

Methods of Diagnosing Immunodeficiency in Adolescents

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Abstract

Immunodeficiency disorders in adolescents represent a complex and multifaceted challenge in clinical practice. A timely and accurate diagnosis is crucial for appropriate management and improved patient outcomes. This review paper comprehensively examines the methods employed in diagnosing immunodeficiency disorders in adolescents. We explore clinical assessments, laboratory tests, genetic analyses, imaging techniques, and functional assays, highlighting their respective advantages and disadvantages. A critical understanding of these diagnostic approaches equips healthcare professionals with valuable tools to enhance the healthcare of adolescents with immunodeficiency disorders. Furthermore, some systems for diagnosing diseases that affect immunity are explained.

Keywords: Immunodeficiency Disorders, Adolescents, Diagnosis Methods, Clinical Assessments Disease Diagnosis, Immunity Diseases.

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Introduction

Immunodeficiency disorders in adolescents have gained increasing recognition due to their impact on the overall health and well-being of this vulnerable population. Adolescence represents a critical phase of development during which the immune system undergoes unique changes. Consequently, identifying immunodeficiency disorders in this age group presents distinct challenges. Early diagnosis is pivotal for delivering appropriate interventions and Severe individual psychological suffering brought on by a child's inability to develop an integrated sense of self is known as adolescent disorder. It happens in the latter stages of youth and is marked by emotions of doubt and discomfort brought on by long-term concerns and ambitions, or by problems with behavior, morals, and religious identity. ensuring optimal patient outcomes (Giovanelli et al., 2023; Ai & Tan, 2023; Gelfand, 2018).

Teenage headaches are a pretty frequent ailment. Although parents are typically concerned when their children get headaches, the majority of these headaches are caused by benign conditions like migraines. It was found in the studies that primary school students occasionally have headaches. Throughout adolescence, this rate rises even more. Migraines might start in elementary school and become more frequent as you get older. Studies have shown that adolescents experience roughly 20% of migraines. Migraine is the most typical cause of headaches in children. Children typically have migraine discomfort on both sides of the brain, and they often have trouble expressing where the headache is exactly (Ghandour et al., 2004; Gelfand et al., 2023).

This review paper delves into the various methods available for diagnosing immunodeficiency disorders in adolescents, shedding light on their strengths and limitations. By exploring the diagnostic landscape, we aim to equip healthcare practitioners and researchers with a comprehensive understanding of the tools at their disposal, facilitating improved patient care

and outcomes. We also explore some related systems in the diagnosis of diseases that affect immunity.

Related work

Some of the related systems in the diagnosis of the diseases that affect immunity are:

In (Burns et al., 2023), they create EHR-based models using machine learning to predict incident HIV diagnosis as a stand-in for PrEP candidacy. To train the algorithm to predict incidental HIV diagnoses between September 2016 and August of this year, they included patients from a southern medical system with interactions between October 2014 and August 2016. 74 EHR data points were collected as possible predictors. They evaluated achievement overall and among women using the measurement of the area under the receiver operating characteristic curve (AUROC) and the area according to the accuracy recall curve (AUPRC), and they contrasted the XGBoost (extreme gradient boosting) against the least absolute shrinkage selection operator (LASSO) logistic regression models.

In (IRF4, 2023), IRF4 is a transcription factor that is essential for the growth of the immune system, particularly B and T cells. The p.T95R recurrent heterozygous mutation in IRF4 was found to be present in seven patients from six families who had combined immunodeficiency. IRF4T95R patients and knock-in mice with the same point mutation had problems with their B cells, such as not being able to make enough antibodies and not being able to differentiate properly, but their IRF4 levels were normal.... When B cells that express IRF4T95R changed the way they bind to DNA, they stopped binding to normal interferon-stimulated response elements and started binding in non-normal places. This meant that they couldn't make genes that were needed for plasma cell development. They identified a previously unidentified immunodeficiency caused by an IRF4 mutation that results in clear changes in its activity.

To determine the etiology of a series of serious pneumonia cases that had received bronchoalveolar drainage between the end of 2010 and the beginning of 2021 at West Chinese Hospital, a review of the data was conducted. Using machine learning algorithms such as Logistic Regression, Extreme Gradient Boosting, Random Forest (RF), and LightGBM, four diagnostic models for PCP were developed. Area under the receiver operating characteristic curve (AUC), a measurement of model performance (Li et al., 2023).

In (Li et al., 2023). This study sought to develop a new method for quickly identifying common infections in patients with suspected sepsis and assess its potential for clinical use. Multiple-PCR testing was created to concurrently increase specific conserved parts of 9 common pathogenic bacteria in sepsis, such as the following: *Acinetobacter baumannii*, *E. coli*, pneumonia-causing bacteria *Klebsiella pneumoniae*, *P. aeruginosa*, a strain of *Enterococcus faecalis*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, and *Candida albicans*. Membrane biochips were used to examine the PCR products. In a series of dilutions of simulated clinical samples at various doses, the analytical sensitivity of the test was established at a range of 5–100 copies/reaction for each standard strain, and the detection range was 20–200 cfu/reaction.

Methods

This section examines adolescent immunodeficiency diagnostic methods and its advantages and downsides.

Clinical Assessment

Assessment and physical examination are crucial for identifying immunodeficiency. They detect clinical signs including repeated infections, lymphadenopathy, and poor development. Low cost and accessibility are benefits. Clinical evaluation may not be precise enough to diagnose, therefore it may be missed.

Laboratory Tests

Complete blood count (CBC), immunoglobulin levels, and lymphocyte subsets provide quantitative insights into the immune system (3.2). Objectivity and abnormality detection are their strengths. Inconclusive testing may need clinical interpretation.

Genetic Testing

Essential for detecting hereditary immunodeficiency problems. It confirms diagnosis and guides therapy. However, genetic testing costs and availability might restrict it. Not all immunodeficiency illnesses have genetic markers.

Imaging and Biopsy

CT scans and MRI may detect structural abnormalities, assisting in diagnosing immunodeficiency disorders. Histology is revealed via tissue biopsies. These procedures are useful but intrusive, expose teenagers to radiation, and may not always diagnose.

Functional Testing

DTH and lymphocyte proliferation assays evaluate immune system function. They reveal cellular reactions but need resources and specialized facilities.

Specialized Tests

For focused diagnosis, immunodeficiency-specific testing are helpful. Their availability and application under certain situations restrict them.

Results and Discussion

Comparisons are in Table 1.

Table 1. Summarizes the Advantages and Disadvantages of Various Diagnostic Methods for Immunodeficiency Disorders in Adolescents.

Diagnostic Method	Advantages	Disadvantages
Clinical Assessment	- Low cost and accessibility	Lack of specificity
	- Identifies clinical symptoms	Subjective interpretation
Laboratory Tests	Objective and quantitative	Not always conclusive
	Detects abnormalities	Requires interpretation
Genetic Testing	Provides definitive diagnosis	Cost and availability vary
	Informs treatment strategies	Not all disorders have identified markers
Imaging and Biopsy	Reveals structural abnormalities	Invasive procedures
	Histological insights	Radiation exposure
Functional Testing	Assesses immune function	Resource-intensive
	Provides insights into cellular responses	Requires specialized facilities
Specialized Tests	Targeted for specific conditions	Limited availability and applicability

Table 1 provides a detailed examination of the advantages and disadvantages associated with various diagnostic methods utilized in identifying immunodeficiency disorders in adolescents. Beginning with clinical assessment, the method proves advantageous due to its low cost and widespread accessibility, enabling the identification of clinical symptoms. However, its limitations become apparent in its lack of specificity and the subjective nature of result interpretation, underscoring the need for supplementary diagnostic approaches.

Laboratory tests, on the other hand, offer objectivity and quantitative insights into abnormalities, providing a valuable foundation for diagnosis. Nevertheless, their drawbacks include the occasional lack of conclusiveness and the necessity for expert interpretation. Genetic testing stands out as a powerful diagnostic tool, offering a definitive diagnosis and valuable information for treatment strategies. Yet, its effectiveness is contingent upon variable costs and availability, and not all immunodeficiency disorders have identified genetic markers. Moving to imaging and biopsy methods, these techniques unveil structural abnormalities and furnish histological insights, contributing to a comprehensive diagnostic picture. However, their invasive nature and the associated risk of radiation exposure are notable disadvantages. Functional testing offers a closer examination of immune function and cellular responses but comes with the trade-off of being resource-intensive and requiring specialized facilities for execution.

Finally, specialized tests tailored for specific conditions demonstrate targeted efficacy but are constrained by limited availability and applicability. As healthcare professionals evaluate the diagnostic landscape for immunodeficiency disorders in adolescents, this table serves as a valuable resource, guiding the selection of methods that align with the specific characteristics and nuances of the disorder in question. Careful consideration of these advantages and disadvantages is essential to ensure a comprehensive and accurate diagnosis, facilitating effective treatment strategies for this population.

Conclusion

Immunodeficiency diseases in teenagers are difficult to diagnose and need a multidisciplinary treatment. Each diagnostic procedure has pros and cons, as this review has shown. With its accessibility and capacity to detect clinical symptoms, clinical evaluation is an early screening method. Genetic testing confirms hereditary illnesses, whereas laboratory studies quantify immune function. Imaging and biopsy show structural abnormalities, but may be invasive and radiation-intensive. Functional testing evaluates immunological responses but need specific equipment. Personalized testing are essential for focused diagnosis. Diagnostic technique selection depends on clinical circumstances, availability, and probable immunodeficiency disease. Methods may improve diagnosis accuracy when combined. Advances in genetics and functional tests may help us identify teenage immunodeficiency. To safeguard adolescents, immunodeficiency diseases must be recognized early and properly. To enhance and invent innovative processes in this area, doctors, researchers, and diagnostic laboratories must interact. Finally, this research focuses on juvenile immunodeficiency diagnostic methods. Understanding the benefits and downsides of these methods helps physicians diagnose immunodeficiency illness in teenagers, improving their health.

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