

Prevention and Nursing of Adverse Reactions of Novel Coronavirus Inactivated Vaccine (Vero Cells)

Jingyu He, Muyang Bian, Jianan Du, Liping Wang*

Department of Disease Control, Xi'an People's Hospital (Xi'an Fourth Hospital), Xi'an 710004, China

*Corresponding author: Liping Wang, 516637231@qq.com

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Abstract: *Objective:* To discuss and analyze the causes of adverse reactions caused by the inactivated novel coronavirus vaccine (Vero cells), and to propose methods of prevention and care. *Methods:* A questionnaire was used to randomly select 229 adults who were vaccinated with the inactivated novel coronavirus vaccine (Vero cells) at Xi'an People's Hospital (Xi'an Fourth Hospital). The adverse reactions were statistically analyzed. *Results:* Among the 229 adults vaccinated with the inactivated novel coronavirus vaccine (Vero cells), 30 experienced vaccination reactions. The main reaction was local induration at the inoculation site, and dizziness was the primary systemic symptom. *Conclusion:* To reduce the incidence of adverse reactions to the inactivated novel coronavirus vaccine (Vero cells), it is necessary to effectively evaluate the health status of adults before vaccination, select the correct vaccination site, and strictly implement the rules of 3-inspections, 7-checks, and 1-verification. Standardizing the operation process and providing thorough health education after vaccination can effectively reduce the occurrence of adverse reactions.

Keywords: Novel coronavirus inactivated vaccine (Vero cells); Vaccination; Adverse reactions nursing

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1. Introduction

Novel coronavirus pneumonia (COVID-19) is a new infectious disease caused by a novel coronavirus. The main transmission routes are respiratory droplets and contact transmission, and the general population is susceptible to this infectious disease^[1]. The main clinical features are fever, dry cough, and fatigue. A small number of patients may also experience nasal congestion, runny nose, sore throat, expectoration, conjunctivitis, myalgia, and diarrhea. Most patients have a good prognosis, though some may be in critical condition^[2].

In China's "Novel Coronavirus Pneumonia Diagnosis and Treatment Program," it is stated that the primary source of infection is patients infected with the novel coronavirus, but asymptomatic carriers can also transmit the virus. The main route of transmission is through respiratory droplets and contact. Droplets are directly sprayed onto the mouth, eyes, nose, and other mucous membranes, mainly during close face-to-face contact, such as talking loudly, unprotected dental or ophthalmic procedures, and respiratory operations. Infection can also occur by touching the mouth, eyes, and nose with hands contaminated with the virus. Additionally, aerosol transmission is possible: in poorly ventilated confined spaces, larger droplets can lose water and become small-

particle aerosols capable of longer-distance propagation ^[3].

Over time, COVID-19 has posed a serious threat to global public health. According to current needs for the prevention and control of the novel coronavirus pneumonia, vaccination with the novel coronavirus vaccine has been implemented. The inoculation of the inactivated novel coronavirus vaccine (Vero cells) can stimulate the body to produce immunity against the virus and is used to prevent diseases caused by the novel coronavirus.

2. Clinical data

The research subjects included 17,481 adults vaccinated with the inactivated novel coronavirus vaccine (Vero cells) at the vaccination clinic of the Fourth Hospital of Xi'an (Xi'an People's Hospital) from January 2021 to April 2021. These adults, aged 18–59, had no contraindications to the vaccine. According to the regulations of the National Health Commission in January 2021, key groups for a vaccination with the inactivated novel coronavirus vaccine (Vero cells) include those engaged in industries with a relatively high risk of infection, such as imported cold chain, port quarantine, ship piloting, aviation aircrew, fresh market workers, public transportation, medical treatment, and disease control.

For epidemic prevention and control, the inactivated novel coronavirus vaccine (Vero cells) can be used urgently within a certain range and period. Vaccination induces active immunity, but it takes time for the body to produce neutralizing antibodies, so appropriate protective measures still need to be taken ^[4].

The inactivated novel coronavirus vaccine (Vero cells) is the first such vaccine approved for emergency use in China and is the main vaccine used for widespread vaccination in the country. The active ingredient is the whole virus, which no longer has the ability to replicate. It contains all the structural proteins of the virus. After entering the human body, it activates helper T cells through antigen-presenting cells, which in turn activate B cells to produce humoral immunity. Using virus inactivation to prepare vaccines is a classic method of vaccine research and development, with the advantages of mature technology and high safety, though it requires contact with live viruses during production ^[3].

This experiment used a random sampling method, distributing the WeChat version of the questionnaire randomly among the vaccinated population. A total of 229 valid questionnaires were collected. The vaccines used were produced by Beijing Institute of Biological Products Co., Ltd. and Beijing Kexing Zhongwei Biotechnology Co., Ltd., and were within their validity period. The basic immunization for the inactivated novel coronavirus vaccine (Vero cells) consists of 2 doses, each of 0.5 ml, with an interval of 3-8 weeks between doses. The vaccines are stored and transported at 2-8°C, away from light, and must not be frozen ^[5].

3. Adverse reactions

Adverse reactions refer to unrelated or unexpected adverse events that occur after the administration of qualified vaccines and can be divided into general reactions and abnormal reactions according to the circumstances of the reactions ^[6]. General reactions refer to the abnormal functioning of tissues and organs caused by the inherent characteristics of the vaccine. The main clinical manifestations can be divided into local reactions and systemic reactions. The local reaction after inoculation with the inactivated novel coronavirus vaccine (Vero cells) is primarily induration at the vaccination site, which may also include local itching, rash, and redness. General systemic adverse reactions mainly include dizziness and fatigue, and can also encompass fever, muscle pain, cough, diarrhea, nausea, and vomiting.

Abnormal reactions refer to physiological damage to organs or functions after vaccination, with main clinical manifestations including systemic anaphylactic shock, convulsions, hysteria, and other serious conditions.

Out of 229 valid questionnaires collected, there were 30 cases of adverse reactions, resulting in an incidence rate of 13.1%. Among these, 10 cases (33.3%) exhibited induration at the inoculation site, 2 cases (6.7%) had redness and swelling, and 1 case (3.3%) developed a skin rash. Regarding general symptoms, 10 cases (33.3%) experienced dizziness, 3 cases (10%) had diarrhea, 3 cases (10%) had a fever, and 1 case (3.3%) experienced nausea and vomiting. No other abnormal reactions were observed (**Table 1**).

Table 1. Adverse reactions of the novel coronavirus vaccine (Vero cells) vaccination

Adverse reactions	Number of cases	%
Induration at the inoculation site	10	33.3
Swelling	2	6.7
Rash	1	3.3
Dizziness	10	33.3
Diarrhea	3	10.0
Fever	3	10.0
Nausea and vomit	1	3.3

4. Adverse reaction prevention measures

4.1. Pre-vaccination prevention

Before administering the inactivated novel coronavirus vaccine, it is essential to identify individuals who are contraindicated for vaccination. These include (1) those who are allergic to the vaccine or its components; (2) individuals who have had severe allergic reactions to vaccines in the past; (3) those with uncontrolled epilepsy, encephalopathy, or other progressive neurological diseases; (4) individuals with fever, acute diseases, acute exacerbations of chronic diseases, or uncontrolled severe chronic diseases; and (5) pregnant individuals ^[7].

Additionally, it is important to thoroughly inquire about the recipient’s history of drug and other allergies, as well as their current health status. Recipients need to accurately report their recent physical condition, which should be documented in detail. Recipients should carefully read the injection instructions for the inactivated novel coronavirus vaccine (Vero cells) and sign the “Vaccination Informed Consent.”

For recipients with fever or other illnesses, vaccination should be postponed. After the cause is clarified and the symptoms have disappeared or the disease has recovered, a new appointment for vaccination can be made. If the recipient has recently received other vaccines, it is recommended that there be an interval of more than 14 days between those vaccines and the inactivated novel coronavirus vaccine (Vero cells) to avoid impacting the vaccine’s effectiveness. However, when rabies vaccine, tetanus vaccine, and immunoglobulin need to be administered due to animal injury or trauma, the vaccination interval with the novel coronavirus vaccine may not need to be considered ^[8].

4.2. Prevention during vaccination

4.2.1. Vaccines check

The vaccination site should assign full-time personnel to manage and maintain the cold chain, setting up a dedicated medical refrigerator for vaccines with a temperature range of 2°C–8°C. The refrigerator temperature should be strictly monitored every six hours during vaccination. Vaccines should be placed in batches within the medical refrigerator, ensuring they are not placed against the side wall of the refrigerator door. There should be a distance of 2–3 cm between the vaccines and the inner wall of the refrigerator ^[9].

Before use, the vaccine should be well shaken, and it should be checked for abnormalities such as clots that

cannot be dissolved, foreign objects, unclear labels, or cracks or failures in syringes or ampoules. Vaccination personnel must strictly adhere to operating procedures and guidelines. When opening vaccine ampoules and injecting vaccines, disinfectants should not contact the vaccines, and they should be used immediately after opening.

4.2.2. Inoculation method selection

The recommended route of inoculation is intramuscular injection, with the middle part of the deltoid muscle on the outer side of the upper arm being the best inoculation site. Intravenous injection of this vaccine is strictly prohibited. After inserting the needle, blood must be withdrawn to confirm intramuscular injection. When inoculating, use a cotton swab dipped in a small amount of alcohol to disinfect the thicker part of the deltoid muscle of the upper arm, wait for the skin to dry naturally, then insert the needle at a 90-degree angle. The depth should reach more than 2/3 of the needle. Slowly inject the vaccine when there is no blood return after aspiration. After the injection, quickly pull out the needle and instruct the recipient to press the injection site for 2 minutes.

4.2.3. Care during vaccination

Strictly implement the 3-inspections, 7-checks, and 1-verification process during inoculation:

- (1) 3-inspections: (a) Inspect the health status of the recipient and check for contraindications to vaccination; (b) Inspect the vaccination information and vaccination records; (c) Inspect the appearance, batch number, and expiration date of vaccines and syringes.
- (2) 7-checks: (a) Recipient name; (b) Recipient age; (c) Product name; (d) Product specification; (e) Vaccine dose; (f) Vaccination site; (g) Vaccination route.

Finally, the recipient or guardian should verify the name and expiration date of the vaccinated vaccine. Follow strict aseptic operation principles: draw 0.5 mL of liquid medicine with a 1 mL sterile syringe, expel air, and perform the injection according to the operational guidelines. Hand hygiene and disinfection must be carried out after each vaccination, complying with hand hygiene specifications for medical personnel.

Medical Waste Management: After vaccination, used syringes, cotton swabs, ampoules, and cartons should be treated as infectious medical waste, marked as medical waste for the novel coronavirus vaccination. Follow the relevant provisions of the “Medical Waste Management Regulations” for standardized disposal. It is strictly forbidden for inoculated recipients to take used cotton swabs out of the inoculation room ^[10].

Table 2 shows the inclusion and exclusion criteria for the prevention of adverse reactions to the novel coronavirus vaccine (Vero cells).

Table 2. Inclusion and exclusion criteria for the prevention of adverse reactions of the new crown vaccine (Vero cells)

Inclusion criteria
Clarify contraindications for vaccination
Confirm the health status of the vaccinated population
Vaccine cold chain management and maintenance
Strictly follow the procedure for vaccination
Nursing practices
Exclusion criteria
Rashes caused by the recipient’s skin problems, etc.
Allergic reactions to ingredients such as vaccines or allergic constitution in the past
The onset of various acute diseases or the onset of chronic diseases
Failure to protect the vaccination site according to health education

4.3. Observation and care after vaccination

4.3.1. Observation area preparation

- (1) Environmental preparation: Rest tables and chairs should be arranged in the observation area, accommodating approximately 100 people for observation. Hot water and food should be provided to avoid confusion between hypoglycemia reactions and adverse reactions to vaccination. Ensure the observation area has a spacious environment with fresh air. Recipients should strictly wear masks, sit at intervals, and avoid gatherings. Health education sessions should be conducted for recipients, covering post-vaccination precautions, health observation, advice, and contact information.
- (2) First-aid equipment and medicine preparation: The observation area should be equipped with first-aid stations, first-aid equipment, and medicines. An observation and disposal area for suspected abnormal reactions should be set up adjacent to the observation area. Prepare emergency medicines according to the relevant documents of the National Health Commission, such as epinephrine hydrochloride injection, norepinephrine bitartrate injection, diazepam injection, etc. First-aid equipment includes defibrillators, simple respirators, endotracheal intubation kits, ECG monitors, and negative pressure suction devices. Regularly check the equipment to ensure normal operation and verify the packaging and expiry date of rescue medicines and supplies ^[11]. The vaccination unit should have “four essentials”: emergency personnel, first-aid equipment and medicines, 120 ambulances, and green channels for treatment. Adequate preparations should be made for severe adverse reactions such as anaphylactic shock.

4.3.2. Observation after vaccination

After inoculation, recipients should remain in the observation room for 30 minutes. They should pay attention to any abnormal reactions such as acute allergic reactions, febrile convulsions, hypotensive shock, etc. If no abnormal reaction occurs, recipients can scan the QR code to leave. For local adverse reactions, provide health education to patients.

Emergency principles for suspected abnormal vaccination reactions: Early identification and early treatment are crucial. Promptly identify severe allergic reactions and provide immediate treatment. Detect respiratory and circulatory instability early. Recognize symptoms or signs of other serious illnesses such as asthma, confusion, collapse, loss of consciousness, and incontinence. In cases of anaphylaxis, shock, or cardiac arrest, immediately perform chest compressions and administer epinephrine 0.3–0.5 mg as directed by a doctor. Repeat every 15–20 minutes and administer antihistamines or steroids. Critically ill patients should be transferred to the nearest hospital with treatment capabilities for follow-up rescue treatment as soon as possible.

4.4. Health guideline

Recipients should be reminded to pay attention to their physical condition after returning home and ensure proper rest. They should drink plenty of water and avoid scratching the injection site to prevent skin irritation and infection. Additionally, recipients should avoid excessive movement of the vaccinated arm to prevent sweat from irritating the site. Individuals with known allergens should avoid contact to prevent allergic reactions. In daily life, maintain a healthy diet, drink plenty of water, and avoid spicy, seafood, and alcoholic products. Recipients should be informed about possible local reactions such as fever, redness, swelling, and induration at the injection site.

For lactating women: Lactation is not a contraindication for vaccination. Considering the importance of breastfeeding to infant nutrition and health, breastfeeding women are encouraged to continue breastfeeding after receiving the novel coronavirus vaccine. The antibodies present in breast milk have strong neutralizing abilities, which may provide potential protection to breastfeeding infants ^[7].

For women of childbearing age: If a woman becomes pregnant after vaccination or is vaccinated without knowing she is pregnant, she should be informed about the vaccine's safety. It is not recommended to take special medical measures (such as termination of pregnancy) solely because of vaccination against the novel coronavirus. Instead, she should undergo pregnancy examinations and follow-up care. For women planning to conceive, there is no need to delay pregnancy solely because of the inactivated vaccine (Vero cells) against the novel coronavirus [8].

5. Nursing care of adverse reactions after vaccination

5.1. Local reactions

Based on routine vaccination experience, pain, induration, swelling, and redness may occur at the vaccination site after inoculation. These adverse reactions are typically mild and do not usually require special treatment, often resolving within 2–3 days. The incidence of infection at the vaccination site is low.

- (1) Local skin flush after inoculation: Typically appears within 12–24 hours and subsides within 48–72 hours.
- (2) Pain and tenderness: Usually manifest within 12–24 hours and subside within 48 hours to 7 days.
- (3) Swollen lymph nodes: These may last from 24 hours to 1–2 weeks or longer before subsiding on their own.
- (4) Induration: May persist for 7 days to 2–3 months.

For local redness, swelling, and induration with a diameter of less than 15 mm at the inoculation site, generally, no treatment is necessary. If the diameter of redness and induration is between 15–30 mm, applying a cold compress with a clean towel can help. Cold compresses can constrict local blood vessels, reduce permeability, alleviate local congestion, and mitigate or eliminate redness and swelling caused by vaccination [12]. Those experiencing induration can apply local hot compresses 2–3 times a day for 10–15 minutes each time. They should also avoid excessive physical activity involving the injected limbs, prevent impacts to the injection site, and keep the area dry. For local reactions with redness, swelling, and induration exceeding 30 mm in diameter, or if recipients experience diarrhea, nausea, or vomiting that cannot be self-relieved, prompt medical attention should be sought.

5.2. Systemic symptoms

Following vaccination, recipients may experience mild discomfort such as fever, fatigue, diarrhea, nausea, or general malaise, which typically resolves without specific treatment.

- (1) Fever: Body temperature elevation usually occurs 5–6 hours or 24 hours post-vaccination and typically resolves within 1–2 days, rarely lasting more than three days.
- (2) Dizziness, headache, fatigue, general malaise: These symptoms generally subside within 1–2 days.
- (3) Gastrointestinal symptoms: Nausea, vomiting, abdominal pain, or diarrhea typically resolve within 1–2 days.

If the recipient's body temperature is $\leq 37.5^{\circ}\text{C}$, increased observation, proper rest, adequate hydration, and regular temperature monitoring are recommended to prevent other illnesses. Seek medical attention promptly if symptoms persist. If the recipient's body temperature exceeds 38.5°C , physical cooling measures should be taken, and appropriate antipyretic drugs may be administered based on the individual's condition. Persistent high fever warrants further medical examination.

For dizziness, bed rest is advisable to prevent injury from falls. Adequate hydration is essential to address diarrhea and prevent dehydration, and a bland diet is recommended to avoid stimulating the gastrointestinal

tract with spicy foods.

Recipients experiencing multiple systemic symptoms or symptoms that do not resolve on their own should seek medical attention promptly. Suspected allergic reactions may include:

- (1) Skin symptoms such as itching of hands, feet, palms, scalp, or generalized flushing.
- (2) Respiratory symptoms such as dyspnea, cyanosis, or hoarseness.
- (3) Manifestations of shock such as incontinence, clammy skin, or a drop in blood pressure.
- (4) Alarming signs like difficulty breathing, loss of carotid pulse, or loss of consciousness.

5.3. Psychological support

Recipients experiencing adverse reactions post-vaccination often have concerns about the vaccine's safety, given its recent launch. It is important to address recipients' emotions and actively respond to their questions regarding adverse reactions, providing clear explanations to alleviate their concerns. By understanding the causes of adverse reactions, recipients' anxiety can be reduced. Engage in open communication with recipients based on their symptoms to lighten their psychological burden during treatment^[13].

6. Discussion

The primary component of the novel coronavirus inactivated vaccine (Vero cells) is the inactivated virus itself^[5]. This vaccine stimulates the body to produce immunity against the novel coronavirus, thus preventing diseases caused by the virus. Moreover, the protective efficacy of the new coronavirus-inactivated vaccine (Vero cells) is reported to be 79%. Ongoing observation and research are being conducted to understand its role in preventing infection, pathogenesis, and transmission, as well as the duration and extent of its protection in the population.

The occurrence of adverse reactions following vaccination may be attributed to various factors, including the recipients' physical health, vaccine storage and transportation conditions, vaccine quality, administration technique, and medical staff's proficiency during vaccination^[14]. Therefore, it is essential to conduct thorough health assessments of adults before vaccination, ensure proper vaccination site selection, adhere to stringent inspection and verification protocols, standardize operational procedures, and provide comprehensive post-vaccination health education. By implementing these nursing and preventive measures, the occurrence of adverse reactions can be effectively minimized. A proactive approach is required for the subsequent vaccination of both elderly and young individuals, with efforts aimed at ensuring the safety and efficacy of the vaccination process.

Disclosure statement

The authors declare no conflict of interest.

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