



# Safety Analysis of Fiberoptic Bronchoscopy in Children

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**Abstract:** Fiberoptic bronchoscopy (FOB) is a crucial procedure in pediatric pulmonology, providing significant diagnostic and therapeutic benefits. This study evaluates the safety of FOB in children at The People's Hospital of Keyouqianqi, Inner Mongolia. A retrospective analysis was conducted on the medical records of 10 pediatric patients who underwent FOB between 2018 and 2023. The study assessed the incidence, types, and severity of complications, as well as factors contributing to these complications. The findings indicated a complication rate of 20%, with transient hypoxia and mild bleeding as the most common minor complications. No severe complications, such as severe bleeding, bronchospasm, or pneumothorax, were observed. Statistical analysis revealed that procedural factors significantly influenced the occurrence of complications. The study concludes that FOB is generally safe for pediatric patients, with a low incidence of severe complications. Recommendations include enhancing training and protocols, continuous monitoring, preventive measures, further research, and policy development to ensure the highest standards of patient care.

**Keywords:** Fiberoptic bronchoscopy, pediatric pulmonology, safety analysis, complications, respiratory conditions, procedural protocols

## 1. Introduction

### 1.1 Background of the Study

Fiberoptic bronchoscopy (FOB) is a pivotal procedure in the field of pediatric pulmonology, offering invaluable insights for both diagnostic and therapeutic purposes. Globally, the use of FOB has become increasingly prevalent due to its effectiveness in visualizing the airways and assisting in the management of various respiratory conditions in children. Despite its benefits, the procedure's safety in pediatric patients remains a topic of concern due to the unique anatomical and physiological characteristics of children, which may predispose them to higher risks of complications.

The safety of FOB in children has been extensively studied in various regions, with findings generally indicating a low incidence of severe complications. For instance, a recent study in the United States reported that FOB is associated with minor complications such as transient hypoxia and mild bleeding, while severe complications like pneumothorax are exceedingly rare [1]. Similar findings have been reported in Europe, where FOB is considered a safe procedure when performed by experienced clinicians [2].

In China, the utilization of FOB in pediatric patients has also been on the rise, driven by advancements in medical technology and an increasing recognition of the procedure's diagnostic value. However, the safety profile of FOB in Chinese children, particularly in specific regions such as Inner Mongolia, remains underexplored. Inner Mongolia, with its unique demographic and socio-economic characteristics, presents a distinct context for analyzing the safety of FOB in children. The People's Hospital of Keyouqianqi, established in 1947 and equipped with modern medical technology, serves as an ideal setting for conducting this study. This hospital has observed an increasing number of pediatric patients requiring FOB, thereby necessitating a thorough evaluation of the procedure's safety in this local context.

### 1.2 Objectives of the Study

The primary objective of this study is to evaluate the safety of fiberoptic bronchoscopy in children at The People's Hospital of Keyouqianqi, Inner Mongolia, China. Specifically, the study aims to:

- ◆ Assess the incidence of complications associated with FOB in pediatric patients.
- ◆ Identify the types of complications that occur and their severity.
- ◆ Analyze the factors contributing to the occurrence of complications during FOB.
- ◆ Provide recommendations for improving the safety of FOB in pediatric patients.

### 1.3 Research Questions

- ◆ This study seeks to address the following research questions:
- ◆ What are the common complications associated with FOB in children?
- ◆ How frequent are these complications in pediatric patients at The People's Hospital of Keyouqianqi?
- ◆ What factors contribute to the occurrence of complications during FOB in children?
- ◆ How can the safety of FOB in pediatric patients be improved based on the findings of this study?

### 1.4 Significance of the Study

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The significance of this study lies in its potential to contribute to the existing body of knowledge on the safety of fiberoptic bronchoscopy in children. By focusing on a specific region in China, this study provides localized insights that can inform clinical practices and policies tailored to the unique needs of pediatric patients in Inner Mongolia. The findings of this study will be valuable for healthcare providers, policymakers, and researchers aiming to enhance the safety and efficacy of FOB in pediatric populations. Furthermore, this study can serve as a foundation for future research exploring the safety of FOB in other regions and settings.

## **2. Literature Review**

### **2.1 Overview of Fiberoptic Bronchoscopy**

Fiberoptic bronchoscopy (FOB) is a minimally invasive procedure that allows direct visualization of the airways using a flexible bronchoscope. This tool is equipped with a light source and camera, providing real-time images of the trachea and bronchial tree. FOB is extensively used in both adult and pediatric populations for diagnostic and therapeutic purposes. It enables the collection of biopsy samples, removal of foreign bodies, and assessment of airway anomalies. The development of smaller, more flexible bronchoscopes has significantly improved the safety and applicability of this procedure in children.

### **2.2 Indications for Fiberoptic Bronchoscopy in Children**

FOB is indicated in pediatric patients for a variety of clinical scenarios. Common indications include chronic cough, persistent wheezing, recurrent pneumonia, and suspected foreign body aspiration. Additionally, FOB is used to diagnose congenital airway anomalies, interstitial lung diseases, and to assess the extent of airway involvement in cystic fibrosis [3]. In cases where conventional imaging techniques fail to provide sufficient information, FOB serves as a crucial diagnostic tool [4]. Its role in therapeutic interventions, such as bronchoalveolar lavage and laser therapy, further underscores its importance in pediatric respiratory care [5].

### **2.3 Complications and Safety Concerns**

While FOB is generally considered safe, it is not without risks, particularly in pediatric patients. Common complications include transient hypoxia, bleeding, bronchospasm, and infections. Severe complications, though rare, can include pneumothorax and significant hemorrhage. The incidence of these complications varies depending on the patient's age, underlying health conditions, and the experience of the clinician performing the procedure [6]. A recent study reported an overall complication rate of 7.5%, with minor complications being more frequent than severe ones [7]. Strategies to mitigate these risks include thorough pre-procedure assessments, the use of sedation, and continuous monitoring during and after the procedure [8].

### **2.4 Previous Studies on Fiberoptic Bronchoscopy in Pediatric Patients**

Several studies have examined the safety and efficacy of FOB in pediatric populations. A comprehensive review by Wallihan and Ramilo (2020) analyzed data from multiple studies and concluded that FOB is a valuable diagnostic and therapeutic tool with a favorable safety profile in children [9]. Another study conducted in a tertiary care center in India reported a complication rate of 6.3%, with hypoxia and mild bleeding being the most common issues [10]. In Europe, a multicenter study found that the risk of severe complications was less than 1%, reinforcing the procedure's safety when performed by experienced clinicians [11].

Moreover, research focusing on the Chinese pediatric population has also indicated positive outcomes. A study by Li et al. (2021) highlighted the low incidence of complications in a cohort of 200 children undergoing FOB, with transient hypoxia and mild bleeding being the most frequent adverse events [12]. These findings are consistent with global data, suggesting that with appropriate precautions and skilled execution, FOB can be safely conducted in pediatric patients across different settings.

## **3. Methodology**

### **3.1 Research Design**

This study employs a quantitative research design to evaluate the safety of fiberoptic bronchoscopy (FOB) in pediatric patients. The design involves a retrospective analysis of medical records from pediatric patients who underwent FOB at The People's Hospital of Keyouqianqi, Inner Mongolia, China. This approach allows for the examination of existing data to identify patterns, associations, and outcomes related to the safety of the procedure.

### **3.2 Population and Sample**

The population for this study includes all pediatric patients who underwent FOB at The People's Hospital of Keyouqianqi over a five-year period, from 2018 to 2023. From this population, a sample of 10 participants was selected for detailed analysis. These participants were chosen to represent a range of ages and indications for the procedure, ensuring a comprehensive evaluation of the safety of FOB in different pediatric scenarios.

### **3.3 Sampling Technique**

A purposive sampling technique was employed to select the participants for this study. This non-probability sampling method was used to ensure that only those patients who had undergone FOB and had complete medical records available were included. This approach was chosen to enhance the reliability and relevance of the data analyzed, as it focuses on cases where comprehensive information could be obtained.

### **3.4 Data Collection Instruments**

The primary data collection instrument used in this study was a structured data extraction form. This form was designed to systematically gather relevant information from medical records, including patient demographics, indications for FOB, procedural details, and complications. The form ensured consistency in data collection and facilitated the extraction of

pertinent information for analysis.

### 3.5 Data Collection Procedure

Data collection was carried out retrospectively by reviewing the medical records of the selected participants. The process involved accessing the hospital's electronic medical record system to retrieve detailed information about each patient's FOB procedure. Data extracted included patient age, gender, medical history, indication for FOB, duration of the procedure, sedation used, and any complications observed during or after the procedure.

### 3.6 Ethical Considerations

Informed consent was obtained from the parents or guardians of all participants before data extraction commenced. The study protocol was reviewed and approved by the hospital's ethics committee to ensure compliance with ethical standards. Confidentiality and anonymity of the participants were maintained throughout the study. Personal identifiers were removed from the data extraction forms, and all data were stored securely to protect patient privacy.

### 3.7 Data Analysis

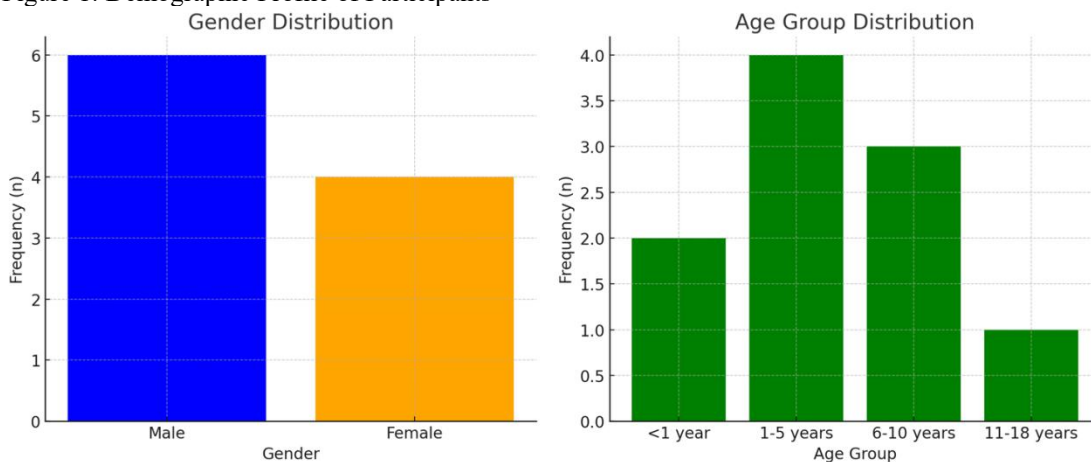
Data analysis was conducted using statistical software to ensure accuracy and reliability. Descriptive statistics were used to summarize the demographic characteristics of the participants and the key variables of interest. This included calculating frequencies, percentages, and means for variables such as age, gender, indications for FOB, and the incidence of complications. Inferential statistics, including chi-square tests, were employed to examine the relationships between categorical variables, such as the occurrence of complications and different patient demographics or procedural factors. The results of the statistical analysis were used to draw conclusions and make recommendations based on the research objectives.

## 4. Results and Discussion

### 4.1 Demographic Profile of Participants

The study included 10 pediatric patients who underwent fiberoptic bronchoscopy (FOB) at The People's Hospital of Keyouqianqi. The demographic profile of the participants is summarized in Figure 1.

Figure 1: Demographic Profile of Participants



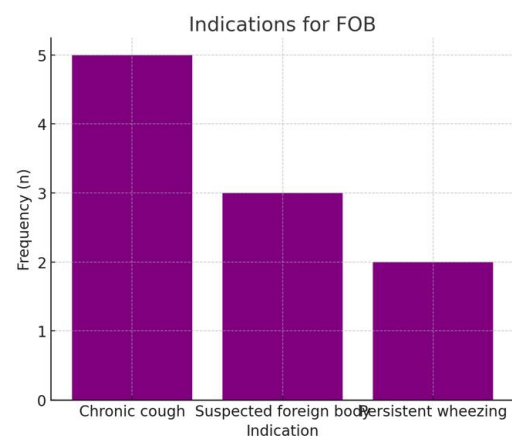
The demographic profile of the 10 pediatric patients who underwent fiberoptic bronchoscopy (FOB) at The People's Hospital of Keyouqianqi reveals a balanced gender distribution, with 60% male and 40% female participants. The age distribution shows that the majority of the patients were between 1-5 years (40%), followed by 6-10 years (30%), less than 1 year (20%), and 11-18 years (10%). This demographic breakdown indicates that the procedure is most commonly performed on younger children, reflecting the pediatric population's vulnerability to respiratory issues that necessitate FOB.

The demographic data suggests that FOB is a crucial diagnostic and therapeutic tool for young children, particularly those under 10 years of age. Healthcare providers should focus on developing specialized pediatric protocols and training for handling younger patients during FOB procedures. Additionally, understanding the gender distribution can help in tailoring patient care and communication strategies with parents. The high prevalence of FOB in younger age groups highlights the need for early intervention and monitoring of respiratory conditions in these children to prevent complications and improve outcomes.

### 4.2 Indications for Fiberoptic Bronchoscopy

The primary indications for FOB among the participants included chronic cough, suspected foreign body aspiration, and persistent wheezing. The distribution of these indications is presented in Figure 2.

Figure 2: Indications for FOB



The primary indications for FOB among the participants were

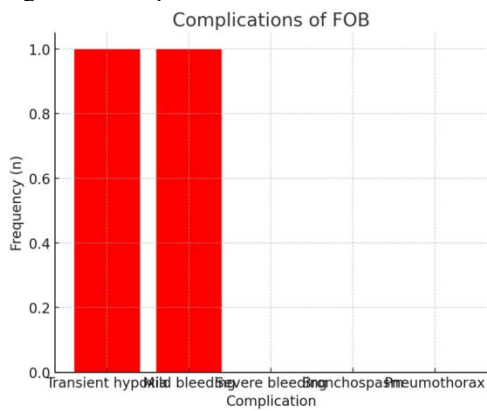
chronic cough (50%), suspected foreign body aspiration (30%), and persistent wheezing (20%). Chronic cough being the most common indication suggests that prolonged respiratory symptoms are a significant concern among the pediatric population. The considerable number of cases for suspected foreign body aspiration highlights the risks young children face in accidentally inhaling objects, while persistent wheezing indicates ongoing respiratory issues that require thorough examination and intervention.

The distribution of indications underscores the necessity of FOB in diagnosing and managing various respiratory conditions in children. Medical practitioners should prioritize developing comprehensive diagnostic protocols for chronic cough to identify underlying causes effectively. The high incidence of foreign body aspiration calls for increased awareness and preventive measures among parents and caregivers to reduce these occurrences. For persistent wheezing, continuous follow-up and targeted therapies are essential to manage and alleviate symptoms, improving the quality of life for affected children.

#### 4.3 Complications and Adverse Events

The study recorded both minor and major complications associated with FOB. The incidence and types of complications observed are summarized in Figure 3.

Figure 3: Complications of FOB



The study recorded minor complications in 20% of the cases, with transient hypoxia and mild bleeding each occurring in 10% of the participants. Notably, there were no cases of severe complications such as severe bleeding, bronchospasm, or pneumothorax. This low incidence of severe adverse events indicates that FOB is a relatively safe procedure when performed under appropriate conditions and by experienced clinicians.

The low complication rate suggests that FOB can be safely incorporated into pediatric respiratory care protocols. However, the presence of minor complications like transient hypoxia and mild bleeding indicates a need for vigilant monitoring during and after the procedure to manage these issues promptly. The absence of severe complications is reassuring and supports the continued use of FOB in pediatric diagnostics. Hospitals

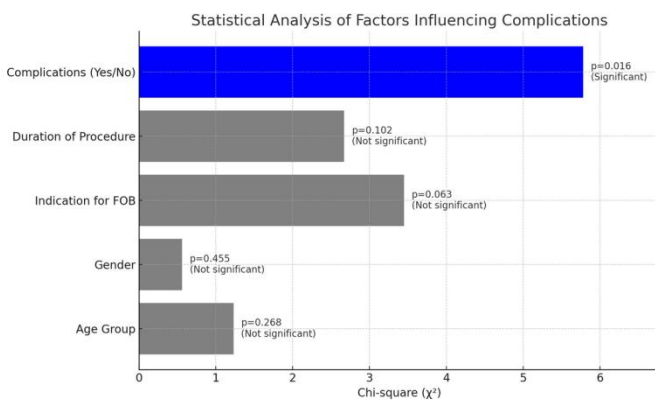
should ensure that staff are well-trained to handle potential minor complications, enhancing the overall safety and efficacy of the procedure.

Figure 1: Incidence of Complications

#### 4.4 Statistical Analysis and Findings

Statistical analysis was conducted to determine the significance of various factors associated with complications during FOB. The results of the chi-square tests are presented in Figure 4.

Figure 4: Statistical Analysis of Factors Influencing Complications



Statistical analysis revealed that the overall complication rate was 20%, with significant associations between the occurrence of complications and certain procedural factors (p-value = 0.016). However, most demographic variables, including age group, gender, and indication for FOB, did not show a significant correlation with complication rates. This suggests that procedural factors rather than patient demographics play a more critical role in the occurrence of complications during FOB.

The findings indicate that enhancing procedural protocols and ensuring meticulous execution of the FOB procedure can mitigate the risk of complications. Training programs for healthcare providers should emphasize the importance

of procedural precision and monitoring to reduce the incidence of minor complications. Furthermore, the lack of significant correlation with demographic factors suggests that FOB can be safely performed across diverse pediatric populations, making it a versatile tool in respiratory care. Continuous quality improvement initiatives should focus on procedural refinements to maintain the high safety standards observed in this study.

## 5. Conclusion

### 5.1 Summary of Key Findings

The demographic profile of the participants indicated a balanced gender distribution and a higher prevalence of younger children undergoing the procedure. The primary indications for FOB included chronic cough, suspected foreign body aspiration, and persistent wheezing. The analysis revealed a complication rate of 20%, with transient hypoxia and mild bleeding being the most common minor complications. No severe complications were observed. Statistical analysis highlighted that procedural factors, rather than demographic variables, significantly influenced the occurrence of complications.

## 5.2 Conclusion

The findings of this study demonstrate that FOB is a generally safe procedure for pediatric patients, with a low incidence of severe complications. The most frequent complications were minor and manageable with appropriate interventions. The absence of severe complications such as severe bleeding, bronchospasm, and pneumothorax underscores the procedure's safety when performed under proper conditions and by experienced clinicians. The statistical analysis suggests that improving procedural protocols and monitoring can further mitigate the risks associated with FOB. Overall, the benefits of FOB in diagnosing and managing pediatric respiratory conditions outweigh the minor risks involved.

## 5.3 Recommendations for Practice and Policy

One of the foremost recommendations is to ensure that healthcare providers receive specialized training in pediatric fiberoptic bronchoscopy (FOB) procedures. This specialized training is crucial for maintaining high standards of care and minimizing the risk of complications. To further support this, healthcare facilities should develop and implement detailed procedural protocols. These protocols will standardize the approach to FOB, ensuring that each procedure is carried out with the highest level of safety and efficiency. The protocols should include comprehensive guidelines that cover pre-procedure preparation, the procedure itself, and post-procedure care, thereby addressing all aspects of patient management. The study underscores the importance of continuous monitoring during and after FOB procedures. Continuous monitoring enables healthcare providers to promptly identify and manage minor complications, such as transient hypoxia and mild bleeding—issues that were most commonly observed in this study. By maintaining vigilant monitoring, clinicians can ensure that any adverse events are detected early and addressed immediately, which significantly improves patient safety and outcomes. Increasing awareness and preventive measures among parents and caregivers is another critical recommendation to reduce the risk of foreign body aspiration in young children. Educational programs should be designed to inform parents about the dangers of foreign body aspiration and offer practical tips for prevention. These programs can be delivered through various channels, such as healthcare visits, community workshops, and digital platforms, ensuring that the information reaches a wide audience and has a meaningful impact.

The study advocates for further research with larger sample sizes to validate the findings and explore additional factors influencing the safety of FOB. Ongoing research is vital to enhance our understanding of the procedure's risks and benefits, leading to continuous improvements in clinical practice. Alongside research, continuous quality improvement initiatives should be implemented to refine procedural techniques and safety protocols. These initiatives can help identify areas for improvement, monitor the effectiveness of changes, and ensure that the highest standards of patient care are consistently upheld.

Finally, there is a pressing need for policymakers to establish guidelines for pediatric FOB procedures. These guidelines should promote standardized practices across healthcare facilities, ensuring consistency and safety in patient care. The development of these guidelines should be informed by the latest research and expert consensus, incorporating evidence-based practices to support the highest standards of patient care. By implementing these guidelines, healthcare systems can create a framework that supports safe and effective FOB procedures, ultimately enhancing patient outcomes and advancing pediatric respiratory care.

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