In 127 infants admitted to intensive care for RSV bronchiolitis, concomitant bacterial sepsis was a rare event. However, in the subgroup of intubated patients the incidence of bacterial pneumonia was 43.9% (95% CI 31.0–56.8%), half community acquired and half nosocomial. As clinical signs are not helpful in identifying these patients, tracheal aspirates have to be investigated microbiologically on a routine basis in order to start antibiotics in time.

Methods

We included infants admitted with RSV bronchiolitis to the ICU of the University Children’s Hospital of Zurich during 1997–2001. In patients with multiple admissions, only the first RSV episode was taken for analysis. Length of hospital and ICU stay, occurrence of bacterial pneumonia and sepsis, systemic inflammatory response syndrome (SIRS) on the day of ICU admission, use of antibiotics, artificial ventilation parameters, and mortality data were gathered from the records.

Respiratory compromise was quantified using: (1) highest oxygenation index (mean airway pressure × FiO2/paO2) in the first 24 hours of artificial ventilation; and (2) the respiratory severity score on admission and before intubation in spontaneously breathing patients. According to their respiratory severity score on admission and before intubation (1), the five groups did not differ significantly in length of stay and respiratory parameters (table 1). Table 2 shows the bacteria isolated from tracheal aspirates and blood specimens.

During the first two hospital days, 73 patients were given antibiotics. Since only 14 patients had severe bacterial infections on admission (community acquired bacterial pneumonia/sepsis; table 1), 59 patients (46.5% of the whole patient sample) were initially unnecessarily treated with antibiotics. There was a high proportion of patients receiving antibiotics in the groups without bacterial pneumonia and/or sepsis (table 1: groups 1 and 2). In the SIRS positive, sicker looking infants, antibiotic use was higher (67%) than in the SIRS negative infants (53%) (p = 0.11, Fisher’s exact test).

Discussion

In infants hospitalised in the ICU for RSV bronchiolitis, sepsis was rare, as confirmed by others. The risk of bacterial pneumonia in intubated infants was 43.9% and corresponded roughly with numbers found in non-ICU RSV patients (32% and 59%). However, pneumonia in the latter patients was diagnosed on clinical signs and radiological findings only. In

Abbreviations: ICU, intensive care unit; RSV, respiratory syncytial virus; SIRS, systemic inflammatory response syndrome


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our study, the numbers for bacterial co-infections may be a conservative estimate as: (1) for methodological reasons, a diagnosis of bacterial pneumonia was only made in intubated patients; and (2) there were infants already on antibiotics when cultures were taken, thus preventing possible bacterial infections from being diagnosed. Bacterial co-infection does not add specific symptoms to the clinical signs already present in RSV bronchiolitis. Therefore, a diagnosis of bacterial pneumonia was only attempted in cases where a tracheal aspirate was available for microbiological investigation. The inconstant relation between the timing of cultures and start of antibiotic treatments is an important limitation in this retrospective study.

The presence of concomitant bacterial pneumonia did not aggravate the clinical course in our sample (table 1: group 3 vs groups 1 and 2). Furthermore, the clinical parameters did not differ between SIRS negative and SIRS positive patients (without concomitant bacterial infections). Obviously, the presence of systemic inflammation as well as bacterial pneumonia (if treated correctly) does not influence the hospital course in infants with severe RSV bronchiolitis. The clinical course might be rather influenced by RSV specific consequences such as apnoea and lung disease.

No previous study assessed bacterial co-infections in the subgroup of infants with severe RSV bronchiolitis—that is, in infants admitted to the ICU. Furthermore, the diagnostic criteria for bacterial infections were very vague.3,4 We diagnosed bacterial pneumonia and sepsis specifically as we used rigorous criteria.

According to our data, almost half of the patients were initially unnecessarily treated with antibiotics. However, in intubated RSV patients the number of unnecessarily treated patients was lower due to the high proportion of bacterial pneumonia. A high percentage of infants with RSV bronchiolitis are given antibiotics at ICU admission,5 usually on the basis of clinical signs, such as fever, young age, “ill looking” appearance, respiratory deterioration, or laboratory parameters (leucocytosis, C reactive protein).1 Antibiotics are of no benefit in RSV bronchiolitis.6,7 It has been suggested that in infants admitted for acute lower respiratory tract infections, routine antibiotic treatment is not indicated, even if pulmonary consolidations are present. However, in these studies, infants on mechanical ventilation or with supposed sepsis were excluded from analysis.

In infants with RSV bronchiolitis severe enough to require ICU admission, bacterial pneumonia (community acquired or nosocomial) is a frequent complication in the subgroup of patients who need to be mechanically ventilated. As clinical signs such as SIRS symptoms are not helpful in identifying these patients, tracheal aspirates have to be investigated microbiologically on a routine basis in order to restrict antibiotic use to the infants in real need of it.

Table 1  Length of stay, respiratory parameters, and antibiotic use in RSV patients with and without SIRS or bacterial co-infections

<table>
<thead>
<tr>
<th></th>
<th>Group 1 SIRS negative (na pneumonia) (n = 54)</th>
<th>Group 2 SIRS positive (na pneumonia) (n = 46)</th>
<th>Group 3 Bacterial pneumonia (na pneumonia) (n = 24)</th>
<th>Group 4 Bacterial sepsis (no bacterial pneumonia) (n = 2)</th>
<th>Group 5 Bacterial sepsis and pneumonia (n = 1)</th>
<th>All patients (n = 127)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community acquired pneumonia/sepsis</td>
<td>NA</td>
<td>NA</td>
<td>12 (50%)</td>
<td>1 (50%)</td>
<td>1 (100%)</td>
<td>14 (11%)</td>
</tr>
<tr>
<td>Length of hospital stay, days</td>
<td>11 (1–158)</td>
<td>9 (1–298)</td>
<td>10 (1–168)</td>
<td>12, 12</td>
<td>8</td>
<td>10 (1–298)</td>
</tr>
<tr>
<td>Length of ICU stay, days</td>
<td>4 (0–76)</td>
<td>3 (0–298)</td>
<td>6 (1–62)</td>
<td>9, 12</td>
<td>5</td>
<td>4 (0–298)</td>
</tr>
<tr>
<td>Mortality</td>
<td>1 (1.9%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (0.8%)</td>
<td>1 (0.8%)</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>19 (36%)</td>
<td>12 (26%)</td>
<td>24 (100%)*</td>
<td>1</td>
<td>1* (100%)</td>
<td>57 (45%)</td>
</tr>
<tr>
<td>Intubation time, days</td>
<td>5.5 (1–76)</td>
<td>6.5 (1–298)</td>
<td>4 (0–50)</td>
<td>6</td>
<td>4</td>
<td>5 (1–298)</td>
</tr>
<tr>
<td>Nitric oxide</td>
<td>7 (13%)</td>
<td>3 (7%)</td>
<td>2 (9%)</td>
<td>1</td>
<td>0</td>
<td>13 (10%)</td>
</tr>
<tr>
<td>RSS on admission</td>
<td>8 (3–9)</td>
<td>8.5 (5–9)</td>
<td>8 (6–9)</td>
<td>8, NA</td>
<td>9</td>
<td>8 (3–9)</td>
</tr>
<tr>
<td>RSS before intubation or CPAP</td>
<td>8 (2–9)</td>
<td>8.5 (5–9)</td>
<td>7 (5–9)</td>
<td>NA</td>
<td>9</td>
<td>8 (2–9)</td>
</tr>
<tr>
<td>Highest oxygenation index</td>
<td>7.5 (1.4–28.6)</td>
<td>5.0 (2.6–14.4)</td>
<td>6.1 (1.7–14.4)</td>
<td>NA</td>
<td>NA</td>
<td>6.0 (1.4–28.6)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>29 (54%)</td>
<td>31 (67%)</td>
<td>23 (96%)</td>
<td>2 (100%)</td>
<td>1 (100%)</td>
<td>86 (68%)</td>
</tr>
</tbody>
</table>

*NA, not applicable or no data; RSS, respiratory severity score (minimal score: 0, maximal score: 9).

Table 2  Bacteria isolated in tracheal aspirates and blood specimens from infants with RSV bronchiolitis and bacterial co-infections

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Community pneumonia*</th>
<th>Bacterial sepsis†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemophilus influenzae</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>7 (2–11)</td>
<td>7 (6–9)</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*n = 25 infants, 15 tracheal aspirates with >1 microorganism (maximum 3 microorganisms).

†n = 3 infants, 1 blood culture with 2 microorganisms (Streptococcus pyogenes and Pseudomonas aeruginosa).

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Dilated cardiomyopathy: immunosuppressive treatment and long term outcome

Patients with dilated cardiomyopathy (DCM) have a large, poorly contractile, left ventricle. The causes of DCM are unknown but viral infection and/or autoimmunity are the favourite suggestions. Endomyocardial biopsy (EMB) studies have suggested two types of DCM; those with mononuclear infiltration of the myocardium (myocarditis) and those with only fibrosis (cardiomyopathy). With conventional non-immunosuppressive treatment the outlook for these children has been poor with reported survival rates of 40–75% at 1 year and 37–47% at 5 years. Children, but not adults, with myocardial fibrosis tend to do worse than those with myocarditis and there is evidence that immunosuppressive treatment may be more effective in patients with myocarditis. Researchers in Rome (Maria G Gagliardi and colleagues. Heart 2004;90:1167–71) have reported a long-term observational study. Between March 1986 and December 2001 a total of 114 children (mean age 3 years 1 month, range 1 month to 19 years 9 months) were referred to the department with recent onset DCM and congestive heart failure. Heart defects and metabolic causes of DCM were excluded and all had EMB. The histological classification was: acute florid myocarditis (35), borderline myocarditis (35), and non-inflammatory cardiomyopathy (44). Children in the two myocarditis groups were treated with prednisone and cyclosporine in addition to conventional treatment whereas those with cardiomyopathy received only conventional treatment. The actuarial probability of event-free survival at 1 year was 0.96 in the myocarditis groups and 0.61 in the cardiomyopathy group. The probabilities of event-free survival at 13 years were 0.83 and 0.32. No patient in the acute florid myocarditis group died. Six in the borderline myocarditis group and three in the cardiomyopathy group died without heart transplant. Heart transplantation was performed in 32 patients; one with acute myocarditis, four with borderline myocarditis, and 27 with cardiomyopathy. Ten of the 27 died after transplantation. Complete recovery of cardiac function occurred in 79%, 64%, and 36% of survivors in the three groups respectively. Three factors predicted poor outcome: reduced left ventricular ejection fraction, increased left ventricular end diastolic volume, and non-inflammatory histology. Serial biopsies often showed resolution of the inflammatory changes in the children with myocarditis.

The children treated with immunosuppression in this series appeared to do better than children in previously reported series not given immunosuppression. The authors of this paper believe that a randomised trial might be unethical.
Pulmonary and systemic bacterial co-infections in severe RSV bronchiolitis

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