Respiratory Syncytial Virus (RSV): an Overview

Description/Etiology

Respiratory syncytial virus (RSV) is a paramyxovirus that typically causes lower respiratory tract infection (LRTI) in children (primarily bronchiolitis and pneumonia) and upper respiratory tract infection (URI) and tracheobronchitis in adults. RSV is transmitted directly from person to person by contact with respiratory secretions that contain the virus, and indirectly through fomites (i.e., inanimate objects that carry infectious microorganisms). The virus enters a host through the mucous membranes of the face (e.g., the eyes and nose). Proteins found on the viral surface of infected respiratory cells cause uninfected cells that are in the area to fuse with each other, which spreads viral progeny. The fusion of cells creates syncytia (i.e., giant, coalesced cells), which initiates the release of inflammatory cells and mucus collection in the lungs. The incubation period is 4–5 days. The virus replicates in the nasopharynx and spreads to the epithelial cells of the respiratory tract. Sloughing of RSV-invaded epithelial cells and increased mucus production cause airway congestion and obstruction.

Most persons are infected with RSV by 2 years of age, but immunity is not permanent and reinfection can occur throughout life, although in much milder forms. Aging diminishes serum levels of RSV antibody, which may partially explain why older adults are at greater risk of developing severe RSV and complications.

Most cases of RSV are diagnosed by history and physical examination. Laboratory and radiologic tests are not ordered routinely. Supportive treatment for RSV includes antipyretics, IV fluids, and supplemental oxygen. The antiviral agent ribavirin is approved by the U.S. Food and Drug Administration for treatment of patients with severe RSV infection. The monoclonal antibody palivizumab (Synagis) or anti-RSV IV immunoglobulin (RSV IVIG, which is not available in the United States) can be administered to prevent infection in high-risk patients. The American Academy of Pediatrics recommends that palivizumab prophylaxis be limited to infants born before 29 weeks’ gestation and children with chronic underlying disease, including congenital heart disease or chronic lung disease.

Facts and Figures

An estimated 64 million RSV infections occur worldwide annually, resulting in 160,000 deaths. In the U.S., RSV infection results in 2 million outpatient visits and > 57,000 hospitalizations yearly in children younger than 5 years of age. While both males and females are equally susceptible to contracting RSV, males are twice as likely to require hospital care for RSV infection. About 40% of children with RSV infection will have concomitant otitis media.

Annual outbreaks occur from November to April (with a peak in January or February) in nontropical areas of the Northern Hemisphere, from May to September (with a peak in May, June, or July) in nontropical areas of the Southern Hemisphere, and during the rainy season in the tropics. Peak occurrence of RSV occurs between 2–8 months of age. Reinfection with RSV occurs throughout life, with the upper respiratory tract affected more often in advancing age.

In the U.S., the mortality rate, even in children hospitalized with RSV, is < 1%; the mortality rate may be as high as 3–5% in infants hospitalized for RSV with chronic lung disease, congenital heart disease, or marked prematurity. Fewer than 500 children in the U.S. die...
from RSV infection annually. RSV infection occurs in 0.3–2.2% of children with acute myeloid leukemia and in 1–12% of adults with hematologic cancer and hematopoietic stem cell transplantation. An estimated 5–10% of long-term care residents develop RSV infection each year; of these, 10–20% develop pneumonia and 2–5% die.

Risk Factors
Risk factors for RSV infection in children include prematurity, low birth weight, age < 6 months, day care attendance, crowded living conditions, exposure to cigarette smoke and other environmental pollutants, school-aged siblings, underlying cardiopulmonary disease (e.g., bronchopulmonary dysplasia, congenital heart disease), immunodeficiency, and severe neuromuscular disease. Adults with certain occupational exposures (e.g., pediatric hospital staff members, daycare workers) are at increased risk for RSV infection. Risk factors for severe infection include infancy, older age, immunosuppression (e.g., due to HIV/AIDS or bone marrow transplantation), polymorphisms in various interleukins and CCR5, Down syndrome, and cardiopulmonary dysfunction.

Signs and Symptoms/Clinical Presentation
Signs and symptoms of RSV infection include coughing, wheezing, rales, rhonchi, and a low-grade fever. Nasal and pharyngeal passageways can be inflamed. In severe cases, signs of respiratory distress (e.g., nasal flaring, retraction, cyanosis, tachypnea) may develop. Hyperinflation of the lungs can make the liver and spleen palpable. The patient may complain of coughing, sneezing, malaise, sore throat, earache, dyspnea, and fever, which can persist for 2–4 days. Dehydration can develop, as evidenced by dry mucous membranes and poor skin turgor. Signs and symptoms usually last 3–7 days, and infection usually resolves without sequelae in previously healthy persons. However, complications (e.g., pneumonia, other severe LRTIs, bronchiolitis, croup, otitis media, residual lung damage) can occur. Infants with RSV may develop altered consciousness, seizures, and encephalopathy. Persons with organ compromise or complications are likely to have a longer duration of illness (e.g., several weeks) and can remain contagious > 3 weeks.

Assessment
› Patient History
  • Ask about risk factors for RSV (e.g., prematurity, immunodeficiency, daycare attendance)
› Laboratory Tests That May Be Ordered
  • Serum is tested for RSV-specific immunoglobulin (IgM and IgG). The presence of IgM and/or a 4-fold increase in IgG levels indicate active infection
  • Polymerase chain reaction (PCR), enzyme linked immunosorbent assay (ELISA), and culture of nasopharyngeal or lower respiratory tract secretions will identify RSV
  • ABGs may show hypoxemia and respiratory acidosis
  • BUN is elevated if dehydration is present
  • WBCs may be normal or elevated
› Other Diagnostic Tests/Studies
  • Chest X-ray can show hyperinflation, peribronchiolar thickening, alveolar infiltrates, lobar consolidation, atelectasis, or pleural fluid (rare)

Treatment Goals
› Reduce Risk of Complications and Control Spread of Disease
  • Monitor vital signs and assess all physiologic systems (especially respiratory); administer prescribed supportive treatment (e.g., antipyretics for fever, antibiotics for concomitant bacterial infection, IV fluids for dehydration (e.g., evaluate skin turgor, mucous membranes) and electrolyte imbalance, supplemental oxygen for hypoxia, ventilation [e.g., by ventilator, croup tent, or humidifier], respiratory therapy [e.g., percussion, suctioning] to loosen and remove secretions, corticosteroids, and/or bronchodilators for asthma exacerbation or bronchospasm)
  • Monitor for signs and symptoms of RSV complications (e.g., abnormalities in BUN, electrolytes [e.g., sodium, potassium], skin turgor, and/or skin color; weight loss; increased lung congestion on auscultation; increased expectoration; a change in respiratory rate > 5 breaths/minute from baseline); report abnormalities to the treating clinician and manage as ordered
  • Reduce the risk of aspiration pneumonia by placing the patient in semi-Fowler position; infants may not tolerate food and may frequently vomit
  • Promote bed rest; offer activities tailored to the patient’s medical condition and age
• Reduce the risk of transmission by initiating droplet and contact precautions per facility infection control protocols; use gloves and gowns for any direct contact with the patient, wear a mask if within 3 feet of the patient, and dedicate equipment to the infected patient whenever possible. Follow facility protocols for decontaminating shared equipment before use.
– Encourage visitors to use personal protective equipment, especially for close patient contact, per facility protocol.
• Administer aerosolized antiviral medication (i.e., ribavirin) as prescribed for patients with significant underlying risk factors (e.g., transplant recipients) and severe acute RSV disease.
• Administer prescribed drugs that prevent RSV infection to children with high-risk conditions (e.g., < 2 years with chronic lung disease, premature [e.g., infants < 32 weeks’ gestation at birth]) once a month during peak infection months. Palivizumab can be given once a month during the RSV season, if prescribed.

Provide Emotional Support and Educate
• Assess patient/parental anxiety level and coping ability; educate about RSV infection, treatment risks and benefits, and the importance of good hand hygiene (e.g., frequent use of soap and water or alcohol-based hand rub) and proper cough etiquette (e.g., cough or sneeze into the sleeve of arm or tissue, discard contaminated tissue, decontaminate hands) in controlling the spread of RSV.

Food for Thought
› RSV prophylaxis with palivizumab has been shown to reduce the incidence of mild RSV infection (e.g., illness that can be managed in an outpatient setting) and moderate RSV infection (i.e., illness that requires hospitalization and possibly ICU admission), but not the incidence of severe RSV infection (i.e., illness requiring mechanical intubation or associated with death).
› RSV can survive for several hours on toys or other hard surfaces, 2 hours on clothing, and > 30 minutes on unwashed hands. Incomplete decontamination of surfaces, objects, and hands can lead to healthcare-associated transmission.
› Ribavirin is expensive and has not been proven to decrease hospitalization or mortality rates.
› A prospective cohort study involving treatment with palivizumab and RSV-related hospitalization in children younger than 2 with Down syndrome demonstrated a 3.6-fold reduction in the incidence of RSV-related hospitalization (Yi et al, 2014).
› While not yet commercially available, several vaccines against RSV are in development (Wheatley et al., 2018).
› Evidence has shown that RSV infection during childhood may cause increased risk for the development of chronic obstructive pulmonary disease (COPD) in adulthood (Paes, 2018).
› Molecular rapid tests for RSV are now commercially available, enabling earlier detection of RSV (Schnee et al., 2017).

Red Flags
› Do not administer aspirin to children with RSV infection because of risk of Reye syndrome.
› Aerosolized ribavirin has theoretically been posed to be a toxic risk to healthcare workers; take appropriate precautions when administering the drug.

What Do I Need to Tell the Patient/Patient’s Family?
› Encourage a nonsmoking environment in the home; for infection in children, explain the need to remove the child from day care or school if RSV infection is suspected and emphasize the importance of seeking immediate medical attention for new or worsening signs and symptoms.

References