

APPLICATION OF PEDIATRIC FLEXIBLE BRONCHOSCOPY IN DIAGNOSIS AND TREATMENT OF RESPIRATORY DISEASES IN VIET NAM NATIONAL CHILDREN'S HOSPITAL

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ABSTRACT

Objective: Analyze diagnoses and indications before bronchoscopy, evaluate results after flexible bronchoscopy (FB)

Methods: Descriptive study of 1643 cases of FB over a period of 2 years from January 1, 2022 to December 30, 2023 at the Pediatric Respiratory Diseases Central of Viet Nam National Children's Hospital.

Results: 1643 cases of children from 1 month to 16 years old were performed flexible endoscopy with 1296 cases for diagnostic purposes (78.9%) and 347 cases (21.1%) for interventional bronchoscopy. The main reasons for FB were abnormal airway (tracheal stenosis, wheezing, prolonged stridor) (30.3%), persistent and recurrent pneumonia (27.4%), and suspected foreign body in airway (11.6%). Results: airway abnormalities (51.9%), including: subglottic stenosis/tracheobronchial stenosis due to scarring (30.4%), malacia laryngeal cartilage (19.5%), malacia bronchial (13.2%). Most common interventional procedures: stenotic scar dilation (142 cases), airway foreign body removal (98 cases). Bacteria isolated in bronchoalveolar lavage: *Pseudomonas aeruginosa* 21.5%, *Klebsiella pneumonia* 16.9%, *Klebsiella aerogenes* 15.4%, *Streptococcus pneumonia* 10.0% of total cultured specimens.

Conclusion: FB is an important tool in the diagnosis and treatment of respiratory diseases, finding airway anatomical abnormalities, taking specimens for microbiological causes, and providing interventional treatment to resolve obstruction airway.

Keywords: Flexible bronchoscopy, pediatric

I. INTRODUCTION

The flexible bronchoscopy was first applied in 1966 and applied in children 10 years later [1]. Nowadays, the flexible bronchoscopy is widely used and has become an indispensable part in the diagnosis and treatment of respiratory diseases in children. Endoscopy helps to observe the inside of the airways to examine and describe the normal and abnormal anatomy inside the tracheobronchial tree, observe obstructions in the

airways such as foreign bodies, warts, or sputum, and at the same time take samples of secretions and biopsies in the airways for tests to find the microbiological and pathological causes [2].

Indications for flexible bronchoscopy include [3]:

- Diagnostic bronchoscopy: cases of persistent/recurrent wheezing, stridor, persistent cough, persistent pneumonia, relapse, suspected foreign body aspiration, hemoptysis and pulmonary hemorrhage, suspected airway

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abnormalities or X-ray abnormalities (atelectasis, recurrent/persistent, consolidation, atypical and unspecified infiltrates, localized air retention), monitoring patients with lung transplantation or tracheoplasty and obstructive sleep apnea.

- Therapeutic bronchoscopy includes: suctioning of mucus plugs, pus plugs, or fragmentation of airway obstructions in cases of mucus plugging or blood clots, treatment of alveolar filling disorders (alveolar proteinosis and lipid pneumonia), control of hemorrhage, removal of airway foreign bodies, biopsy of airway tumors, laser electrocautery of airways and bronchoscopy-assisted intubation in cases of difficult oral intubation.

Most contraindications to bronchoscopy are relative. Absolute contraindications to bronchoscopy include severe hypoxemia, hemodynamic instability, and uncontrolled visceral bleeding. Severe, early pulmonary hypertension and cyanotic congenital heart disease with increased bronchial collateral circulation are relative contraindications [4].

According to a multicenter report conducted by the European Society of Paediatric Lung Disease, summarizing 198 centers, a total of 56,145 bronchoscopy cases were performed over a 3-year period (2012-2014), with each center performing an average of 74 flexible bronchoscopy cases and 20 rigid bronchoscopy cases per year. Most indications for bronchoscopy were due to the following reasons: radiographic abnormalities (48.5%), infection (48.5%), airway obstruction (39.4%), and cough (29.3%). General anesthesia was used for most patients, and complications were quite rare [5].

The main purpose of our study is to focus on the indications and results achieved through bronchoscopy to provide an overview of the clinical reasons for performing bronchoscopy in children, the investigations, interventions and microbiological results achieved, helping to better treat respiratory diseases.

II. RESEARCH SUBJECTS AND METHODS

- Time and location: implementation time from January 1, 2022 to December 30, 2023 at the National Children's Hospital

- Research subjects: patients undergoing bronchoscopy

- Research method: retrospective cross-sectional description.

- Sample size: convenient

- Bronchoscopy technique:

- + Bronchoscopy is performed in a specialized room. In severe cases where patients cannot move to the bronchoscopy room, bedside endoscopy is arranged.

- + Endoscopy and bronchoalveolar lavage procedures are performed according to the process approved by the Ministry of Health and the National Children's Hospital.

- + Results: images of observations, measurements, and intervention procedures are recorded in the bronchoscopy form.

- Culture tests to identify bacteria, fungi, and xpert tuberculosis genes in bronchoalveolar lavage fluid are performed at the Department of Microbiology, National Children's Hospital.

- Data collection: patient information and test results are collected based on medical records.

- Data processing and analysis are performed using SPSS 20.0 software.

III. RESULTS

3.1. Age and gender characteristics

During the 2-year period from January 1, 2022 to December 31, 2023, there were 1643 flexible bronchoscopy patients with 1296 cases of diagnostic endoscopy (78.9%), 347 (21.1%) cases of interventional endoscopy combining flexible and rigid tubes, of which 162 cases were treated by bronchoscopy emergency in the beds of the resuscitation units and operating rooms (9.9%). Male/female ratio = 1.55/1

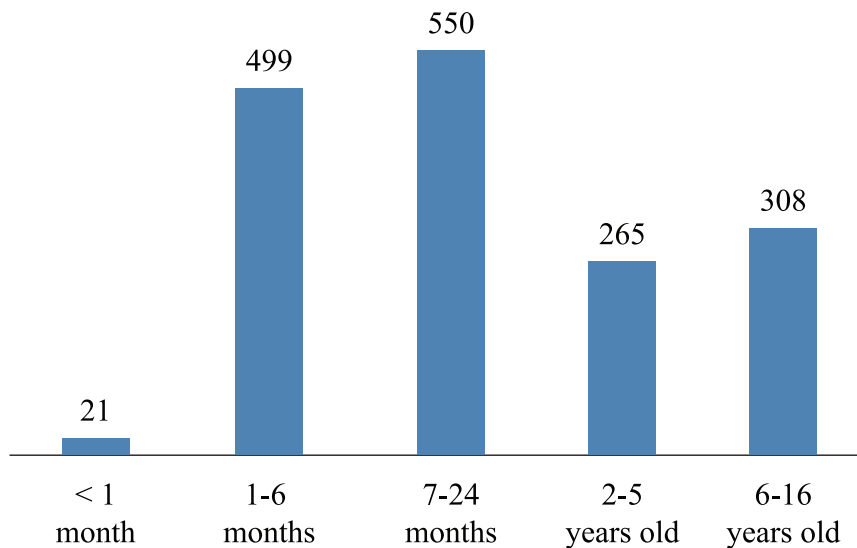


Chart 1. Age of bronchoscopy patients

The age group with the highest indication for bronchoscopy is the group from 1-24 months old (63.9%), the youngest age for bronchoscopy is 2 days old, the oldest is 16 years old

3.2. Reasons for bronchoscopy

Table 1. Pathologies indicating bronchoscopy

Reasons for bronchoscopy	N	%
Persistent/recurrent pneumonia	450	27.4%
Prolonged wheezing, stridor, monitor airway abnormalities	499	30.3%
Suspected foreign body	191	11.6%
Prolonged cough	44	2.7%
Hemoptysis, monitor pulmonary bleeding	61	3.7%
Difficulty weaning off ventilator	43	2.6%
Prolonged atelectasis	39	2.4%
Cannula check	64	3.9%
Other (monitor for pyriform sinus fistula, check t tube, etc.)	252	15.3%
Total	1643	100%

Comments: The reason for bronchoscopy with the highest rate is the group of wheezing, prolonged stridor, suspected airway abnormalities (30.3%), followed by the group of prolonged pneumonia (27.4%). Other reasons leading to the indication of bronchoscopy include suspected airway foreign body (11.6%), prolonged cough (2.7%), hemoptysis and monitoring for pulmonary bleeding (3.7%), etc.

3.3. Results of bronchoscopy

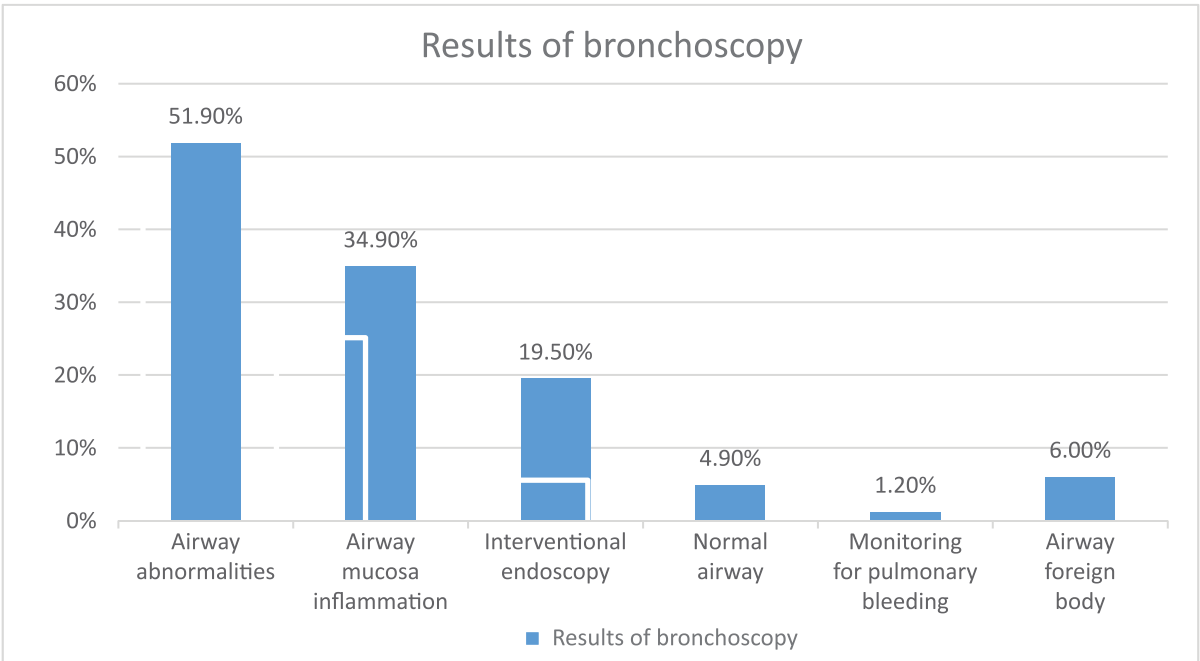


Chart 2. Bronchoscopy results

Comments: Bronchoscopy results detected 51.9% of patients with airway abnormalities, 34.9% of airway mucosa inflammation, 19.5% of airway intervention.

Table 2. Airway morphology abnormalities by Bronchoscopy

Morphological abnormalities	N	%
Posterior laryngeal cleft	41	4.8%
Vocal cord abnormalities	46	5.4%
Laryngeal chondromalacia	164	19.2%
Tracheomalacia	111	13.0%
Bronchomalacia	58	6.8%
Tracheoesophageal fistula	26	3.1%
Tracheal stenosis due to closed cartilage rings	55	6.5%
Subglottic/tracheobronchial stenosis due to scarring	256	30.0%
Subglottic/tracheal hemangioma	17	2.0%
Airway polyps/tumors	62	7.3%
Pyriform sinus fistula	16	1.9%
Total	852	100%

Comments: Common airway morphological abnormalities include subglottic stenosis, tracheal stenosis due to scarring (30%), laryngeal chondromalacia (19.2%), and bronchomalacia (13%).

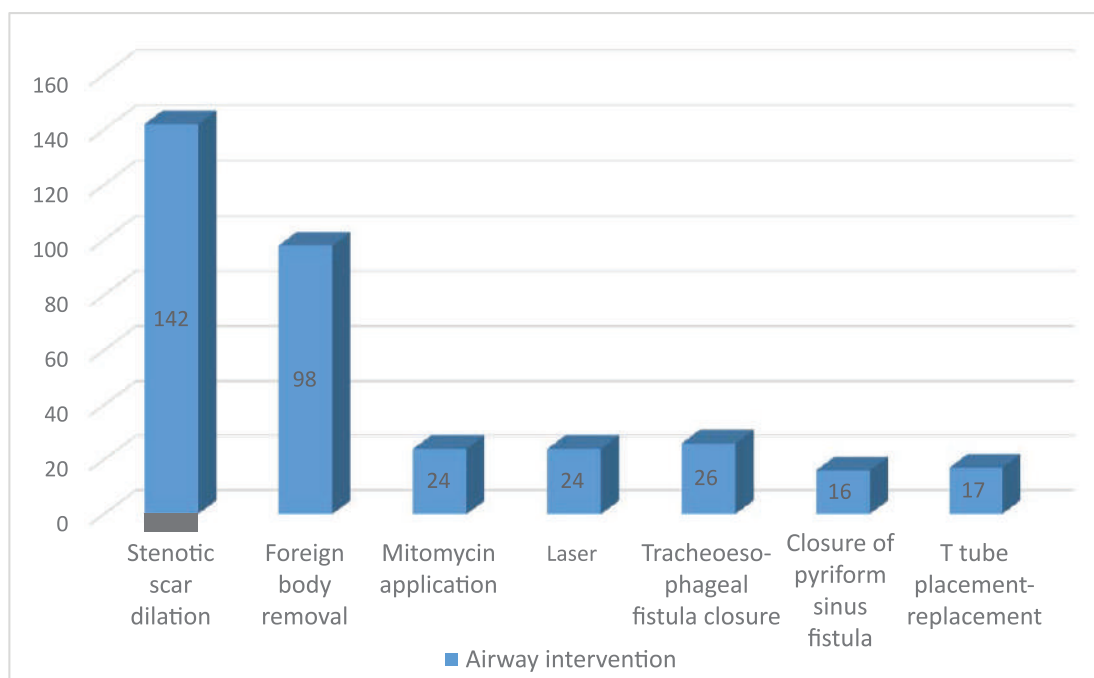


Chart 3. Airway Interventions

Comments Total number of interventional bronchoscopy is 347 cases. The stenotic scar dilation accounted for the highest rate of 142 interventions in 85 patients, airway foreign bodies in 98 patients, total number of patients underwent bronchoscopy.

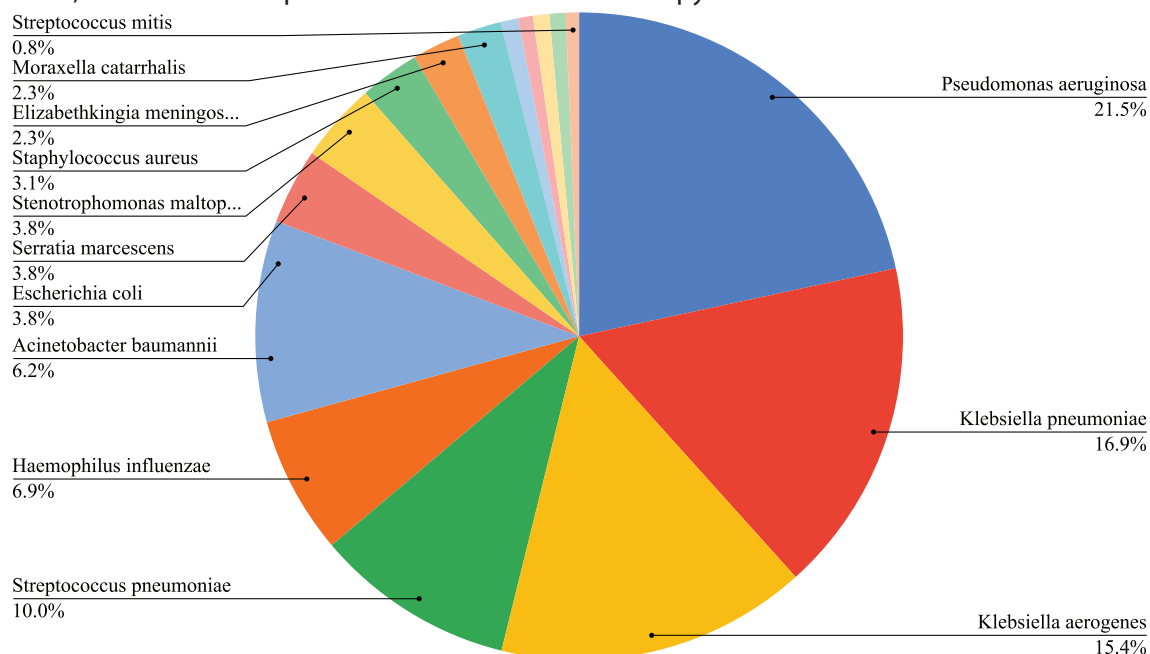


Chart 4. Bacterial etiology in bronchial lavage fluid

Comments A total of 1188 bacterial cultures were obtained, 130 were positive (10.94%), of which the most common bacteria were Pseudomonas aeruginosa 21.5%, Klebsiella pneumonia 16.9%, Klebsiella aerogenes 15.4%, Streptococcus pneumonia 10.0%.

Table 4. Fungal culture, genxpert tuberculosis screening test and Aspergillus fungal antigen in bronchial lavage fluid

	Fungal name	Positive (n=28)	%
	Candida albicans	23	82.1%
Fungal culture (n=428 specimens)	Aspergillus niger	1	3.6%
	Candida glabrata	1	3.6%
	Rhodotorula mucilaginosa	1	3.6%
	Saccharomyces cerevisiae	1	3.6%
	Saprochaete capitata	1	3.6%
Xpert TB (n = 826 specimens)		Positive = 24 (2.9%)	
Aspergillus Ag (n = 772 specimens)		Positive = 88 (11.4%)	

Comments: Positive fungal culture rate was 6.54%, mainly Candida albicans (82.1%), positive rate of Genxpert tuberculosis in bronchoalveolar lavage fluid was 2.9%, Aspergillus 11.8%.

IV. DISCUSSION

4.1. Discussion on general characteristics of the study group

In our study, the age of children undergoing bronchoscopy ranged from newborn to 16 years old. The youngest patient was 2 days old, the reason for endoscopy was respiratory failure and difficulty in intubation. The age group most indicated for bronchoscopy was the 1-24 month group, which is also the group that is prone to recurrent respiratory diseases and abnormal airway symptoms are also manifested very early in this period.

4.2. Indications for bronchoscopy

The most common indication for bronchoscopy was persistent wheezing and stridor (30.3%), some cases were suspected by clinicians of abnormal airway pathologies through clinical examination, or suggested through imaging diagnosis. This is also a group of diseases typically related to airway obstruction that begins very early in children, persists, and requires hospitalization for monitoring. Many cases of wheezing and stridor cause severe obstruction leading to respiratory failure, mechanical ventilation such as subglottic stenosis due to hemangioma and scarring, etc. According to author Sherif *et al.* [6], the most commonly performed indication for flexible

bronchoscopy in infants is prolonged wheezing, loud breathing, and inspiratory stridor.

The group of patients with a tendency to persistent disease, or unknown cause, poor response to treatment need to be indicated for bronchoscopy such as prolonged, recurrent pneumonia (27.6%), prolonged atelectasis (2.7%), prolonged mechanical ventilation difficult to wean (2.6%), prolonged cough (2.4%). The purpose of bronchoscopy is to help assess whether the morphological structure of the airway is abnormal or not, the nature of secretions, release of mucus plugs causing airway obstruction if any, and take microbiological specimens to find the cause of the disease. The study by Valentina Agnese Ferraro *et al.* also concluded that the main indications for bronchoscopy were recurrent lower respiratory tract infections (32.2%) and chronic phlegmy cough (9.4%) in a total of 477 study patients [7].

Cases of hemoptysis or clinical hemorrhagic triad (hemoptysis, iron deficiency anemia, diffuse infiltrative lesions on chest x-ray) indicating bronchoscopy accounted for 3.7%, thereby determining the status of localized or diffuse bleeding in the airways, taking bronchoalveolar lavage fluid to find the microbiological cause, perform pathological anatomy and in some cases intervene to stop bleeding and relieve

obstruction caused by blood clots blocking the airway.

The main indication for bronchoscopy intervention was with a rigid tube, after the flexible bronchoscopy detected the lesion. Indications for intervention at our center include: removal of foreign bodies in the airway, dilation of secondary stenosis after endotracheal intubation, laser cauterization of tracheobronchial polyps, closure of pyriform sinus fistula, tracheoesophageal fistula with Tricloacetic acid, Mitomycin application to prevent proliferation of stenosis after dilation.

4.3. Bronchoscopy results

Bronchoscopy results detected 51.9% of patients with airway abnormalities. In this group, the most common were subglottic stenosis due to scarring (30%), laryngeal chondromalacia (19.2%), and bronchomalacia (13%). Other less common abnormalities such as tracheal stenosis due to closed cartilage rings, subglottic hemangioma, and tracheoesophageal fistula were also detected through flexible bronchoscopy. In a study by author Samia Hamouda *et al.* on 365 patients, up to 60 patients had soft airway abnormalities. A study conducted at Children's Hospital 1 with 57 children with wheezing lasting more than 4 weeks receiving bronchoscopy, 11/57 children (19.3%) had airway abnormalities, including tracheal stenosis in 8 cases (14%), tracheoesophageal softening in 3 cases (5.3%), and tracheobronchial fistula in 1 case (1.8%) [8].

Before bronchoscopy, 11.6% of children were suspected of having a foreign body in the airway, after endoscopy, 4.3% of children were found to have a foreign body in the airway out of the total number of patients. In a study by Sinan Yavuz *et al.* on 72 bronchoscopy patients, up to 32% were suspected of having a foreign body in the airway before endoscopy, and after endoscopy, up to 25% of children had a real foreign body [10].

In 1643 cases of flexible bronchoscopy, 347 cases were identified with abnormalities requiring intervention. Of which, the stenotic scar dilation accounted for the highest rate of

142 cases (8.6%), and the removal of foreign bodies in the airway accounted for 98 cases (6%) of the total number of patients undergoing bronchoscopy. Other procedures accounted for a lower rate such as tracheoesophageal fistula closure (1.6%), pyriform sinus fistula with trichloroacetic acid, mitomycin application to prevent stenotic scar proliferation after dilation, and laser ablation of tracheobronchial polyps. For many decades, interventional bronchoscopy in children was limited to the removal of foreign bodies. In 1978, the first report of diagnostic flexible bronchoscopy in children was published. Since then, bronchoscopy has become an increasingly important tool in children with acute and chronic respiratory diseases. In parallel with bronchoscopy in adults, pediatric airway endoscopy has evolved from diagnostic to therapeutic (i.e. interventional), supported by the development of new and smaller instruments and devices. Today, advanced therapeutic techniques such as laser therapy, balloon dilation, and stenting are widely used in pediatric centers to treat airway diseases in children [10].

Regarding the most common microbiological etiology when culturing bronchoalveolar lavage specimens, a total of 1188 samples, 130 samples were positive (10.94%), in which the most common bacteria were *Pseudomonas aeruginosa* 21.5%, *Klebsiella pneumoniae* 16.9%, *Klebsiella aerogenes* 15.4%, and *Streptococcus pneumoniae* 10.0%. Our study had similar results to the author Sinan Yavuz *et al.* with the infection rate of *Pseudomonas aeruginosa* 19.5%, Methicillin-resistant staphylococcus 14.29% [9]. However, there were differences with some authors Valentina Agnese Ferraro *et al.* with the most common bacterial etiologies being *Haemophilus influenzae*, *Streptococcus pneumoniae*, and *Moraxella catarrhalis* [7].

The rate of positive fungal culture was 6.54%, mainly *Candida albicans* (82.1%). This result is similar to the study by Sinan Yavuz [9]. For the group of prolonged pneumonia, poor response to antibiotic treatment, indicated for *Aspergillus* antigen testing, genexpert tuberculosis detected

11.2% positive for fungi, 2.9% positive for tuberculosis in the total number of bronchial lavage fluid specimens indicated.

The microbiological results obtained are very valuable in choosing antibiotics for patients, helping to improve the effectiveness of treating respiratory infections.

V. CONCLUSION

Bronchoscopy can be performed on all ages, is an important tool in the diagnosis and treatment of respiratory diseases, helps detect airway anatomical abnormalities, collect specimens for microbiological causes, and treat by interventions to resolve airway obstruction.

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