

# Airway Stenosis Related to Foreign Body Aspiration: An Under-recognized Long term Complication

Ravindra M Mehta, Nadakuditi Rashmi<sup>id</sup>, Pooja Bajaj<sup>id</sup>, Shyam Krishnan and Lakshmi Priya Srinivasan

Department of Pulmonary, Critical Care and Sleep Medicine, Apollo Hospitals, Bangalore, India.

Clinical Medicine Insights: Case Reports  
Volume 12: 1–4  
© The Author(s) 2019  
Article reuse guidelines:  
sagepub.com/journals-permissions  
DOI: 10.1177/1179547619863816



## ABSTRACT

**INTRODUCTION:** Sequelae of chronic foreign body aspiration include occlusive granulation tissue formation, which can cause delayed fixed airway stenosis. The aim of this study is to highlight this complication, which should be diagnosed early and treated proactively.

**METHODS:** We present a case series of areca nut aspiration, an organic foreign body commonly chewed in Southeast Asia, complicated by delayed airway stenosis and examine the peculiar nature of areca nut that predisposes to this complication.

**RESULTS:** Long-term sequelae of areca nut aspiration are granulation tissue formation, potentially complicated by airway stenosis due to the mechanical and chemical irritant nature of areca nut.

**DISCUSSION:** Organic impacted foreign bodies such as areca nut can cause delayed complications of airway stenosis. Both the sharp edges of the areca nut and chemical irritation caused by alkaloids released by the nut in constant contact with the airway mucosa can predispose to this long-term complication. Early diagnosis and appropriate therapeutic interventions such as balloon bronchoplasty can help restore airway patency and prevent lung damage.

**KEYWORDS:** Foreign body aspiration, airway stenosis, long-term sequelae

**RECEIVED:** June 19, 2019. **ACCEPTED:** June 21, 2019.

**TYPE:** Case Report

**FUNDING:** The author(s) received no financial support for the research, authorship, and/or publication of this article.

**DECLARATION OF CONFLICTING INTERESTS:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**CORRESPONDING AUTHOR:** Ravindra M Mehta, Department of Pulmonary, Critical Care and Sleep Medicine, Apollo Hospitals, #2 (Old no. 21/2), 14th Cross, 3rd Block, Jayanagar, Bangalore 560011, Karnataka, India. Email: ravihetal@gmail.com

## Introduction

Airway foreign body aspiration (FBA) is more common in children, with adult FBA accounting for 20% of cases.<sup>1</sup> Foreign body aspiration is broadly classified into 2 groups, organic and inorganic. Inorganic FBA has few symptoms, whereas organic FBA presents with symptoms such as recurrent cough, fever, and infections. Peanuts are the most commonly aspirated organic foreign body (FB), followed by sunflower seeds, vegetable pieces, corn, peas, and areca nut.<sup>2</sup> Areca nut (betel nut) is widely consumed by all age groups in many parts of the world, especially the Indian subcontinent in Southeast Asia.

Long-standing or intrinsically irritant FB's can cause delayed airway stenosis, a phenomenon that has not been commonly described. The aim of this study is to describe the delayed complication of airway stenosis in a case series of complicated FBA due to organic FBs (areca nut). This aspect of organic FBA is important to highlight, as it can lead to permanent airway issues and distal parenchymal sequelae.

### Case 1

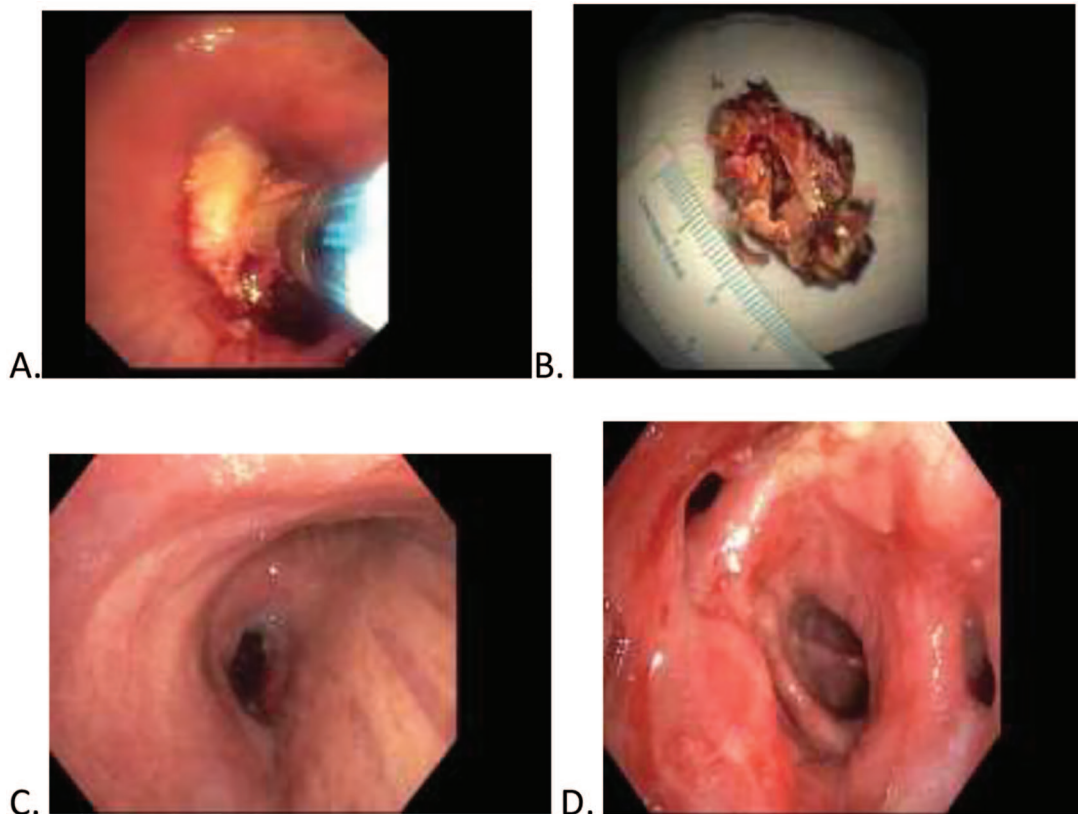
A 61-year-old man, a habitual betel nut chewer, presented with dry cough and dyspnea for 1 month with recurrent respiratory infection, and with a background of choking on a large betel nut piece a month ago. Initial bronchoscopy showed a large betel nut firmly impacted in the right bronchus intermedius (RBI). This was difficult to remove and bronchoscopy done

twice, including rigid bronchoscopy, was unsuccessful. He was referred for further management, including surgical options. Computed tomography of the thorax (CT thorax) showed a well-defined density spanning the RBI. Bronchoscopy showed an FB completely occluding the RBI with surrounding granulation. Rigid bronchoscopy was repeated, but the tightly impacted betel nut could not be removed with rigid forceps or basket. Finally, cryo-adhesion was used to remove the FB (2.5 cm long) piecemeal. The airway was recanalized with residual inflammation, granulation, and postobstructive infection seen. He was treated with antibiotics and a short course of steroids for the edema. A month later, cough with mild dyspnea persisted, and although there was partial resolution of the right lower lobe (RLL) collapse, bronchoscopy showed critical stenosis of the RBI (Figure 1). Balloon bronchoplasty was performed and the RBI lumen was re-established. Surveillance over 3 months showed no recurrence of the stenosis.

### Case 2

A 52-year-old man presented with cough and streaky hemoptysis, with history suggestive of FBA 1 month ago. The CT thorax showed an RLL consolidation with an RBI lesion. Bronchoscopy showed FB impaction in the RBI. Rigid bronchoscopy showed a large residual FB completely occluding the RBI, with surrounding granulation. The FB, a betel nut, was removed using the cryo-probe and rigid forceps, leaving a





**Figure 1.** (A) Cryo-extraction of foreign body impacted in right bronchus intermedius (RBI), (B) extracted betel nut, (C) RBI stenosis, and (D) patent distal right bronchial tree.

narrowed and inflamed RBI. Check bronchoscopy done after 3 weeks showed critical RBI narrowing, which was recanalized with balloon bronchoplasty (Figure 2), and stayed patent in follow-up over a period of 3 months.

### Case 3

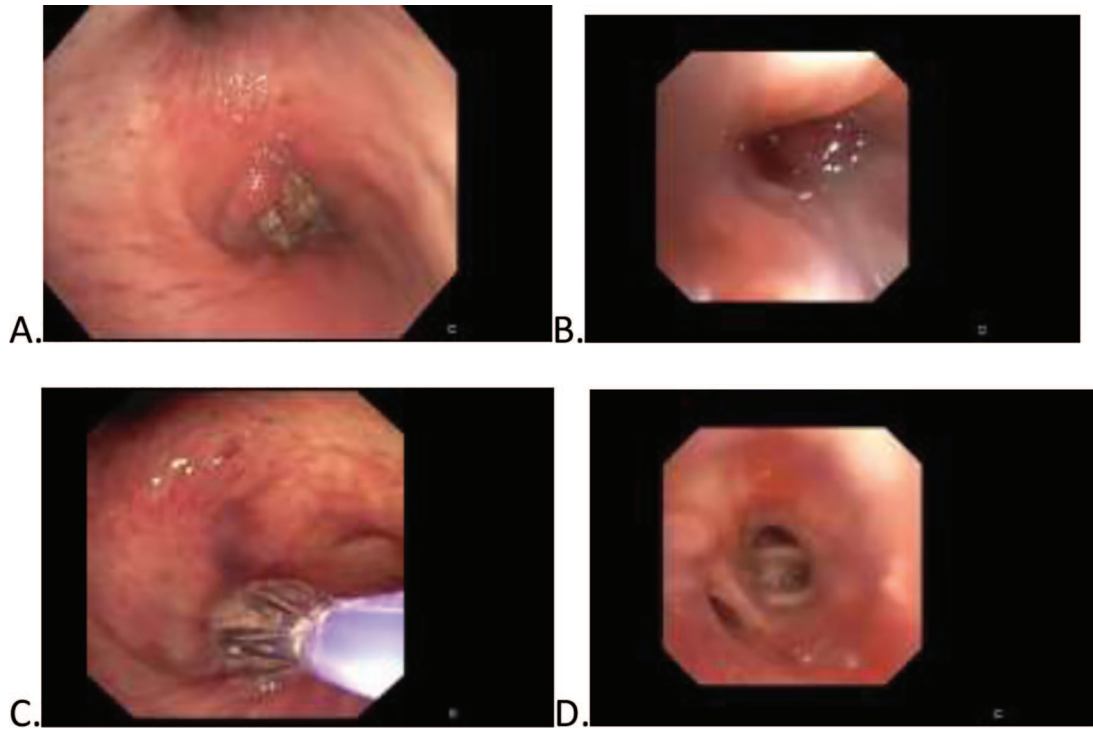
A 10-year-old boy presented with cough and recurrent infection, with suspected betel nut aspiration 3 months ago. CT thorax showed an RBI lesion, suggestive of an FB with postobstructive RLL collapse. Bronchoscopically, the RBI was completely occluded with granulation overlying a FB. A cryoprobe and rigid forceps were used to remove the FB, with persistent RBI luminal narrowing. Balloon bronchoplasty of the RBI was done, with postobstructive pus drainage and patency of the RLL was established. Surveillance bronchoscopy after 1 month showed near-complete RBI reocclusion. A guide wire was passed across the stenosis, and balloon bronchoplasty of the stenotic segment was repeated (Figure 3), restoring patency with no restenosis at 4-month follow-up.

### Discussion

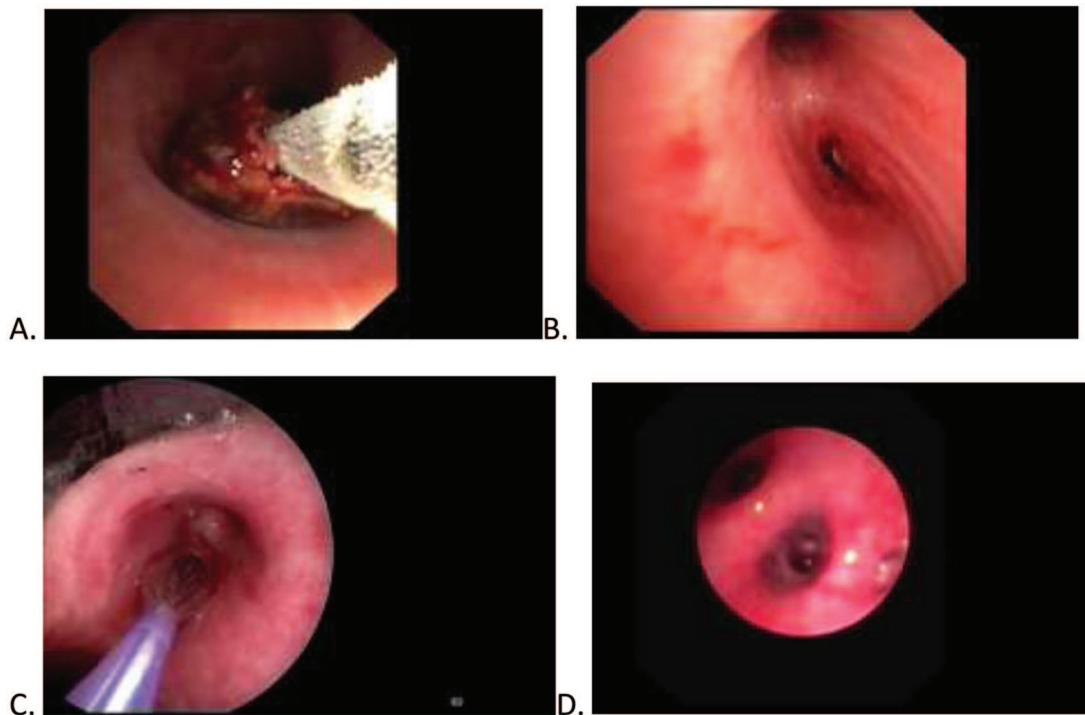
The symptoms and complications of FBA are mainly related to the effects of the FB on the airway and problems in removal. Impacted, irritant, long-standing, and difficult-to-remove FB's can be challenging and can directly or indirectly lead to long-term complications. Scant data exist on delayed airway stenosis

as a complication of FBA. An impacted FB incites granulation tissue around it. In the short term, the granulation anchors it to the airway wall making extraction more complicated, with the risk of bleeding and airway trauma. Later, granulation and mucosal trauma can lead to cicatrization and airway stenosis, with long-term issues. The stenosis can be short or long segment and can involve cartilage secondarily, increasing the complex nature of the stenosis. It is important to be aware of these sequelae, and follow-up with bronchoscopy is needed for detection of occlusive granulation tissue formation or airway stenosis in such situations.

The pathophysiology of stenosis is related to the properties of the FB and tissue response of the airway. The irritation potential of the FB is related to the intrinsic properties of the FB and duration of impaction, the main factors causing the granulation-stenosis cycle. As mentioned earlier, organic FBs, impacted FBs, and long-standing FBs have the maximum potential to incite the cycle of mucosal irritation, chronic inflammation, and granulation. The process of bronchoscopic removal adds a component of trauma to the irritated and inflamed airway. The multifactorial inflammation-fibrosis cycle, if extensive or circumferential, can lead to cicatrization and stenosis. Airway stenosis, when left uncorrected, leads to postobstructive infection, with consequences of bronchiectasis or permanent volume loss. Even after the FB is removed, the resultant granulation may heal without any sequelae or cause scarring with stenosis. This appears to be more with organic



**Figure 2.** (A) Foreign body tightly impacted in right bronchus intermedius (RBI), (B) post-foreign body extraction RBI stenosis, (C) balloon bronchoplasty, and (D) patent distal bronchus.



**Figure 3.** (A) Cryo-extraction of foreign body impacted in right main bronchus, (B) narrowed right bronchus intermedius, (C) balloon dilatation of the stenotic segment, and (D) patent distal right bronchial tree.

FBs, and peculiar features of the areca nut in this respect are described below.

Areca nut (betel nut) is an organic FB, and all the airway stenosis cases described above were complications of accidental areca nut aspiration. It is an irritant as described below, has

relatively sharp edges, does not soften and dissolve easily, and firmly wedges in the airway causing both focal and circumferential irritation. The most important biologically active ingredients of areca nut are alkaloids such as arecoline, arecaidine, guvacine, guvacoline, nicotine, and piperidine.

Areca nut extracts increase the expression of inflammatory cytokines such as tumor necrosis factor- $\alpha$ , interleukin-1 $\beta$ , interleukin-6, and interleukin-8 in peripheral blood mononuclear cells.<sup>3</sup> The mechanism of areca nut promoting granulation is not fully understood and is postulated to be both chemical and mechanical. Chemical alkaloid irritant effects can occur due to the extracts mentioned above, and mechanical irritation is due to its sharp edges with firm impaction. Both can lead to circumferential irritation, granulation tissue and scarring, followed by stenosis. The chemical irritant effects of the areca nut have been well studied in the oral mucosa and can be extrapolated to the airway mucosa. With contact between the betel nut quid and the oral mucosa, the alkaloids and the flavonoids from the quid are absorbed, undergo metabolism, and serve as a constant source of mucosal irritation. In addition to this chemical irritation, mechanical irritation of the oral mucosa occurs due to the coarse fibers in the betel quid. The micro-trauma from the continuous friction of areca nut fibers facilitates diffusion of its alkaloids and flavonoids into the subepithelial connective tissue, with juxtaepithelial inflammatory cell infiltration.<sup>4</sup> This vicious cycle of mechanical micro-trauma and chemical irritation sets the stage for inflammation and fibrosis. In the airway, unlike the temporary contact of the betel nut in the oral cavity, there is prolonged continuous contact, which maybe worse. It is conceivable that the airway pseudostratified ciliated columnar epithelium is as vulnerable as the oral stratified squamous epithelium to chronic mechanical and chemical irritation of the areca nut, with ramifications of airway stenosis and postobstructive sequelae.

In conclusion, complicated and long-standing FBA such as the areca nut, with sharp-edged and chemically active agents can lead to delayed airway stenosis—an important complication not mentioned in literature. Awareness, proactive follow-up, and prompt bronchoscopic intervention are recommended to tackle this delayed complication of organic FBA.

### Author Contributions

Conceptualization: Ravindra M Mehta, Rashmi Nadakuditi, Lakshmipriya Srinivasan.

Data curation: Ravindra M Mehta, Rashmi Nadakuditi, Pooja Bajaj.


Methodology: Ravindra M Mehta, Shyam Krishnan.

Supervision: Ravindra M Mehta.

Writing – original draft: Ravindra M Mehta, Rashmi Nadakuditi.

Writing – review & editing: Ravindra M Mehta, Rashmi Nadakuditi, Pooja Bajaj, Shyam Krishnan, Lakshmipriya Srinivasan.

### ORCID iDs

Nadakuditi Rashmi  <https://orcid.org/0000-0002-3782-4391>

Pooja Bajaj  <https://orcid.org/0000-0002-3023-5068>

### REFERENCES

1. Boyd M, Chatterjee A, Chiles C, Chin RJr. Tracheobronchial foreign body aspiration in adults. *South Med J.* 2009;102:171–174.
2. Midulla F, Guidi R, Barbato A, et al. Foreign body aspiration in children. *Pediatr Int.* 2005;47:663–668.
3. Chang LY, Wan HC, Lai YL, et al. Areca nut extracts increased expression of inflammatory cytokines, tumor necrosis factor- $\alpha$ , interleukin-1 $\beta$ , interleukin-6 and interleukin-8, in peripheral blood mononuclear cells. *J Periodontal Res.* 2009;44:175–183.
4. Prabhu RV, Prabhu V, Chatra L, Shenai P, Suvarna N, Dandekeri S. Areca nut and its role in oral submucous fibrosis. *J Clin Exp Dent.* 2014;6:e569.