Diagnosis and Laryngeal Complications of *Bordatella pertussis* Infection in the Ambulatory Adult Population

Thomas M. Leschke, Joel H. Blumin and Jonathan M. Bock

*Otolaryngology -- Head and Neck Surgery* 2014 151: 714 originally published online 9 September 2014

DOI: 10.1177/0194599814549316

The online version of this article can be found at:

http://oto.sagepub.com/content/151/5/714

Published by:

SAGE

http://www.sagepublications.com

On behalf of:

AMERICAN ACADEMY OF OTOLARYNGOLOGY--HEAD AND NECK SURGERY

American Academy of Otolaryngology- Head and Neck Surgery

Additional services and information for *Otolaryngology -- Head and Neck Surgery* can be found at:

- **Email Alerts**: http://oto.sagepub.com/cgi/alerts
- **Subscriptions**: http://oto.sagepub.com/subscriptions
- **Reprints**: http://www.sagepub.com/journalsReprints.nav
- **Permissions**: http://www.sagepub.com/journalsPermissions.nav

**>> Version of Record** - Oct 24, 2014

**OnlineFirst Version of Record** - Sep 9, 2014

**What is This?**
Diagnosis and Laryngeal Complications of Bordatella pertussis Infection in the Ambulatory Adult Population

Thomas M. Leschke¹, Joel H. Blumin, MD¹, and Jonathan M. Bock, MD¹

Abstract

Bordatella pertussis infection leads to a chronic, debilitating, and paroxysmal cough that can last for months to years. Incidence of B pertussis in the immunized adult population is rising nationwide, but many otolaryngologists are unfamiliar with the diagnosis and management of this disease. Adults often present late in the disease process when traditional diagnostic testing is ineffective and without the classic pediatric symptoms of whooping cough. As a result, B pertussis infections in adults are often overlooked or misdiagnosed as asthma exacerbations or viral bronchitis, leading to increased morbidity, unnecessary testing, and additional exposure of vulnerable populations to the pathogen. This commentary describes 3 adult cases of B pertussis confirmed with serum testing in the ambulatory population and describes varied presentations based on time from initial infection. Specific emphasis is presented on the physical manifestations of the disease in laryngeal structures, methods of diagnosis, and recommendations for treatment.

Keywords

Bordatella pertussis, whooping cough, chronic cough, serum testing, immunoglobulin G, IgG, subacute cough, voice, larynx, laryngeal, diagnosis, laryngitis

Introduction

Bordetella pertussis infection is a well-known cause of subacute and chronic cough and is an increasing cause of morbidity and mortality in the United States.¹ Vaccines against B pertussis and antibiotic therapy led to a dramatic reduction in the impact of this disease on society in the 1940s.¹ B pertussis is currently a growing public health concern due to the waning nature of immunity derived from vaccination over time, decreasing childhood vaccination rates in certain populations, and decreased effectiveness of acellular vaccines.²,³ Incidence has slowly been rising over the past decade in the United States, with certain areas showing recent marked increases in B pertussis outbreaks (Figure 1). Adults typically present with a severe paroxysmal cough that can mimic bronchitis or asthma exacerbation without the classic inspiratory “whoop” seen in pediatric populations. Diagnosis requires a high index of suspicion and careful review of the patient’s history. Patients infected with B pertussis are also at risk for harm from unnecessary and potentially invasive pulmonary testing (computed tomography [CT], pulmonary function testing [PFT], bronchoscopy, biopsy), overtreatment with inhaled or systemic steroids, and

---

¹Division of Laryngology & Professional Voice, Department of Otolaryngology & Communication Sciences, Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Corresponding Author:
Jonathan M. Bock, MD, Division of Laryngology & Professional Voice, Department of Otolaryngology & Communication Sciences, Medical College of Wisconsin, 9200 W. Wisconsin Ave, Milwaukee, WI 53226, USA.
Email: jbock@mcw.edu

---

Figure 1. Bordatella pertussis incidence. Overall cases of pertussis have slowly been rising for the past decade, and certain areas of the United States demonstrate increased incidence rates over the past 12 months. From http://www.cdc.gov/pertussis.
unnecessary allergy testing. Adults with *B. pertussis* also serve as an important reservoir of infection to nonvaccinated and otherwise at-risk populations. Evidence from our group and others has shown that a markedly elevated 1-time serum *B. pertussis* immunoglobulin G (IgG) level may be useful to establish a likely diagnosis of *B. pertussis* in the ambulatory adult population after cough has developed. This test conveys a high likelihood of recent infection when elevated over 3-fold with concurrent symptoms consistent with a *B. pertussis* diagnosis.

**Main Point**

The objective of this commentary is to describe the common laryngeal clinical findings of *B. pertussis* infection in the ambulatory adult population using prototypical cases in an effort to aid otolaryngologists in the recognition, diagnosis, and treatment of this disease. This case series was approved by the Institutional Review Board of the Medical College of Wisconsin.

**Acute Pertussis (<2 months)**

A 20-year-old male college student with remote childhood immunization for *B. pertussis* presented with 8 weeks of severe coughing paroxysms and associated shortness of breath following a mild respiratory infection. The coughing spells were much worse at night and were associated with stridor, near-syncopal, and post-tussive emesis. The patient also described an episode of coughing that nearly resulted in a collision while driving. Two separate emergency department visits had not established a diagnosis aside from possible reflux, which ultimately was treated with twice-daily proton pump inhibitors (PPI). His internist later diagnosed him with presumed laryngospasm and subsequently treated him with azithromycin, cetirizine, prednisone, and cough suppressants. At the time of presentation to the otolaryngologist he had no dysphonia, and his coughing paroxysms were still severe but had decreased in frequency to 1 to 2 episodes a day. Videostroboscopic laryngeal exam demonstrated mobile vocal folds without lesions of the vocal fold vibratory surface and normal laryngeal biomechanics. Posterior laryngeal pachydermia and a small left vocal process granuloma were noted (Figure 2A). A coughing spell was elicited during examination with paradoxical vocal cord motion noted leading to subtle inspiratory stridor, which was controlled with nasal breathing instruction (Figure 2B). A chest x-ray was negative. A diagnostic laboratory test of serum *B. pertussis* fimbrial agglutinin IgG level was highly elevated at 95 IU/mL (normal <9). The patient continued with narcotic antitussives, and he was weaned off prednisone and PPIs. He was referred to an expert speech-language pathologist for respiratory control and cough suppressive therapy. His symptoms slowly resolved over the following several months.

**Intermediate Pertussis (2-6 months)**

A 47-year-old female sales executive with uncertain *B. pertussis* immunization history presented for evaluation of severe dysphonia. Her past medical history was significant for severe asthma and prior documented paradoxical vocal fold motion disorder. The onset of her illness occurred shortly after a memorable airline flight near a man that “could not stop coughing” roughly 4 months prior to presentation. Her initial illness was characterized by severe coughing spells that often led to syncopal episodes and post-tussive emesis, which were markedly worse at night. She had been evaluated by her allergist who attributed her cough to a severe asthma exacerbation and began 2 different simultaneous steroid inhalers (mometasone furoate/formoterol and budesonide), albuterol, 2 courses of azithromycin, and 2 consecutive oral steroid tapers. Prior testing included chest CT, PFTs with spirometry, and bronchoscopy. Her cough had slowly improved in severity and frequency over the previous month, but her dysphonia had progressively worsened. Examination demonstrated an obese patient with moon facies and severely rough dysphonia. There was no evidence of oral cavity thrush or infection. Videostroboscopy demonstrated mobile vocal folds with large areas of hyperkeratosis and inflammation covering approximately 70% of the superior surface of both vocal folds contributing to a significantly reduced mucosal wave bilaterally, consistent with severe steroid inhaler laryngitis (Figure 3A). Serum *B. pertussis* fimbrial agglutinin IgG level was markedly elevated at 105 IU/mL (normal <9). The patient was weaned off her budesonide inhaler and down to 1 puff daily of her mometasone furoate/formoterol inhaler with good asthma symptom control. She was treated with a 14-day course of fluconazole and relative voice rest. She was later referred for cough suppressive therapy and voice therapy with an expert speech-language pathologist. Follow-up evaluations over the following year demonstrated a gradual return to normal voice. The laryngeal hyperkeratosis resolved, and mucosal pliability returned with mild ongoing dysphonia and residual L vocal fold stiffness (Figure 3B).

**Remote Pertussis (> 6 months)**

A 68-year-old female with remote *B. pertussis* immunization history presented with nearly 2 years of nonproductive chronic cough and mild fluctuating dysphonia. She recalled...
no inciting event and noted the cough was abrupt in onset. Her cough was nonproductive, worse at night, and associa-
ted with post-tussive syncope. The severe spells of cough had long since subsided, but her cough now persisted as a
dry, nonproductive, barky cough associated with persistent mild dysphonia and lowered vocal pitch. The patient had prior nonrevealing gastroenterology and pulmonary evaluations including PFTs with spirometry, chest x-ray, and eso-
phagogastroduodenoscopy. Examination demonstrated mildly rough fluctuating dysphonia with lowered vocal pitch. Videostroboscopy demonstrated mobile vocal folds with mild posterior pachydermia and erythema, vocal fold edema, and mild polyloid degeneration with large mucosal wave. Marked hyperfunctional closure was also present with false vocal cord approximation during phonation (Figure 4A, 4B). Serum B pertussis fimbrial agglutinin IgG level was highly elevated at 93 IU/mL (normal <9). She was diagnosed with behavioral cough and muscle tension dys-
phonia secondary to likely initial B pertussis and referred for behavioral laryngeal control therapy with an expert
speech-language pathologist. She had a fast and complete resolution of all symptoms with voice therapy.

Discussion
Ambulatory adult patients with recent B pertussis present to the otolaryngologist with varying histories of protracted coughing paroxysms that seem to worsen at night and are often accompanied by post-tussive emesis and syncope. Many patients will describe it as “the worst cough of my life.” Infection begins with a catarrhal phase that is marked by nonspecific symptoms of upper respiratory infection followed by a paroxysmal phase with severe and frequent coughing spells lasting for weeks. Coughing improves slowly during the final convalescent phase, but this phase may last for many months to years. Prolonged cough is an unfortunate and necessary part of the post-pertussis healing process, as the ciliated tracheobronchial epithelium must entirely repopulate following its direct destruction by the bacterium. Patients usually present to the otolaryngologist for evaluation of chronic cough months after initial infection, and physical findings and symptoms can vary markedly based on this duration. Post-pertussis patients may also lapse into chronic behavioral cough and dysphonia from resultant muscle tension behavioral patterns as they convale-
scle from this disease.

Many practitioners are unaware of the increasing prevalence of B pertussis infection in the community and are unfamiliar with testing strategies for this disease. Nasopharyngeal culture or biochemical tests for B pertussis (polymerase chain reaction or PCR) are only useful in the first 2 to 3 weeks of infection before coughing develops. In addition, B pertussis is a highly fastidious bacterium that is difficult to grow in culture, leading to many false-negative culture results. Culture and PCR testing are therefore of very low yield in this population. We have found one-time serum testing for B pertussis IgG level very helpful in this scenario, as elevation of greater than 3-fold the upper limit of normal is highly consistent with recent infection. Patients with recent immunization do not elevate their IgG past this level. Our institution generally tests for serum B pertussis fimbrial agglutinin IgG levels, but B pertussis toxin IgG levels may also be used. Serum IgG levels may remain highly elevated for years after a recent infection and are markedly higher than those acquired from immunization.

Treatment of the post-pertussis patient depends largely on the timing of their presentation and concomitant symp-
toms. All patients with unexplained cough of greater than 2 weeks should have a chest x-ray to rule out a mass or other infection (tuberculosis, pneumonia). Patients in the acute phase of infection (case 1) may benefit greatly from respira-
tory retraining therapy to help break coughing paroxysms, and treatment with macrolide antibiotic (azithromycin or clarithromycin) or trimethoprim-sulfamethoxazole is appropriate to ensure clearance of disease and reduce possible further disease spread. All immediate family members should also be treated with antibiotics. Narcotic cough preparations can be of great use for these patients, especially at night to assist with sleep. Prescription of sleep aids may also be indicated due to the severe insomnia this infection may cause. Patients past the initial phase (2-6 months, case 2) often have already had antibiotics, and treatment for them is likely supportive. No further testing is warranted with positive serum IgG confirmation of recent B pertussis infection, negative chest x-ray, and classic

Figure 3. Intermediate Bordatella pertussis. (A) Bilateral vocal fold hyperkeratosis and inflammation consistent with severe steroid inhaler laryngitis is noted with poor vocal fold pliability on mucosal wave. (B) Six months after initial presentation, exam demonstrated resolution of hyperkeratosis and return of vocal fold pliability.

Figure 4. Remote Bordatella pertussis. (A) Examination showed severe false vocal fold adduction and aperiodic phonation due to hyperfunctional closure. (B) Laryngeal exam demonstrated diffuse mild erythema and edema with large mucosal wave.
symptom presentation. Patients in this group and those with long-term symptoms (>6 months, case 3) may benefit from formal evaluation by an expert speech-language pathologist to correct maladaptive behavioral accommodations to the inflammation and trauma of recent *B pertussis* infection.

Patients with *B pertussis* are at significant risk for iatrogenic harm if it is not appropriately diagnosed, as was seen in case 2, especially with a history of preexisting asthma and allergy. Treatment with steroid inhalers, inhaled beta agonists, antihistamines, repeated antibiotic courses, systemic steroid tapers, and invasive testing are all unlikely to change the overall course of disease. Increased asthma treatment had no effect on disease course in our patients and led to severe steroid inhaler laryngitis with permanent changes in vocal fold pliability. Unnecessary and invasive procedures also add significant costs and potential morbidity to the patient’s care. Patients with documented uncomplicated pertussis who are gradually improving with supportive care should be reassured that their “100-day” cough is likely to continue to improve, with further testing reserved for more complicated cases.

**Author Contributions**

Thomas M. Leschke, data acquisition and analysis, drafting manuscript, final approval; Joel H. Blumin, conception and design, manuscript revision, final approval; Jonathan M. Bock, conception and design, drafting manuscript, revision, final approval.

**Disclosures**

**Competing interests:** None.

**Sponsorships:** None.

**Funding source:** None.

**References**