ลักษณะผิดปกติของภาพรังสีทรวงอกของผู้ป่วยเด็กโรคติดเชื้อทางเดินหายใจส่วนล่างจากเชื้อไวรัส RSV และ Influenza โรงพยาบาลมหาวิทยาลัยบูรพา

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บทคัดย่อ

บทนำ เชื้อไวรัส Influenza และ Respiratory syncytial virus (RSV) เป็นเชื้อที่ทำให้เกิดโรคติดเชื้อทางเดินหายใจส่วนล่างได้บ่อยในผู้ป่วยเด็ก หลายการศึกษาได้อธิบายลักษณะภาพถ่ายทางรังสีปอดในผู้ป่วยกลุ่มนี้แต่ยังไม่ได้ข้อสรุปที่ชัดเจนจากการศึกษาก่อนหน้า

จุดประสงค์ เพื่อสืบค้นลักษณะที่พบได้จากภาพถ่ายรังสีปอดของผู้ป่วยที่เป็นโรคติดเชื้อทางเดินหายใจส่วนล่างจากเชื้อไวรัส รายงานอุบัติการณ์และบรรยายข้อมูลพื้นฐานของกลุ่มตัวอย่าง

วิธีวิจัย ภาพถ่ายทางรังสีปอดของกลุ่มตัวอย่างผู้ป่วยเด็ก 30 คนอายุตั้งแต่ 1 เดือนถึง 15 ปีได้รับการนอนโรงพยาบาลมหาวิทยาลัยบูรพาตั้งแต่เดือนกันยายน พ.ศ.2553 ถึงสิงหาคม พ.ศ.2558 และได้รับการวินิจฉัยเป็นโรคติดเชื้อทางเดินหายใจส่วนล่างจากเชื้อไวรัส Influenza หรือ RSV นำมาสืบค้นและบรรยายภาพด้วยรังสีแพทย์ รวมถึงได้มีการบันทึกข้อมูลพื้นฐานของกลุ่มตัวอย่าง

ผลการศึกษา อุบัติการณ์การเกิดโรคติดเชื้อทางเดินหายใจส่วนล่างด้วยเชื้อไวรัส Influenza และ RSV ในผู้ป่วยเด็กของการศึกษานี้คือ 32/556 (ร้อยละ 5.8) คน โดยกลุ่มตัวอย่าง 30 คนแบ่งออกเป็นกลุ่มที่ได้รับการวินิจฉัยว่าติดเชื้อ RSV 19 คน (ร้อยละ 63.3) และ Influenza 11 คน (ร้อยละ 36.7) ลักษณะภาพถ่ายทางรังสีปอดที่พบได้บ่อยเป็นแบบ Interstitial infiltration (ร้อยละ 57.9 ในกลุ่ม RSV, ร้อยละ 72.7 ในกลุ่ม influenza) มีการกระจายรอยโรคแบบ Multifocal (ร้อยละ 66.4 ในกลุ่ม RSV, ร้อยละ 72.7 ในกลุ่ม influenza)

สรุป ลักษณะภาพถ่ายรังสีปอดที่พบบ่อยในทั้งสองกลุ่มตัวอย่างเป็นแบบ Interstitial infiltration โดยมีการกระจายของรอยโรคแบบ multifocal ลักษณะที่พบร่วมในภาพถ่ายรังสีปอดคือพบน้ำและลมในเยื่อหุ้มปอดโดยพบในกลุ่มตัวอย่างที่ติดเชื้อ RSV

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Chest Radiographic Findings in Hospitalized Children with Influenza and Respiratory Syncytial Viral Lower Respiratory Tract Infections

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Abstract

Background Respiratory syncytial virus (RSV) and influenza virus account for the majority of lower respiratory tract infections (LRTI) in children. Although there were several studies describing chest radiographic findings in these cases, results were different.

Objectives The aim of this study was to describe the chest radiographic patterns of the two common viruses in children with LRTI. Moreover, incidence, demographic data, and clinical characteristics were also reported.

Material and Methods Chest radiographs of 30 children aged 1 month to 15 years who were hospitalized in Burapha University Hospital from September 2010 to August 2015 with the diagnoses of LRTI by either RSV or influenza virus were evaluated and described. The incidence, demographic data, and clinical characteristics were also evaluated.

Results The incidence of RSV and influenza LRTI in our study was 32/556 (5.8%) patients. Of the 30 patients, 19 patients (63.3%) were infected with RSV and 11 patients (36.7%) with influenza virus. The most common pulmonary infiltration patterns of both RSV and influenza infections were interstitial infiltration (57.9% in RSV, 72.7% in influenza) and multifocal distribution (66.4% in RSV, 72.7% in influenza). Diffuse distribution was more frequently found in RSV (31.1% vs. 9.1%).

Conclusion The most common chest radiological findings in children with RSV and influenza infection of lower respiratory tract were interstitial pattern and multifocal distribution. The complications, found only in RSV group, were pleural effusion and pneumothorax.

Key Words Influenza virus, lower respiratory tract infection, radiographic finding, respiratory syncytial virus,

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Introduction

Lower respiratory tract infections (LRTI) are among the diseases that cause significant morbidity and mortality in Thai children under five years of age[1]. The most common pathogens are viruses including respiratory syncytial virus (RSV) and influenza virus[1-2] . Among LRTI, pneumonia is the most common diagnosis, followed by croup and bronchiolitis[2]. Bacteria and viruses are the two most common etiologies of LRTI in children[2]. These two conditions are treated differently. Antimicrobial agents are specific for bacterial infections[3], whereas viral infections need only supportive treatment. Sputum culture is very helpful for distinguishing between bacterial and viral infection but the result takes several days. As a result, many patients receive excessive antibiotics or unnecessary hospitalizations. Chest radiographs in LRTI is often used 1) to confirm the diagnosis when physical examination is inconclusive, 2) for monitoring response to therapy, 3) to detect complications, or 4) to exclude other diseases. Previous literature has reported some specific patterns of chest radiographs in adult pneumonia that may help to distinguish between bacterial and viral causes[4].

The objectives of this study are: (1) to describe the chest radiographic patterns of the two common viral LRTI in children; and (2) to describe the incidence, demographic data, and clinical characteristics of these patients.

Material and Methods

Patients

This is a descriptive retrospective case series. Inclusion criteria of this study were: (1) children aged between 1 month to 15 years; (2) hospitalized in Burapha University Hospital, Thailand between 1 September 2010 and 31 August 2015; (3) a diagnosis of acute LRTI; (4) positive viral studies for RSV or influenza; and (5) underwent frontal chest radiography during admission. The medical charts, radiographs and laboratory findings were retrospectively reviewed. Their medical records were analyzed for demographics, underlying diseases, symptoms and lung signs, length of stay in the hospital, admission to the intensive care unit (ICU), body temperature, oxygen saturation, and white blood cell counts. Children who had mixed organisms were excluded.

This study was approved by our institutional review board No 30/2558 with a waiver of informed consent.

Viral studies

Nasal swab was collected from children on admission. QuickVue RSV 10 was used for the detection of RSV. This method had a sensitivity of 86% and a specificity of 96%. Clearview Exact influenza A&B was used for the detection of influenza virus. It had a sensitivity of 81.7% and a specificity of 98.5% for influenza A strains and a sensitivity of 88.6% and a specificity of 97.4% for influenza B strains.

Radiographic assessment

All chest radiographs were retrospectively reviewed on PACS Workstation by an experienced general radiologist (> 20 years of experience). The reviewer was blinded to the viral study results but was not blinded to the clinical diagnosis of LRTI. Chest radiographic findings were classified as interstitial pattern (reticulation, linear opacity or peribronchial thickening), alveolar pattern (ground-glass opacity or consolidation) and mixed pattern. The aeration was characterized as normoaeration, hypoaeration and hyperaeration. The distribution of abnormalities was categorized as focal, multifocal and diffuse. A focal distribution was defined as a single focus of abnormality. If there were two or more foci, the distribution of abnormality was considered multifocal and sub-categorized as either unilateral or bilateral. The presence of associated findings (pleural, hilar or mediastinal abnormalities) was assessed as well. An illustration of chest radiographic patterns was shown in Figure 1-4.

Statistical analysis

The findings of chest radiographs and baseline characteristics were expressed as percentage.

Results

Baseline characteristics

During the study period, there were 556 children admitted with the diagnosis of LRTI. Of these, 32 patients were diagnosed with LRTI and laboratory reports influenza or RSV. Thus the incidence rate was 5.8%. Two patients were excluded because they were recurrent pneumonia with mixed infections.

Of the 30 patients, 28 (93%) patients were under 5 years old. Boys were infected slightly higher than girls (18:12). Nineteen patients (63.3%) had RSV infection and 11 patients (36.7%) had influenza infection. The demographic data were shown in Table 1. The age range of children with RSV infection was one month to one year, lower than children with influenza which was one to three years.

Fever between 37.8-38.9 °C was found in all patients. Crepitation was the most common lung signs detected in patients infected with RSV while crepitation and rhonchi were equally common lung signs in influenza. The white blood cells (WBCs) count was normal or slightly below normal. Hypoxemia was observed in 11 patients (36.7%). One patient admitted to ICU had the lowest oxygen saturation level (88%). This patient was in the RSV group.

Chest radiographs

The imaging findings of chest radiographs are demonstrated in Fig.5.and Fig.6. Normal aeration was most commonly found in RSV (47.4%) whereas hypoaeration was most commonly shown in influenza (45.5%). The predominant pulmonary infiltrate patterns of both RSV and influenza infection were interstitial infiltration (57.9% in RSV, 72.7% in influenza) and multifocal distribution (66.4% in RSV, 72.7% in influenza). Mixed pattern

tended to be present more often in RSV than in influenza (36.8% vs. 9.1%). Similarly, diffuse distribution was more frequently found in RSV (31.1% vs. 9.1%). The distribution of pulmonary infiltrates is shown in Fig.7.

Associated findings were present in four patients infected by RSV, of whom 2 were left pleural effusions (10.5%) and 2 were left pneumothoraces (10.5%). In influenza group, no associated abnormality was identified.

Discussion

Respiratory syncytial virus and influenza virus account for the majority of LRTI in children[1-2]. Antibacterial treatment is not necessary in these pathogens. However, specific diagnosis is not possible initially. This results in excessive antibiotic treatment and unnecessary hospitalization. The initial diagnosis is based on patient history and physical examination. Chest radiographs have been suggested whenever pneumonia is suspected in adults[4] and in children suspected of RSV bronchiolitis[5]. Previous studies have proposed a specific pulmonary infiltration pattern of chest radiographs in pneumonia that can suggest a likely diagnosis. Lobar pneumonia and bronchopneumonia were most often caused by bacterial infection and fungal infection whereas interstitial pneumonia was caused by viral infection[4, 6, 7]. This is in accordance with the findings in our study that the predominant pulmonary infiltration patterns of both RSV and influenza infection were interstitial infiltration in multifocal distribution. However, another study has suggested that chest radiograph features are unhelpful in distinguishing between bacterial and viral infections in children[8] . For example, Guo et al.[9] found that bilateral patchy areas of consolidation (alveolar pattern) were the most common radiologic finding in pediatric viral pneumonia. Jartti et al.[10] also reported that the predominant radiologic findings in H1N1 influenza were consolidation. Friis et al.[11] observed that alveolar pneumonia was found more often in RSV infected children under 6 months of age, compared to the older RSV children. But Kern et al.[12] found no predominant pulmonary infiltration_pattern in RSV of LRTI in 108 children.

In the current study, the rate of pleural effusion was comparable to the study of Kern et al.[12] which was 11%. Both of our patients with pleural effusions were around 2 years old. This is in contrast to the earlier study which compared pneumonic children with and without pleural effusion, and observed that children in pleural effusion group were significantly older with the median age of 3 years[13]. Our current study demonstrated a higher rate of pneumothorax (10.5%), compared to Kern et al.[12] which was 2% and Friis et al.[11] which was 0%. However, no mortality in our study was observed.

The majority of our patients were under 5 years old in concordance with previous data[12,14] . The age group in RSV patients was younger than that in the influenza group as observed in the literature[12,15] . All of our

patients had fever and lung signs which were predominantly crepitation in RSV group and equally crepitation and rhonchi in influenza group. The WBCs count of all children showed normal or slightly below normal. This is in agreement with the previous study[16]. Rate of ICU admission among RSV group in our study was 5.3 % while Ferone et al.[17] reported an incidence of 13.7%.

Limitation

The main limitation of our study is the small number of the patients and the lack of comparison with a controlled group. Although viral culture is considered the gold standard for diagnosing influenza and RSV, it takes up to 10 days for the results to return. Thus, rapid diagnostic tests are generally used in clinical settings. The radiologist was aware of the study project. This may cause more positive findings. Our study included only hospitalized patients. Therefore the severity or positive findings should be more than in general population.

Conclusion

Most of RSV and influenza pneumonia in our patients were children under 5 years of age. All children had fever. The most common lung sign was crepitation. The most common radiological findings were interstitial pattern with multifocal distribution. The complications were pleural effusion and pneumothorax which were present only in RSV group.

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Table 1 Baseline characteristics of hospitalized patients with laboratory confirmed influenza and RSV infection

Baseline Characteristics					
Factor		RSV (19)	%	FLU (11)	%
Age	1mo-1yr	10	53	3	27
	1-3yr	8	42	5	45
	3-5yr	1	5	1	9
	5-12yr	0	0	2	18
Sex	Boy	10	53	8	73
	Girl	9	47	3	27
U/D		2 (allergic rhinitis)	10	2 (Delay development, asthma, allergic rhinitis)	18
Temperature	<37.8 °c	7	36	1	9
	37.8-38.9 °c	8	42	7	63
	≥ 39.0 °c	4	21	3	27
Oxygen saturation	≤ 95%	7	36	4	47
	> 95 %	12	63	7	63
Lung sign	Crepitation	13	68	5	45
	Rhonchi	9	47	5	45
	Wheezing	3	15	1	9
	Clear	0	0	2	18

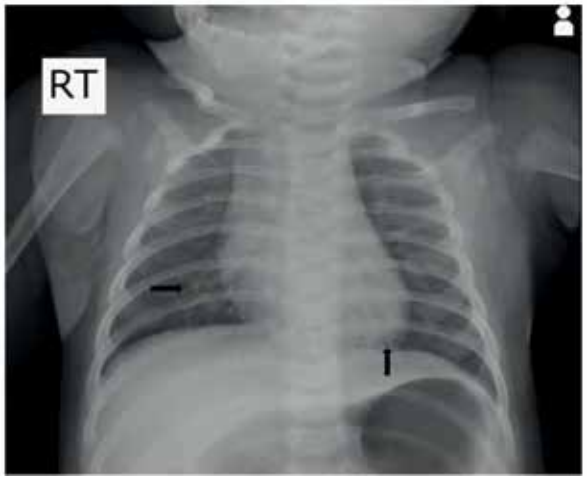

Figure 1 An example of focal small consolidation with air bronchograms (arrows), (alveolar pattern) over both lower lobes (multifocal distribution) obtained from a 2-month- old girl with RSV pneumonia

Figure 2 An example of consolidation (alveolar pattern) over both lungs (diffuse distribution) with left pneumothorax (arrow) obtained from a 1-month-old boy with RSV pneumonia

Figure 3 An example of diffuse fine reticular opacity (interstitial pattern) over both lungs and minimal left pleural effusion (arrow) obtained from a 2-year-old boy with RSV pneumonia

Figure 4. An example of diffuse peribronchial thickening over both lungs (interstitial pattern, diffuse distribution) obtained from a 19-month-old boy with influenza pneumonia

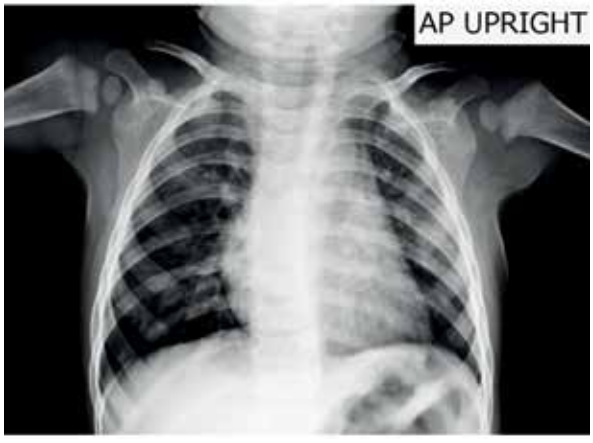

Figure 5. An example of focal peribronchial thickening over right lower lobe (interstitial pattern, focal distribution) obtained from a 1-year-old boy with influenza pneumonia

Figure 6 An example of diffuse fine reticular opacity over both lungs and focal consolidations (arrows) over both upper lung zones (mixed pattern, diffuse distribution) obtained from a 1-year-old girl with influenza pneumonia

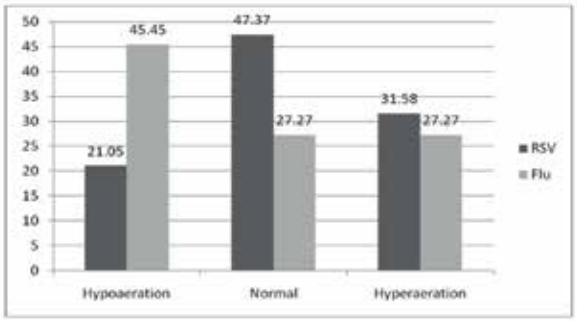

Figure-5 Aeration in radiographic findings, in percent, in children with respiratory syncytial virus and influenza virus infection

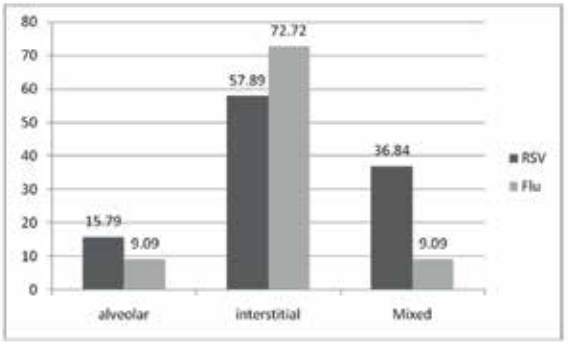

Figure-6 Pulmonary infiltrate pattern in radiographic findings, in percent, in children with respiratory syncytial virus and influenza virus infection

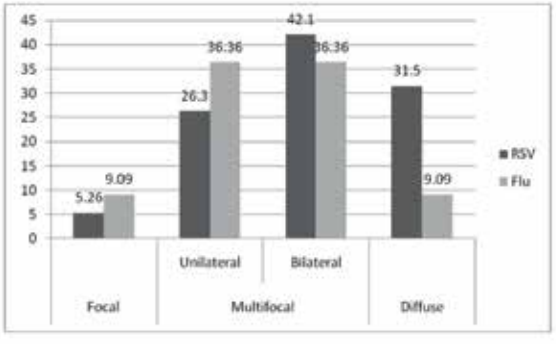

Figure-7 Distribution in radiographic findings, in percent, in children with respiratory syncytial virus and influenza virus infection

Reference

1. Hasan R, Rhodes J, Thamthitiwat S, Olsen JS, Prapasiri P, Naorat S, et al. Incidence and Etiology of Acute Lower Respiratory Tract Infections in Hospitalized Children Younger Than 5 Years in Rural Thailand. Pediatr Infect Dis J. 2014; 33: e45–e52.
2. Ekalaksananan T, Pientong C, Kongyingyoes B, Pairojkul S, Teeratakulpisarn J, Heng S. Etiology of acute lower respiratory tract infection in children at Srinagarind Hospital, Khon Kaen, Thailand. Southeast Asian J Trop Med Public Health. 2001; 32: 513 -9.
3. Korppi M. Community-acquired pneumonia in children issues in optimizing antibacterial treatment. Paediatr Drugs. 2003; 5, 821-32.
4. Franquet T. Imaging of pneumonia: trends and algorithms. Eur Respir J. 2001; 18:196–208.
5. Eriksson J, Nordshus T, Carlsen K-H, Orstadvik I, Eng J, Westvik J. Radiological findings in children with respiratory syncytial virus infection: relationship to clinical and bacteriological findings. Pediatr Radiol. 1986; 16: 120-2.
6. Hansell DM, Lynch DA, McAdams HP, Bankier AA. Imaging of diseases of the chest. 5th ed. China: Elsevier; 2010. 7. Lahti E, Peltola V, Virkki R, Ruuskanen O. influenza pneumonia. Pediatr Infect Dis J. 2006; 25: 160–4.
7. Lahti E, Peltola V, Virkki R, Ruuskanen O. influenza pneumonia. Pediatr Infect Dis J. 2006; 25: 160–4.
8. Madhi SA, Klugman KP. World health organization definition of “radiologically-confirmed pneumonia” may under-estimate the true public health value of conjugate pneumococcal vaccines. Vaccine. 2007; 25: 2413-9.
9. Guo W, Wang J, Sheng M, Zhou M, Fang L. Radiological findings in 210 pediatric patients with viral pneumonia: a retrospective case study. Br J Radiol. 2012; 85: 1385–9.
10. Jartti A, Rauvala E, Kauma H, Renko M, Kunnari M, Syrjala H. Chest imaging findings in hospitalized patients with H1N1 influenza. Acta Radiol. 2011; 52: 297-304.
11. Friis B, Eiken M, Hornsleth A, Jensen A. Chest X-ray appearances in pneumonia and bronchiolitis. Correlation to virological diagnosis and secretory bacterial findings. Acta Paediatr Scand. 1990; 79: 219–25.
12. S. Kern, Uhl M, Berner R, Schwoerer T, Langer M. Respiratory syncytial virus infection of the lower respiratory tract: radiological findings in 108 children. Eur Radiol. 2001; 11: 2581-4.
13. Calado C, Nunes P, Pereira L, Nunes T, Barreto C, Bandeira T. Are there any differences in the community acquired pneumonias admitted to hospital over the past decade? Rev Port Pneumol. 2010; 16: 287-305.

14. Simmerman JM, Chittaganpitch M, Levy J, Chantra S, Maloney S, Uyeki T, et al. Incidence, seasonality, and mortality associated with influenza pneumonia in Thailand: 2005-2008. PLoS ONE. 2009; 4: e7776.
15. Simpson W, Hacking PM, Court SD, Gardner PS. The radiological findings in respiratory syncytial virus infection in children. Part II. The correlation of radiological categories with clinical and virological findings. Pediatr Radiol. 1974; 2: 155-60.
16. Punpanich W, Chotpitayasunondh T. A review on the clinical spectrum and natural history of human influenza. Int J of Infectious Dis. 2012; 16: e714-e723.
17. Ferone EA, Berezin EN, Durigon GS, Finelli C, Felicio MC, Storni JG, et al. Clinical and epidemiological aspects related to the detection of adenovirus or respiratory syncytial virus in infants hospitalized for acute lower respiratory tract infection. J Pediatr (Rio J) 2014; 90: 42-9.