An Analysis of Operated Mediastinal Cysts and Masses

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AIM: This study had two aims: to analyze surgical patients with mediastinal cysts and masses according to clinical, histopathological, and surgical types; and compare the impact of the coronavirus disease 2019 (COVID-19) pandemic on these cases.
METHODS: A retrospective analysis was conducted on 132 patients who had undergone surgical intervention for mediastinal cysts and masses. Demographic, clinical, and histopathologic data were recorded. Patients were divided into two groups based on their preference for video-assisted thoracoscopic surgery (VATS) and other surgical methods. Patients who had undergone surgery during and before the COVID-19 pandemic were also compared.
RESULTS: Lesions were detected incidentally in 56 patients (42.4%). The lesions were most commonly located in the anterior mediastinum (n = 86, 65.2%), while the most common pathology was found to be thymoma (n = 47, 35.6%). VATS was the most preferred method of operation (n = 36, 27.3%). The duration of hospital stay was observed to be statistically significantly shorter in patients who underwent VATS ($p = 0.016$). After the COVID-19 pandemic, the incidental incidence of mediastinal cysts and masses was significantly higher ($p = 0.005$).
CONCLUSIONS: The incidental detection rate of operated mediastinal cysts and masses increased after the COVID-19 pandemic. It is suggested that this study act a starting point for investigating the impact of the pandemic on mediastinal cysts and masses.

Keywords: mediastinal compartment; mediastinal cyst; mediastinal mass

Introduction

Many histopathological types of lesions, from benign cystic lesions to aggressive malignant masses, can develop in the mediastinum, and all ages and genders are susceptible. While lesions are mostly asymptomatic, symptoms may occur in which they put pressure on surrounding tissues and cause systemic diseases. It is accepted that diagnosis can be made when symptoms develop, but the incidental detection rates reported in the literature are also remarkable [1, 2].
The thoracic inlet, the diaphragm, the mediastinal pleura, the sternum, and the vertebral body all limit the mediastinum. Radiologically, this area is divided into three compartments: the area between the sternum and the heart is called the prevascular mediastinum (anterior), the area between the heart and the paravertebral area is called the paravertebral mediastinum (posterior), and the remaining area is called the visceral mediastinum (middle). These compartments classify cysts and masses based on their biological behavior [1, 2, 3, 4, 5].
It is generally thought that the best treatment for mediastinal cysts and masses is complete resection [6, 7, 8]. A common form of treatment nowadays is thoracotomy, sternotomy, video-assisted thoracoscopic surgery (VATS), and robot-assisted thoracic surgery (RATS) [7, 9]. Mediastinal cysts and masses are rare, and the information provided in the literature varies due to limitations in the patient populations of studies. As it is important to keep the literature on this issue up to date, considering the events affecting the world such as developing technology and pandemics [8, 10], this study aims to conduct a comprehensive assessment of the existing literature on mediastinal lesions by specifically focusing on diverse histopathologic characteristics, radiologic classifications, and therapeutic strategies. The main objective was to investigate the impact of coronavirus disease 2019 (COVID-19) on these parameters.

Materials and Methods

132 patients operated for cysts or masses between 2012 and 2021 in any mediastinal compartment in three differ-

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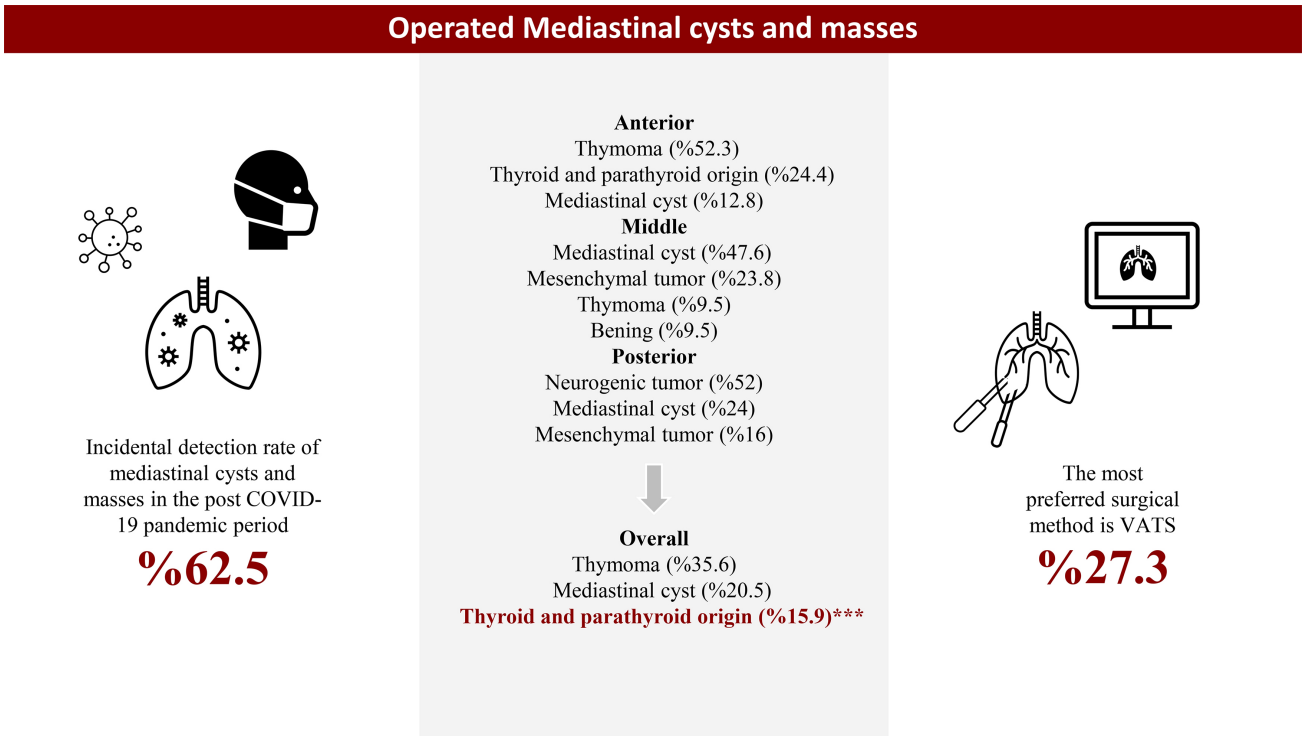

Graphical Abstract

ent hospitals were included in the study. Ethics committee approval is received for the study protocol with the decision number of E1/21/2189 in Ankara Bilkent City Hospital Ehics Committee. The study has been conducted in accordance with the World Medical Association Declaration of Helsinki. A written consent has been obtained from the patients and/or their guardians.

Age, gender, symptoms, comorbidities, mediastinal compartment where the lesion is located, type of operation, mortality, and the histopathological diagnosis of all cases were recorded and evaluated retrospectively. The start of the COVID-19 pandemic period was determined as being March 2020. Patients were classified based on the mediastinal origin of their lesions as anterior, middle, and posterior mediastinal origin, according to the compartment in which the mediastinal cysts and masses were located, and pathology results were recorded. Demographic information, and preoperative, intraoperative, and postoperative data of the patients were obtained from the hospital information technology system and patient files. Patients under the age of 18, those patients who underwent diagnostic surgical procedures, and those patients with incomplete information were all excluded from the study.

The presence of symptoms, the increase in size observed in earlier radiological imaging, the difficulty to definitively exclude malignancy based on radiological findings, and the significant compression of important structures in the mediastinum, were all determined as being factors that impacted the decision to proceed with surgical removal of the lesion. Prior to surgery all patients, apart from six who only had magnetic resonance imaging (MRI) scans, received computed tomography (CT) scans. This majority group either opted solely for CT scans, or a combination of positron emission tomography (PET) and MRI scans. In addition, the surgeon conducted standard preoperative investigations, including a comprehensive blood test, electrocardiography, and a pulmonary function test, with the surgeon having complete discretion in determining the procedures utilized. Patients who were unable to effectively differentiate their neighborhood from mediastinal structures typically showed a preference for sternotomy.

A thoracotomy was additionally conducted to address lesions that spread into the thorax. This procedure involved making an incision around the neck to address lesions originating from the parathyroid and thyroid glands. A partial sternotomy and thoracotomy were also conducted if the position of the tumor made such procedures necessary. Larger incisions, specifically the Clemshell incision and the thoracoabdominal incision, were only deemed necessary with three patients, with all remaining patients being prioritized for VATS. Patients were required to lie on their sides at an angle of 30 degrees for the treatment of lesions located in the front part of the mediastinum and lying on the side for lesions located in the middle and back parts of the mediastinum. The VATS procedure was conducted using either a biportal or triportal approach.

Statistical Analysis

Statistical analysis was performed by using SPSS version 26 software (IBM Corp, Armonk, NY, USA). The suitability of the variables for normal distribution was examined vi-

sually (histograms and probability graphs) and analytically (Kolmogorov-Smirnov fit test). Descriptive analysis was performed using mean and standard deviation values for continuous variables, while ordinal/nominal were given by using frequency tables. The Mann-Whitney U test was used for continuous variables and the Pearson *chi*-square test was used for categorical variables. The Fisher's exact test was additionally applied in categories where the *chi*-square test produced suspicious results. When comparing numerical variables according to dichotomous variables, we used an independent two-sample *t*-test for normally distributed data and a Mann-Whitney U test for non-normally distributed data. A *p*-value of <0.05 was considered to be statistically significant unless otherwise stated in the analysis.

Results

The study included a total of 132 patients: 63 (47.7%) males and 69 (52.3%) females. The average age of the patients was 45.6 ± 15.4 (M: 44.5, min: 18–max: 80) years, and the most common reported symptom was chest pain (n = 19, 14.4%). Lesions were detected incidentally in 56 (42.4%) of the patients and most commonly located in the anterior mediastinum (n = 86, 65.2%). VATS was the preferred method of operation (n = 36, 27.3%). The most common pathology was thymoma (n = 47, 35.6%). General information about the patients is presented in Table 1, while symptoms, results of pathology, and operation types according to compartments are shown in Table 2.

When VATS and other surgical methods were compared within the scope of our study, VATS was applied statistically significantly less frequently in operations for lesions observed in the anterior compartment ($p = 0.029$) and in thyroid and parathyroid origin pathologies ($p = 0.001$). There was no statistically significant difference between the patients' tube follow-up times ($p = 0.114$). Hospitalization periods were seen to be statistically significantly shorter in patients who had undergone VATS ($p = 0.016$) (Table 3).

When the periods before and after the COVID-19 pandemic were compared, the incidental incidence of mediastinal cysts and masses was statistically significantly higher in the post-pandemic period ($p = 0.005$). In the pre-pandemic period, the use of CT alone as a radiological imaging method was statistically significantly higher ($p < 0.001$), whereas in the post-pandemic period, the combined use of CT and PET was statistically significantly higher ($p < 0.001$). In the post-pandemic period, the preference for VATS as a surgical method was statistically significantly higher ($p < 0.001$) (Table 4).

Patients were monitored for a minimum of one month and a maximum of 128 months. The median survival time was 116.01 months and mortality was observed in 11 (8.3%) of the patients. One patients died due to postoperative pneumonia, two due to massive haemothorax, two due to postoperative cerebrovascular reasons, three due to cardiac reasons in the postoperative period, and three as a result of postoperative respiratory distress. Mass excision and lung resection were performed on three of the patients and mediastinal mass excision was performed on the remaining pa-

Table 1. General information about patients.

	n (%)
Gender	
Female	69 (52.3)
Male	63 (47.7)
Age, (years)	
$\bar{x}$ ± SD	45.6 ± 15.4
M (min–max)	44.5 (18–80)
Comorbidity	
None	55 (41.7)
Cardiovascular disease	16 (12.1)
Myesthenia graves	15 (11.4)
Malignancy	11 (8.3)
Diabetes	9 (6.8)
Thyroid diseases	9 (6.8)
Collagen tissue diseases	9 (6.8)
Respiratory diseases	2 (1.5)
Epilepsy	1 (0.8)
Other	5 (3.8)
Radiological diagnostic method	
CT	78 (59.1)
CT and PET	31 (23.5)
CT and MRI	14 (10.6)
MRI	6 (4.5)
CT, MRI and PET	3 (2.3)
Compartment	
Anterior	86 (65.2)
Posterior	25 (18.9)
Middle	21 (15.9)
Thorax tube follow-up time, (days)	
$\bar{x}$ ± SD	3.0 ± 2.7
M (min–max)	3 (0–22)
Duration of hospitalization, (days)	
$\bar{x}$ ± SD	10.1 ± 6.3
M (min–max)	8.5 (1–51)
Complications	
None	108 (81.8)
Respiratory distress	6 (4.5)
Atelectasis	4 (3)
Hemothorax	3 (2.3)
Wound site infection	3 (2.3)
Vocal cord paralysis	2 (1.5)
Other	6 (4.5)
Mortality	
No	121 (91.7)
Yes	11 (8.3)

n, number of patients; %, percent; $\bar{x}$, mean; SD, standard deviation; M, median; min, minimum value; max, maximum value; CT, computed tomography; PET, positron emission tomography; MRI, magnetic resonance imaging.

Table 2. Comparison according to compartments.

	Anterior	Middle	Posterior	Overall
	n (%)	n (%)	n (%)	n (%)
Symptoms				
Insidental	33 (38.4)	10 (47.6)	13 (52)	56 (42.4)
Chest pain	10 (11.6)	5 (23.8)	4 (16)	19 (14.4)
Shortness of breath	12 (14)	2 (9.5)	2 (8)	16 (12.1)
Swelling in the neck	13 (15.1)	0 (0)	0 (0)	13 (9.8)
Back pain	1 (1.2)	2 (9.5)	2 (8)	5 (3.8)
Cough	1 (1.2)	1 (4.8)	2 (8)	4 (3)
Difficulty swallowing	4 (4.7)	0 (0)	0 (0)	4 (3)
Eyelid drooping	4 (4.7)	0 (0)	0 (0)	4 (3)
Dysphagia	0 (0)	1 (4.8)	1 (4)	2 (1.5)
Other	8 (9.3)	0 (0)	1 (4)	9 (6.8)
Pathology				
Thymoma	45 (52.3)	2 (9.5)	0 (0)	47 (35.6)
Mediastinal cyst	11 (12.8)	10 (47.6)	6 (24)	27 (20.5)
Thyroid and parathyroid origin	21 (24.4)	0 (0)	0 (0)	21 (15.9)
Neurogenic tumor	0 (0)	0 (0)	13 (52)	13 (9.8)
Mesenchymal tumor	1 (1.2)	5 (23.8)	4 (16)	10 (7.6)
Germ cell tumor	4 (4.7)	0 (0)	0 (0)	4 (3)
Lymphoma	4 (4.7)	0 (0)	0 (0)	4 (3)
Bening	0 (0)	2 (9.5)	1 (4)	3 (2.3)
Non specific	0 (0)	1 (4.8)	1 (4)	2 (1.5)
Metastasis	0 (0)	1 (4.8)	0 (0)	1 (0.8)
Mode of operation				
VATS	17 (19.8)	9 (42.9)	10 (40)	36 (27.3)
Median sternotomy	34 (39.5)	1 (4.8)	0 (0)	35 (26.5)
Thoracotomy	5 (5.8)	7 (33.3)	14 (56)	26 (19.7)
Collar incision and partial sternotomy	10 (11.6)	0 (0)	0 (0)	10 (7.6)
Mediastinotomy	4 (4.7)	3 (14.3)	0 (0)	7 (5.3)
Partial sternotomy	6 (7)	0 (0)	0 (0)	6 (4.5)
Collar incision and median sternotomy	4 (4.7)	0 (0)	0 (0)	4 (3)
Collar incision and thoracotomy	3 (3.5)	0 (0)	0 (0)	3 (2.3)
Collar incision	1 (1.2)	0 (0)	0 (0)	1 (0.8)
Collar incision, thoracotomy and partial sternotomy	1 (1.2)	0 (0)	0 (0)	1 (0.8)
Median sternotomy and thoracotomy	1 (1.2)	0 (0)	0 (0)	1 (0.8)
Clamshell incision	0 (0)	1 (4.8)	0 (0)	1 (0.8)
Thoracoabdominal incision	0 (0)	0 (0)	1 (4)	1 (0.8)

n, number of patients; %, percentage; VATS, video-assisted thoracoscopic surgery.

tients. Two patients who underwent VATS died, and thoracoabdominal incision, clamshell incision, and thoracotomy were performed on the other patients.

Discussion

There was a remarkable incidental detection rate of mediastinal cysts and masses in the study (42%), and an even higher incidental detection rate (62.5%) in the post-COVID-19 pandemic period. In the post-pandemic period, the combined use of CT and PET for diagnosis was higher. In detecting mediastinal lesions, the first step of imaging is generally posterior-anterior radiographs and lateral radiographs, and CT is normally used for the characterization of the lesion. While MRI is used to evaluate the relationship of the lesion with surrounding tissues, PET is generally used to differentiate malignancy. Developments in the field of radiology continue to aid doctors in the diagnosis and detailing of mediastinal lesions [2, 8, 11].

In the early stages of the COVID-19 pandemic, there was no clear consensus on how to diagnose the disease and so imaging methods were frequently used for diagnosis. In a study, it was reported that the number of thoraxes CT used in the first year of the pandemic increased fivefold compared to the previous year [12, 13]. In consideration of all these circumstances, the high rate of incidental detection of

Table 3. Comparison of VATS and other surgical methods.

	VATS (n = 36)	Others (n = 96)	Test statistics	
	n (%)	n (%)	Test value	*p*
Compartments			7.055	**0.029**
Anterior	17 (47.2)	69 (71.9)		
Posterior	10 (27.8)	15 (15.6)		
Middle	9 (25)	12 (12.5)		
Pathology			28.907	**0.001**
Thymoma	6 (16.7)	41 (42.7)		
Mediastinal cyst	15 (41.7)	12 (12.5)		
Thyroid and parathyroid origin	0 (0)	21 (21.9)		
Neurogenic tumor	6 (16.7)	7 (7.3)		
Mesenchymal tumor	4 (11.1)	6 (6.3)		
Germ cell tumor	2 (5.6)	2 (2.1)		
Lymphoma	1 (2.8)	3 (3.1)		
Bening	1 (2.8)	2 (2.1)		
Non specific	1 (2.8)	1 (1)		
Metastasis	0 (0)	1 (1)		
Thorax tube follow-up time, (days)			1.590	0.114
$\bar{x} \pm$ SD	2.4 ± 1.9	3.2 ± 2.9		
M (min–max)	2.2 (0–12)	3(0–22)		
Duration of hospitalization, (days)			2.455	**0.016**
$\bar{x} \pm$ SD	8.3 ± 4.1	10.7 ±6.8		
M (min–max)	7.4 (3–29)	9 (1–51)		
Complications			3.227	0.072
No	33 (91.7)	75 (78.1)		
Yes	3 (8.3)	21 (21.9)		
Mortality				0.726
No	34 (94.4)	87 (90.6)		
Yes	2 (5.6)	9 (9.4)		

n, number of patients; %, percentage; $\bar{x}$, mean; SD, standard deviation; M, median; min, minimum value; max, maximum value. *p* values in bold are statistically significant.

mediastinal cysts and masses in the study is attributed to developments in imaging technology and the effects of the pandemic.

Patients most frequently complained of chest pains (14.4%). While the first symptoms reported in studies in the literature varies, they are generally shortness of breath, cough, and chest pains. Tachycardia and hypertension are also observed in those who are hormonally active [2, 8, 14, 15]. In this study, the most common symptoms after chest pain were shortness of breath and neck swelling, which are largely similar to findings in the literature. The diversity in symptoms is attributed to the wide variety of patient populations in the studies. In this study, thyroid-parathyroid origin pathologies were in third place, and this is thought to be the reason why the complaint of neck swelling, which is less common in other studies, is in third place.

The lesions were most frequently located in the anterior mediastinum (65.7%) and the most common pathology was thymoma (35.6%). When the literature is reviewed, the location and histopathological distribution of mediastinal cysts and masses vary, as do the symptoms, due to the diversity in patient populations. In studies with a large number of patients, it can be seen that mediastinal cysts and masses are most frequently located in the anterior mediastinum and consist of lesions of thymic origin, and that the rate of intrathoracic goitre and lesions of thyroid-parathyroid origin is very low [4, 6, 10, 16]. The data obtained from this study have largely been consistent with findings in the literature, and this is attributed the fact that thyroid-parathyroid origin pathologies rank third to this study being multicentre and multidisciplinary.

The pathology result of 10 (7.6%) of the patients was reported as the mesenchymal tumor. Primary benign and malignant mediastinal mesenchymal tumors are rare, with incidence rate of less than 5% in studies in the literature. Due to their rarity, such tumors are generally reported as case reports or case series [17]. It is seen from the higher incidental detection rate in this study that these rare cases are detected more frequently than in the literature.

The most preferred surgical method in the study was VATS (27.3%), and this preference for VATS also resulted in a shortening of hospital stays. Nowadays, VATS and

Table 4. Comparison of periods before and after COVID-19.

	Before COVID-19 (n = 69)	Post COVID-19 (n = 63)	Test statistics	
	n (%)	n (%)	Test value	*p*
Insidental			8.508	**0.005**
Yes	21 (30.5)	35 (55.6)		
No	48 (69.5)	28 (44.4)		
Radiological diagnostic method			38.859	**<0.001**
CT	54 (78.3)	24 (38.1)		
CT and PET	4 (5.8)	27 (42.9)		
CT and MRI	5 (7.2)	9 (14.3)		
CT, MRI and PET	0 (0)	3 (4.8)		
MRI	6 (8.7)	0 (0)		
Compartment where the lesion is located			0.560	0.756
Anterior	47 (68.1)	39 (61.9)		
Posterior	12 (17.4)	13 (20.6)		
Middle	10 (14.5)	11 (17.5)		
Mode of operation			14.758	**<0.001**
VATS	9 (13.5)	27 (42.8)		
Other	60 (86.5)	36 (57.2)		
Complications			1.230	0.267
No	54 (78.3)	54 (85.7)		
Yes	15 (21.7)	9 (14.3)		
Mortality			2.012	0.156
No	61 (88.4)	60 (95.62)		
Yes	8 (11.6)	3 (4.8)		

n, number of patients; %, percentage; CT, computed tomography; PET, positron emission tomography; MRI, magnetic resonance imaging; VATS, video-assisted thoracoscopic surgery. COVID-19, coronavirus disease 2019. *p* values in bold are statistically significant.

RATS are widely used in the surgical treatment of mediastinal cysts and masses, and many studies have reported that VATS and RATS are advantageous over other surgical methods due to shorter stays in hospital, less pain and fewer complications [6, 7, 9]. The data of this study have been consistent with the literature. In addition, although anterior mediastinal pathologies were most frequently observed in this study, VATS was least preferred in this compartment compared to other surgeries. This is attributed to the large number of thyroid-parathyroid-origin pathologies mentioned above.

Limitations of this study might include the fact that it is retrospective, only included patients who underwent resection and the relatively small number of patients. When other studies in the literature are reviewed, it can be seen that almost all studies have similar limitations [10]. On the other hand, the fact that there have been very few studies including all three compartments within the last 20 years, that it is a multicentre study, and that the COVID-19 pandemic affects incidental detection rates, mean that this study is of value.

Conclusions

This study is the first to point out that the COVID-19 pandemic has increased the incidental detection rate of operated mediastinal cysts and masses. It is evident that along with technological developments and several events affecting the whole world such as the COVID-19 pandemic, imaging methods, surgical techniques, and general known characteristics of diseases also evolve. It is thought that this study can be a guide for future research as it updates the literature and analyses the effects of the COVID-19 pandemic.

Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions

Conception or design of the work: BOC. Data collection: BOC, KBC. Data analysis and interpretation: BOC, YA, EY, BK, NK. Drafting the article: BOC, KBC. Critical revision of the article: BOC, KBC, YA, EY, BK, NK. Study supervision, fundings, materials: BOC, KBC, YA, EY, BK, NK. All authors contributed to important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Ethics committee approval is received for the study protocol with the decision number of E1/21/2189 in Ankara Bilkent City Hospital Ethics committee. The study has been conducted in accordance with the World Medical Association Declaration of Helsinki. A written consent has been obtained from the patients and/or their guardians.

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Conflict of Interest

The authors declare no conflict of interest.

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