

Original article:

Factors Influencing the Subjective Symptoms of Submandibular Gland Sialolithiasis

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Abstract:

Objectives: The aim of this study is to evaluate the factors affecting subjective symptoms, especially pain and swelling in submandibular gland sialolithiasis. **Methods:** We analyzed the computed tomographic (CT) findings of submandibular gland sialolithiasis (stone size/location/number) and assessed white blood cell (WBC) (neutrophil/absolute neutrophil count) and erythrocyte sedimentation rate (ESR) to elucidate the correlation with subjective symptoms, especially swelling and pain. **Results:** Of the 82 patients, 45 had a solitary stone. Thirty seven patients experienced pain and 73 patients had swelling. The number, location and size of the calculi were not associated with symptoms, especially pain and swelling. From logistic regression analysis, WBC ($p=0.048$) and the percentage of neutrophils ($p=0.027$) were associated with the presence of pain, but not swelling. **Conclusion:** To our knowledge, this is the first study to observe that both the location and size of stone are not significantly related to subjective symptoms, especially pain and swelling in submandibular gland sialolithiasis.

Keywords: Sialolithiasis; submandibular gland; pain; swelling

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Introduction

Sialolithiasis is the presence of stone in the duct of the major salivary glands.¹ It is the most commonly found in the main duct of the submandibular gland.¹ The anatomical and physiological characteristics of the gland are responsible for commonly encountered submandibular gland stone or calculi. Saliva is alkaline and has a higher concentration of calcium and phosphate with higher viscosity in the submandibular gland.² Furthermore, saliva flows against gravity because of its anatomic location, and the submandibular duct is longer than the ducts of the other major glands.³ Sialolithiasis results in a mechanical obstruction of the salivary duct, causing repetitive swelling during meals, which can remain

transitory or be complicated by bacterial infections.^{4,5} Patients with sialolithiasis may complain of moderate to severe pain. However, in some cases, they may be asymptomatic except for a palpable and enlarged mass in the submandibular gland area.¹

The aim of this study is to evaluate various factors including stone size affecting subjective symptoms, especially pain and swelling in patients with submandibular gland sialolithiasis.

Methods and Materials

Study participants and Data collection

We retrospectively reviewed the records of patients with submandibular gland sialolithiasis from January 2012 to December 2017 diagnosed at the

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Department of Otorhinolaryngology-Head and Neck Surgery, Chung-Ang University College of Medicine. All patients were diagnosed with neck computed tomography (CT) with or without contrast enhancement (Fig 1). We analyzed the CT findings of stone according to stone size, location, and number. Stone size was classified into three types (<4mm, 4-9mm, and >9mm). Its stone location was classified into three types (proximal, middle, and distal) based on distance from hilum of submandibular gland. We assessed white blood cell (WBC), neutrophil, absolute neutrophil count and erythrocyte sedimentation rate (ESR). On clinical symptoms, we focused on pain and swelling.

Data analysis

All statistical analyses were performed using software SPSS version 18.0 (SPSS, Inc., Chicago, IL). For continuous variables, the distribution of the data was first evaluated for normality using the Kolmogorov-Smirnov test. Although the variables did not pass the normality test, data did not deviate from the linearity in the QQ plot. So, these data were analyzed using parametric tests, including logistic regression analysis. Univariate and multivariate (if *p*-value <0.1 in univariate analysis) analyses were performed on three factors related to stone to analyze factors affecting the clinical symptoms, pain and swelling. *P*-value < 0.05 (two-tailed) was considered to be statistically significant.

Ethics approval: This study was approved by the Institutional Review Board of Chung-Ang University Hospital.

Results

A total of 82 patients were enrolled in our study. Their ages ranged from 10 to 88 years, and there were no significant differences in the number of male and female patients. About 65% of submandibular sialolithiasis patients (54 out of 82 patients) had a solitary stone with a mean age of 38 years, which was not considerably different from the patient characteristics in previous studies. There was no preponderance of right- or left-sided involvement, and there was one case of bilateral submandibular stones (Table 1).

Table 1 Characteristics of the enrolled patients.

Demographic factors	Number	%
Sex		
Male	40	48.8
Female	42	51.2
Age		
Median	38	
Range	10-88	
Site		
Right	42	51.2
Left	39	47.5
Bilateral	1	1
Number		
Single	54	65.9
Multiple	28	34.1
Size		
<4 mm	25	30.5
4-9 mm	31	37.8
>9 mm	26	331.7
Symptom		
Pain	37	45.1
Swelling	73	89

The most common symptoms of submandibular gland calculi are pain and swelling. Similarly, about half of our cases (37 of 82 patients) experienced pain and 90% of patients (73 of 82 patients) had swelling (Table 1).

Discussion

Seventy to eighty percent of submandibular calculi involve a solitary stone, and submandibular gland calculi were common in people over the age of 40 years.⁶The most common symptoms of submandibular gland calculi are pain and swelling.⁶Sialolithiasis involving the duct may result in symptoms of pain because duct occlusion decreases the salivary flow rate, leading to the accumulation of saliva in gland, which can cause pain due to the pressure.¹ We hypothesized that the location and size of the calculi might be associated with the development of acute symptoms such as pain and swelling.

To evaluate the association of clinical characteristics with subjective symptoms, we analyzed our data using by logistic regression test. In contrast to our

expectations, the location or size of the calculi was not associated with subjective symptoms such as pain and swelling (Tables 2 and 3).

However, although there was not statistically significant, univariate analysis showed that pain frequency was associated with the increase of stone size. OR value of 4-9 mm group of stone size was 2.743 (0.893-8.421, 95% CI) in univariate analysis and was 2.56 (0.681-9.626, 95% CI) in multivariate analysis. In case of above 9 mm stone size, OR value was 3.0 (0.936-9.616, 95% CI) in univariate analysis and 2.28 (0.586-8.872, 95% CI) in multivariate analysis. Further study is needed to elucidate the association between stone size and pain.

In another study, the most common cause of sialolithiasis was thought to be acute bacterial infections of the salivary glands, resulting in the slowing of the salivary flow.⁷ Therefore, we hypothesized that the degree of acute inflammation might be associated with the onset of acute symptoms. We evaluated the correlation of acute inflammatory indicators such as WBC, the percentage of neutrophil, neutrophil count and ESR with the subjective symptoms and found that WBC (OR=1.26, 95% CI=1.002-1.587, $p=0.48$) and the percentage of neutrophils (OR=1.057, 95% CI=1.006-1.110, $p=0.27$) were associated with the presence of pain on the basis of univariate analysis (Table 2).

Table 2. Factors affecting pain

Factors	Number	Univariate Analysis			Multivariate Analysis		
		OR	(95% CI)	<i>p</i> -value	OR	(95% CI)	<i>p</i> -value
Size							
<4mm	25	1			1		
4-9mm	31	2.743	0.893-8.421	0.078	2.56	0.681-9.626	0.164
>9mm	26	3.0	0.936-9.616	0.065	2.28	0.586-8.872	0.234
Location							
Distal	45	1					
Middle	25	1.789	0.456-7.021	0.404			
Proximal	12	1.778	0.449-7.040	0.413			
Number							
Single	54	1					
Multiple	28	1.348	0.539-3.370	0.523			
Value (Number)	Mean ± SD	□	□	□	□	□	□
WBC (60/82)	6,702 ± 2,688	1.26	1.002-1.584	0.048*	0.638	0.292-1.392	0.258
Neutrophil % (60/82)	56.498±10.816	1.057	1.006-1.110	0.027*	2.321	0.904-5.6-963	0.08
Absolute neutrophil count (60/82)	3,980±2459	1.16	0.967-1.392	0.11			
ESR (60/82)	16.467±13.899	1.02	0.982-1.061	0.309	□	□	□

However, this relationship was not significant in terms of the presence of swelling, and ESR was associated with neither pains nor swelling (Table 2 & 3).

Table 3. Factors affecting swelling

Factors	Number	Univariate Analysis		
		OR	(95% CI)	p-value
Size				
<4mm	25	1		
4-9mm	31	1.977	0.304-12.868	0.476
>9mm	26	0.75	0.150-3.750	0.726
Location				
Distal	45	1		
Middle	25	1.000	0.456-7.021	1.000
Proximal	12	0.527	0.449-7.040	0.578
Number				
Single	54	1		
Multiple	28	0.368	0.539-3.370	0.163
Value (Number)	Mean ± SD	□	□	□
WBC (60/82)	6,702 ± 2,688	1.074	1.002-1.584	0.662
Neutrophil % (60/82)	56.498±10.816	1	1.006-1.110	0.995
Absolute neutrophil count (60/82)	3,980±2459	0.989	0.967-1.392	0.989
ESR (60/82)	16.467±13.899	1.018	0.982-1.061	0.645

To the best of our knowledge, this is the first trial to evaluate the factors that are associated with acute subjective symptoms such as pain in sialolithiasis. In contrast to our expectations, the location and size of the calculi were not associated with the presence of pain or swelling. Unexpectedly, we found that the percentage of neutrophils and the total neutrophil count were statistically associated with the presence of pain, suggesting that the degree of acute inflammation might be associated with the onset of acute symptom.

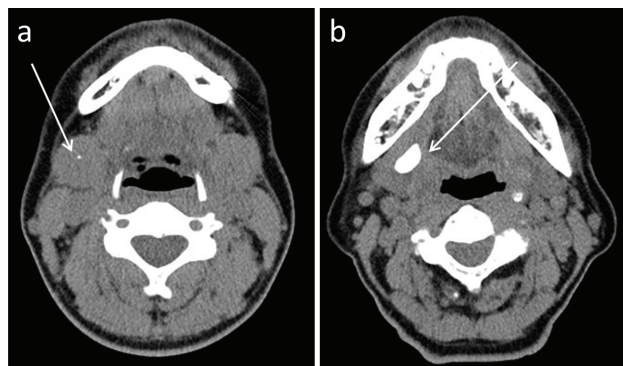


Figure 1. CT images of two patients. **a.** Axial CT scan showed a tiny stone without ductal dilatation, but the patient complained of severe pain and swelling during acute onset. **b.** Axial CT scan showed a large stone 15 mm in size in the right submandibular gland

with mild intra-glandular ductal dilatation, but the patient only experienced the subjective symptom of swelling of right submandibular gland area for more than one month.

Limitation

There is one important limitation in our study. Our study was based on a relatively small number of patients. So, further study with larger populations may reveal unknown relationships between the clinical features of submandibular gland sialolithiasis and patient characteristics. These trials might help us understand the mechanisms underlying symptom development in sialolithiasis.

Conclusion

To our knowledge, we are the first study to observe that the location and size of the stones are not significantly related to acute symptoms, especially pain and swelling in patients with submandibular gland sialolithiasis. Instead, we found that the percentage of neutrophils and absolute neutrophil count were associated with the presence of pain. Our findings suggest that the degree of inflammation may be associated with the development of subjective symptoms.

Implications for general practice

- Both the location and size of the stones are not significantly related to acute symptoms such as pain or swelling in patients with submandibular gland sialolithiasis.
- The percentage of neutrophils and absolute neutrophil count are associated with the presence of pain.
- The degree of inflammation may be associated with the development of subjective symptoms.

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