Clinical features of capillary bronchitis related to bordetella pertussis

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Abstract: Pertussis infection can mimick the clinical manifestations of lower airway infection, while the symptoms and signs in some cases are like Bronchiolitis. The paper carried out retrospective analysis of infant pertussis bordetella infected cases admitted by the Respiratory Dept. of Tianjin Children's Hospital for "capillary bronchitis" from Sept. 2015 to Feb. 2016. It analyzed its clinical features, radiological features, laboratory characteristics and outcome through comparing the capillary bronchitis cases induced by the non-bordetella pertussis. 26 cases of patients infected with bordetella pertussis were included in the group, 15 male patients and 11 female patients, aging from 40 days to 11 months. Comparing with non-pertussis infected cases, the capillary bronchitis induced by pertussis presents spasmodic cough, vomiting after cough, apnea suspension and lymphocythemia and obvious prolong of LOS. However the clinical symptom score is decreased and the duration of breathing is shorter. The follow-up visit detects that the recurrent number of respiratory symptoms of pertussis infected children is higher than that of non-pertussis infected children. The clinical symptoms of patients with capillary bronchitis infected by bordetella pertussis are not typical and are susceptible to be ignored. The duration of respiratory symptoms is longer and susceptible for recurrence.

Keywords: Pertussis; capillary bronchitis; infant

INTRODUCTION

Pertussis, also called whooping cough, is an ancient respiratory tract infectious disease and was recorded with very high incidence and mortality rates among humans (Hartzell & Blaylock, 2014) [. In 1930s, the mortality rate of pertussis among infants was over 0.2%, but it was up to 10% in 1900s (Lynfield & Schaffner, 2014). Bordetella pertussis (Bp) is one of the pathogeny for paediatric respiratory-tract infections. The elderly children and adult after infection may present spasmodic cough, vomiting after cough and other characteristic features. However, the symptoms of infant cases are not typical in most cases. The breathing performance similar to capillary bronchitis may occur. In case of cognition shortage, it is easy to cause diagnostic delay and underestimation of severity.

MATERIAL AND METHODS

Object and diagnostic criteria

The research is a single-center retrospective one. Among the infant capillary bronchitis cases accepted treatment at the Respiratory Dept. of Tianjin Children's Hospital from Sept. 2015 to Feb. 2016, 26 cases of infant patients who completed follow-up treatment presenting Bp positive detected by polymerase chain reaction (PCR) were divided to Bp-capillary bronchitis group; 26 cases of non-Bp infected children infected by capillary bronchitis matched according to the proportion of 1:3 of gender and age were included to non-Bp-capillary bronchitis group. The follow-up visit schedule is the same as above. The diagnostic criteria of capillary bronchitis refer to relevant standard (Ralston *et al*, 2014). The clinical cases inclusion criterion include: aging from one month to one year, preliminary occurrence of lower respiratory tract infections. The symptoms include rhinorrhoea and cough etc., with tachypnea, chest extrusion, breathing or lung sounds etc.. Exclusion criterion include: Repeatedly included case, Bp merging other pathogen infection, merging congenital heart disease, bronchopulmonary dysplasia and immunodeficiency cases. The guardians of all patients shall sign information consent form (ICF). The research was approved by the Ethics Committee of Tianjin Children's Hospital (Approvd No 2015LLXK07).

Pathogen detection

Took phlegm specimens from the deep respiratory tract of patient children after abrosia. The specimens were divided into three parts. The first part is for microbiologic culture. The other part of specimens adopted direct fluorescence detection to check influenza virus A, influenza virus B, respiratory syncytial virus, adenovirus, parainfluenza virus type I, parainfluenza virus type 2 and parainfluenza virus type 3; other specimens were kept in a refrigerator of -80^{o}C for Bp nucleic acid test. The primer design and amplified method of Bp nucleic acid test shall refer to correlational researches of Fry (Fry *et al*, 2009).

Clinical data collection

Collect the following data of all patient children included to the research: epidemiological data, including long-term cough (cough exceeding two weeks) contact history, passive smoking history, Catarrh symptoms at the beginning of the disease, course of disease at hospital admission; clinical manifestation includes body temperature, spasmodic cough, cough after vomiting or vomiturition, apnea, physical signs of lung at admission; laboratory indexes record the maximum values of

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leukocyte and lymphocyte; chest imaging changes record over inflation and consolidation cases respectively.

Disease conditions assessment and follow-up treatment

The scoring shall refer to Midulla F standard (Midulla *et al*,2010). Carry out illness severity score for patient children every day and record the Max. value of disease course; record the LOS; record recurrence times of acute respiratory symptoms. The repeat recurrence of acute respiratory symptoms is defined as exacerbation over 24 hours after 72 hours of coughing or breathes easing; record the repeated occurrences and times for outpatient service or hospitalization.

STATISTICAL ANALYSIS

SPSS18.0 statistical software is applied for statistical analysis of research data. The difference is of statistical significance in case of a=0.05 and $P<0.05$. The data used mean, standard deviation, and proportion report. The enumeration data adopted $\chi 2$ inspection (Pearson chi-square test and Fisher test). And the measuring data adopted t inspection (Mann-Whitney U test).

RESULT

General data

The difference between Bp-capillary bronchitis group and non-Bp-capillary bronchitis group on age, gender distribution, number of receiving DPT vaccine, place of residence and smoking history is of no statistical significance; The difference between long-term cough patients with contact history and Catarrh symptoms at the beginning of the disease is of statistical significance. The patients in Bp-capillary bronchitis group frequently contact with long-term cough patients. Catarrh symptoms will appear at the initial stage of the disease as shown in table 1. The pathogenic conditions of Bp negative group are as following: 30 cases of respiratory syncytial virus, 6 cases of influenza virus type A, 3 cases of influenza virus B and 39 cases of patients without pathogeny detected.

Clinical features

The differences on the course of disease, spasmodic cough, vomiting after coughing and apnea of Bp-capillary bronchitis group and those of non-Bp-capillary bronchitis group are of statistics significance. Bp capillary bronchitis shows longer patient course, and higher proportion of spasmodic cough, vomiting after caught and apnea; the difference of the two groups shows no statistical significance. See table 2

Laboratory characteristics

The peak values of leukocyte and lymphocyte of Bp-capillary bronchitis group at the course of disease are higher than those of non-Bp-capillary bronchitis group. The difference is of statistical significance; on the aspect of chest imaging, non-Bp-capillary bronchitis group presents over inflation. Comparing with Bp-capillary bronchitis group, the difference is of statistical significance. See table 2

Disease severity and prognosis

On the aspect of evaluating disease severity, comparing with the patients of Bp-capillary bronchitis group, the score of disease severity of patients in non-Bp-capillary bronchitis group is higher and the difference is of statistics significance; the patients in Bp-capillary bronchitis group present longer duration in the hospital, more recurrence of respiratory symptoms and more further consultation. Comparing with the patients of non-Bp-capillary bronchitis group, the differences are of statistics significance. See table 3

DISCUSSION

The retrospective study detected that infant pertussis cases may present similar clinical features of capillary bronchitis. Nakamura ever reported a girl of 28 days old with pertussis who was admitted for severe capillary bronchitis (Nakamura *et al*, 2009). Nuolivirta detected that Bp can be detected on 8.5% capillary bronchitis patient cases younger than 6 months (Nuolivirta *et al*, 2010). In pertussis epidemic seasons or in case of insufficient vaccine protection, whooping caused by bordetella pertussis infection is frequent (Greenberg *et al*, 2007). Therefore, pertussis should be excluded from differential diagnosis of capillary bronchitis (Taylor *et al*, 2014). Other studies have found that infected children with Bp after vaccination can be presented as breathing. Consequently, it is suggested that the differential diagnosis of Children's breathing should include pertussis (Kline *et al*, 2013).

Our researches detect that over half of the patients with BP capillary bronchitis has even contacted with long-term coughing patients. In most cases, family members closely contacting with patient children are sources of infection. Most of the adults affected with Bp infection present long-term coughing but not typical spasm. Therefore, the BP infection of adults will be underestimated. Careful inquiring of exposing history is conductive for improving the diagnosis efficiency (Chiappini *et al*, 2013). Pertussis generally presents non-purulent conjunctivitis at the initial stage, too much nasal mucus and tears as well as other catarrh performance. The Bp affected patients in the research also present the characteristics: pertussis will be aggravated within 1-2 weeks after the onset. And most of the symptoms of capillary bronchitis will be aggravated within one week. The description of the course before admission complies with the characteristic as well. The epidemiologic feature may contribute to early identification of Bp infection.

Table 1: Epidemiological characteristics of Bp-capillary bronchitis group and non-Bp-capillary bronchitis group

Characteristics	Bp-capillary bronchitis group N=26	Non Bp-capillary bronchitis N=78	p
Age (months)	5.21/2.98	5.02/2.84	0.813
Gender (male: female)	15:11	45:33	n.s
DPT vaccination times			0.650
0 time	9	30	
1 time	3	15	
2 times	4	6	
3 times	10	18	
Place of residence (Town: rural)	14:12	48:30	0.578
Passive smoking (Yes: No)	8:18	30:48	0.564
Long-term cough exposure history (%)	52.8	23.1	0.000
Catarrh symptoms at the initial stage of the disease (%)	76.9	23.1	0.000
Course of disease at admission (day)	6.58/1.84	3.88/1.48	0.000

Table 2: Clinical and laboratory features of Bp-capillary bronchitis group and non-Bp-capillary bronchitis group

Clinical and laboratory features	Bp-capillary bronchitis group N=26	Non Bp-capillary bronchitis N=78	p
Fever (%)	23.1	30.8	0.536
Spasmodic cough (%)	69.2	11.5	0.000
Vomit after coughing (%)	30.8	7.70	0.037
Apnea (%)	26.9	3.80	0.022
Lung auscultation (wheezing: moist rales)	16:10	16:10	n.s
Peak value of leukocyte	17.65±4.56	8.32±3.47	0.000
Peak value of leukocyte	11.29±3.89	4.84±1.90	0.000
Chest imageology (over inflation: not over inflation)	7:17	57:21	0.025
Disease severity	4.04±1.59	5.08±1.76	0.03

Table 3: Prognosis of Bp-capillary bronchitis group and non-Bp-capillary bronchitis group

Disease and prognosis	Bp-capillary bronchitis group N=26	Non Bp-capillary bronchitis N=78	p
HLOS	9.77±2.86	7.50±2.88	0.002
Repetition of respiratory symptom	1.12±1.37	0.35±0.63	0.013
Times of further consultation	0.65±0.98	0.15±0.37	0.020

Through analyzing the clinical features, we detect that the proportion of BP infected patients presenting spasmodic cough, vomiting and breathing proportion after coughing is higher than non-Bp infected patients. It is similar to the research of Nicolai (Nicolai, 2013). It is prompted that the above symptoms can be used as diagnosis clue; most pertussis patients will show leukocyte and lymphocyte. Guinto-Ocampo analyzed a group of infant pertussis cases and believed that the absolute counting of lymphocyte 9.4×10^9/L is the inflection point for infant pertussis (Guinto-Ocampo *et al*, 2008). The sensibility is 89%, the specific degree is 75% and the negative forecast value is up to 97%. Although the patient cases in the group present similar capillary bronchitis and lung features which are free of obviously difference with non-Bp infected patients. The laboratory check also reflects the features and reminds us to focus on the increasing of leukocyte and lymphocyte increasing; capillary bronchitis will lead to gas choking in the lungs and the imageology will presents hyperinflation since the bronchiolar obstruction presents “ball valve” effects. The patients in Bp infection group are not presenting preponderance which is similar to imageology test. Illness severity score promotes that comparing with non-Bp infected capillary bronchitis, the clinical features arising from BP infected capillary bronchitis are slighter which is similar to the research of Abu Raya B (Abu Raya *et al*, 2013).

It is interesting that the LOS of patients in Bp infection group is longer than that of non-Bp infected group. The time of respiratory symptoms and further consultation occurred in two months are obviously higher than those of Bp infected group which reflect paroxysmal and slight symptoms. In addition, it reminders that only evaluating the performance of patients with Bp infected capillary bronchitis at the acute stage will seriously underestimate the severity of the disease.

CONCLUSIONS

Infant pertussis cases may show clinical manifestations similar to capillary bronchitis. The diagnosis and clinical manifestations may be underestimated.

REFERENCES

Abu Raya B, Bamberger E, Kassis I, Kugelman A, Srugo I and Miron D (2013). Bordetella pertussis infection attenuates clinical course of acute bronchiolitis. *Pediatr. Infect Dis. J*., **32**: 619-621.

Chiappini E, Stival A, Galli L and de Martino M (2013). Pertussis re-emergence in the post-vaccination era. *BMC Infect Dis*., **13**: 151.

Fry NK, Duncan J, Wagner K, Tzivra O, Doshi N, Litt DJ, Crowcroft N, Miller E, George RC and Harrison TG (2009). Role of PCR in the diagnosis of pertussis infection in infants: 5 years' experience of provision of a same-day real-time PCR service in England and Wales from 2002 to 2007. *J. Med. Microbiol*., **58**: 1023-1029.

Greenberg D, Bamberger E, Ben-Shimol S, Gershtein R, Golan D and Srugo I (2007). Pertussis is under diagnosed in infants hospitalized with lower respiratory tract infection in the pediatric intensive care unit. *Med. Sci. Monit*., **13**: CR475-480.

Guinto-Ocampo H, Bennett JE, Attia MW. (2008)Predicting pertussis in infants.*Pediatr Emerg Care*. **24**:16-20.

Hartzell JD and Blaylock JM (2014). Whooping cough in 2014 and beyond:an update and review. *Chest*. **146**: 205-214.

Kline JM, Lewis WD, Smith EA, Tracy LR and Moerschel SK (2013). Pertussis: A reemerging infection. *Am. Fam. Physician*., **88**: 507-514.

Lynfield R and Schaffner W (2014). Can we conquer coqueluche? *J. Infect Dis*., **209**: S1-s3.

Midulla F, Scagnolari C, Bonci E, Pierangeli A, Antonelli G, De Angelis D, Berardi R and Moretti C (2010). Respiratory syncytial virus, human bocavirus and rhinovirus bronchiolitis in infants. *Arch Dis. Child*. **95**: 35-41.

Nakamura A, Sakano T, Nakayama T, Shimoda H, Okada Y, Hanayama R, Nomoto K, Suto T, Kinoshita Y, Furue T, Ono H and Ohta T (2009). Neonatal pertussis presenting as acute bronchiolitis: Direct detection of the Bordetella pertussis genome using loop-mediated isothermal amplification. *Eur. J. Pediatr*., **168**: 347-349.

Nicolai A, Nenna R, Stefanelli P, Carannante A, Schiavariello C, Pierangeli A, Scagnolari C, Moretti C, Papoff P, Bonci E, Ferrara M, Papasso S and Midulla F (2013). Bordetella pertussis in infants hospitalized for acute respiratory symptoms remains a concern. *BMC Infect Dis*. **13**: 526.

Nuolivirta K, Koponen P, He Q, Halkosalo A, Korppi M, Vesikari T and Helminen M (2010). Bordetella pertussis infection is common in nonvaccinated infants admitted for bronchiolitis. *Pediatr. Infect Dis. J*., **29**: 1013-1015.

Ralston SL, Lieberthal AS, Meissner HC, Alverson BK, Baley JE, Gadomski AM, Johnson DW, Light MJ, Maraqa NF, Mendonca EA, Phelan KJ, Zorc JJ, Stanko-Lopp D, Brown MA, Nathanson I, Rosenblum E, Sayles S, Hernandez-Cancio S; American Academy of Pediatrics (2014). Clinical practice guideline: The diagnosis, management and prevention of bronchiolitis. *Pediatrics*. **134**: e1474-e1502.

Taylor ZW, Ackerson B, Bronstein DE, Lewis K, Steinberg E, Stone MM, Viraraghavan R, Wong VK and Salzman MB (2014). in children with pertussis associated with delayed pertussis diagnosis. *Pediatr. Infect Dis. J*., **33**: 351-354.