concentration high, a pattern reminiscent of bacterial meningitis. Mumps meningitis is a self-limited manifestation without significant risk of death or long-term sequelae. Cranial nerve palsies have occasionally led to permanent sequelae, particularly deafness. The reported incidence of mumps-associated hearing loss varies between 1 in 1000 and 1 in 100,000. In ~0.1% of infections, mumps virus may cause encephalitis, which presents as high fever with marked changes in the level of consciousness, seizures, and focal neurologic symptoms. Electroencephalographic abnormalities may be seen. Permanent sequelae are sometimes identified in survivors, and adult infections more commonly have poor outcomes than do pediatric infections. The mortality rate associated with mumps encephalitis is ~1.5%. Other CNS problems occasionally associated with mumps include cerebellar ataxia, facial palsy, transverse myelitis, hydrocephalus, Guillain-Barré syndrome, flaccid paralysis, and behavioral changes.

Mumps pancreatitis, which may present as abdominal pain, occurs in ~4% of infections but is difficult to diagnose because an elevated serum amylase level can be associated with either parotitis or pancreatitis. An etiologic association of mumps virus and juvenile diabetes mellitus remains controversial. Myocarditis and endocardial fibroelastosis are rare and self-limited but may represent severe complications of mumps infection; however, mumps-associated electrocardiographic abnormalities have been reported in up to 15% of cases. Other unusual complications include thyroiditis, nephritis, arthritis, hepatic disease, keratouveitis, and thrombocytopenic purpura. Abnormal renal function is common, but severe, life-threatening nephritis is rare. It remains at issue whether an excessive number of spontaneous abortions are associated with gestational mumps. Mumps in pregnancy does not appear to lead to premature birth, low birth weight, or fetal malformations.

DIFFERENTIAL DIAGNOSIS

During a mumps outbreak, the diagnosis is made easily in patients with parotitis and a history of recent exposure; however, when disease incidence is low, other causes of parotitis should be considered and laboratory testing is required for case confirmation. Infectious causes of parotitis include other viruses (e.g., HIV, coxsackievirus, parainfluenza virus type 3, influenza A virus, Epstein-Barr virus, adenovirus, parvovirus B19, lymphocytic choriomeningitis virus, human herpesvirus 6), gram-positive bacteria, atypical mycobacteria, and *Bartonella* species. Rarely, other gram-negative or anaerobic bacteria are associated with parotitis. Parotitis can also develop in the setting of sarcoidosis, Sjögren's syndrome, Mikulicz's syndrome, Parinaud's syndrome, uremia, diabetes mellitus, laundry starch ingestion, malnutrition, cirrhosis, and some drug treatments. Unilateral parotitis can be caused by ductal obstruction, cysts, and tumors. In the absence of parotitis or other salivary gland enlargement, symptoms of other visceral organ and/or CNS involvement may predominate, and a laboratory diagnosis is required. Other entities should be considered when manifestations consistent with mumps appear in organs other than the parotid. Testicular torsion may produce a painful scrotal mass resembling that seen in mumps orchitis. Other viruses (e.g., enteroviruses) may cause aseptic meningitis that is clinically indistinguishable from that due to mumps virus.

LABORATORY DIAGNOSIS

Laboratory diagnosis is primarily based on detection of viral RNA by reverse-transcriptase polymerase chain reaction (RT-PCR) or on serology. Detection of viral antigens (e.g., via mumps virus–specific immunofluorescent staining of cultured clinical specimens) is comparatively inefficient and is no longer commonly performed.

For RT-PCR-based testing, viral RNA can be extracted either directly from clinical samples or from cell cultures incubated with clinical samples. Buccal swabs appear to be the best specimens for virus detection, particularly when obtained within 2 days of clinical onset; however, mumps virus can also be detected readily in throat swabs and saliva and, in cases of meningitis, in CSF. Despite the apparent high frequency of viremia during mumps, mumps virus has rarely been detected in blood. The ability to detect viral RNA in clinical samples rapidly diminishes beyond the first week after symptom onset, and in several studies rates of virus detection were substantially lower in recipients of two vaccine doses than in unvaccinated persons or recipients of one dose. The rate of false-negative RT-PCR findings can be quite high, approaching 70% in some studies.

A serologic diagnosis of mumps is typically made by enzyme-linked immunosorbent assay (ELISA). The data must be interpreted with caution. In vaccinated persons with mumps, IgM is typically absent; thus, a negative IgM result in a vaccinated person does not rule out mumps. In addition, regardless of vaccination status, IgM may not be detectable if serum is assayed too early (prior to day 3 of symptom onset) or too late (beyond 6 weeks after symptom onset) in the course of disease. Reliance on a rise in IgG titer in paired acute- and convalescent-phase sera also is problematic: IgG titers in convalescent-phase sera may be only nominally greater than those in acute-phase sera. Thus, at present, the capacity of RNA or viral antigen detection to confirm cases is much greater than that of serologic testing. Traditional and labor-intensive serologic tests such as complement fixation, hemagglutination inhibition, and virus neutralization are now performed only rarely. The main downside to replacement of these functional serologic assays with the more rapid ELISA method is the latter's detection of all virus-specific antibodies, including those that are nonneutralizing (i.e., nonprotective). Thus, an individual who is seropositive by ELISA may lack protective levels of antibody. While there is a strong association between the presence of mumps virus neutralizing antibody and protection from disease, an absolute antibody titer predictive of serologic protection is lacking; in this respect, mumps differs from other respiratory infections, such as measles.

TREATMENT MUMPS

Mumps is generally a benign, self-resolving illness. Therapy for parotitis and other clinical manifestations is symptom based and supportive. The administration of analgesics and the application of warm or cold compresses to the parotid area may be helpful. Testicular pain may be minimized by the local application of cold compresses and gentle support for the scrotum. Anesthetic blocks also may be used. Neither the administration of glucocorticoids nor incision of the tunica albuginea is of proven value in severe orchitis. Anecdotal information on a small number of patients with orchitis suggests that SC administration of interferon α2b may help preserve the organ and fertility. Lumbar puncture is occasionally performed to relieve headache associated with meningitis. Mumps immune globulin has not been consistently shown to be effective in preventing mumps and is not recommended for treatment or postexposure prophylaxis.

PREVENTION

Vaccination is the only practical control measure. Nearly all developed countries use mumps-containing vaccines, but in many countries mumps is not a notifiable disease and vaccination is often voluntary. However, where used, mumps vaccination has had a tremendous impact, with reductions in incidence and morbidity typically exceeding 90%. Despite the tremendous success of mumps vaccination programs, large mumps outbreaks continue to occur globally, even in settings of high-level two-dose vaccine coverage. Whereas outbreaks historically involved young (often unvaccinated) children in primary and secondary schools, more recent outbreaks have predominantly involved young adults, particularly on college and university campuses. While primary and secondary (waning-immunity) vaccine failures have been hypothesized to be factors in mumps outbreaks in several countries, in some countries other factors may have played a role, such as lack of compliance with the recommended vaccine schedule, changes to vaccination schedules resulting in missed cohorts, or changes in population demographics, such as large-scale immigration.

In the United States, the benefit-cost ratios for mumps vaccination alone are >13 for direct costs (e.g., medical expenses) and >24 for societal costs (including productivity losses for patients and caregivers).