Chapter 7: Mumps

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I. Disease description

Mumps is a viral illness caused by a paramyxovirus of the genus Rubulavirus. The classic symptom of mumps is parotitis, most commonly bilateral, which develops an average of 16 to 18 days after exposure.[1] Nonspecific symptoms including myalgia, anorexia, malaise, headache, and low-grade fever may precede parotitis by several days. There is evidence that as many as 40%–50% of mumps infections are associated with nonspecific or primarily respiratory symptoms, particularly among children less than 5 years.[2, 3] Not all cases of parotitis—especially sporadic ones—are due to mumps infection. Parotitis can also be caused by parainfluenza virus types 1 and 3, influenza A virus, Coxsackie A virus, echovirus, lymphocytic choriomeningitis virus, human immunodeficiency virus, and other non-infectious causes such as drugs, tumors, immunologic diseases, and obstruction of the salivary duct. However, these agents do not produce parotitis on an epidemic scale.

The average incubation period for mumps is 18 days, with a range of 12–25 days.[4] Fever may persist for 3–4 days and parotitis, when present, usually lasts 7–10 days. Persons with mumps are usually considered infectious from 2 days before until 9 days after onset of parotitis. Because mumps can be asymptomatic, the diagnosis is easily missed.

Severe complications of mumps are rare. However, mumps can cause acquired sensorineural hearing loss in children; incidence is estimated at 5 per 100,000 cases. Mumps-associated encephalitis occurs in < 2 per 100,000 cases and approximately 1% of encephalitis cases are fatal.

Some complications of mumps are known to occur more frequently among adults than among children. Adults have a higher risk for mumps meningoencephalitis than children. In addition, orchitis occurs in up to 38% of cases in post pubertal males. Although it is frequently bilateral, it rarely causes sterility. Mastitis has been reported in as many as 31% of female patients older than 15 years who have mumps. Other rare complications of mumps are oophoritis and pancreatitis.

Permanent sequelae such as paralysis, seizures, cranial nerve palsies, aqueductal stenosis, and hydrocephalus are rare, as are deaths due to mumps. Although mumps infection in the first trimester of pregnancy may result in fetal loss, there is no evidence that mumps during pregnancy causes congenital malformations.

II. Background

The number of reported mumps cases in the United States has decreased more than 99% since licensure of the mumps vaccine in 1967, from 152,209 cases in 1968 to 274 cases in 2001. Most cases (57%) in 2001 occurred among persons younger than 20 years of age. Despite the routine vaccination of children with mumps vaccine, outbreaks have occurred among older children and adults. Although outbreaks in the 1980s were generally attributed to failure to vaccinate all susceptible children, adolescents, and young adults, more recent outbreaks have occurred among highly vaccinated populations.[5,6] In 1991, a mumps outbreak was sustained in a population where 98% of individuals had been vaccinated and where all but one individual with mumps had been vaccinated before the outbreak.[5] Between December 1997 and May 1998, a mumps outbreak occurred in New York City. Among the 111 cases with known vaccination history, 92% had received at least one dose of mumps containing vaccine, and 62% had received two or more doses.[7]

As more children, adolescents, and adults received two doses of measles-mumps-rubella (MMR) vaccine, the number of reported cases of mumps has continued to decrease.[8] Because many reported cases are not confirmed by laboratory testing, it is likely that many of the cases lacking laboratory confirmation are, in fact, not due to infection with mumps virus. Experience in states that have conducted more complete laboratory testing for confirmation suggests that case investigation, combined with appropriate laboratory testing, will result in many suspected cases being discarded and a resulting decrease in reported mumps morbidity.[9,10] Laboratory confirmation helps ensure that only true mumps cases are reported.

Mumps vaccine is routinely used in only 38% of countries or areas in the world,[11] and importation of mumps into the United States is now increasingly recognized. In some European countries the Rubini mumps vaccine continues to be used, despite its low efficacy.

III. Importance of rapid case identification

Identification of suspected or confirmed cases of mumps is important in the initiation of control measures to prevent the spread of the disease among susceptible persons.

IV. Importance of surveillance

Information obtained through surveillance is used to follow disease trends in the population, to assess progress towards disease reduction goals, and to characterize populations requiring additional disease control measures.

V. Disease reduction goals

The 338 reported cases of mumps in 2000 met the Healthy People 2000 reduction goal of < 500 cases and a goal of elimination of indigenous mumps by the year 2010 has been established.[12]

VI. Case definitions

The following case definition for mumps was approved by the Council of State and Territorial Epidemiologists (CSTE) in 1999.[13]

Clinical case definition

An illness with acute onset of unilateral or bilateral tender, self-limited swelling of the parotid or other salivary gland, lasting >2 days, and without other apparent cause.

Laboratory criteria for diagnosis

- Positive serologic test for mumps immunoglobulin M (IgM) antibody, or
- Significant rise between acute- and convalescent-phase titers in serum mumps immunoglobulin G (IgG) antibody level by any standard serologic assay, or
- Isolation of mumps virus from clinical specimen, or
- Detection of virus by reverse transcription polymerase chain reaction (RT-PCR)

Case classification

Probable: A case that meets the clinical case definition, has noncontributory or no serologic or virologic testing, and is not epidemiologically linked to a confirmed or probable case.

Confirmed: A case that is laboratory confirmed or that meets the clinical case definition and is epidemiologically linked to a confirmed or probable case. A laboratory-confirmed case does not need to meet the clinical case definition.

Comment. False-positive IgM results by immunofluorescent antibody assays have been reported.[14]

VII. Laboratory testing

Acute mumps infection can be confirmed by the presence of serum mumps IgM, a significant rise in IgG antibody titer in acute and convalescent serum specimens, positive mumps virus culture, or detection of virus by reverse transcription-polymerase chain reaction (RT-PCR).

Sera should be collected as soon as possible after onset of parotitis for IgM testing or as the acute specimen for examining seroconversion. The convalescent specimen for IgG detection should be drawn about 2 weeks later. IgM antibodies are detectable within the first few days of illness, reach a maximum level about a week after onset of symptoms, and remain elevated for several weeks or months.[15,16] Virus may be isolated from the buccal mucosa from 7 days before until 9 days after salivary enlargement, and from urine during the period from 6 days before to 15 days after the onset of parotitis.[4]

Immunity to mumps may be documented by the presence of serum IgG mumps-specific antibodies by EIA.

For additional information on use of laboratory testing for surveillance of vaccine-preventable diseases, see Chapter 19, "Laboratory Support for the Surveillance of Vaccine-Preventable Diseases."

Serologic testing

The serologic tests available for laboratory confirmation of mumps acute infections and immunity vary among laboratories. The health department can provide guidance in available laboratory services and preferred tests.

- **Enzyme immunoassay (EIA).** EIA is a highly specific test for diagnosing acute mumps infection and mumps immunity. At present, there are no FDA-approved EIA tests for detection of mumps IgM antibodies. At the direction of the state health department, health-care providers and state and local health departments may send serum specimens from patients in whom the diagnosis of mumps is suspected to the CDC Measles Virus Section for IgM detection by EIA.

- **Complement fixation (CF).** Although CF tests are useful in detecting certain mumps antigens, they are not reliable for determining mumps immunity and should not be used for screening purposes.[4]

- **Hemagglutination inhibition test (HI).** As in the case of CF tests, HI tests cannot be used to assess immunity to mumps and should not be used for screening purposes. A rise in mumps HI titer can be used to diagnose mumps infection, but anamnestic responses may occur during parainfluenza infections.[4]

Viral cultures

Mumps virus can be isolated from throat swabs, urine, and cerebrospinal fluid (CSF). Efforts should be made to obtain the specimen as soon as possible after parotitis or meningitis onset. Because there are few laboratories that perform mumps virus culture, it is rarely used for clinical diagnosis in uncomplicated cases. Successful isolation should always be confirmed by immunofluorescence with a mumps-specific monoclonal antibody or by molecular techniques. Molecular typing of virus isolates provides epidemiologically important information and is now recommended (see below).

Molecular typing

Molecular techniques such as RT-PCR can be used to detect mumps RNA in appropriately collected throat swabs, urine samples, and CSF.

Molecular epidemiologic surveillance allows the building of a sequence database that will help track transmission pathways of mumps strains circulating in the U.S. In addition, typing methods are available to distinguish wild-type mumps virus from vaccine virus. Specimens for molecular typing should be obtained from the buccal mucosa with nasopharyngeal swabs and from urine as soon as possible after the onset of parotitis, from the day of onset to 3 days later. Specific instructions for specimen collection and shipping may be obtained from the CDC by contacting the Viral Vaccine Preventable Diseases Branch, National Immunization Program, 404-639-8230. Specimens for virus isolation and molecular typing should be sent to CDC as directed by the state health department.

VIII. Reporting

Each state and territory has regulations or laws governing the reporting of diseases and conditions of public health importance.[17] These regulations and laws list the diseases that are to be reported and describe those persons or groups responsible for reporting, such as health-care providers, hospitals, schools, laboratories, daycare and childcare facilities, and other institutions. Contact the state health department for reporting requirements in your state.

Reporting to CDC

A provisional report of probable, and confirmed cases should be sent to the National Notifiable Diseases Surveillance System by the state health department via the National Electronic Telecommunications System for Surveillance (NETSS) or National Electronic Disease Surveillance System (NEDSS). Reporting should not be delayed because of incomplete information or lack of confirmation; following completion of case investigations, data previously submitted to NETSS or NEDSS should be updated with the available new information.

Information to collect

Basic demographic information (age, race or ethnicity, sex, county, and country of birth), date of onset of symptoms, and mumps vaccination history allow cases to be characterized and also allow identification of groups at increased risk of disease.

In most states, resource limitations have prevented routinely obtaining laboratory confirmation or conducting detailed case investigations of mumps cases. However, recent experience in one large state suggests that if such an effort is undertaken, many reported cases will be found not to be cases of mumps.[9] Because the number of cases of mumps reported each year is now low, a detailed case investigation of each case should be conducted. In cases for

which laboratory testing is done, final laboratory results may not be available for the initial report but should be submitted when available.

The following data are epidemiologically important and should be collected in the course of case investigation. Additional information may be collected at the direction of the state health department.

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Information to collect

- Demographic information
  - Name
  - Address
  - Date of birth
  - Age
  - Sex
  - Ethnicity
  - Race
  - Country of birth
  - Length of time in U.S.

- Reporting source
  - County
  - Earliest date reported

- Clinical
  - Hospitalizations and duration of stay
  - Date of illness onset, especially parotitis
  - Duration of parotitis
  - Symptoms
  - Complications
    - Meningitis
    - Deafness
    - Encephalitis
    - Orchitis
  - Outcome (case survived or died)
    - Date of death
    - Postmortem examination results
    - Death certificate diagnoses

- Treatment
  - Medications given (e.g., antiviral drugs, VZIG, aspirin, non-steroidal anti-inflammatory drugs)
  - Duration

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Information to collect (con't.)

- Laboratory
  - Virus isolation
  - Serology

- Vaccine Information
  - Dates of mumps vaccination
  - Number of doses of vaccine given
  - Manufacturer of vaccine
  - Vaccine lot number
  - If not vaccinated, reason

- Epidemiological
  - Transmission setting
  - Source of transmission (e.g., age, vaccination status, relationship to decedent)
  - Source of exposure
  - Travel history

IX. Vaccination

Live attenuated mumps virus vaccine is recommended for persons ≥ 12 months of age unless medically contraindicated or unless a person is immune as defined by documentation of one of the following:

- Physician-diagnosed mumps

- Immunization with at least one dose of mumps vaccine on or after the first birthday

- Serological evidence of mumps immunity

- Birth before 1957

With use of MMR for measles vaccination under the currently recommended two-dose schedule, most children and adolescents now receive two doses of mumps vaccine. Studies have shown a trend toward a lower attack rate among children who have received two doses of mumps vaccine as opposed to those who have received one dose.[18] Mumps vaccine, as MMR, is recommended at 12–15 months of age and 4–6 years of age.[19]

X. Enhancing surveillance

Obtaining accurate and complete immunization histories

Mumps case investigations should include complete immunization histories that document any doses of mumps-containing vaccine. Acceptable proof of vaccination is a documented administration of one dose of live mumps vaccine virus. Vaccination histories may be obtained from schools, medical providers or on immunization records provided by the case-patient. Verbal history of receipt of mumps vaccine is not considered adequate proof of vaccination.

Expanding laboratory testing

Experience suggests that routine use of laboratory testing for confirmation of mumps cases and of case investigation will result in a marked reduction in reported cases of mumps.[9, 10] Therefore, if mumps is suspected, laboratory testing should be performed in order to confirm or rule out the case. If a case is confirmed, a case investigation should be conducted. Mumps specimens may also be sent to the CDC for testing if this resource is needed.

Promoting awareness

Promote awareness that mumps outbreaks have occurred in highly vaccinated populations. Outbreaks of mumps have occurred among highly vaccinated populations; therefore, mumps should not be ruled out on the assumption that individuals are already immune due to vaccination.

Active surveillance

In outbreak settings, active surveillance for mumps should be maintained for at least two incubation periods (50 days) following parotitis onset of the last case. Two incubation periods allow for the identification of transmission from subclinical infection or unrecognized cases.

A number of other activities can improve the detection and reporting of cases and improve the comprehensiveness and quality of reporting. For general information on improving surveillance of vaccine-preventable diseases, see Chapter 16, “Enhancing Surveillance.”

XI. Case investigation

The Mumps Surveillance Worksheet (**Appendix 8**) may be used as a guideline to collect case information during a case investigation. Essential components of the case investigation include the following:

Establishing a diagnosis of mumps. Because clinical diagnosis of mumps may be unreliable, cases of mumps should be laboratory confirmed. Not all cases of parotitis, especially sporadic ones, are due to mumps infection; however, mumps is the only known cause of epidemic parotitis. Experience indicates that case investigations combined with laboratory testing will result in many suspected mumps cases being discarded.

Obtaining accurate, complete immunization histories. Mumps case investigations should include complete immunization histories that document any doses of mumps-containing vaccine. Recent outbreaks of mumps have occurred among older children and adults, many who had already received at least one dose of mumps-containing vaccine. All vaccination histories should be verified by documentation of administration of one dose of live mumps vaccine virus. Verbal history of receipt of mumps vaccine is not considered adequate proof of vaccination.

Identifying the source of infection. Efforts should be made to identify the source of infection for every confirmed case of mumps. Case-patients should be asked about contact with other known cases. When no history of contact with a known case can be elicited, opportunities for exposure to unknown cases should be sought. After determining when and where transmission likely occurred, investigative efforts should be directed to locations visited.

Assessing potential transmission and identifying contacts. As part of the case investigation, the potential for further transmission should be assessed, and contacts of the case-patient during the infectious period (2 days before until 9 days after onset of parotitis) should be identified.

Obtaining specimens for virus isolation. Efforts should be made to obtain clinical specimens (throat swabs, urine, and CSF) for viral isolation for all cases or at least some cases in each outbreak at the time of the initial investigation. Virus may be isolated from the buccal mucosa from 7 days before until 9 days after parotitis and from urine during the period from 6 days before to 15 days after the onset of parotitis.

XI. Outbreak control

Mumps is the only known cause of epidemic parotitis. The main strategy for controlling a mumps outbreak is to define the at-risk population and a transmission setting, and to rapidly identify and vaccinate susceptible persons or, if a contraindication exists, to exclude susceptible persons from the setting to prevent exposure and transmission. Adequate proof of mumps immunity includes a) written documentation of receipt of > 1 dose of a mumps-containing vaccine administered on or after the first birthday, b) laboratory evidence of immunity, c) birth before 1957, or d) documentation of physician-diagnosed mumps. Persons who do not meet the above criteria are considered susceptible.

Mumps vaccine, preferably as MMR, should be administered to susceptible persons. Although mumps vaccination has not been shown to be effective in preventing mumps in persons already infected, it will prevent infection in those persons who are not infected. If susceptible persons can be vaccinated early in the course of an outbreak, they can be protected. However, cases are expected to continue to occur among newly vaccinated persons who are already infected for at least 3 weeks following vaccination because of the long incubation period for mumps.[20]

As with all vaccines, there are some individuals who will not gain immunity after receipt of mumps vaccine. Because vaccine effectiveness is not 100%, a second dose of mumps containing vaccine is recommended during outbreak situations

for individuals who have received only one dose previously. Studies have shown a trend toward a lower attack rate among children who have received two doses of mumps vaccine as opposed to those who have received one dose.[18] Furthermore, birth before 1957 does not guarantee mumps immunity, and in outbreak settings vaccination with a mumps containing vaccine should be considered for those born before 1957 who may be exposed to mumps and who may be susceptible.

Exclusion of susceptible students from schools affected by a mumps outbreak (and other, unaffected schools judged by local public health authorities to be at risk for transmission of disease) should be consider among the means to control mumps outbreaks.[19] Once vaccinated, students can be readmitted to school. Students who have been exempted from mumps vaccine for medical, religious, or other reasons should be excluded until at least 26 days after the onset of parotitis in the last person with mumps in the affected school.[19]

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