Accidental Infection of Laboratory Worker with Vaccinia Virus

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We report the accidental needlestick inoculation of a laboratory worker with vaccinia virus. Although the patient had previously been vaccinated against smallpox, severe lesions appeared on the fingers. Western blot and polymerase chain reaction—restriction fragment length polymorphism were used to analyze the virus recovered from the lesions. The vaccinia virus–specific immunoglobulin G levels were measured by enzyme-linked immunosorbent assay. Our study supports the need for vaccination for laboratory workers that routinely handle orthopoxvirus.

The smallpox vaccine, formulated with vaccinia virus, is a highly effective immunizing agent. In 1980, the World Health Organization certified that the world was free of naturally occurring smallpox, and smallpox immunization programs were subsequently discontinued (1). Vaccination is still recommended for particular groups, namely, healthcare workers who handle materials potentially infected with vaccinia virus or other orthopoxviruses that infect humans (2).

The use of vaccinia virus in laboratories is likely to increase as a consequence of international concerns about the potential use of variola (smallpox) virus as a bioterrorism weapon. The vaccine is considered safe but can produce mild to moderate disease in vaccinees and can be disseminated to their close contacts (1,3,4). Accidental infections have also been reported. In 1991, an accidental infection with recombinant vaccinia virus was described after a needlestick injury on the left thumb of a laboratory worker (5). A case of vaccinia keratouveitis has been reported with vaccinia virus genome were analyzed by using the following PCR primers: A24Rfwd 5′-GACTAAATATTCATCA-3′ and B14Rrev 5′-AGTGTTGAACACATGATTC-3′. The A24R gene was used as marker for the nonvariable region of the virus genome, and the PCR amplicons were digested with the endonucle-
ases SspI and Rsal (New England Biolabs, Beverly, MA, USA), as recommended by the manufacturer. The variable region of vaccinia virus genome was investigated by amplifying the DNA segment from the B9R to B14R genes and digestion of the amplicons with EcoRV and AluI (Life Technologies, Rockville, MD, USA), as recommended. The digestion products were analyzed by using 1.2% agarose gels. The restriction patterns obtained for both regions in the test sample were identical to the profiles observed with the genome of vaccinia virus–WR (Figure 2B).

Serum collected from the patient day 20 after the initial inoculation was tested for vaccinia virus–specific immunoglobulin (Ig) G response by enzyme-linked immunosorbent assay (ELISA) as described (9,10). Purified vaccinia virus (1 µg/mL in 0.05 M carbonate buffer, pH 9.6) was used as the antigen, and the serum samples were diluted 1/100. Bound antibodies were detected with peroxidase-labeled, anti-human IgG (Biolab Diagnóstica, São Paulo, Brazil) dulated 1/8,000 as described (9,10). The optical density (OD) values were obtained with a microtiter plate spectrophotometer at 450 nm (BioRad, Model 3550 UV, Bio-Rad Laboratories, Hercules, CA, USA). The test serum specimen was compared to a panel of serum specimens from 22 unvaccinated persons and 11 persons who had been vaccinated some time previously, including a sample from the laboratory worker taken 6 years before the accident. When we compared the serum specimens collected before and after the accident, we observed an increase by a factor of 3.5 in the IgG-antibody response to vaccinia virus (Figure 2C). Furthermore, the vaccinia virus–specific IgG levels in the test serum were 1.6 to 2.8 times higher than the levels in the panel of positive control samples and >5 times higher than levels in naive persons. Together, these results confirm that after the recent accident, a productive infection was found in the lesion and an immune response to vaccinia virus was elicited.

Conclusions

Accidental infection with live pathogens by healthcare and laboratory workers has been frequently reported (11,12). The risk of infection cannot be avoided, although it can be prevented or minimized by safety measures. In some cases, vaccination of the workers is the best way to prevent the disease; however, vaccines are not always available.

We report the response of a laboratory worker to an accidental needlestick inoculation with vaccinia virus in 2002. After the accident, typical symptoms of vaccinia infection developed in the worker, followed by full recovery 4 weeks later. Vaccinia virus could be reisolated from the pustular fluid, and no major variation from the original seed virus was detected. Although the patient had been vaccinated against smallpox >20 years ago, a serum sample isolated 6 years before the accident showed a level of vaccina virus–specific IgG antibodies approximately 2 times higher than the level in naive persons. This level of humoral immunity was not able to prevent the progression of the infection as would be expected if she had been vaccinated recently. This result indicates that despite the high IgG levels induced after vaccina virus inoculation, persons vaccinated for >20 years are no longer fully protected against vaccina virus infection and could be vulnerable to variola virus or other orthopoxviruses that infect humans.

Nevertheless, we should consider some aspects of this accident that are not common in other situations (e.g., revaccination). The amount of virus in the needle before the accident was approximately 1,000 times higher than the amount in the vaccine preparations used for smallpox.
vaccination (1). Even in a recently vaccinated person, a response to an infection of such high magnitude will most likely result in a local lesion. However, the question of whether a major reaction with severe symptoms would emerge in this hypothetical situation remains. Usually, a severe reaction has occurred only when a long period has elapsed after vaccination (1). Therefore, after a properly conducted risk assessment, laboratory workers vaccination should be considered as an occupational protection measure against accidental exposure to orthopoxviruses. The results of this study support the current Advisory Committee on Immunization Practices guidelines that recommend a 1-year vaccination regimen for workers who handle low-virulence poxvirus and a 3-year regimen for workers that handle high-virulence strains.

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References


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