VIDEO TRANSCRIPT

Smallpox Vaccine Administration

Introduction

Hello, I'm Dr. Lisa Rotz, of the Bioterrorism Preparedness and Response Program at the Centers for Disease Control and Prevention. The eradication of smallpox from the earth was one of the greatest achievements in the history of medicine and public health.

Unfortunately, smallpox is once again considered a potential threat because of its possible use as a biological weapon.

As part of our bioterrorism preparedness activities, public health and hospital-based healthcare providers should again become familiar with smallpox vaccine and the technique for its administration. This video will describe smallpox vaccine and common reactions following vaccination; how to screen potential vaccinees for contraindications to vaccination; how to administer smallpox vaccine; and describe how to care for the vaccination site.

Thank you for your participation in this important public health preparedness activity.

Vaccine Overview

In this segment of the program, we will discuss the characteristics of smallpox vaccine and adverse reactions that may occur following vaccination.

As many as three different smallpox vaccines are available, or will soon be available, in the United States. All three vaccines contain the New York City Board of Health strain of live vaccinia virus.

Smallpox vaccine does NOT contain smallpox, or variola virus. So when we refer to smallpox vaccine in this video, we are actually talking about vaccinia vaccine.

Dryvax was produced by Wyeth Lederle in the early 1980s from calf lymph containing live vaccinia virus. This vaccine is provided as a freeze-dried powder and contains the antibiotics polymyxin B, streptomycin, tetracycline, and neomycin. The diluent used to reconstitute the vaccine is 50 percent glycerin with a small amount of phenol as a preservative.

The newest vaccines also contain live New York City Board of Health vaccinia virus, but are produced using cell culture technology rather than live animals. These vaccines will be distributed as a freeze-dried powder but do not contain antibiotics. The diluent contains glycerin and phenol, like the Dryvax diluent.

Proper reconstitution of smallpox vaccine is critical to successful vaccination. Instructions for reconstitution are vaccine-specific, and will be provided with your vaccine shipment. It's important that you follow these instructions very carefully.

Smallpox vaccine is unique in that it is not administered by injection. It's administered into the superficial layer of the skin with a two-pronged, or bifurcated, needle like this one. Bifurcated needles will be supplied to you in individual sterile packages.

Live vaccinia virus is present at the vaccination site beginning 3 to 4 days after vaccination, and until the scab separates. This occurs about 2 to 3 weeks after vaccination. Since the developing vaccinia lesion usually itches, care must be taken to avoid scratching, then touching other parts of the body, such as the eye, or other people. This could transfer the vaccine virus to these sites or individuals. Washing hands immediately after touching the vaccination site or dressing is very important in preventing this. We will discuss care of the vaccination site in more detail later in the program.

Adverse Reactions

Reactions following smallpox vaccination can be divided into three types: local reactions at the site of vaccination; systemic symptoms; and events resulting from transfer or dissemination of vaccinia virus in healthy people or in people with certain underlying medical conditions.

A local reaction at the site of inoculation, like the one shown here, indicates a successful vaccination. But in addition to a pustule, the local reaction at the site of inoculation can be very dramatic.

In several recent studies of old and new vaccines given to unvaccinated adults, the average size of the pustule at 2 weeks after vaccination was 12 millimeters—or about half an inch. The average size of erythema surrounding the pustule was 16 to 24 millimeters, and average induration was 11 to 15 millimeters, or up to 2/3 of an inch.

Some vaccinees may have larger amounts of erythema and induration that can be mistaken for cellulitis. These reactions generally improve within 24 to 48 hours without specific therapy but may require clinical evaluation to rule out bacterial cellulitis.

Forty to 47 percent of the vaccinees reported mild pain at the site of inoculation. But 2 to 3 percent reported the pain as severe. Axillary lymphadenopathy was reported in about one third of recipients. Most lymphadenopathy was mild, but in 3 to 7 percent it was considered moderate—that is, bothersome to the vaccinee but not otherwise interfering with normal activities.

Fever is common after administration of smallpox vaccine. In a recent study of Dryvax given to unvaccinated adults, 5 to 9 percent reported a fever of 100 degrees Fahrenheit or higher, and 3 percent reported temperature of 102 or higher. Fever is most common 7 to 12 days after vaccination. In addition to fever, adult vaccinees also report a variety of constitutional symptoms, including headache, myalgias, chills, nausea, and fatigue on or about the eighth or ninth day after vaccination. One or 2 percent of recipients reported these symptoms as severe.

Historically, fever was more common among children. In past studies, about 70 percent of children experience 1 or more days of temperature of 100 degrees Fahrenheit or higher after primary vaccination. Fifteen to 20 percent of children experienced temperatures higher than 102 degrees Fahrenheit.

Beginning about 4 days after vaccination, vaccinia virus is present at the site of inoculation. If the lesion is touched, virus can be transferred to another part of the body.

Transfer, or autoinoculation, of vaccinia from the vaccination site is called inadvertent autoinoculation. This is the most frequent complication of smallpox vaccination. It usually occurs because the site itches as it heals, and the person scratches the site.

Inadvertent autoinoculation accounted for approximately half of all complications of primary vaccination and revaccination. In studies of smallpox vaccination in 1968, inadvertent autoinoculation occurred at a rate of 25 to 529 cases per million primary vaccinations. Carefully following the site care instructions will significantly decrease the risk of this complication.

Lesions of inadvertent autoinoculation can occur anywhere on the body, but the most common sites usually involved are the face, eyelid, nose, mouth, genitalia, and rectum.

A variety of erythematous and urticarial rashes occur approximately 10 days after primary vaccination. These rashes are referred to as erythema multiforme, roseola vaccinia, toxic erythema, and postvaccinial urticaria.

They are flat, erythematous, macular, or urticarial lesions, usually with microscopic vasculitis. The pathophysiology of these rashes is not well understood. They don't usually become vesicular, and don't appear to involve viral multiplication or systemic dissemination. The rash resolves spontaneously within 2 to 4 days.

Patients with erythematous urticarial rashes associated with vaccinia are generally not severely ill and are usually afebrile despite the sometimes extensive skin involvement. On rare occasions Stevens-Johnson syndrome, or bullous erythema multiforme, may develop.

Another type of rash following smallpox vaccination is called generalized vaccinia. This condition is believed to result from a vaccinia viremia with implantations in the skin in persons without underlying illnesses.

True generalized vaccinia consists of vesicles or pustules appearing on normal skin distant from the vaccination site, and is often accompanied by symptoms such as fever, headache, and myalgias. In the 1968 studies, rashes diagnosed as generalized vaccinia occurred at a rate of 23 to 242 cases per million primary vaccinations.

Most rashes labeled as generalized vaccinia produce only minor illness with little residual damage. The rash is generally self-limited and usually requires no specific therapy.

Three complications of smallpox vaccination are rare, but can be very severe or fatal. These are eczema vaccinatum, progressive vaccinia, and postvaccinial encephalitis.

Eczema vaccinatum is the generalized spread of vaccinia on the skin of a person with eczema or true atopic dermatitis, or a history of eczema or atopic dermatitis. The most serious cases among vaccine recipients occur among primary vaccinees and are independent of the activity of the underlying eczema.

Severe cases have also been observed after contact of a recently vaccinated person with someone who has eczema or atopic dermatitis. It occurred at a rate of 10 to 39 cases per million primary vaccinations.

This person has eczema vaccinatum. This woman had eczema and acquired her infection after contact with her recently vaccinated boyfriend. She survived the illness but had extensive residual scarring of her skin.

Eczema vaccinatum is believed to result from either blood dissemination of vaccinia virus or by direct skin inoculation of vaccinia on skin affected by eczema or atopic dermatitis. Vaccinia virus is readily recoverable from skin lesions. Vaccinia immune globulin or VIG has been shown to be effective for the treatment of this complication.

This person has progressive vaccinia, also known as vaccinia necrosum. Progressive vaccinia is a severe, potentially fatal illness, characterized by a nonhealing vaccination site with progressive necrosis. Metastatic lesions are often present.

Progressive vaccinia occurs almost exclusively among persons with cellular immunodeficiency, but can occur in persons with humoral immunodeficiency. Progressive vaccinia can occur following revaccination of

people who have become immunosuppressed since their primary vaccination. In the 1968 studies progressive vaccinia occurred at a rate of 0.9 to 1.5 cases per million primary vaccinations. Progressive vaccinia could be seen more often in today's population, with the greater prevalence of HIV and posttransplant immunosuppression. VIG has variable effectiveness in treating this complication.

A major unpredictable complication is postvaccinial encephalitis. In the majority of cases, postvaccinal encephalitis affects primary vaccinees 12 months of age or younger, and adolescents and adults receiving a primary vaccination.
It presents with any of a variety of central nervous system signs, such as ataxia, confusion, paralysis, seizures, or coma. Most cases are believed to result from autoimmune or allergic reactions, similar to other postviral CNS syndromes rather than direct viral invasion of the nervous system.
Approximately 15 to 25 percent of vaccinees with this complication die, and 25 percent develop permanent neurological sequelae. It occurred at a rate of 3 to 12 cases per million primary vaccinations.
Treatment of postvaccinial encephalitis is supportive care, as VIG is not effective.

A fetus may be infected if a pregnant woman receives smallpox vaccine. Fetal vaccinia is a rare complication of smallpox vaccination. Fewer than 50 cases of fetal vaccinia infection have been reported. When this complication did occur, it was usually following primary vaccination of the mother in the second or third trimester. Fetal infection following vaccination in the first trimester would presumably result in spontaneous abortion. But studies are contradictory as to whether an increased number of spontaneous abortions actually occurred in pregnant women. Smallpox vaccination of a pregnant woman has not been associated with fetal malformations or birth defects.

Death resulting from smallpox vaccination is rare, with approximately 1 death per million primary vaccinations and 1 death per 4 million revaccinations. Death is most often the result of postvaccinial encephalitis or progressive vaccinia. However, death can also result from eczema vaccinatum.

Vaccinia immune globulin, or VIG, has been used to successfully treat some smallpox vaccine complications. It is a sterile solution of the immunoglobulin fraction of plasma from persons vaccinated with vaccinia vaccine. It's been used to treat eczema vaccinatum, progressive vaccinia, and severe generalized vaccinia.
It's also been used in the treatment of ocular vaccinia resulting from inadvertent autoimplantation. VIG provides no benefit in the treatment of postvaccinial encephalitis or in the treatment of smallpox.

VIG supplies are limited, so it should be reserved for the treatment of vaccine complications with more serious clinical manifestations. CDC is currently the only source of VIG for civilians.

So in summary, reactions following smallpox vaccination, such as fever, erythematous rashes, and autoinoculation are common but generally self-limited. Pain, induration, and erythema at the site of vaccination can be dramatic but are also generally self-limited.

Severe complications, such as eczema vaccinatum, progressive vaccinia, and postvaccinal encephalitis are rare, but can be fatal. Severe complications are more common in persons receiving primary vaccination compared to those being revaccinated. The risk of these rare, severe complications can be reduced by careful medical screening for conditions such as eczema, atopic dermatitis, or immunodeficiency.

More information about smallpox vaccine can be found at www.bt.cdc.gov/agent/smallpox.

Contraindications and Precautions to Vaccination and Screening Potential Vaccine Candidates

In this segment of the program, we will discuss contraindications and precautions to the administration of smallpox vaccine. These contraindications and precautions are applicable for situations of nonemergency use of smallpox vaccine.

In an outbreak, for persons exposed or potentially exposed to a person with smallpox, there are no contraindications to vaccination.

Smallpox vaccine contains live vaccinia virus, which is administered into the superficial layers of the skin. A successful vaccination produces a lesion on the skin that contains vaccine virus for up to 3 weeks. The vaccine virus can be transmitted to household and other close contacts. So, in the absence of smallpox cases, candidates for vaccination must be screened for contraindications very carefully. Certain medical conditions in the person's household contacts must also be considered as contraindications for vaccination.

As with all vaccines, smallpox vaccine is contraindicated for persons who have experienced a serious allergic reaction to a prior dose of vaccine, or to a vaccine component. By serious allergic reaction, we mean anaphylaxis or symptoms of an anaphylaxis-like reaction, such as generalized urticaria, wheezing, or difficulty breathing.

In addition to live vaccinia virus, reconstituted Dryvax vaccine contains trace amounts of the antibiotics polymyxin B, streptomycin, tetracycline, and neomycin. It also contains phenol as a preservative. People with serious allergy to any of these products should not be vaccinated. The newer cell culture vaccines do not contain antibiotics. No smallpox vaccine available in the United States contains penicillin.

People with significant immunosuppression should not receive smallpox vaccine. Replication of vaccinia virus can be enhanced among people with immunodeficiency diseases and immunosuppression, and result in serious adverse reactions. Also, because the recent vaccination site contains live virus that can be transmitted to other individuals, people with household contacts who are immunosuppressed should also not be vaccinated in nonemergency situations.

Significant immunosuppression can be caused by many diseases, including leukemia, lymphoma, generalized malignancy; solid organ or stem cell transplantation; and humoral or cellular immunity disorders, including HIV infection.

Drugs that can cause immunosuppression include alkylating agents, antimetabolites, radiation, or high-dose corticosteroid therapy. Prednisone doses of 2 milligrams per kilogram of body weight per day or higher or 20 milligrams per day or higher for 14 days or more should be considered immunosuppressive. As with other live vaccines, those on high levels of these drugs should not be immunized for three months after their last dose.

Live viral vaccines are contraindicated during pregnancy. Smallpox vaccine should not be administered to pregnant women or people with pregnant household contacts for nonemergency indications. Pregnancy should also be avoided for at least a month after vaccination. Women who are breastfeeding should not be vaccinated, because the close contact that occurs during this activity could increase the chance of transmission of the vaccine virus to the breastfeeding infant.

Because of the increased risk for eczema vaccinatum, smallpox vaccine should not be administered to people with eczema or atopic dermatitis or a past history of these conditions. People who have a HOUSEHOLD CONTACT with eczema or atopic dermatitis or a history of these conditions should also not be vaccinated.

People with other types of acute, chronic, or exfoliative skin conditions, such as psoriasis, contact dermatitis, or varicella zoster might be at higher risk for disseminated skin rashes from the vaccine, although these rashes are generally not as severe as eczema vaccinatum. People with exfoliative skin conditions should not be vaccinated until the condition is under good control or resolves.

Children less than 12 months of age should not be vaccinated. All vaccinated people should take precautions to prevent virus transmission to young children and other household contacts. As with all vaccines, vaccination should be deferred for people with moderate or severe acute illnesses.

One reminder: in the event of an actual exposure to smallpox, vaccination may be considered for individuals who otherwise have contraindications, because the benefits of vaccination would most likely outweigh the risks

In summary, smallpox vaccine should not be administered to persons known to have a serious allergy to a prior dose of vaccine or vaccine component; persons with significant immunosuppression from any cause; someone with an immunosuppressed household contact; a woman who is pregnant or attempting to become pregnant, or someone with a household contact who is pregnant; and women who are breastfeeding.

Smallpox vaccine should not be administered to persons with a diagnosis of eczema or atopic dermatitis, including eczema or atopic dermatitis that is not currently active; or a person who has a household contact who has eczema or atopic dermatitis or a history of these diseases; persons with other extensive exfoliative skin conditions; children less than 12 months of age; and persons with a moderate or severe acute illness.

A careful medical history for contraindications to vaccination should be done for EVERY person prior to vaccination. Additional information about contraindications and precautions for smallpox vaccine can also be found on the CDC websites.

Vaccine Administration

In this segment of the program, we will discuss the administration of smallpox vaccine and demonstrate the recommended method of administration.

We recommend that you wear gloves when administering smallpox vaccine. Because of the risk of inadvertent exposure to vaccine virus, persons administering the vaccine should be vaccinated. Healthcare providers or vaccinators who themselves have a contraindication to vaccination should not handle or administer the vaccine.

You should consult the package insert or protocol that comes with the vaccine for instructions on vaccine reconstitution.

Once you have prepared the vaccine, you're ready to administer it. To administer the smallpox vaccine, a special bifurcated needle is used. No other vaccine uses this type of needle, and smallpox vaccine must never be administered by any other method. You should review the package insert or protocol that is provided with the vaccine for any additional instructions regarding vaccine administration.

When the bifurcated needle is dipped into the vaccine vial and withdrawn, the tiny amount of vaccine required for a single dose is captured between the two prongs of the needle.

A stopper for the vial and sterilized, individually packaged needles will be provided within the vaccine packaging.

In general, alcohol, soap and water, or other chemical agents are not needed for preparation of the skin for vaccination unless the area is grossly contaminated. If needed, soap and water are the preferred cleaning agents. If any cleaning agent is used, the skin must be thoroughly dry in order to prevent inactivation of the vaccine.

Remove the bifurcated needle from its packaging. The needle is sterile, so be careful not to touch the bifurcated, pointed end.

Dip the bifurcated point of the needle into the vaccine solution so that the needle is perpendicular to the floor. The needle will pick up a drop of the vaccine in the space between the two prongs.

Remember—do not redip the needle into the vaccine solution once it has touched the patient's skin. This will prevent contamination of the vaccine vial.

Prior to the administration of smallpox vaccine, please refer to the package insert for the appropriate number of needle punctures to administer. The following is a demonstration of 15 punctures, which would be used for revaccination.

Pull the skin on the arm taut, rest your wrist on the arm, and prick the skin 15 times as shown here. This should be done rapidly, perpendicular to the skin, within an area 5 millimeters in diameter. The intention is to break the skin and introduce the vaccine into the skin. The wrist of the vaccinator should be resting on the arm while pricking the skin. Enough pressure should be used to visibly push down the skin and produce a trace of blood at the vaccination site that appears 10 to 20 seconds after vaccination.

Administering the strokes rapidly, within about 3 seconds, also helps induce enough pressure by the needle to produce this small amount of bleeding and assure that the vaccine was administered appropriately. This method allows the live vaccinia virus to penetrate the superficial layers of the skin so that viral multiplication can occur and produce immunity.

Once the vaccine is administered, you should dispose of the needle into an appropriate sharps disposal container. Cover the vaccination site with a piece of gauze or other appropriate dressing.

Here is the vaccination procedure again.

Instructions are included with each vaccine shipment that outline the vaccination procedure you've just seen. The instructions also contain other important information about smallpox vaccine.

Response to Smallpox Vaccination

In this segment of the program, we will describe the response to smallpox vaccination.

Following vaccination, vaccinia virus replicates in the epidermis, resulting in the development of a lesion at the site of vaccination. Persons receiving their first dose of vaccine normally experience tenderness, redness, and swelling at the vaccination site. Primary vaccination may also be associated with fever for a few days and enlarged, tender lymph nodes in the axilla of the vaccinated arm.

A papule develops at the inoculation site 3 to 5 days after primary vaccination. About 7 days following primary vaccination, a vesicle surrounded by erythema forms at the site. This is known as a "Jennerian vesicle." The vesicle usually becomes pustular by 11 days after vaccination. Maximum erythema occurs 8 to 12 days after vaccination. The erythema then subsides, the pustule dries, and a crust develops 2 to 3 weeks after vaccination. By the end of the third week, the crust separates, leaving a permanent scar at the vaccination site.

This response to vaccination is called a major reaction. It indicates that virus replication has taken place, and that vaccination was successful. A person is considered immune with the development of a major reaction at the vaccination site. A revaccinated person often develops a skin reaction similar to that after primary vaccination, but the lesion progresses faster than after primary vaccination.

Vaccine sites should be examined for the expected vesicle or pustule on about day 7 following vaccination to confirm that the vaccination was successful.

Some people may have no response or develop erythema and redness lasting only a few days. Such responses are referred to as "equivocal."

An equivocal response may result from a person being sufficiently immune to suppress viral replication, or it may be the result of using subpotent vaccine or improper technique. Some persons may exhibit erythema and redness lasting several days, which may be the result of a hypersensitivity reaction to components of the vaccine. Such responses can be induced using vaccine that has been inactivated by heat. Because it's impossible to know which of the situations pertain, the reaction is called "equivocal" and repeat vaccination is done, preferably using vaccine from another vial when possible.

Care of the Smallpox Vaccination Site

Successful smallpox vaccination produces a lesion on the skin. Vaccinia virus can be cultured from this lesion until the scab separates from the skin, as long as 21 days after vaccination. During this time, care must be taken to prevent spread of the virus to another area of the body or to another person. Proper care of the site will also reduce the chance of secondary bacterial infection.

Healthcare workers must take special precautions to prevent transmission of vaccinia virus in the workplace. We will discuss vaccination site care recommendations for healthcare workers in a moment.

Following vaccination, the site should be loosely covered with a porous bandage such as gauze. The vaccinated person can wear a long sleeved shirt in addition to the dressing to help cover the site

Vaccinees should be instructed that thorough hand washing with soap and water or disinfecting agents should be performed after ANY direct contact with the site or CONTACT with materials that have come into contact with the site.

Care must be taken to prevent contact of the site or contact with contaminated materials from the site by any other person. Keeping the site covered provides barrier protection against inadvertent inoculation or transmission.

Recently vaccinated healthcare workers should utilize additional vaccine site precautions while at work. They should cover the site with an absorbent material such as gauze that is in turn covered by a semipermeable dressing. This provides an additional barrier to prevent contact transmission during patient care activities.

As the vaccination site heals it will itch. The vaccine recipient must make a conscious effort not to scratch the lesion. The vaccine recipient should consider wearing a sleeved shirt to bed in addition to the dressing to avoid scratching the lesion or contaminating the bedding while sleeping.

An occlusive bandage should not be routinely used because maceration of the site might occur. Bandages used to cover the vaccination site should be changed every day to prevent maceration of the vaccination site caused by fluid buildup. Contaminated bandages should be disposed of in a manner that would prevent others from coming into direct contact with them. This may be done by placing the dressings in a

sealed plastic bag before disposal in the trash. The site scab should also be appropriately disposed of after it has fallen off.

The vaccination site should be kept dry, although normal bathing can continue. A waterproof bandage can be used while bathing but should be changed back to a porous bandage such as gauze after bathing.

No salves or ointments should be placed on the vaccination site. Clothing or other cloth materials, such as bedding, that have had contact with the site can be cleaned with routine laundering in hot water. Individuals should wash their hands after handling any contaminated clothing or bedding.

Remember, the most critical measure in preventing inadvertent implantation and contact transmission following smallpox vaccination is thorough hand washing after changing the bandage or after any other contact with the vaccination site. The importance of hand washing must be stressed to every vaccinated person.

Additional information about smallpox vaccine, vaccination site care, recognition and treatment of adverse events, and medical screening guidance, including updated recommendations from the Advisory Committee for Immunization Practices is available on our websites. The address of the CDC National Immunization Program website is www.cdc.gov/nip. The address of the CDC Public Health Emergency Preparedness and Response smallpox website is www.bt.cdc.gov/agent/smallpox.

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For more information, visit www.cdc.gov/smallpox, or call the CDC public response hotline at (888) 246-2675 (English), (888) 246-2857 (Español), or (866) 874-2646 (TTY)
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