RSV infection and lung ultrasound

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Poznań, 28.09.2018
Disclosure

• In relations to this presentation, I declare NO conflicts of interest
RSV infection

• RSV- enveloped negative sense, single-strand RNA virus, *Pneumoviridae*

• Respiratory syncytial virus (RSV) is the single most important cause of severe respiratory infection in very young infants

• Most common viral pathogen of pneumonia in children <2 years (28-31% identified)
RSV infection

RISK FACTORS

• prematurity
• BPD
• CHD
• immunodeficiency
• chromosomal abnormalities eg. Down syndrome

Incidents of HOSPITALIZATION among preterm infants <32 weeks:

• Pre- palivizumab era - 7,5- 35% (infants with BPD) , 2-12% (without BPD)
• Palivizumab profilaxis - 5,8% (BPD), 2,1% (without BPD) *

RSV infection

EPIDEMIOLOGY

- Temperate climate - annual epidemics - winter
- RSV circulation - 16-22 weeks in a community, overlaps with influenza epidemics
- In the tropics circulation more variable throughout the year

TRANSMISSION

- Older children introduce into family, spread to infants
- Nasal secretion, aerosol
- Virus stable for several hours on hands and hard surface
RSV infection

• Acute illness, pneumonia

• 1-2% of infants in their first year of life are hospitalized (US) *Walsh E, Clin Chest Med. 2017

• 20% emergency patients with acute respiratory symptoms – RSV (+)

• Mortality in developed countries low (50-100 annually in US),

• Developing world- 66.000-199.000 deaths, and >3 milion hospitalization

• Subsequent wheezing in childhood, may be related to asthma in later life
Radiologic findings

- NOT typical, variable
- 31% asymptomatic
- 16% overinflation without infiltrates in X-ray
- 48% consolidation (diffuse areas, lobar consolidation, unilateral single-lower zone involvement)
- Interstitial lung disease
- Ground-glass opacity

*Guo W, Brit Jour of Radiol, 2012
*Wang S, AJR 2014
CT scans

- Viral pneumonia- variable, described in adults
- Poorly defined centrilobular nodules
- Patchy areas of peribronchial ground- glass opacity
- Segmental consolidation, parenchymal airspace consolidation
- Diffuse ground- glass attenuation with bronchial wall thickening (tree in bud)

*Syha R, Eur J Radiol 2012,
LUS signs according to references

- **Lack of studies**, but:
  
  - LUS found to be **valuable tool** in the diagnosis of bronchiolitis *Caiulo VA et al., Eur j Pediatr, 2011*
  
  
  - Longitudinal, transversal sections, ANT, LAT, POST *Copetti R, Catarosi L, Neonatology 2007, 2008*
  
  - **No particular findings characteristic only for RSV** *Tsung JW, Kessler DO, ShahVP, Crit Ultrasound J, 2012.*
  
  - **BPD could be similar to bronchiolitis in RSV** *Basile V et al., Pediatrics, 2015*
Ultrasound signs according to references

- Pleural line thickening
- B-lines, pulmonary interstitial syndrome - concentration of vertical artifacts - confluent or coalescing
- Areas of lung dysventilation - consolidation adjacent to the pleural line associated or not with local pleural effusion
- Comet tail sign
- Signs of bronchiolitis
Ultrasound signs according to references

- Ultrasound anomalies on posterior and paravertebral scans – gravity of supine newborns and infants

- Quantitative classification of interstitial syndrome (eg. involved intercostal spaces post bilaterally) corresponds with the need for oxygen supplementation and severity of bronchiolitis

- Subpleural consolidation of 1 cm or more in the posterior area - need of oxygen supplementation

*Basile V et al., Pediatrics, 2015
Mild pneumonia

**Patient W.**
- Male, Hbd 32, BW 1780g
- Surfactant INSURE after birth, nCPAP 7 days
- 26th day of hospitalisation need of oxygen, cracles, feeding problems
- On 28th RSV diagnosis, need of nCPAP that was continued for consecutive 6 days
- Oxygen for next several days
- On 57th day of life patient discharge

**Patients W. – Twin 1 and Twin 2**
- Male, Hbd 27, BW 1160g & 1140g
- Surfactant INSURE after birth, nCPAP
- RSV diagnosis on 60th day T2, on 67th T1
- Twin 2 CPAP, Twin 1 oxygen
- Discharge on 78th day of life

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Neonatus 2018
Severe complicated pneumonia

- **Patient S.**
  - Male, Hbd 28, BW 780g
  - Trisomy 21
  - nCPAP continued for 4 weeks
  - ASD II, VSD treated with enalapryl
  - On 54-56th day of life episodes of desaturation
  - 3 days of nCPAP, then invasive ventilation (21 days)
  - Coinfection with Acinetobacter
  - Extubated on 76th day of life
  - Discharged on 118th day of life

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Our observations

• Pleural line thickening and numerous B lines
• Consolidations –prodromal and advanced phases
• Paravertebral atelectasis
• Pleural effusion
• Accidental finding by iNO therapy
• Role of positioning
Prodromal phase
Pleural line and B lines

Patient S
small consolidations
and B lines in front
areas, thickening and
interruption of pleural
line
Proromal phase
Pleural line and B lines

Patient W
small consolidations in front areas, thickening and interruption of pleural line

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Pleural line and B lines

Patient S more intense consolidations and B lines in back areas, thickening and interruption of pleural line
Prodromal phase
Consolidations

Patient S. triangle (qouin) like consolidation in the prodromal phase
Prodromal phase
Consolidation

Patient W.
triangle (qouin) like consolidation in the prodromal phase
Consolidations prodromal phase

Patient S

Patient W twin1

Patient W twin2

Patient W
AO3  scapular, midvertebral line
Agnieszka Ochoda; 2018-07-17
Progression of consolidations

Intensification of B lines, white lung
Progression of consolidations

Intensification of B lines, white lung

Progression of consolidations

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Paravertebral consolidations
**D4 Patient S**

- respiratory failure, intubation
- CRP: 15.3 mg/l
- PCT: 0.25 ng/ml
- RSV

**D4 Patient W**

- respiratory failure, nCPAP
- CRP: <4.8 mg/l
- PCT: 0.12 ng/ml
- RSV

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D4 Patient W

D4 Patient S
D4 Patient S
Consolidation with air static bronchogram

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Patient S – D5
Mild atelectasis
D8 - Patient S
Pleural effusion
D8 - Patient S
iNO therapy
D8 - Patient S
Rich pulmonary vasculature
Atelectasis - right inferior lobe partly aerated and fully collapsed
Patient S

Day 5

Day 10

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D10 - Patient S
dynamic air bronchogram
D13 - Patient S
Atelectasis of the inferior left lobe
D17 - Patient S
better aeration of front parts (baby mainly in supine position)
D17 - Patient S
Partly inflated atelectasis of the back parts

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D31 - Patient S on nCPAP

22 Hz

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D31 - Patient S - nCPAP thymus and small consolidation
D31 - Patient S - nCPAP
small pericardial consolidation
Summarise

• LUS is more sensitive in prodromal phase than X-ray

• Sudden respiratory deterioration (even mild) in preterms should always be checked by LUS

• Triangle-like consolidations are probably the typical sign in early phase of RSV pneumonia

• Other signs present in all patients: pleural line thickening, numerous B lines, paravertebral consolidations

• LUS is a non-invasive method that may be used every day to monitor the state and helps to chose the right intervention

• LUS is a 4D method (real time, localises precisely change in all dimensions)
THANK YOU 😊
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