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Chicken egg allergy and vaccination – modern approaches

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ABSTRACT

Introduction: The study examined how people with chicken egg allergies react to vaccines that contain egg-derived components.

Aim: The purpose of the study was to determine the reaction of an organism with hypersensitivity to a chicken egg to immunisation of the body with drugs that contain this allergen.

Material and methods: To achieve this goal, vaccines against measles, mumps, rubella, influenza, chickenpox, rabies, and yellow fever were analysed.

Results and discussion: It was determined that these patients did not have an allergic reaction, since the finished vaccines have minimal remnants of chicken egg elements that cannot cause hypersensitivity, but it is worth noting that such vaccination should be carried out in a hospital setting. Immunisation against diseases such as influenza and chickenpox is a safe method of disease prevention. After vaccination against measles, mumps, and rubella, only 2 of them after the procedure had clinical signs of developing allergies, in the form of lacrimation, sneezing, and allergic rhinitis, which was 3.5%. Rabies, yellow fever, and chickenpox vaccines can cause allergies, so an alternative vaccination should be used in this case. It was determined that hypersensitivity of the body to chicken eggs is not a contraindication to vaccination against measles, mumps, rubella, influenza.

Conclusions: Immunisation of the body is safe, even in the case of a previous anaphylactic complication in contact with an allergen in humans, because the finished preparation contains only the remains of a chicken egg, which are not able to cause a full-fledged allergic reaction.

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1. INTRODUCTION

The importance of vaccination has become increasingly critical due to several contemporary challenges. The rise in allergic reactions, particularly food allergies, has raised concerns about vaccine safety, making it essential to develop alternative formulations and ensure accurate risk assessments. Additionally, the widespread dissemination of misinformation about vaccines, fueled by social media and unverified sources, has led to vaccine hesitancy and a decline in immunisation rates. This, in turn, contributes to the resurgence of preventable infectious diseases, posing a significant public health threat. As global mobility increases, the rapid spread of contagious diseases across borders further highlights the necessity of maintaining high vaccination coverage. Addressing these challenges requires not only medical advancements in vaccine composition but also effective public education and policy measures to counter misinformation and reinforce the benefits of immunisation.

An allergic reaction to chicken eggs can be of varying severity, from mild to severe. This creates special risks during vaccination, as some vaccines are made with chicken eggs or contain their residues. Because of this, people with such an allergy may experience adverse reactions during vaccination. At the same time, the lack of immunization against diseases such as measles, rubella, mumps, chickenpox, yellow fever, and rabies significantly increases the likelihood of developing severe complications. Although vaccination can cause allergic reactions, including potentially dangerous ones such as anaphylaxis, timely medical care significantly reduces the risk of serious consequences. Therefore, patients with egg allergy require careful monitoring and preliminary examination before vaccination. Given the existing danger, vaccines that are created using a chicken egg were strictly contraindicated in patients with allergies to the components of immunisation products.

Abrams et al.[1] noted that measles, mumps, and rubella, as well as influenza vaccines, are safe and can be used without prior skin allergy testing. It was also pointed out that chickenpox vaccines can theoretically cause an allergic reaction, so during vaccination, the patient should be monitored for another 30 minutes after immunisation. Vaccination against rabies and yellow fever is carried out with alternative vaccines and requires observation and a preliminary allergy test.

Analysis of the yellow fever vaccine was performed by García-Paba et al.,[2] the researchers noted that patients who had a history of chicken egg allergy, but who never showed signs of an anaphylactic reaction, were vaccinated without complications, although they had food hypersensitivity. And patients who had manifestations of Quincke's oedema or anaphylactic shock had clinical manifestations of allergy. Therefore, it is always necessary to monitor the medical history of patients for the entire period of life. The same issue was analysed by Cunha et al.[3] The researchers noted that the problem of vaccinating patients with allergies to the components of immunisation products can lead to the spread of infectious diseases and their complications. Research conducted by Yılmazbaş et al.[4] confirms information about the safety of vaccination of patients against measles, mumps, and rubella. The researchers noted that when analysing the anamnestic data of 61 patients who were found to be allergic to eggs and vaccinated, none of them showed allergic reactions and manifestations of life-threatening complications. Vaccination against influenza virus in children was investigated by Gruenberg and Shaker.[5] The researchers noted that vaccination approaches do not require preliminary skin allergy tests, since the body's immunisation agent does not cause signs of anaphylaxis and is safe for patients with chicken egg allergy.

Manifestations of allergic reactions to the yellow fever vaccine were investigated by Lopes et al.,[6] the researchers determined that the probability of the occurrence of anaphylactic shock in patients with egg hypersensitivity is 1.29%. Of all the studied individuals (435), only 1 had an allergic reaction, while the rest either did not have one at all or had a minimal and non-life-threatening reaction. Therefore, it can be noted that the yellow fever vaccine contains a minimal amount of egg product residues, which rarely causes serious complications. However, immunisation should be carried out under the supervision of a doctor and on an outpatient basis, and it is also necessary to monitor the patient after vaccination for 30 minutes to quickly stop possible body reactions.

The issue of determining the presence of an allergy for further safe vaccination from an early age was investigated by Simão Coelho et al.[7] The researchers noted that in order to protect a child from undesirable complications of immunisation, it is necessary to respond in time to changes in health status during the first year of life. Complications can only be reduced or minimised by preventing them. Therefore, parents should contact an allergist from an early age in case of minimal signs of allergies. This protects them from further diseases and reactions, including vaccination. The issue of vaccination against measles, mumps and rubella was analysed by Magistà et al.[8] The researchers noted that vaccination during the first year of life is extremely important, and its absence can lead to deaths and serious complications. The researchers conducted a study in which it was determined that the vaccine is safe for patients with egg allergies, so it is not necessary to refuse people with this type of hypersensitivity, and if necessary, conduct skin tests before vaccination and conduct constant monitoring of the patient during the day. During the analysis of already available studies, it was determined that the issue of using analogues of vaccines with a component in the form of a chicken egg was not sufficiently investigated, because it is important not only to identify dangerous vaccines, but also to find a solution to the problem of immunisation.

2. AIM

The purpose of the study was to systematise and analyse various reactions of the body to vaccination, which contains an allergen in the form of a chicken egg or its residues. The objective of the study was to analyse the mechanisms of al-

lergic reactions to chicken egg and its components, and systematise the body's reactions to available vaccines and their safety.

3. MATERIAL AND METHODS

The study analysed the available results of previous studies on chicken egg allergy during vaccination against measles, mumps, rubella, chickenpox, yellow fever, and influenza over the past 5 years (2019–2024). The mechanism of action of the occurrence of an emergency condition with the action of immunoglobulin E is also systematised and analysed. The research papers were selected from such sources as Scopus, Web of Science, and Researchgate, published in Ukrainian and English. The results of the studies were also systematised and summarised and compared with each other, which gave a better understanding of the mechanisms of allergy action. During the study, official sources were used. When selecting publications, the following keywords in English were used: 'allergy,' 'immunoglobulin,' 'chicken egg,' 'vaccination,' 'acute conditions,' 'anaphylactic shock.' After the source was selected and the abstract and keywords were studied, a full analysis of all sections was carried out and the available information was summarised. The authors made an in-depth analysis of 26 modern sources, examining each chapter and research detail. At the same time, they briefly analysed 4 older sources, paying attention only to the main conclusions. The researchers analysed additional materials from the sources, such as graphs and tables, which helped to better understand the mechanisms of allergic processes in the body. Two key figures were included in the study (Figure 1 and Figure 2), the main source for which was the scientific article number [9] in the list of references. These visuals provided important additional information about the biological mechanisms of allergic reactions. The percentage ratios of the results obtained in different sources were compared and the most informative data were identified, which were included in the study and systematised. Based on the studied sources, a conclusion was made about the safety of vaccination against measles, mumps, rubella, chickenpox, yellow fever, and flu in the presence of allergies to chicken eggs. The statistical data of the research results was the percentage of people with allergies who had manifestations of health problems after vaccination and those patients who were successfully vaccinated. It was also considered that the researchers observed patients who in the past had cases of anaphylactic shock from the ingestion of a chicken egg allergen in the body, which significantly increased the risk of an emergency in humans.

It is also worth noting that the materials were selected in such a way that the researchers analysed either vaccination against one disease separately or among several. Preference was given to studies conducted over the past 5 years to more accurately understand the safety situation of vaccination of people with allergies as of 2024.

The study has several limitations that should be considered when interpreting the results. The research is based on a review of existing studies from selected databases, which may introduce selection bias and limit the generalisability of the findings. The analysis focused on sources published in English and Ukrainian, potentially excluding relevant data from other languages. Additionally, while the study systematises allergic reactions to vaccines containing chicken egg components, individual immune responses may vary, and the findings may not fully account for rare or undocumented cases of severe hypersensitivity. The reliance on secondary data limits the ability to verify the accuracy and consistency of reported results, and differences in study methodologies could affect the comparability of findings.

4. RESULTS AND DISCUSSION

4.1. Body reaction with chicken egg allergy when vaccinated against measles, mumps, rubella, chickenpox, yellow fever, and flu

During the study, vaccines against measles, mumps and rubella, influenza, chickenpox, and yellow fever were analysed. They are created based on chicken eggs. However, the risk of allergic reactions in people with hypersensitivity to this component varies as a percentage, because the human body is specific.

Vaccination can lead to a risk of developing a type I anaphylactic reaction and hypersensitivity, which is manifested by difficulty breathing, upper respiratory tract edema, lacrimation, frequent sneezing, redness of the skin, itching and rashes. In severe cases, anaphylaxis can cause a sharp drop in blood pressure, tachycardia, bronchial spasm, and laryngeal edema, leading to critical hypoxia. Without timely medical care, including the administration of epinephrine, antihistamines, and support for respiratory function, this condition can be fatal. Therefore, after vaccination, it is important to carefully observe the patient for at least 30 minutes, especially if there is a history of allergic reactions, and medical staff should be prepared to provide emergency care.

Allergic reactions can manifest as lacrimation, sneezing, urticaria, redness of skin areas, upper respiratory tract spasm, which can lead to hypoxia and endanger the patient's life. The main mechanism of occurrence of an allergic reaction of the first type is associated with the action of IgE, which is also called anaphylactic, which belongs to the category of humoral type, because the main link in their development is B-lymphocytes and allergic antibodies. Symptoms also include allergic rhinitis and itchy skin (Figure 1).[9] However, not all clinical signs of allergy are always detected immediately and may have their own frequency.[10,11] The most dangerous reactions of the body are anaphylactic shock and Quincke's oedema, because there is swelling of the upper respiratory tract and the supply of air to vital organs decreases, or may even stop in the absence of medical care, which directly threatens the patient's life (Figure 2). Considering all the above-mentioned complications of an allergic reaction, it is worth noting that a person who is allergic to chicken eggs should avoid entering the aller-

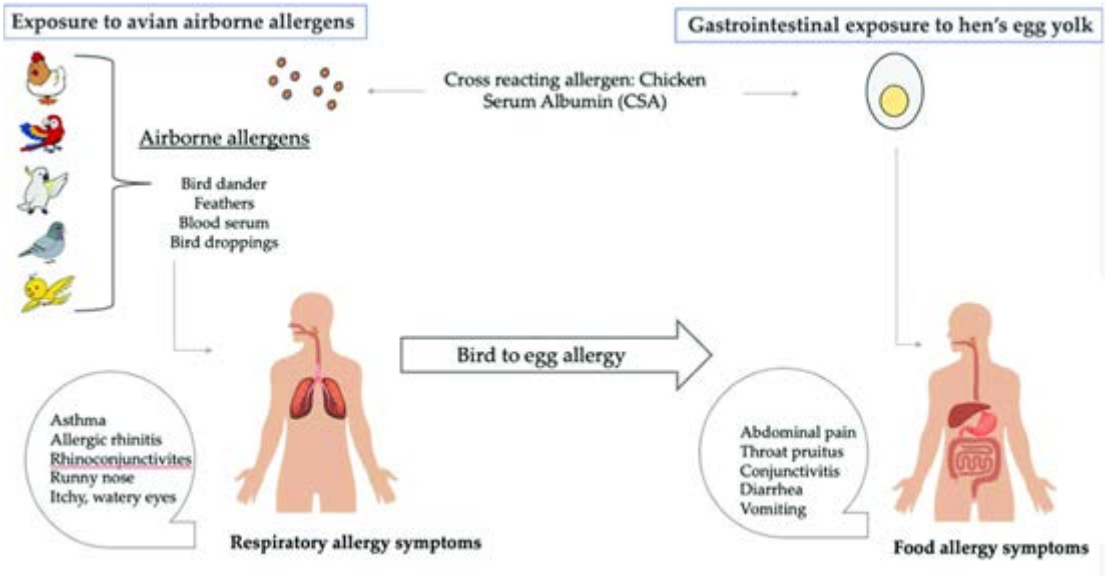

Figure 1. Mechanism of occurrence of allergy to chicken egg.[9]

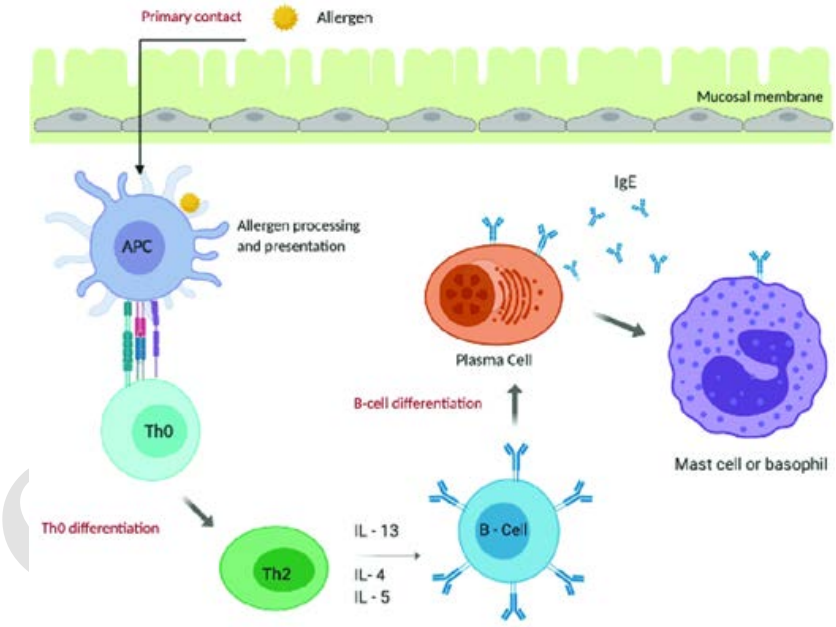

Figure 2. Molecular mechanism of occurrence of allergic reactions.[9]

gen into the body, regardless of the route of administration. Therefore, the issue of vaccination, where the component is a chicken egg, is difficult for such patients.

It is also worth noting that vaccination against mumps and measles is safe and does not require a preliminary skin test, because it is safe for the life and health of patients. It is worth adding that the human body is specific for each patient, so vaccination should be carried out in healthcare institutions so that medical professionals can immediately stop the slightest manifestations of allergies.[12] Vaccination should not be delayed, especially in childhood. Failure to follow the vaccination calendar can lead to a decrease in the immune system's response in the future, and complications in the event of illness. Measles, mumps, and rubella are diseases that can have serious health consequences. Measles, mumps, and rubella are infectious diseases that can lead to a range of complications beyond their initial symptoms. Measles, for instance, can result in severe complications such as pneumonia, which is one of the most common causes of death associated with the disease. It can also lead to encephalitis, an inflammation of the brain that may result in permanent neurological damage. Additionally, measles can cause diarrhea, ear infections, and vision problems due to corneal scarring. In rare cases, it can lead to a fatal condition known as subacute sclerosing panencephalitis, which typically occurs years after the initial infection.

Mumps, primarily known for causing swelling of the salivary glands, can also lead to more serious complications. In men, mumps may cause orchitis, an inflammation of the testes that can result in infertility if both testes are affected.

Mumps can also lead to meningitis, an infection of the protective membranes surrounding the brain and spinal cord, and hearing loss, which can be permanent in some cases. Additionally, in rare instances, mumps can cause pancreatitis and encephalitis. Rubella, apart from its well-known effect on the developing fetus, where it can lead to congenital rubella syndrome causing heart defects, deafness, and cataracts, can also cause complications in adults. These include joint pain and swelling, particularly in women, and in severe cases, it can lead to encephalitis. Additionally, rubella can cause a transient low platelet count, leading to a condition known as thrombocytopenia, which can result in bleeding or bruising. It is important to get vaccinated against these diseases to protect oneself and others from their negative effects. Vaccination is important to prevent flu. This helps to reduce the risk of serious complications that can be particularly dangerous for certain populations, such as people with weak immune systems, the elderly, children, and pregnant women. It is recommended to get a flu shot every year for everyone, starting from childhood.[13]

4.2. Individual approach to vaccination: risk assessment and selection of alternative vaccines

The risk of allergic reactions during vaccination in patients with egg allergy is an important topic for discussion, as a misunderstanding of this problem can lead to refusal of vaccination. Not all vaccines contain eggs or their components, and having an egg allergy is not an absolute contraindication to vaccination. An allergy to eggs, in particular to chicken egg white, can cause allergic reactions in the body, but only if the vaccine contains this component. Many modern vaccines use technologies that eliminate the need for egg components, which allows for safe vaccination of patients with such allergies.[14,15] It is important that healthcare providers inform patients about these nuances, helping them to distinguish between food allergies and vaccine components. If an egg allergy is confirmed, the doctor may suggest alternative vaccination options that minimize the risks to the patient.

Health care providers play a critical role in ensuring safe vaccination for patients with egg allergy. Consultation with an allergist is an important step in identifying potential risks and determining the safest way to vaccinate for each patient.[16] An allergist can conduct a detailed assessment of a patient's condition, determine if they are allergic to specific components of vaccines, and make recommendations for the most appropriate vaccines. It is important that doctors ensure that patients are appropriately monitored before, during, and after vaccination, especially for those with a history of serious allergic reactions to eggs. As allergic reactions can be severe, consultation with an allergist and sensitivity testing is an important part of the vaccination process to reduce risks and ensure patients receive the level of protection they need.

The choice of alternative vaccines that do not contain egg components is one of the main aspects of safe vaccination of patients with egg allergy. Many modern vaccines do not use egg proteins in their composition, which allows for safe vaccination of patients with egg allergy. Physicians should be aware of all available vaccine options and be able to choose the safest vaccine for each patient. For example, inactivated vaccines or vaccines produced using recombinant technology do not contain egg components and are safe for people with egg allergies. It is important to remember that not all vaccines can be replaced, so the doctor must know exactly which vaccines have the appropriate composition and do not cause allergic reactions. Timely and accurate choice of vaccine can not only reduce risks but also ensure proper immunization effectiveness.[17]

The psychological aspect of vaccination is no less important, as many patients may have fears or misunderstandings about the safety of vaccination, especially if they are allergic to eggs. Warnings and concerns about possible side effects often become an obstacle to timely vaccination. Healthcare providers should actively communicate with patients, explaining that vaccination is essential to prevent serious infectious diseases, even in patients with egg allergies.[18] Doctors should use clear, evidence-based explanations to allay the fears of patients and their families, emphasizing the importance of vaccination for overall health. It is also important to provide support to patients at every stage of the vaccination process, ensuring that they understand that their individual needs and allergic reactions will be taken into account. This will help to reduce stress and anxiety, as well as increase trust in healthcare providers and the vaccination process in general.

An egg allergy is not an absolute contraindication to vaccination, as modern vaccines often do not contain egg components, which allows for safe vaccination of such patients. The role of an allergist in the vaccination process is critical, as they can assess the risks, conduct the necessary tests, and recommend alternative vaccines that reduce the potential risks of allergic reactions. Psychological support for patients is also important, as fears and misunderstandings about the safety of vaccination can be an obstacle to timely vaccination. Overall, the appropriate choice of vaccines, consultation with an allergist, and active communication with patients can ensure effective and safe vaccination for people with egg allergy, which is an important part of health care and infectious disease prevention.

4.3. Safety of vaccination for patients with egg allergy: risks and alternative vaccines

During the study, it was determined that flu vaccination in people with chicken egg allergies is safe and recommended for carrying out. This was also highlighted by Tozandehjani et al.[19] The researchers noted that the risk of an allergic reaction is 0.001%, so it is safe and necessary to prevent the occurrence of the disease and its spread. The analysis of the influenza vaccine in childhood was carried out by Shimizu et al.[20] The researchers pointed out the safety of immunisation, this statement can be agreed with, but it is worth noting that in order to reduce the risk of anaphylaxis, skin

allergy tests can be performed, which will help to determine the presence or absence of an allergy to a chicken egg.

Vaccines against measles, mumps, and rubella were analysed by Elitok et al.[21] The researchers noted that the risk of a severe allergic reaction is less than 0.001%, so the immunisation process is considered safe for people with egg allergies. However, it is worth noting that the researchers did not consider the specificity of each organism and the possibility of hypersensitivity to the components and the presence of cross-allergy, and sensitivity to other allergens, especially if there are several of them. In addition, the analysis of this vaccine was carried out by Chow et al.[22] Their study revealed the safety and introduction of measles, mumps, and rubella vaccines into the routine vaccination calendar, even if a person is allergic to chicken eggs, which puts at risk people who cannot be vaccinated due to medical contraindications, such as infants, pregnant women, and people with weakened immune systems.

Consultation with an allergist is important in the process of vaccinating patients with egg allergies. Allergists have the expertise to evaluate individual allergy profiles, recommend appropriate vaccine options, and safely administer vaccines in a controlled environment. In cases of IgE-mediated chicken egg allergy, allergists can ensure that emergency facilities are available to quickly treat potential allergic reactions.[23] By engaging allergists to vaccinate patients with egg allergies, health professionals can improve the safety and effectiveness of immunisation, considering individual needs and minimising the risks associated with allergen exposure during vaccination. The role of the allergist includes providing individual advice on vaccination options for people with egg allergies, providing guidance on the treatment of allergic reactions during and after vaccination, providing access to emergency medical care facilities in the event of severe allergic reactions, working closely with the allergist, health professionals can improve the quality of care for patients with egg allergies and promote the safe administration of vaccines to protect against infectious diseases.[24–26] It is important for health professionals to know about the patient's allergic status and the components of the vaccines administered. During the vaccination process, a healthcare professional should conduct a thorough assessment of the patient's medical history, including any allergies, choose vaccines that are safe for people with egg allergies, and carefully monitor the patient for any signs of allergic reactions during and after vaccination, and also be prepared for rapid and effective treatment of allergic reactions.

Before starting vaccination, certain studies are required to confirm the suitability and safety of vaccination for people with allergies. These pre-vaccination assessments are important for determining a patient's suitability for vaccination and may include: allergy tests to detect specific allergens, including chicken egg protein, assessment of the severity of an allergic reaction to chicken eggs, consultation with an allergist or immunologist to assess the risk of allergic reactions during vaccination, review of the patient's medical history to identify previous adverse reactions to vaccines or allergens. These studies help doctors make informed decisions about the type of vaccines that can be safely administered to patients with egg allergies, ensuring their well-being and safety during the vaccination process.[27,28]

Sticking to a vaccination schedule is crucial to prevent the spread of highly contagious diseases. The national calendar of preventive vaccinations defines mandatory preventive vaccinations against diseases such as measles, mumps, rubella, tetanus, and tuberculosis. By sticking to this schedule, people are not only protecting themselves, but also contributing to a broader public health initiative to reduce transmission of these infectious diseases. Failure to comply with the vaccination schedule can lead to outbreaks and epidemics, creating a significant threat to the health and well-being of the population, which significantly worsens the epidemiological situation in society.[29] Adherence to a vaccination schedule is essential to protect vulnerable populations, such as infants and people with weakened immune systems. Children and adults without appropriate vaccinations are particularly susceptible to serious diseases. By ensuring that these vulnerable groups are vaccinated in a timely manner according to the recommended schedule, the community can create a protective shield around those at the highest risk. Vaccinating vulnerable groups not only preserves their health, but also prevents the potential spread of diseases to others in society.[30] One of the main reasons for following the vaccination calendar is to achieve collective immunity and eliminate deadly diseases among the population. Maintaining vaccination coverage for at least 95% of the population helps to establish collective immunity, which provides protection for those who cannot be vaccinated for medical reasons. By creating a shield of immunity around vulnerable individuals, the community can effectively prevent the resurgence of eradicated diseases and ensure overall health and safety.[31] Compliance with the vaccination schedule not only protects individuals, but also contributes to the common good of society, eliminating the threat of deadly diseases through collective immunity.

After analysing all aspects of vaccination in patients with egg allergies, it can be concluded that the measles, mumps, and rubella vaccine is safe for such individuals and does not require special precautions. Influenza vaccination is also considered safe, with no significant allergic reactions reported, making it suitable for both children and adults with egg allergies. However, for rabies and chickenpox vaccines, a preliminary skin test and allergy assessment are recommended, followed by close monitoring for at least 12 h post-vaccination. Patients requiring immunisation against yellow fever should undergo prior desensitisation or be offered alternative vaccines to minimise the risk of anaphylaxis. Medical professionals should conduct a thorough allergy history before vaccination, perform necessary pre-vaccination tests where indicated, and ensure emergency preparedness in cases where allergic reactions are possible. Individualised vaccination plans should be developed in consultation with allergists to ensure both the safety and effectiveness of immunisation in patients with egg allergies.

6. CONCLUSIONS

1. Most vaccines containing egg-derived components are safe for people with chicken egg allergies, as they contain minimal remnants that are unlikely to trigger severe hypersensitivity reactions.
2. It was also analysed that chicken protein allergy during vaccination belongs to type 1 allergic conditions, where the main mechanism of action is immunoglobulin E, which causes symptoms of an allergic emergency.
3. Only 3.5% of patients showed mild allergic reactions (lacrimation, sneezing, rhinitis) after vaccination of measles, mumps, and rubella.
4. Measles, mumps, rubella, and influenza vaccines are safe for people with egg allergies and don't require prior allergy testing.
5. Rabies, yellow fever, and chickenpox vaccines require more caution – alternative vaccines or additional testing/monitoring may be needed.
6. Hospital-based vaccination is recommended for egg-allergic patients to ensure proper monitoring and quick response to reactions.
7. Even patients with previous anaphylactic reactions to eggs can safely receive most vaccines, as the egg protein content is too minimal to trigger severe reactions.

Conflict of interest

Author declares no competing interest.

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