

Self-assessment of vocal symptoms and vocal tract discomfort in individuals with type 1 diabetes mellitus

Autoavaliação de sintomas vocais e desconforto no trato vocal em indivíduos com diabetes mellitus tipo 1

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ABSTRACT

Purpose: To analyze the self-assessment of voice symptoms and vocal tract discomfort in individuals with and without Type 1 Diabetes Mellitus (T1D) and to analyze the influence of the time of diagnosis and the type of insulin therapy in the self-assessment. **Methods:** Sixty individuals participated, divided into two groups: Group I (G1) - 30 individuals with T1D; Group II (G2) - 30 individuals without T1D. The participants responded to the Voice Symptom Scale (VoiSS) and Vocal Tract Discomfort Scale (VTD). G1 participants also answered to a questionnaire to obtain data of the diagnosis and medical treatment of T1D. The data were analyzed using descriptive and inferential statistics. **Results:** There was no difference between groups for self-assessment of voice symptoms and vocal tract discomfort. In G1, a moderate positive correlation was found between time of diagnosis and the variables: burning frequency, burning intensity and frequency of soreness. In addition, there were significantly higher values of frequency and intensity of soreness and irritated throat in individuals who reported performing insulin therapy using an infusion pumps compared to those who realize multiple daily injections. **Conclusion:** Individuals with T1D have few vocal symptoms and vocal tract discomfort; they are not different from the control group. However, characteristics of the disease such as time of diagnosis and type of insulin therapy have influence in the perception of the frequency and intensity of some vocal tract discomfort.

Keywords: Self-assessment; Diabetes mellitus; Voice disorders; Larynx; Voice

RESUMO

Objetivo: Analisar a autoavaliação de sintomas vocais e do desconforto no trato vocal em indivíduos com e sem diabetes mellitus tipo 1 e analisar a influência do tempo de diagnóstico da doença e da forma de administração de insulino terapia na autoavaliação. **Métodos:** Participaram 60 indivíduos, divididos em dois grupos: Grupo I (G1) - 30 indivíduos com diagnóstico de diabetes mellitus tipo 1; Grupo II (G2) - 30 indivíduos sem a doença. Para avaliação dos desfechos, os participantes responderam às questões da Escala de Sintomas Vocais e da Escala de Desconforto no Trato Vocal. Os participantes do G1 responderam também a um questionário sobre o diagnóstico e do tratamento médico da diabetes mellitus tipo 1. Os dados foram analisados por meio de estatística descritiva e inferencial. **Resultados:** não houve diferença entre os grupos para a autoavaliação de sintomas vocais e desconforto no trato vocal. Em indivíduos do G1, foi encontrada correlação positiva moderada entre o tempo de diagnóstico e as variáveis frequência de queimação, intensidade de queimação e frequência de garganta sensível. Além disso, houve valores significativamente maiores de frequência e intensidade de garganta sensível e irritada em indivíduos que referiram realizar insulino terapia utilizando bomba de infusão, em relação aos que mencionaram aplicações ao longo do dia. **Conclusão:** indivíduos com diabetes mellitus tipo 1 apresentam baixa sintomatologia vocal e desconforto no trato vocal. Porém, as características da doença referentes ao tempo de diagnóstico e a forma de administração de insulino terapia influenciam a percepção da frequência e da intensidade de desconforto no trato vocal.

Palavras-chave: Autoavaliação; Diabetes mellitus; Distúrbios da voz; Laringe; Voz

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INTRODUCTION

Diabetes mellitus (DM) is a chronic, systemic disease, related to high levels of glucose in the blood and lack of insulin production - a hormone produced in the pancreas and responsible to maintain normal blood glucose levels⁽¹⁾. There are two types of DM classified according to the reason for the lack of insulin in the blood: type 1 (T1D) and type 2 (T2D). T1D is an autoimmune disease, which results in inefficient insulin production; T2D, the pancreas produces insulin, however, the body is ineffective at using the insulin it has produced and unable to metabolize glucose.

The insulin-dependent T1D or DM is characterized by a lack of insulin⁽²⁾. It is considered the second most common chronic disease in Brazilian children and adolescents^(1,3). In cases of T1D, the insulin is injected subcutaneously in order to keep normal serum insulin levels⁽⁴⁾. Thus, the T1D treatment is performed by taking insulin and controlling glucose levels in the blood. The most common types of insulin administration are insulin infusion pumps or applications throughout the day. The choice of which treatment depends on the characteristics of the disease and the patient⁽⁵⁾.

Some symptoms of the T1D are fatigue, tiredness, thirst and hunger⁽²⁾. In addition, some reports in the literature show association between DM and laryngopharyngeal reflux disease (LPRD)⁽⁶⁾ and laryngeal sensory neuropathy^(6,7). A study that analyzed the T2D and laryngopharyngeal symptoms showed a higher frequency of "throat clearing", "lump sensation in the throat" and "annoying cough" in patients with T2D versus the control group, individuals without T2D⁽⁶⁾.

Evidence are necessary to analyze possible influence of the T1D in vocal symptoms and vocal discomfort. Thus, there will be a better understanding of the T1D patients' complaints when they seek voice assessment and treatment. Also, it is important to analyze information of self-assessment tools and data on the disease, which may be the reason for such symptoms.

Therefore, the aims of the present study were: to analyze self-assessment of voice symptoms and vocal tract discomfort in individuals with and without T1D and to analyze the influence of the time of diagnosis and type of insulin therapy in the self-assessment.

METHODS

This is an observational, transversal and analytical study. It was approved by the Committee for Ethics in Research of UNICENTRO (n.3.231.344). The participants were recruited through social media. The sample selection and data collection were performed online using an invitation link that once clicked invited the participant to complete the survey via Google Forms®.

The inclusion criteria were: both sexes, aged between 18 and 54 years old and signed the informed Consent Form, agreeing to partake in this study. In addition, to place each participant among the study groups, self-referred diagnosis of T1D was considered. The exclusion criteria were: smoking,

self-referred diagnosis of previous laryngeal alterations and/or vocal disorders, respiratory problems, neurological or metabolic/hormonal alterations, hearing complaints and being a professional voice user. To include or not the participants a questionnaire with direct questions regarding the inclusion and exclusion criteria was applied. Some data of this questionnaire were considered to characterize the sample.

Thus, the sample of the present study counted with 60 individuals divided into two groups: Group I (G1) with 30 individuals with T1D, average age of 31 years 7 months, 16 men and 14 women; Group II (G2) with 30 individuals that did not have T1D, average age of 32 years old, 16 men and 14 women. The groups were the same considering age ($p=0.497$ – Independent T-test) and gender ($p=1.000$ – Fischer's exact test).

Two outcomes were assessed: self-assessment of vocal symptoms and self-assessment of vocal tract discomfort.

The Voice Symptom Scale (VoiSS)⁽⁸⁾ has been validated to the Brazilian Portuguese as an instrument to quantify the perception of vocal symptoms and their impact. The instrument has 30 statements that should be analyzed according to its frequency of occurrence using a Likert scale where 0 (zero) is never and 4 (four) is always. Each statement analyzes three factors or subscales: impairment, emotional and physical. Also, there is a total score. The simple sum of the answers gives the questionnaire score for each factor.

The Vocal Tract Discomfort Scale (VTD)⁽⁹⁾ has been translated to the Brazilian Portuguese⁽¹⁰⁾ and measures the frequency and intensity of the vocal tract discomfort. The instrument has 16 items regarding frequency and intensity of eight symptoms that must be answered considering a Likert scale where 0 (zero) is never and 6 (six) is always. The answered were analyzed individually considering the simple sum of the frequency and intensity of the symptoms related to vocal tract discomfort.

The participants of the G1 also answered to a questionnaire that aimed to obtain data of time of diagnosis (in years) and type of insulin therapy. This questionnaire was developed by the present study authors.

The data were analyzed using descriptive and inferential analysis. In the descriptive analysis, measures of central tendency, variability and position were calculated. To perform the inferential analysis, the quantitative data underwent the Shapiro-Wilk Test. The Independent T-Test was used to compare the normal variable of two independent groups; the Mann-Whitney Test was used to compare the non-normal quantitative variables. The Spearman Correlation was used to analyze the correlation between the non-normal quantitative variables. The correlation strength was analyzed⁽¹¹⁾. The Fisher's exact test was used to perform the association between two qualitative nominal variables. The significance level was set at 5%.

RESULTS

No difference was observed between both groups regarding self-assessment of vocal symptoms and self-assessment of vocal tract discomfort (Table 1).

Considering the G1, the median time of diagnosis was 15 years and the type of therapy more common was

Table 1. Comparison of the self-assessment of vocal symptoms and the vocal tract discomfort between individuals with and without Diabetes mellitus type 1

Variable	Group	Mean	SD	Minimum	Maximum	1Q	Median	3Q	p-value
VoiSS Impairment	G1	8.30	7.33	0.00	26.00	2.00	8.00	10.25	0.218
	G2	10.87	9.15	0.00	37.00	3.50	10.00	15.25	
VoiSS Physical	G1	6.33	4.52	0.00	20.00	2.75	5.50	8.50	0.649
	G2	5.73	4.13	0.00	17.00	2.00	5.00	8.25	
VoiSS Emotional	G1	1.13	2.96	0.00	14.00	0.00	0.00	0.50	0.185
	G2	2.70	4.85	0.00	18.00	0.00	0.00	4.00	
VoiSS Total	G1	15.77	12.51	0.00	54.00	7.00	14.00	20.00	0.391
	G2	19.30	16.05	2.00	63.00	7.50	16.00	25.00	
Frequency burning	G1	0.43	1.04	0.00	4.00	0.00	0.00	0.00	0.453
	G2	0.47	0.90	0.00	4.00	0.00	0.00	1.00	
Frequency tightness	G1	0.30	0.70	0.00	3.00	0.00	0.00	0.00	0.734
	G2	0.37	0.76	0.00	3.00	0.00	0.00	0.25	
Frequency dryness	G1	0.93	0.94	0.00	4.00	0.00	1.00	1.00	0.550
	G2	0.77	0.77	0.00	3.00	0.00	1.00	1.00	
Frequency aching	G1	0.53	0.63	0.00	2.00	0.00	0.00	1.00	0.403
	G2	0.43	0.68	0.00	2.00	0.00	0.00	1.00	
Frequency tickling	G1	0.60	1.00	0.00	4.00	0.00	0.00	1.00	0.223
	G2	0.80	1.06	0.00	5.00	0.00	1.00	1.00	
Frequency soreness	G1	0.30	0.47	0.00	1.00	0.00	0.00	1.00	0.483
	G2	0.43	0.63	0.00	2.00	0.00	0.00	1.00	
Frequency irritable throat	G1	0.50	0.78	0.00	3.00	0.00	0.00	1.00	0.474
	G2	0.53	0.57	0.00	2.00	0.00	0.50	1.00	
Frequency lump in the throat	G1	0.57	1.19	0.00	4.00	0.00	0.00	0.25	0.757
	G2	0.27	0.52	0.00	2.00	0.00	0.00	0.25	
Frequency VTD	G1	4.17	4.68	0.00	18.00	1.00	3.00	5.25	0.526
	G2	4.07	3.54	0.00	15.00	2.00	4.00	5.25	
Intensity burning	G1	0.43	1.14	0.00	4.00	0.00	0.00	0.00	0.423
	G2	0.47	1.04	0.00	5.00	0.00	0.00	1.00	
Intensity tightness	G1	0.23	0.50	0.00	2.00	0.00	0.00	0.00	0.718
	G2	0.30	0.60	0.00	2.00	0.00	0.00	0.25	
Intensity dryness	G1	0.80	0.76	0.00	3.00	0.00	1.00	1.00	0.674
	G2	0.73	0.78	0.00	3.00	0.00	1.00	1.00	
Intensity aching	G1	0.43	0.68	0.00	2.00	0.00	0.00	1.00	0.575
	G2	0.37	0.72	0.00	3.00	0.00	0.00	1.00	
Intensity tickling	G1	0.53	1.01	0.00	4.00	0.00	0.00	1.00	0.094
	G2	0.77	0.94	0.00	4.00	0.00	1.00	1.00	
Intensity soreness	G1	0.33	0.55	0.00	2.00	0.00	0.00	1.00	1.000
	G2	0.33	0.55	0.00	2.00	0.00	0.00	1.00	
Intensity irritable throat	G1	0.60	1.00	0.00	4.00	0.00	0.00	1.00	0.781
	G2	0.43	0.68	0.00	3.00	0.00	0.00	1.00	
Intensity lump in the throat	G1	0.40	0.97	0.00	4.00	0.00	0.00	0.00	0.660
	G2	0.33	0.61	0.00	2.00	0.00	0.00	1.00	
Intensity VTD	G1	3.77	4.30	0.00	17.00	0.00	3.00	5.25	0.551
	G2	3.73	3.37	0.00	13.00	1.00	3.00	5.25	

Mann-Whitney test

Subtitle: G1 = Group 1; G2 = Group 2; SD = standard deviation; 1Q = first quartile; 3Q = third quartile; VoiSS = Voice Symptom Scale; VTD = Vocal Tract Discomfort Scale

applications throughout the day (90%). In this group there was a positive moderate correlation between the time of diagnosis and frequency of burning ($r=0.575$; $p=0.001$), frequency of soreness ($r=0.518$; $p=0.003$) and intensity of burning ($r=0.516$; $p=0.004$) (Table 2).

Still regarding G1, higher values of frequency soreness ($p=0.006$), frequency irritable throat ($p=0.004$), intensity soreness ($p=0.003$) and intensity irritable throat ($p=0.004$) were observed in individuals who reported using insulin infusion pumps for treatment (Table 3).

Table 2. Correlation between time of diagnosis and the self-assessment of vocal symptoms, vocal tract discomfort and the vocal self-assessment in individuals with Diabetes mellitus type 1 (Group 1)

		Time of diagnosis (in years)
VoiSS Impairment	r	-0.083
	p- value	0.661
VoiSS Physical	r	0.075
	p- value	0.692
VoiSS Emotional	r	-0.040
	p- value	0.832
VoiSS Total	r	-0.063
	p- value	0.742
Frequency burning	r	0.575
	p- value	0.001*
Frequency tightness	r	0.038
	p- value	0.842
Frequency dryness	r	0.052
	p- value	0.785
Frequency aching	r	0.174
	p- value	0.357
Frequency tickling	r	0.116
	p- value	0.542
Frequency soreness	r	0.518
	p- value	0.003*
Frequency irritable throat	r	0.186
	p- value	0.325
Frequency lump in the throat	r	0.334
	p- value	0.071
Frequency VTD	r	0.259
	p- value	0.166
Intensity burning	r	0.516
	p- value	0.004*
Intensity tightness	r	-0.074
	p- value	0.697
Intensity dryness	r	0.156
	p- value	0.412
Intensity aching	r	0.192
	p- value	0.309
Intensity tickling	r	0.197
	p- value	0.297
Intensity soreness	r	0.309
	p- value	0.097
Intensity irritable throat	r	0.323
	p- value	0.082
Intensity lump in the throat	r	0.193
	p- value	0.306
Intensity VTD	r	0.342
	p- value	0.064
Vocal Self-assessment	r	-0.080
	p- value	0.865

Spearman Correlation; *p<0,05;

Subtitle: r = Spearman's correlation coefficient; VoiSS = Voice Symptom Scale; VTD = Vocal Tract Discomfort Scale**Table 3.** Comparison of the self-assessment of vocal symptoms and vocal tract discomfort regarding the type of insulin therapy in individuals with Diabetes mellitus type 1 (Group 1)

Variable	Type of insulin therapy	Mean	SD	Minimum	Maximum	1Q	Median	3Q	p-value
VoiSS Impairment	Insulin infusion pumps	7.33	4.62	2.00	10.00	2.00	10.00	0.00	0.754
	Applications	8.41	7.63	0.00	26.00	2.00	8.00	11.00	
VoiSS Physical	Insulin infusion pumps	7.67	2.52	5.00	10.00	5.00	8.00	0.00	0.330
	Applications	6.19	4.70	0.00	20.00	2.00	5.00	8.00	

Mann-Whitney Test; *p<0,05;

Subtitle: SD = standard deviation; 1Q = first quartile; 3Q = third quartile; VoiSS = Voice Symptom Scale; VTD = Vocal Tract Discomfort Scale

Table 3. Continued...

Variable	Type of insulin therapy	Mean	SD	Minimum	Maximum	1Q	Median	3Q	p-value
VoiSS Emotional	Insulin infusion pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.327
	Applications	1.26	3.10	0.00	14.00	0.00	0.00	2.00	
VoiSS Total	Insulin infusion pumps	15.00	5.00	10.00	20.00	10.00	15.00	0.00	0.628
	Applications	15.85	13.14	0.00	54.00	7.00	14.00	20.00	
Frequency burning	Insulin infusion pumps	0.33	0.58	0.00	1.00	0.00	0.00	0.00	0.656
	Applications	0.44	1.09	0.00	4.00	0.00	0.00	0.00	
Frequency tightness	Insulin infusion pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.372
	Applications	0.33	0.73	0.00	3.00	0.00	0.00	0.00	
Frequency dryness	Insulin infusion pumps	1.67	2.08	0.00	4.00	0.00	1.00	0.00	0.597
	Applications	0.85	0.77	0.00	3.00	0.00	1.00	1.00	
Frequency aching	Insulin infusion pumps	0.67	0.58	0.00	1.00	0.00	1.00	0.00	0.585
	Applications	0.52	0.64	0.00	2.00	0.00	0.00	1.00	
Frequency tickling	Insulin infusion pumps	1.00	1.73	0.00	3.00	0.00	0.00	0.00	0.840
	Applications	0.56	0.93	0.00	4.00	0.00	0.00	1.00	
Frequency soreness	Insulin infusion pumps	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.006*
	Applications	0.22	0.42	0.00	1.00	0.00	0.00	0.00	
Frequency irritable throat	Insulin infusion pumps	2.00	1.00	1.00	3.00	1.00	2.00	0.00	0.004*
	Applications	0.33	0.55	0.00	2.00	0.00	0.00	1.00	
Frequency lump in the throat	Insulin infusion pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.327
	Applications	0.63	1.24	0.00	4.00	0.00	0.00	1.00	
Frequency VTD	Insulin infusion pumps	6.67	3.21	3.00	9.00	3.00	8.00	0.00	0.153
	Applications	3.89	4.77	0.00	18.00	1.00	3.00	4.00	
Intensity burning	Insulin infusion pumps	0.33	0.58	0.00	1.00	0.00	0.00	0.00	0.523
	Applications	0.44	1.19	0.00	4.00	0.00	0.00	0.00	
Intensity tightness	Insulin infusion pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.371
	Applications	0.26	0.53	0.00	2.00	0.00	0.00	0.00	
Intensity dryness	Insulin infusion pumps	1.33	1.53	0.00	3.00	0.00	1.00	0.00	0.518
	Applications	0.74	0.66	0.00	2.00	0.00	1.00	1.00	
Intensity aching	Insulin infusion pumps	1.00	1.00	0.00	2.00	0.00	1.00	0.00	0.157
	Applications	0.37	0.63	0.00	2.00	0.00	0.00	1.00	
Intensity tickling	Insulin infusion pumps	1.33	2.31	0.00	4.00	0.00	0.00	0.00	0.638
	Applications	0.44	0.80	0.00	3.00	0.00	0.00	1.00	
Intensity soreness	Insulin infusion pumps	1.33	0.58	1.00	2.00	1.00	1.00	0.00	0.003*
	Applications	0.22	0.42	0.00	1.00	0.00	0.00	0.00	
Intensity irritable throat	Insulin infusion pumps	2.67	1.53	1.00	4.00	1.00	3.00	0.00	0.004*
	Applications	0.37	0.63	0.00	2.00	0.00	0.00	1.00	
Intensity lump in the throat	Insulin infusion pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.373
	Applications	0.44	1.01	0.00	4.00	0.00	0.00	0.00	
Intensity VTD	Insulin infusion pumps	8.00	4.36	3.00	11.00	3.00	10.00	0.00	0.086
	Applications	3.30	4.11	0.00	17.00	0.00	2.00	5.00	

Mann-Whitney Test; *p<0,05;

Subtittle: SD = standard deviation; 1Q = first quartile; 3Q = third quartile; VoiSS = Voice Symptom Scale; VTD = Vocal Tract Discomfort Scale

DISCUSSION

Reports from the literature show that T1D is associated with pathologies, such as laryngopharyngeal reflux disease (LPRD)⁽⁶⁾ and laryngeal sensory neuropathy^(6,7). In addition, there are reports that associate DM with vocal symptoms or discomfort in the vocal tract⁽⁶⁾. Thus, further investigations are necessary to better understand vocal symptoms and vocal discomfort in individuals with and without T1D and to analyze its influence on self-assessment.

No difference was observed between groups regarding vocal symptoms. The self-assessment of vocal symptoms showed median values of central tendency equal or smaller than the

VoiSS cutoff point, for all factors and in both groups⁽¹²⁾. Thus, the groups were not at risk to develop vocal disorders.

Also, no difference was observed between groups regarding the self-assessment of vocal tract discomfort. The VTD has only been translated to Brazilian Portuguese⁽¹⁰⁾ and it has no cutoff point that differentiates individuals at risk to develop vocal disorders. Hence, it is not possible to analyze values of central tendency. However, a research that applied the VTD in a control group, i.e., individuals with no vocal complaints, obtained values of central tendency very similar to the values observed in the present study, both for frequency and intensity⁽¹³⁾. Thus, it can be inferred that the answers of individuals with T1D are consistent with answers of vocally healthy individuals.

Overall, the self-perception data for vocal symptoms and vocal tract discomfort were low for both groups and do not have influence in the daily life of the participants. Therefore, having the T1D diagnosis alone, does not suggest risk to develop vocal symptoms or vocal tract discomfort. These data seem to be more related to the characteristics of T1D.

A moderate positive correlation was observed between the time of diagnosis and the frequency and intensity of burning and the frequency of soreness. It is noteworthy that T1D is a progressive disease and this may establish a relationship between time of diagnosis. Other studies have shown a relationship between the duration of gastrointestinal symptoms and the time of diagnosis of DM. Authors related symptoms of soreness and burning to LPRD, which is a common pathology in individuals with DM⁽⁶⁾. In this case, the symptoms of burning and soreness would be due to a poor defense mechanism to guard the laryngeal and pharyngeal mucosa against the acid and pepsin in the LPRD⁽⁶⁾.

It was observed significantly higher values of intensity and frequency soreness and irritable throat in individuals who reported using insulin infusion pumps for treatment when compared with individuals who performed applications throughout the day. The sample size of the group that used insulin infusion pumps was small, therefore, there is a chance of type I error in this outcome; hence, it can be a random factor.

A meta-analysis comparing the two types of insulin therapy observed that insulin infusion pump therapy is unnecessary for most people with T1D and should be reserved for those with special problems with optimized insulin injections⁽¹⁴⁾. Another study also observed that insulin infusion pump therapy has been useful in patients with difficult to control DM, who have episodes of diabetic ketoacidosis or hypoglycemia⁽⁶⁾.

One study reported that, due to prolonged hypoglycemia there is a possible laryngeal dysfunction that generates laryngeal sensory neuropathy⁽⁶⁾, which causes degeneration of large myelinated nerve fibres in the recurrent laryngeal nerve⁽⁷⁾. Still, little is known to explain this outcome, however, it is inferred that there might be a relationship between the laryngeal sensory dysfunction in individuals undergoing insulin infusion pump therapy, due to the higher incidence of hypoglycaemia episodes in these patients⁽⁷⁾.

Although there was no difference between self-assessment of vocal symptoms and self-assessment of vocal tract discomfort in individuals with and without T1D, the type of insulin therapy and the time of diagnosis influenced in the perception of vocal tract discomfort. The convenience sample is a study limitation. Thus, further studies are needed to analyze the association between the characteristics of T1D, gastrointestinal symptoms, laryngeal dysfunction and the clinical and subjective measures of voice and larynx in this population.

CONCLUSION

Individuals with T1D have few vocal symptoms and vocal tract discomfort; they are not different from the control group. However, characteristics of the disease such as time of diagnosis and type of insulin therapy have influence in the perception of the frequency and intensity of some vocal tract discomfort.

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