the patients were 35.51±7.61, 50, and 15 percent, respectively. Table 7 presents the patients' laboratory results. Follow-up revealed that seven patients (6.5%) expired, and 77 (72%) survived. Twenty-three patients (21.5%) responded to no call, and their status was unknown.

Results of the present study indicated a significant relationship between the STR >50 and the SYNTEX score I, as the patients with SYNTEX scores I higher than 22 (high risk) had STR <50 (p=0.013). There was also a significant relationship between the patients' prognosis and SYNTAX scores I (p=0.007), as patients with SYNTAX scores I and II higher than 22

Table 5. Diameter of the stents used in patients

Diameter of the used stent (*mm*)	Number of the used stents				
	0	1	2	3	4
2.25	-	2(1.9%)	1(0.9%)	1(0.9%)	-
2.5	-	5(4.7%)	2(1.9%)	3(2.8%)	-
2.75	-	10(9.3%)	3(2.8%)	-	-
3	-	24(22.4%)	10(9.3%)	-	-
3.5	-	29(27.1%)	6(5.6%)	-	2(1.9%)
4	-	5(4.7%)	1(0.9%)	-	-
4.5	-	1(0.9%)	1(0.9%)	-	-

Table 6. Length of the stents used in patients

Length of the used stent (*mm*)	Number of the used stents				
	0	1	2	3	4
12	-	9(8.4%)	3(2.8%)	-	-
13	-	6(5.6%)	2(1.9%)	-	-
14	-	1(0.9%)	1(0.9%)	-	-
15	-	1(0.9%)	1(0.9%)	-	-
16	-	7(6.5%)	-	1(0.9%)	1(0.9%)
18	-	1(0.9%)	-	-	-
19	-	8(7.5%)	3(2.8%)	1(0.9%)	-
20	-	5(4.7%)	3(2.8%)	2(1.9%)	1(0.9%)
21	-	4(3.7%)	1(0.9%)	-	-
23	-	2(1.9%)	2(1.9%)	-	-
24	-	6(5.6%)	3(2.8%)	-	-
26	-	5(4.7%)	1(0.9%)	-	-
28	-	4(3.7%)	-	-	-
29	-	7(6.5%)	-	-	-
30	-	-	1(0.9%)	-	-
31	-	4(3.7%)	2(1.9%)	-	-
32	-	3(2.8%)	-	-	-
34	-	1(0.9%)	-	-	-
36	-	1(0.9%)	-	-	-
40	-	1(0.9%)	-	-	-

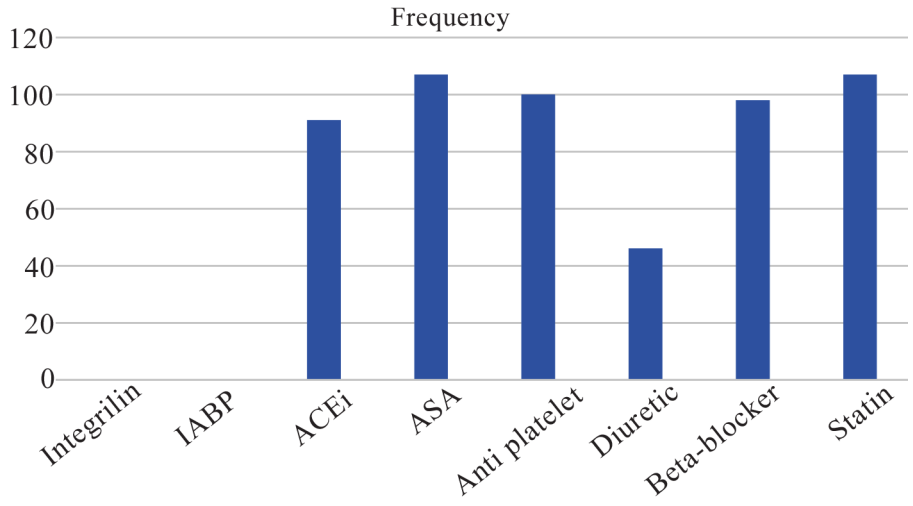

Figure 2. Drugs administered to the patients.

Table 7. Patients' laboratory results

Test	Mean±SD	Maximum	Minimum
Hb (*mg/dl*)	15.38±1.90	21	9.9
BS (*mg/dl*)	157.67±60.21	373	78
Plt (*1000)	221.22±63.79	625	50
TG (*mg/dl*)	155.68±130.22	880	42
LDL (*mg/dl*)	112.41±39.27	270	48
Cr (*mg/dl*)	1.10±0.29	2.9	0.7
CTNI.mean (*µg/L*)	10.32±8.04	40	0.1
CTNI.peak (*µg/L*)	16.02±10.99	40.6	0.1
CKMB.mean (*µg/L*)	114.78±123.30	454	14
CKMB.peak (*µg/L*)	122.85±120.43	454	14

had significantly higher mortality rates. Since there was no recorded patient mortality at the hospital, investigating the relationship between the SYNTAX score I and hospital mortality was impossible.

The results showed that the CHF incidence rate in patients with SYNTAX scores I higher than 22 (high risk) was higher (p=0.005). Furthermore, there was no significant relationship between the positive R-wave at the lead III with the VT and VF (p=0.534) and the location of the vascular occlusion site (p=0.961). The findings indicated that patients with SYNTAX scores I higher than 22 (high risk) had statistically significant positive R-wave at the lead III (p=0.006). It was also revealed that expired patients had statistically significant higher positive R-waves at the lead III (p=0.001).

The conducted analysis revealed that there was no significant relationship between the Positive R-wave at the lead III with patients' Ejection Fraction (EF) (p=0.192) and TIMI before (p=0.394) and after (p=0.272) the angiography. On the other hand, there was no statistically significant relationship present between the positive R-wave at the lead III with the Familial Hypercholesterolemia (FH) family risk factor (p=0.233), STR.avR (p=0.274), and number of the involved blood vessels (p=0.635). The patients' mean±standard deviation, maximum, and minimum SYNTAX scores II were 11.69±6.42, 37, and 5, respectively. Fourteen patients (13.08%) had SYNTAX scores II higher than 22 (high risk), and 93 (86.92%) had scores lower than 22 (low risk). According to table 8, the higher SYNTAX score II

Table 8. Syntax II score and patients' clinical outcomes after one month

Variables	Syntax score II <22 (low) N=97	Syntax score II ≥22 (high) N=10	Total (N=107)	p-value
ACS (Acute Coronary Syndrome)	4	8	12	0.003
Cerebrovascular accidents	1	2	3	0.285
Cardiac arrest	1	6	7	0.001
Revascularization	3	7	10	0.024
Multivariate mortality (all-cause mortality)	1	5	6	0.003

was significantly related to the patients' clinical outcomes after one month, such that patients with high SYNTAX score II (≥22) had high frequencies of ACS (acute coronary syndrome), cardiac arrest, revascularization, and multivariate mortality.

Discussion

Despite the acceptable advances in STEMI diagnosis and treatment, it is still one of the healthcare concerns, especially in developing countries. PCI advances have led us to desirable results in managing acute myocardial infarction (14). Acute STEMI treatment is through cardiac reperfusion by recanalization of occluded blood vessels. Early reperfusion may lead to better results (15). The synergy between percutaneous coronary intervention and SYNTAX determines the severity and complexity of the angiographic disease (6), which can help decide about the revascularization and predict the long-term mortality and morbidity of patients with Coronary Artery Disease (CAD) (16).

Syntax score is among the most valuable criteria for predicting the condition of stable patients with the multi-cardiac vessel or left main artery occlusion who undergo PCI or bypass surgery. Nevertheless, the prognostic value of SYNTAX score in unstable patients is controversial (17-19). Results of the current study showed that the mortality rate of patients with SYNTAX scores I and II higher than 22 was significantly higher. Choudhary *et al* also reported similar results indicating higher mortality of patients with high SYNTAX scores (15). Similar results by Ösken *et al* (14) and Akgun *et al* (20) demonstrated that mortality rates of patients with SYNTAX scores higher than 22 were significantly higher. A meta-analysis in 2022 by Yu *et al* showed that the SYNTAX score can be used to predict the mortality rate of patients with STEMI, as those with higher SYNTAX scores had higher rates (21).

Results of the present study indicated no hospital mortality among the patients with SYNTAX scores higher than 22. However, a study by Akgun *et al* showed that the hospital mortality rate was significantly higher in patients with higher SYNTAX scores (20). Results of a study by Kul also revealed that the hospital mortality rate of patients with high SYNTAX scores was higher (13). Khan *et al* also reported similar results (22).

CHF is among the complications that occur among STEMI patients who undergo PCI, and based on the findings of the current study, it was significantly more frequent in patients with SYNTAX scores higher than 22. The study of Khan *et al* also indicated similar results confirming the relationship between high SYNTAX scores and CHF in patients (22). Different studies showed that heart failure (hospital-acquired complications), cardiovascular complications, and non-fatal MI (out-of-hospital complications) were significantly higher in patients with higher SYNTAX scores (20,23). According to the present study, the higher SYNTAX score II was significantly associated with the patients' clinical outcomes after 30 days, such that patients with high SYNTAX score II had high frequencies of acute coronary syndrome, cardiac death, revascularization, and all-cause mortality. Bortnick *et al*, in a clinical trial, compared the residual synergy between percutaneous coronary intervention with taxus and cardiac surgery score II and long-term outcomes post-ST-elevation myocardial infarction in the USA. The trial revealed that the higher rSS-II score was significantly related to long-term consequences of post-STEMI in an urban population, implying a potential role for risk stratification with this measure in a non-trial setting (24).

Conclusion

Results of the present study indicated that patients with SYNTEX scores I >22 had STR lower than 50. CHF incidence rate in patients with SYNTAX scores I higher than 22 (high risk) was higher. There was also a significant relationship between the patients' prognosis and SYNTAX scores I and II, such that patients with high SYNTAX score II had high frequencies of acute coronary syndrome, cardiac death, revascularization, and all-cause mortality.

Conflict of Interest

The authors have no conflicts of interest to declare.

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