

## Clinical and demographic differences between patients with positive and negative troponin who were attended with supraventricular tachycardia and chest pain at emergency departments

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### Competing interests

The authors declare no competing interests

### Acronyms

SVT: supraventricular tachycardia

### ABSTRACT

**Introduction:** The presentation of supraventricular tachycardia (SVT) with chest pain and elevation of biomarkers contributes to the diagnosis of acute myocardial infarction in the patients who have them.

**Objective:** To evaluate the clinical and sociodemographic characteristics of patients with SVT and chest pain; as well as to know the prevalence of cardiovascular risk factors, electrocardiographic findings, troponin measurement results and the correlation of these variables with the results of ischemia detection tests and coronary angiography.

**Method:** There were reviewed the admissions to emergency departments of patients with SVT, chest pain, and high sensitivity troponin I measurement who underwent ischemia detection test or coronary angiography.

**Results:** A total of 199 patients with an average age of 68 years were included. The 53.3% (106/199) were women, 70.6% (141/199) had some cardiovascular risk factor and high blood pressure was more prevalent 53.8% (107/199). The 38.2% (76/199) of patients had positive troponins and showed statistically significant differences with respect to a higher heart rate (145.5 vs. 133.5 lpm,  $p < 0.05$ ) and a history of coronary disease (26.3% [20/76] vs. 9.8% [12/123],  $p < 0.05$ ). Men predominated (79.3% vs. 20.7%,  $p < 0.01$ ), with a history of coronary disease (41.4% [12/29] vs. 11.8% [20/170];  $p < 0.01$ ) and with positive troponins (79.3% [23/29] vs. 31.2% [53/170],  $p < 0.01$ ).

**Conclusions:** More than a third of patients with SVT and chest pain showed elevated troponins, which was related to the finding of coronary disease. The male sex and previous coronary disease were more frequently associated with significant coronary artery disease.

**Keywords:** Supraventricular tachycardia, Chest pain, High-sensitivity troponin, Coronary disease

**Diferencias clínicas y demográficas entre pacientes con troponina positiva y negativa que acudieron con taquicardia supraventricular y dolor torácico a los servicios de urgencias**

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**RESUMEN**

**Introducción:** La presentación de taquicardia supraventricular (TSV) con dolor torácico y elevación de biomarcadores contribuye al diagnóstico de infarto agudo de miocardio en estos pacientes.

**Objetivo:** Evaluar las características clínicas y sociodemográficas de pacientes con TSV y dolor torácico; así como conocer la prevalencia de factores de riesgo cardiovascular, hallazgos electrocardiográficos, valores de troponina y la correlación de estas variables con el resultado de pruebas inducción de isquemia y la coronariografía.

**Método:** Se revisaron los ingresos a urgencias de pacientes con TSV, dolor torácico, medición de troponina I de alta sensibilidad y estudios de inducción de la isquemia o coronariografía.

**Resultados:** Se incluyeron 199 pacientes con edad promedio de 68 años. El 53,3% (106/199) fueron mujeres, el 70,6% (141/199) tenía algún factor de riesgo cardiovascular y fue más prevalente la hipertensión arterial 53,8% (107/199). Un 38,2% (76/199) de pacientes tuvieron troponinas positivas y mostraron diferencias estadísticamente significativas respecto a una mayor frecuencia cardíaca (145,5 vs. 133,5 lpm;  $p < 0,05$ ) y antecedentes de enfermedad coronaria (26,3% [20/76] vs. 9,8% [12/123];  $p < 0,05$ ). Predominaron los hombres (79,3% vs. 20,7%;  $p < 0,01$ ), con antecedentes de enfermedad coronaria (41,4% [12/29] vs. 11,8% [20/170];  $p < 0,01$ ) y con troponinas positivas (79,3% [23/29] vs. 31,2% [53/170];  $p < 0,01$ ).

**Conclusiones:** Más de un tercio de los pacientes con TSV y dolor torácico mostraron elevación de troponinas, lo que se relacionó con el hallazgo de enfermedad coronaria. El sexo masculino y la enfermedad coronaria previa se relacionaron más frecuentemente con enfermedad coronaria significativa.

**Palabras clave:** Taquicardia supraventricular, dolor torácico, troponina de alta sensibilidad, enfermedad coronaria

**INTRODUCTION**

Supraventricular tachycardia (SVT) with chest pain and elevation of increasingly sensitive biomarkers contributes to the frequent diagnosis of acute myocardial infarction in the patients who have them. Therefore, it is essential to study the coronary anatomy or the presence of ischemia to rule out injuries that may require treatment<sup>1-3</sup>.

Previous studies found a prevalence of coronary disease of about 4-8% in patients with supraventricular arrhythmias. But they did not find any relationship between elevated troponin I (TnI), symptoms during arrhythmia, or ST segment depression during SVT, with an ischemia induction test or coronary arteriography with serious injuries. However, a higher prevalence of cardiovascular risk factors and older age was found<sup>1,2</sup>.

The aim of the study was to evaluate the clinical and sociodemographic characteristics of patients who presented to the emergency department with SVT and chest pain, to know the prevalence of cardiovascular risk factors, electrocardiographic findings, troponin measurement results and the correla-

tion of these variables with the result of ischemia induction tests, coronary angiography, or both.

**METHOD**

A descriptive and analytical cross-sectional study was carried out, which was approved by the ethics committees of the *Universidad Nacional de Colombia* and the *Fundación Clínica Abood Shaio*.

We reviewed 5719 admissions to the emergency department and included patients with SVT, chest pain, high-sensitivity troponin I measurement and ischemia induction test, with or without coronary angiography.

Data were collected on: age, sex, personal history (history of coronary artery disease, diabetes mellitus, smoking, dyslipidemia), heart rate and blood pressure at admission, electrocardiographic findings (type of arrhythmia, ST segment depression, pre-excitation pattern), transient elevation of the ST segment), value and troponin positivity or not

and ischemia induction tests results (stress test, dobutamine stress echocardiogram, myocardial per-

fusion test) and coronary angiography. Subgroups were analyzed according to the biomarker positivity and the result of the non-invasive study or coronary angiography.

### Exclusion criteria

We excluded those patients who presented some of the criteria that could elevate troponin I for a cause other than the imbalance of myocardial demand due to tachycardia, or coronary lesion: patients with associated ventricular tachycardia, history of severe aortic stenosis, functional class III and IV heart failure, chronic kidney disease with glomerular filtration rate  $<60$  ml/min/1.73 m<sup>2</sup> (at the time of biomarker collection) or main diagnosis of pulmonary thromboembolism, sepsis, myocarditis and cocaine abuse (by clinical history or positive urine screening) at discharge.

### Definition of coronary artery disease and positive ischemia induction tests

From the angiographic point of view, the disease was defined based on the presence of coronary lesion(s) with luminal stenosis of more than 75% in one or more coronary arteries, or  $>50\%$  in the left main coronary artery. A positive ischemia induction test was defined as a myocardial perfusion with a stress-inducible perfusion defect, stress echocardiogram with inducible wall motion abnormalities, or stress test with ST elevation and/or depression  $>1.0$  mm 0.08 seconds beyond J point. In cases where there was discordance between the result of the non-invasive test (stress, stress echocardiogram, myocardial perfusion) and coronary angiography, the latter was taken as the gold standard.

### Statistical analysis

To describe the sociodemographic and clinical characteristics of the sample of participants, we used absolute and relative frequencies when the variables were qualitative. When the variables were quantitative, we used measures of central tendency and dispersion: means and standard deviations or medians and interquartile ranges, depending on the data distribution.

The frequency of patients with positive or negative troponins and of patients with or without coronary lesions was presented by means of absolute and relative frequencies.

To compare the demographic and clinical variables between patients without coronary lesions or negative ischemia induction tests versus patients

with coronary lesions or positive ischemia induction tests, and between patients with and without elevated troponins, bar charts and standard means and errors graphs or boxplots (depending on the data distribution) with the use of Chi square tests or Fisher exact test for qualitative variables, depending on the frequency observed in the contingency tables; and for quantitative variables: t tests for independent samples or Mann-Whitney U tests, according to the data distribution in the comparison groups. In the analysis carried out, a type I error of 0.05 was assumed in the statistical packages R and Stata.

## RESULTS

### Description of the patient sample

A total of 199 patients were included in the study, 101 with atrial fibrillation or flutter, and 98 with another type of SVT. Their demographic and clinical characteristics are presented in **table 1**.

The average age among the two groups was 68 years. 53.9% of the patients in the study were women and 46.7% men. The average heart rate was  $138.1 \pm 29.4$ , systolic pressure was  $122 \pm 22.6$  and the majority of patients (70.6%) had some cardiovascular risk factor. Most prevalent were high blood pressure (53.8%) and dyslipidemia (24.6%). When comparing both groups, a higher prevalence of these risk factors was found in patients with atrial fibrillation/flutter compared to those who had another SVT, which turned out to be statistically significant.

The average age by analysis subgroups was 60 and 71 years in patients with SVT and atrial fibrillation/flutter, respectively, being statistically significant an older age in patients of the second group. Similarly, a higher heart rate, higher prevalence of high blood pressure, dyslipidemia and, at least, a risk factor in patients with atrial fibrillation/flutter were found.

### Description of troponin measurements

The frequency of patients with a first positive troponin measurement was 62 (31.2%), 35 (35.7%) in the group of patients with SVT and 27 (26.7%) in the group of atrial fibrillation/flutter. Of the total number of patients, only 71 had a second measurement of troponins that were positive in 46 of them (64.8%); 25 (64.1%) in the group of patients with SVT, and 21 (64.8%) in those with atrial fibrillation/flutter.

**Table 1.** Demographic and clinical characteristics of the patients included in the study.

Characteristics <sup>Ω</sup>	Patients with SVT (n=98)	Patients with atrial fibrillation/flutter (n=101)	Total (n=199)
Age [median (IQR)]	60 (50-74)	71 (63-77)*	68 (54-76)
Female sex	63 (64.3)	43 (42.6)*	109 (53.9)
Male sex	35 (35.7)	58 (57.4)*	93 (46.7)
Heart rate	145.5±33.3	130.9±22.9*	138.1±29.4
Systolic pressure	117.1±23.1	126.8±21.2*	122±22.6
Diastolic pressure	73.7±14.2	80.9±15.4*	77.4±15.2
Risk factors			
- Any risk factor <sup>Ⓜ</sup>	58 (59.2)	83 (82.2)*	141 (70.6)
- High blood pressure	41 (41.8)	66 (65.4)*	107 (53.8)
- Diabetes Mellitus	7 (7.1)	15 (14.9)	22 (11.0)
- Dyslipidemia	18 (18.4)	31 (30.7)*	49 (24.6)
- Smoking	4 (4.1)	6 (5.9)	10 (5.0)
- PH of coronary disease	15 (15.3)	17 (16.8)	32 (16.1)
ST segment depression	8 (8.2)	2 (1.9)	10 (5.0)
Transient elevation of the ST segment	1 (1.0)	1 (0.9)	2 (1.0)

Data express n(%) and mean ± standard deviation.

PH, personal history; IQR, interquartile range; SVT, supraventricular tachycardia.

<sup>Ω</sup> The absolute and relative frequency is presented for the qualitative variables or measures of central tendency and dispersion where it is specified.

<sup>Ⓜ</sup> At least one factor from the clinical history.

\* Value p<0.05 (Chi square test, Fisher exact test or Mann Whitney test).

**Table 2.** Frequency of coronary lesions (positive tests) in patients with positive troponins.

Diagnostic test <sup>Ω</sup>	Patients with SVT	Patients with AF	Total
Exercise stress test (n=7)	1 (16.7)	0 (0.0)	1 (14.3)
Dobutamine stress test (n=2)	0 (0.0)	0 (0.0)	0 (0.0)
Myocardial perfusion imagine (n=37)	1 (5.9)	6 (30.0)	7 (18.9)
Coronary angiography (n=48)	10 (43.5)	12 (48.0)	22 (45.8)

Data express n(%) and mean ± standard deviation.

AF, atrial fibrillation; SVT, supraventricular tachycardia

<sup>Ω</sup> Patients with positive troponins undergoing other tests.

### Description of the frequency of coronary lesions or positive ischemia induction test in patients with positive troponins

A patient was considered to have positive troponins when the result was positive in any of the two measurements, which occurred in 76 (38.2%) patients: 39

(39.8%) and 37 (36.6%) in the patients with SVT and atrial fibrillation, respectively.

All patients underwent induced ischemia or coronary angiography, or both: exercise stress (28) or dobutamine (2), myocardial perfusion (140) and coronary angiography (75). The frequency of is-

chemic lesions, given by the positive result of these tests –only in patients with a positive troponin measurement–, is presented in **table 2**.

### Comparison of demographic and clinical variables between patients with positive and negative troponin

The proportion of patients with positive troponins was 38.2% (76/199). The demographic and clinical variables were similar between those with positive and negative troponins (**Table 3**), with statistically significant differences with respect to a higher heart rate (145.5 vs. 133.5 bpm,  $p<0.05$ ), and to the antecedent of coronary artery disease (26.3% [20/76] vs. 9.8% [12/123],  $p<0.05$ ). A statistically significant difference was found in the group of patients with atrial fibrillation/flutter due to a higher proportion of patients with positive troponin in those who had dyslipidemia and a history of coronary disease, and in the SVT group a significant difference compared to a higher heart rate  $158.9\pm 34.5$  vs.  $136.6\pm 29.5$  bpm, and also a lower systolic pressure  $110.7\pm 20.5$  vs.  $121.3\pm 23.9$ . There was no difference in other variables such as age, sex, dyslipidemia or electrocardiographic findings of depression or ST-segment elevation in the total analysis group.

### Comparison of demographic and clinical variables among patients with coronary lesions or positive/negative ischemia induction tests

Coronary lesion was found in 29 (14.6%) patients: 12 (12.2%) of the group with SVT and 17 (16.8%) corresponding to the atrial fibrillation/flutter group. The comparison of the demographic and clinical variables both for the total group of patients and for the type of arrhythmia is presented in **table 4**.

The prevalence of coronary disease was 14.6% (29/199). In a larger proportion were men (79.3% [23/29] vs. 20.7% [6/29],  $p<0.01$ ), with a history of coronary artery disease (41.4% [12/29] vs. 11.8% [20/170],  $p<0.01$ ) and with positive troponins (79.3% [23/29] vs. 31.2% [53/170],  $p<0.01$ ).

When comparing the groups with and without coronary lesion, several statistically significant differences were found, among them: a greater proportion of male patients (23 [79.3%] vs. women 6 [20.7%]), a higher prevalence of antecedents of coronary disease (41.4% vs. 11.8%) and dyslipidemia (44.8% vs. 21.2%), greater number of patients with at least one cardiovascular risk factor (89.7% vs. 67.7%) and higher transient ST elevation (6.9% vs. 0%). Likewise, troponin elevation was statistically signifi-

cantly greater in patients with coronary lesion 53 (31.2%) vs. 23 (79.3%)  $p<0.001$ . Although there were percentage and numerical differences in the other variables, no statistically significant differences were found in those related to age, patients older or younger than 65 years old, history of high blood pressure, diabetes mellitus or ST segment depression.

In the analysis by groups, in those with SVT, a greater proportion of injuries was found in men 16 (41%) vs. 4 (33%), with a statistically significant difference ( $p=0.024$ ). The same difference is demonstrated in the finding of coronary disease in patients older than >65 years compared to the younger ones and in the higher prevalence of at least one risk factor 47 (54.7%) vs. 11 (91.7%),  $p=0.025$  and background of coronary disease 10 (11.6%) vs. 5 (41.7%),  $p=0.018$ . Although there were numerical and percentage differences in other variables, such as the prevalence of high blood pressure and dyslipidemia, these were not significant and it is striking that no difference was found between the finding of coronary disease in patients who did or did not have ST segment depression. In the atrial fibrillation group, in patients with coronary artery disease, a higher proportion of men was found (88%), women 2 (11.8%),  $p=0.006$ , and also a higher percentage of dyslipidemia, history of coronary disease, ST segment depression and positive troponins, all these variables showed statistically significant differences ( $p<0.05$ ).

## DISCUSSION

In previous studies, such as that of Dorenkamp *et al*<sup>2</sup>, the prevalence of coronary disease in patients with tachyarrhythmias had been investigated, and in other studies, such as that of Bukkapatnam *et al*<sup>1</sup>, the troponin elevation was studied and related to coronary disease. We included a population with and without chest pain, and with and without measurement of troponins or ischemia induction tests, or coronary angiography. Therefore, criteria for inclusion in the study included chest pain associated with tachyarrhythmia, as well as the measurement of troponin and blood test or not; in addition to having the largest patient sample in this type of study.

In our investigation we found a prevalence of intermediate troponin elevation, among those reported in previous studies with samples of similar amounts of patients 12%<sup>2</sup>, 32.3%<sup>4</sup>, 32.9%<sup>5</sup>, 48%<sup>1</sup>, and this positivity was much more observed in patients with coronary



**Table 3.** Comparison of sociodemographic and clinical variables among patients with positive and negative troponins.

Characteristics	Supraventricular tachycardia (n=98)		Atrial fibrillation/flutter (n=101)		Total (n=199)		
	Negative Tn (n=63)	Positive Tn (n=35)	Negative Tn (n=74)	Positive Tn (n=27)	Negative Tn (n=137)	Positive Tn (n=62)	p value
Age [median (IQR)]	60 (49-74)	61 (51-73)	70.5 (63-77.5)	72 (62-77)	68 (54-76)	68 (54.5-76)	0.853
Female sex	40 (67.8)	23 (58.9)	28 (43.8)	15 (40.5)	68 (55.3)	38 (50.0)	0.468
Male sex	19 (32.2)	16 (41.0)	36 (50.3)	22 (59.5)	55 (44.7)	38 (50.0)	<b>0.022*</b>
Heart rate	136.6±29.5	158.9±34.5	130.7±21.8	131.4±25.2	133.5±25.9	145.5±33.2	0.873
Systolic pressure	121.3±23.9	110.7±20.5	126.9±19.3	126.4±24.5	124.3±21.7	118.3±23.7	0.895
Diastolic pressure	75.9±14.7	70.3±13.1	83.2±14.6	77.1±16.1	79.7±15.0	73.6±14.9	0.053
Any risk factor	34 (57.6)	24 (61.5)	54 (84.4)	29 (78.4)	88 (71.5)	53 (69.7)	0.448
High blood pressure	23 (39.9)	18 (46.2)	45 (70.3)	21 (56.8)	68 (55.3)	39 (51.3)	0.168
Diabetes mellitus <sup>Ω</sup>	5 (8.5)	2 (5.3)	9 (14.1)	6 (16.2)	14 (11.4)	8 (10.5)	0.769
Dyslipidemia	10 (16.9)	8 (20.5)	15 (23.4)	16 (43.2)	25 (20.3)	24 (31.6)	<b>0.038</b>
Smoking <sup>Ω</sup>	2 (3.4)	2 (5.1)	5 (7.8)	1 (2.7)	7 (5.7)	3 (3.9)	0.411
PH of coronary disease	6 (10.2)	9 (23.1)	6 (9.38)	11 (29.7)	12 (9.8)	20 (26.3)	<b>0.008</b>
ST segment depression <sup>Ω</sup>	5 (8.5)	3 (7.7)	1 (1.6)	1 (2.7)	6 (4.9)	4 (5.3)	1.000
Transient elevation of the ST segment <sup>Ω</sup>	0 (0)	1 (2.6)	1 (1.6)	0 (0)	1 (0.8)	1 (1.0)	1.000

Data express n(%) and mean ± standard deviation.

PH, personal history; IQR, interquartile range; Tn, troponin.

<sup>Ω</sup> In the analysis of these variables, Fisher's exact test was performed because frequencies equal to or less than 5 were observed in more than 20% of cells in the contingency tables.

\* The comparison between these variables was made through the Mann-Whitney test. For the other variables, a t test was used for independent samples.

**Table 4.** Comparison of sociodemographic and clinical variables among patients with induction test of positive and negative ischemia/coronary angiography.

Characteristics	Supraventricular tachycardia (n=98)		Atrial fibrillation/flutter (n=101)		Total (n=199)		p value
	Without CL (n=86)	With CL (n=12)	Without CL (n=84)	With CL (n=17)	Without CL (n=170)	With CL (n=29)	
Age [median (IQR)] <sup>Ω</sup>	60 (49-74)	61 (51-73)	70.5 (63-77.5)	72 (62-77)	68 (54-76)	68 (54.5-76)	0.853
Age < 65 años	54 (62.8)	3 (25.0)	24 (28.6)	6 (35.3)	78 (45.9)	9 (31.1)	0.136
Age ≥ 65 años	32 (37.2)	9 (75.0)	60 (71.4)	11 (64.7)	92 (54.1)	20 (68.9)	0.580
Female sex	59 (68.6)	4 (33.3)	41 (48.8)	2 (11.8)	100 (58.8)	6 (20.7)	<b>0.000</b>
Male sex	19 (32.2)	16 (41.0)	43 (51.2)	15 (88.3)	70 (41.2)	23 (79.3)	<b>0.006</b>
Any risk factor	47 (54.7)	11 (91.7)	68 (80.9)	15 (88.4)	115 (67.7)	26 (89.7)	<b>0.015</b>
High blood pressure	34 (39.5)	7 (58.3)	57 (67.9)	9 (52.9)	91 (53.5)	16 (55.2)	0.870
Diabetes Mellitus*	7 (8.2)	0 (0.0)	11 (13.1)	4 (23.5)	18 (10.6)	4 (13.8)	0.536
Dyslipidemia	14 (16.3)	4 (33.3)	22 (26.2)	9 (52.9)	36 (21.2)	13 (44.8)	<b>0.006</b>
Smoking*	3 (3.5)	1 (8.3)	5 (5.9)	1 (5.9)	8 (4.7)	2 (6.9)	0.642
PH of coronary disease	10 (11.6)	5 (41.7)	10 (11.9)	7 (41.2)	20 (11.8)	12 (41.4)	<b>0.000</b>
ST segment depression*	7 (8.1)	1 (8.3)	0 (0.0)	2 (11.8)	7 (4.1)	3 (10.3)	0.164
Transient elevation of the ST segment*	0 (0)	1 (8.3)	0 (0.0)	1 (5.9)	0 (0.0)	2 (6.9)	<b>0.021</b>
Positive troponins	28 (32.6)	11 (91.7)	25 (29.8)	12 (70.6)	53 (31.2)	23 (79.3)	<b>0.000</b>

Data express n(%). PH, personal history; CL, Coronary lesion; IQR, interquartile range.

<sup>Ω</sup> The comparison between groups was made by the Mann-Whitney test.

\* In the analysis of these variables, Fisher's exact test was performed because frequencies equal to or less than 5 were observed in more than 20% of cells in the contingency tables

artery disease both in the total analysis group and in both subgroups of SVT and atrial fibrillation/flutter. This last finding, although there are few studies that have evaluated it, was not found in others<sup>1,2</sup>.

The coronary disease found in our series, 17%, was higher than that found in previous studies, 4%<sup>2</sup> and 13%<sup>1</sup>, perhaps due to a more exhaustive search of coronary disease by means of bloody or bloodless ischemia detection tests, to all patients investigated. Another possibility is that a population with a higher risk of coronary artery disease was included as the study was carried out in a referral center. The history of this type of disease was persistently found with greater prevalence both for the presentation of elevation of troponins and for coronary lesions, which agrees with some studies<sup>1,4</sup>, but not others<sup>2</sup>.

Our investigation shows that troponin elevation in patients with SVT, with associated chest pain, occurs in more than a third of those who present to the emergency department. Those with positive troponins had a higher proportion of significant lesions in the ischemia induction tests or in coronary angiography, in comparison with those with negative results, which represented a statistically significant difference.

The electrocardiographic findings evaluated in the study, which were found to be related to a greater proportion of coronary disease, were the ST segment elevation in the total analysis group and ST depression in the atrial fibrillation and flutter analysis subgroup. However, due to the small number of patients, each piece of information must be carefully interpreted.

To our knowledge, this study is the one with the largest sample in addressing the positivity of troponins in supraventricular tachycardias and their association with coronary disease. In this investigation, troponin elevation occurred in more than one third of patients with SVT and chest pain. Those with positive troponins showed a greater proportion of ischemia induction tests and positive coronary angi-

ography, which was statistically significant. The findings of this study suggest the need to request troponin tests in patients with SVT and chest pain, and to perform studies to rule out coronary disease when results are positive.

## CONCLUSIONS

More than a third of the patients with supraventricular tachycardias and chest pain showed elevated troponins, which was related to the finding of coronary disease. This suggests the need to make bloody or bloodless studies of the coronary anatomy in these patients.

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