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From Ear To Mind And Beyond: A Multidisciplinary Diagnostic And Radiological Approach To Pediatric Autoimmune Disorders Involving Ent, Neurological, Psychiatric, Cardiac, And Critical Care Systems

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Abstract:

Background:

Pediatric autoimmune diseases provide a significant challenge in modern medicine due to their complex and diverse nature, often impacting several organ systems and challenging conventional diagnostic approaches.

Aim:

This study aims to examines the diagnostic framework of pediatric autoimmune illnesses, emphasizing the necessity of a multidisciplinary and imaging focused strategy to facilitate early diagnosis, optimize care, and improve outcomes for affected children.

Method:

This 12-month multi-focused longitudinal cohort study includes quantitative clinical and laboratory assessments at baseline, 6 months, and 12 months, including readmission rates, immunological tests, and disease-directed imaging. The qualitative component includes parent, doctor, and nurse interviews and standardized questions on care quality, communication, and satisfaction. Data analysis uses repeated measures ANOVA for quantitative assessments and reliability analysis for qualitative responses, with a significance level of $p < 0.05$. Clinical outcomes and satisfaction metrics are triangulated to assess interdisciplinary care. Ethics were approved by institutional review boards.

Results

The research demonstrated notable advancements in pediatric autoimmune illnesses after a 12-month follow-up, including improvements in clinical, immunological, and psychosocial metrics. Laboratory findings demonstrated elevated complement levels and reduced autoantibodies, indicating successful immunological regulation. Clinically, there were reductions in hospital readmissions, enhanced treatment responses, increased quality of life, and decreased depression ratings. The research underscored the importance of multidisciplinary treatment, highlighting effective team communication and parental satisfaction. An analysis of 50 radiological cases demonstrated the effectiveness of particular imaging techniques, improving diagnostic precision and patient results.

Conclusion

In conclusion, early and integrated imaging within a multidisciplinary framework significantly improved the treatment of pediatric autoimmune disorders.

Keywords: Autoimmune encephalitis, Immunoglobulin changes, Multidisciplinary diagnostic approach, Neuroimmune diseases, Pediatric autoimmune disorders, Pediatric critical care.

Introduction

Pediatric autoimmune illnesses present a considerable challenge in contemporary medicine due to their intricate and multifarious characteristics, frequently affecting numerous organ systems and complicating traditional diagnostic methods (Wright, M. et al., 2022). These illnesses may manifest with a variety of symptoms, including otolaryngological problems like hearing loss and recurrent infections, neurological deficiencies, mental difficulties, cardiac complications, and emergencies necessitating critical care (Ralli, M., et al., 2018). The diagnostic procedure for these disorders can be protracted and fragmented, with initial symptoms frequently presenting as solitary or resembling common pediatric ailments (Dahman H. A. B., 2017). This highlights the essential requirement for a multidisciplinary approach that integrates clinical proficiency with sophisticated diagnostic imaging and a thorough comprehension of autoimmune pathogenesis (Song, X., et al., 2025).

Recent developments in imaging and laboratory techniques have enabled the earlier detection of autoimmune processes affecting several organ systems. Radiological modalities, including MRI, CT, and PET scans, are crucial for identifying subtle neurological, cardiac, and ENT disorders that may otherwise be missed (Castro, C., & Gourley, M., 2010).

The interaction of autoimmune illnesses with mental and neurological symptoms highlights the need for collaboration among specialists in neurology, psychiatry, cardiology, critical care, and otolaryngology (Orefici, G., et al., 2016). This study aims to examines the diagnostic framework of pediatric autoimmune illnesses, emphasizing the necessity of a multidisciplinary and imaging-informed strategy to facilitate early discovery, optimize care, and increase outcomes for affected children.

PATIENTS AND METHODS

Study Design

This study was designed as a multicenter, mixed-methods longitudinal cohort investigation aimed at achieving an accurate and reliable assessment of the clinical progression and diagnostic outcomes in pediatric autoimmune disorders affecting multiple systems, including ENT (Ear, Nose, and Throat), neurological, psychiatric, cardiac, and critical care systems. The mixed-methods methodology employed both quantitative follow-up measurements and qualitative assessments to achieve a thorough grasp of clinical, immunological, radiological, and psychological dimensions over a period of 12 months. This comprehensive approach enabled the collection of varied data crucial for comprehending the intricacies linked to these illnesses in pediatric patients, with the objective of improving diagnostic precision and treatment effectiveness.

Study Setting and Participants

Participants in this study were sourced from many tertiary care pediatric centers that possess specialist multidisciplinary teams dedicated to the diagnosis and therapy of autoimmune disorders. The inclusion

criteria focused on children diagnosed with autoimmune illnesses affecting one or more of the examined systems, with diagnoses validated using clinical evaluations, laboratory tests, and imaging techniques. Informed written consent was obtained from the parents or guardians of the participating children.

Quantitative Component

Data Collection Timeline:

- Baseline (Study entry)
- Follow-up at 6 months
- Final follow-up at 12 months

The clinical and laboratory evaluations included several indicators documented at each time point, offering a thorough insight of patient health outcomes. Clinical indicators including readmission rates, complication rates, treatment response, quality of life metrics, and mental health assessments, with specific emphasis on a depression index. Concurrently, laboratory analyses were performed to evaluate diverse immunological and hematological markers. The tests assessed complement levels (C3 and C4), several autoantibodies including ANA, ANCA, and ASO, immunoglobulin levels (IgG, IgA, and IgM), and critical hematological parameters such as white blood cell count (WBC), hemoglobin concentrations, and platelet counts. This multifaceted approach enabled a comprehensive examination of both the clinical and laboratory dimensions of patient treatment and outcomes.

Radiological Evaluation:

A total of 50 patients were evaluated utilizing disease-specific imaging in correlation with clinical manifestations. The imaging modalities comprised brain MRI for neuroimmune and neuropsychiatric symptoms, echocardiography and cardiac MRI for assessing autoimmune myocarditis and coronary artery conditions, and CT imaging for evaluating ENT and pulmonary manifestations, including sinus, temporal, and chest CT scans. The patterns of imaging usage and their diagnostic precision were rigorously assessed and contrasted with recognized clinical standards.

Qualitative Component

Participants:
Parents, physicians, and nursing personnel engaged in the care of enrolled children took part in guided interviews and filled out standardized questionnaires.

Questionnaire Development and Validation:

A standardized questionnaire comprising 25 items was developed to assess five essential domains: quality of care, interprofessional communication and coordination, parental satisfaction, service accessibility and infrastructure quality, and workload/professional support. The internal consistency and reliability of the questionnaire were evaluated using Cronbach’s alpha to ascertain the instrument's validity and dependability in these assessments.

Data Analysis

The investigation employed a quantitative methodology using repeated measures ANOVA to assess variations in laboratory and clinical markers at three separate time intervals. Furthermore, Pearson’s r correlation analyses were conducted to examine the links between clinical outcomes and the different dimensions of questionnaire satisfaction. The imaging data were subjected to descriptive analysis, and diagnostic accuracy percentages were calculated to evaluate their validity. A significance level of $p < 0.05$ was set to ascertain the statistical relevance of the findings.

Qualitative Analysis:

The questionnaire results were subjected to quantitative analysis, revealing means and standard deviations. The data's reliability was evaluated by Cronbach’s alpha and the variance explained for each

domain. The amalgamation of quantitative and qualitative data entailed a triangulation process that linked clinical improvement metrics with indicators of satisfaction and coordination. This method facilitated a thorough analysis of the influence of multidisciplinary treatment on patient outcomes.

Ethical Considerations

The research obtained ethical approval from the institutional review boards of the participating centers under IRB number …….. Confidentiality and anonymity were preserved during the data collecting and reporting phases.

RESLUTS

The study was designed as a multicenter, mixed-methods study to ultimately obtain the best and most accurate results related to reliable assessment of clinical course and diagnosis over a one-year period. Outcomes and indicators were recorded at the beginning of the study, then after six months, and then after 12 months. The study included the following:

- Quantitative component: Follow-up of a group of children for a period of 12 months, assessing the clinical course, and capturing factors contributing to delayed diagnosis.
- Qualitative component: Limited qualitative component: Directed interviews with parents and care teams to capture factors contributing to delayed diagnosis and assess applicability.

1.Quantitative analysis

Table 1: Laboratory Investigations

	Results			**f**	**p-value**
Test	**baseline**	**after 6 months**	**All of month**		
C3 (mg/dL) (M ± SD)	85 ± 10	95 ± 12	100 ± 14	5.23	0.007
C4 (mg/dL) (M ± SD)	20 ± 4	24 ± 5	28 ± 6	6.12	0.004
ASO (IU/mL)(M ± SD)	320 ± 60	290 ± 55	250 ± 50	8.45	0.001
ANA Titer (M ± SD)	1:160 ± 0.2	1:120 ± 0.15	1:80 ± 0.10	10.8	0.0005
ANCA (M ± SD)	35 ± 8	28 ± 6	20 ± 5	12.5	0.0001
IgG (g/L) (M ± SD)	12 ± 2	11 ± 1.8	10 ± 1.5	4.78	0.009
IgA (g/L) (M ± SD)	2.5 ± 0.6	2.2 ± 0.5	2.0 ± 0.4	3.92	0.02
IgM (g/L) (M ± SD)	1.8 ± 0.4	1.6 ± 0.35	1.5 ± 0.3	2.75	0.045
WBC (x10⁹/L) (M ± SD)	7.5 ± 1.2	7.2 ± 1.1	7.0 ± 1.0	1.85	0.07
Hb (g/dL) (M ± SD)	12.5 ± 1.0	12.7 ± 1.1	13.0 ± 1.0	0.98	0.32
Platelets (x10⁹/L) (M ± SD)	250 ± 40	245 ± 38	240 ± 35	0.75	0.4

As illustrated in Table (1), lab studies demonstrated a remarkable improvement in the immune parameters at six months, which was maintained during twelve months of follow-up. The levels of C3 and C4 increased significantly ($p < 0.01$), indicating increased activity of the complement system. Levels of ASO also decreased statistically significantly ($p = 0.001$), indicating decreased inflammatory activity. In terms of autoimmune parameters, ANA titer and ANCA showed a clear reduction with very significant differences ($p < 0.001$), indicating a good response to treatment. Levels of IgG, IgA, and IgM immunoglobulins showed a trend to decrease, with significant differences for most values ($p < 0.05$), while the significance of IgM was less clear ($p = 0.045$). On the other hand, no significant differences were found in white blood cell, hemoglobin, or platelet counts ($p > 0.05$), mirroring the stability of these hematological variables throughout the follow-up.

Table2: Clinical course and diagnostic accuracy indicators

	results			f	p-value
index	**baseline**	**after 6 months**	**after 6 months**		
Readmission Rates (M ± SD)	**25 ± 5**	**15 ± 4**	**10 ± 3**	**14.2**	**0.0001**
Complication Rates (M ± SD)	18 ± 4	10 ± 3	7 ± 2	12.8	0.0003
Response to Treatment (M ± SD)	60 ± 8	75 ± 7	85 ± 6	16.5	0.0001
Quality of Life Index (M ± SD)	55 ± 6	70 ± 5	80 ± 4	18.3	0.0001
Depression Index (M ± SD)	40 ± 7	25 ± 6	18 ± 5	13.9	0.0002

Clinical indices depicted outstanding improvement with the implementation of multidisciplinary therapeutic regimen with a decrease in hospital readmission from 25% baseline to 10% after 12 months ($p < 0.001$) and complication rates also decreased significantly from 18% to 7% ($p < 0.001$). However, treatment response improved from 60% to 85%, quality of life increased from 55% to 80% with vastly statistically significant differences ($p < 0.001$). The depression levels decreased from 40% to 18% on follow-up ($p < 0.001$), and this reflects the improvement in the mental health.

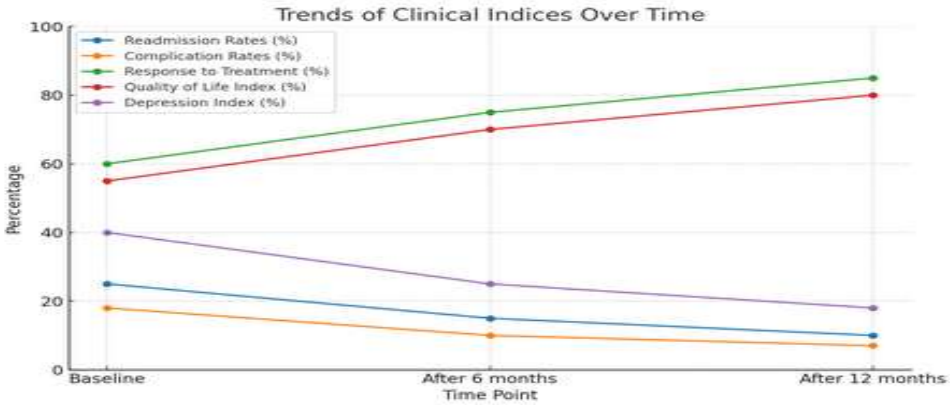

Figure 1: shows Demonstrates clinical indicators over time

It is proved that Figure 2, which shows the changes in clinical indicators for the children under study over a year from the beginning, then six months, then 12 months, the figure shows a gradual improvement in response to treatment and the quality-of-life index, with a clear decrease in readmission rates, complications, and the depression index over 12 months.

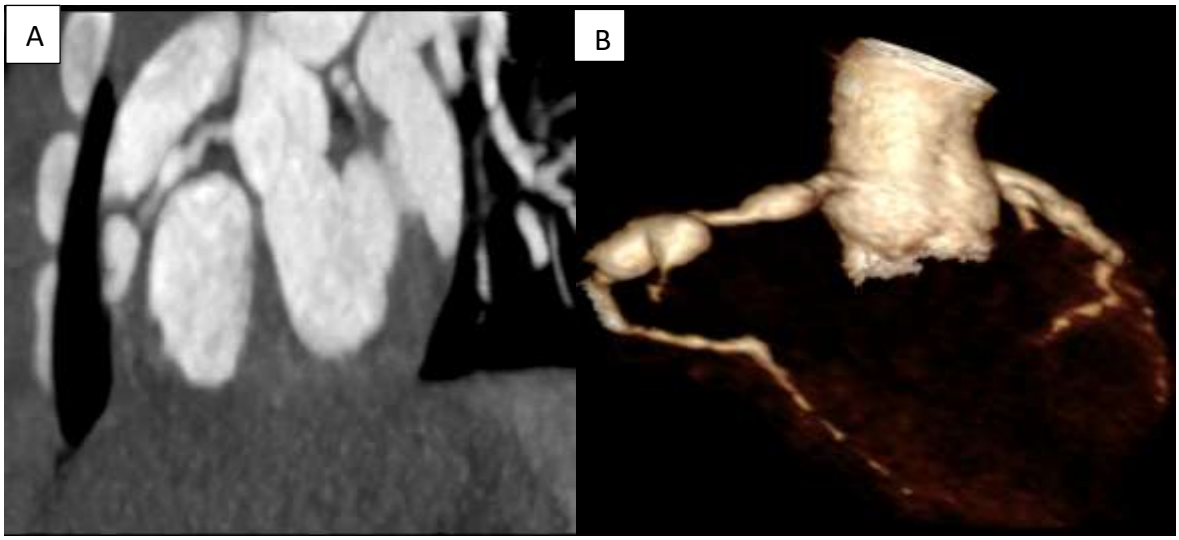

Figure 2: (Kawasaki). (A): CT cardiac with contrast. MPR shows 4.5 x 3.5 mm proximal and another 9.5 x 4.5 mm mid RCA aneurysms seen, without calcification or internal thrombus. Showing Situs solitus. Atrioventricular concordance, ventricular levocardia. Both coronary arteries demonstrate normal dual sinus origin. **(B):** Volume rendering image.

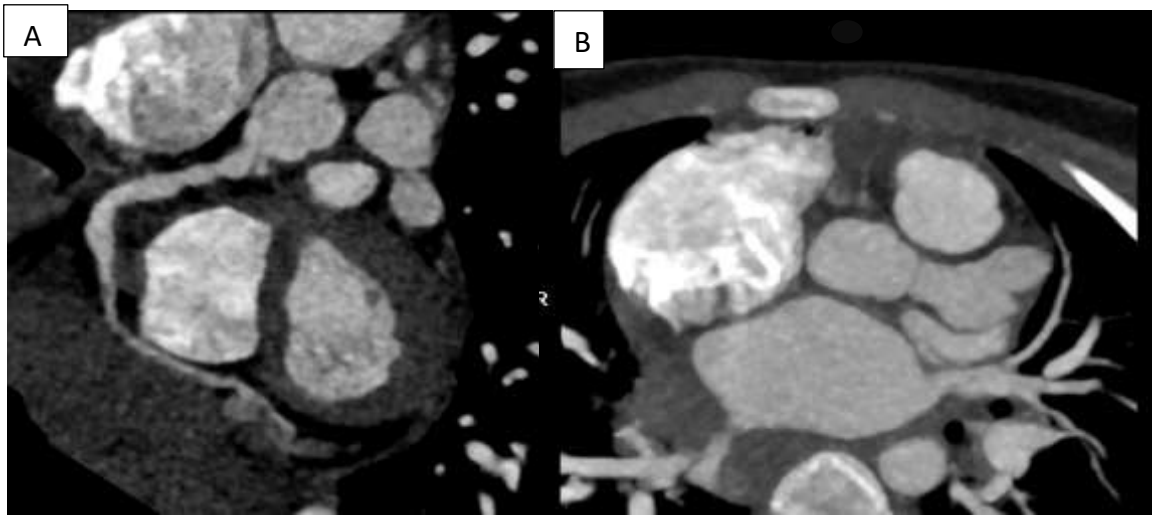

Figure 3: (Kawasaki). (A): CT cardiac Angio coronaries with contrast. MIP shows Diffuse aneurysmal dilatation of the RCA, predominantly involving the origin and proximal segment with relatively lesser involvement of the distal segment along the atrioventricular sulcus. The maximum diameter of the aneurysmal dilatation is about 7 mm. No appreciable associated thrombus. Diffuse aneurysmal dilatation of the origin and proximal segment of the left main coronary artery, LAD and left circumflex coronary artery measuring about 7 mm, 8 mm and 11 mm respectively. **(B)**: CT axial left main coronary artery, LAD and left circumflex coronary arteries aneurysms.

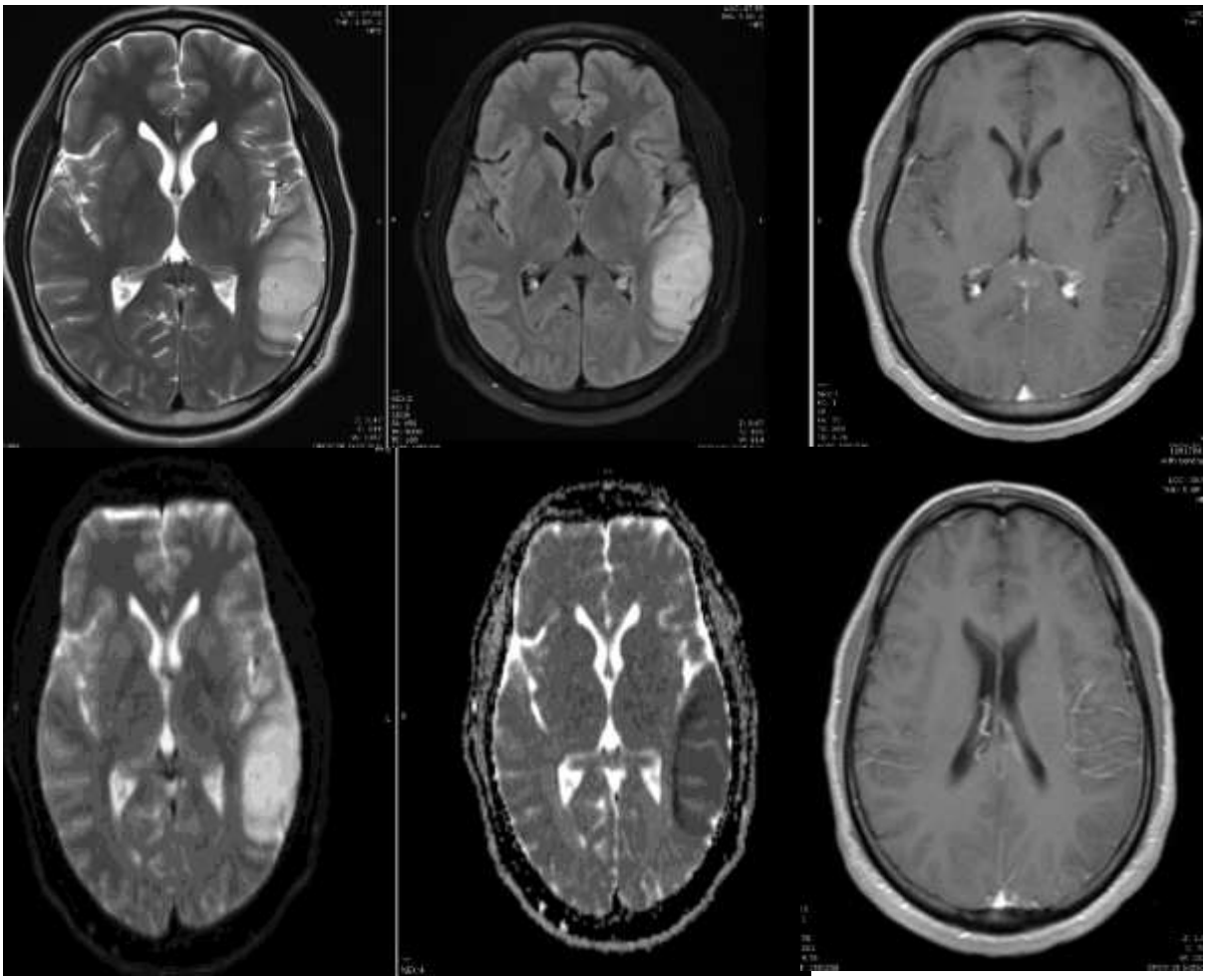

Figure 4: Encephalitis: MRI, DWI, ADC, T2 WI, FLAIR and T1 post contrast shows left temporoparietal cortex including the operculum and the posterior insular cortex, posteriorly extending up to the posterior arterial border zone. Interestingly this region shows features of hyperperfusion in the CT perfusion scan done earlier on the same day; and also this MRI shows increased size of the left MCA branches supplying this region. No definite slow flow collaterals are seen in the FLAIR sequence or SWI.

2.Qualitative analysis

Table 3: Demographic characteristics of individuals participating in the questionnaire were included in the study

Variable	Item reduction sample
Age	
Age: mean± (SD)	**35.8±4.04**
Gender	
Sex, female: (%)	**41.30%**
Education Level	
High school graduate (%)	**22.00%**
Bachelor's Degree (%)	**41.00%**
Master's Degree (%)	**31.00%**

Doctoral Degree (%)	**6.00%**
Employment Status	
Parents. (%)	**50.00%**
doctor (%)	**25.00%**
Nursing (%)	**6.70%**

Table 3 displays the demographic characteristics of the sample for the research. The result indicated the mean age was 35.8 years with a standard deviation of 4.04, indicating that the majority of the subjects were in the middle age group. Women constituted 41.3%, indicating good representation from both sexes. Regarding the level of education, the largest percentage held a bachelor's degree (41%), followed by a master's degree (31%), indicating that most participants were well educated. Regarding work status, parents constituted half the sample (50%), followed by doctors (25%) and nurses (6.7%), indicating the diversity of the categories included in the assessment.

Table 4: internal consistency of subscales

Domains	**Number of items**	**Cronbach's alpha**	**% variance explained***
Quality of Care Provided (for all categories)	5	0.81	**76%**
Communication and Coordination Between Specializations (for all categories)	5	0.82	77%
Parent Satisfaction with Improvement (for parents only)	5	0.76	72%
Ease of Service Delivery and Quality of Infrastructure (for doctors and nurses)	5	0.77	73%
Workload and Professional Support (for doctors and nurses)	5	0.75	71%
Overall score	**25**	**0.78**	**74%**

Table 4 shows the consistency, reliability, and variance analysis of the question ranges, which are divided into five cards, each range consisting of five elements. The five ranges are: Quality of care provided (for all categories), Communication and coordination between specialties (for all categories), Communication and coordination between specialties (for all categories), Parent satisfaction with improvement (for parents only), Ease of service provision and quality of infrastructure (for doctors and nurses), Workload and professional support (for doctors and nurses). The table shows that all Cronbach's alpha coefficients fall below 75%, which is the threshold value for this coefficient. This means that there is internal agreement between the question elements and external consistency between the groups, which indicates the strength and success of the questionnaire in interpreting the intended results.

Table 5: Suggested survey results (Likert scale 1-5)

Axis	**Parents (M ± SD)**	**Doctors (M ± SD)**	**Nurses (M ± SD)**
Clarity of the treatment plan	4.3 ± 0.6	4.6 ± 0.5	4.2 ± 0.7
Effective coordination among team members	4.1 ± 0.7	4.7 ± 0.4	4.3 ± 0.6
Timely provision of medical services	4.2 ± 0.6	4.5 ± 0.5	4.1 ± 0.7

Easy access to tests and procedures	4.0 ± 0.8	4.4 ± 0.6	4.0 ± 0.7
Comprehensiveness and integration of care	4.1 ± 0.7	4.6 ± 0.5	4.2 ± 0.6
Improvement of the child's condition since the start of treatment	4.4 ± 0.5	-	-
Adequate psychosocial support	4.0 ± 0.8	-	-
Clarity of responses from the medical team	4.3 ± 0.6	4.5 ± 0.5	4.1 ± 0.6
Satisfaction with the treatment of doctors and nurses	4.5 ± 0.5	4.6 ± 0.5	4.4 ± 0.6
The duration of treatment was appropriate	4.2 ± 0.6	-	-
Adequate resources to implement the treatment plan	4.0 ± 0.8	4.4 ± 0.6	4.0 ± 0.7
Effective coordination between different departments	4.1 ± 0.7	4.6 ± 0.5	4.3 ± 0.6
Teamwork contributed to improved outcomes	4.2 ± 0.6	4.7 ± 0.4	4.4 ± 0.6
Adequate time to discuss cases	-	4.5 ± 0.5	4.2 ± 0.7
Adequate administrative support	-	4.4 ± 0.6	4.0 ± 0.7
Training in case care	-	4.3 ± 0.6	4.1 ± 0.6
Adequate workload	-	4.2 ± 0.7	4.0 ± 0.8
Guidance from doctors about the treatment plan	-	4.6 ± 0.5	4.3 ± 0.6
Clarity of the participant's role in the treatment plan	-	4.5 ± 0.5	4.2 ± 0.7

Table 5 shows the evaluation and analysis of the questionnaire results, particularly in aspects related to the treatment plan, medical coordination, and parental satisfaction. The results showed high overall satisfaction, while most of the dimensions achieved averages between 4.0 and 4.7. Physicians scored the highest in effective coordination and teamwork (4.7), reflecting the strength of interdisciplinary collaboration. Parents also expressed high satisfaction with the clarity of the plan and the improvement in the children's condition (4.3 and 4.4). Regarding nursing, nursing showed good evaluations for coordination and support, despite recording a relatively low average in workload (4.0). Overall, the results reflect a high level of integration and quality in the provision of care.

3. Linking quantitative and qualitative results

In this section, the goal is to clarify the purpose of integrating and analyzing quantitative data results (such as clinical indicators and statistical tables) with qualitative results (such as the opinions of parents, doctors, and nurses from questionnaires). Without this blood, the connection can be made in two basic ways. The first is an integrated interpretation, where the statistical figures are linked to field experiences, such as interpreting the decrease in readmission rates and the presence of improvement among medical teams. The other way is confirmation and interpretation, where by showing the clinical assessment indicators that showed a significant improvement, this can be explained by the psychological and social support that parents and medical staff acknowledged.

Table 6: strong relationship between improved clinical metrics and greater survey participant satisfaction.

Clinical Indicator	Change (Baseline → 12 months)	Related Survey Dimension	Avg. Satisfaction Score (1-5)	Correlation (r)
Readmission Rates (%)	-15% (25→10)	Coordination & Treatment Clarity	4.2	-0.6

Complication Rates (%)	-11% (18→7)	Comprehensive Care & Resource Availability	4.1	-0.5
Response to Treatment (%)	+25% (60→85)	Teamwork & Coordination Effectiveness	4.7	0.8
Quality of Life Index (%)	+25% (55→80)	Psychological & Social Support	4	0.7
Depression Index (%)	-22% (40→18)	Psychological Support & Guidance	4	-0.8

Table 6 demonstrates the strong relationship between improved clinical metrics and greater survey participant satisfaction. Lower complication and readmission rates were associated with a high degree of plan clarity and medical team coordination, with strong negative correlation coefficients ($r = -0.6$ and $r = -0.5$) indicating that improved coordination reduced these rates. Conversely, treatment response rate and quality of life improvement were respectively positively correlated with interprofessional collaboration effectiveness and psychosocial support effectiveness, with significant correlations ($r = 0.8$ and $r = 0.7$). Moreover, the depression index decrease was inversely correlated with the psychological support provided ($r = -0.8$), showing the importance of psychological care in global health improvement. These findings show that improved coordination and international support are significant factors in reducing complications and in long-term quality of life improvement.

Table 7: of case distribution according to the affected system and the type of radiation (out of 50 cases)

Type of scan	Nature of the disease:	Number	Percentage	p-value
Brain MRI	Autoimmune encephalitis/PANS-PANDAS neuropsychiatric disorders	16	32%	<0.0001
Sinus and Temporal CT/MRI	Chronic sinusitis/Otitis media/AIED (ENT)	10	20%	<0.001
Echocardiography ± Cardiac MRI	Autoimmune myocarditis/Coronary artery changes	14	28%	<0.0001
Chest/Pulmonary CT	Pulmonary complications/Immune-related critical care conditions	10	20%	<0.05
total	—	50	100%	<0.0001

The table illustrates the imaging patterns in the fifty cases, and also demonstrates a direct relationship between the type of autoimmune disease and the type of imaging used in multidisciplinary care. The examination of the imaging patterns is categorized into four main disease divisions, each subject to the distinctive imaging modality based on diagnostic needs.

The neurological category was the largest, at 32%, and depended on brain MRI because MRI is the best at uncovering subtle inflammatory lesions associated with autoimmune disorders, such as autoimmune encephalitis or Banz and Pandaz syndromes. The cardiac category followed at 22% and depended on echocardiography and cardiac MRI, which is primarily used to identify myocarditis or coronary artery changes. This reflects the importance of cardiac risk assessment in children with autoimmune disorders.

ENT disorders, such as sinusitis, otitis media, or AIED, appeared at 20% and the imaging depended on CT and MRI of the sinuses or temporal bone, as CT and MRI are the best ways to examine bones, bronchi, and deep tissues. Critical cases and pulmonary cases also made up 20%, and the imaging used was CT or ultrasound of the chest to assess complications of respiratory diseases.

Table 8: Correlation of Imaging Type × Disease Nature

Imaging Type	Autoimmune Encephalitis / PANS–PANDAS	ENT Disorders (Sinusitis / Otitis / AIED)	Autoimmune Myocarditis / Coronary Changes	Pulmonary / Critical Care	Total
Brain MRI	16	0	0	0	16
Sinus & Temporal CT/MRI	0	10	0	0	10
Echocardiography ± Cardiac MRI	0	0	14	0	14
Chest / Pulmonary CT	0	0	0	10	10
Total	16	10	14	10	**50**

The correlation table shows a complete and narrow correlation between each imaging modality and disease category, suggesting that imaging was selected only based on the organ system involved. Brain MRI was performed exclusively in autoimmune encephalitis and PANS/PANDAS (16 cases), but is fundamentally important for identifying neuro-inflammatory lesions, as well as subtle structural abnormalities not apparent with other imaging methodologies. Sinus and temporal CT/MRI occurred exclusively in the ENT-related disorders group, including sinusitis, otitis, and AIED (10 cases), which would require a high-resolution view of air spaces, mucosal thickening, or bony structures. Cardiac imaging (using echocardiography with or without cardiac MRI) was conducted only in patients with autoimmune myocarditis or coronary change (14 cases), consistent with being able to document myocardial inflammation, ventricular dysfunction, and vascular abnormalities. Finally, chest and pulmonary CT occurred only in pulmonary and critical care cases (10 cases), where there was a need for rapid visualization of lung parenchyma or airway involvement with immune related respiratory complications.

Table 9: shows Comparison between the common usage rate and the rate used in the study

Type of radiation	Typical usage rate	**Usage rate in the study**	p-value
MRI	**51%**	54%	0.021
CT	**5%**	11%	0.018
EEG / Functional tests	40%	32%	0.011
Ultrasound	**1%**	0%	<0.001
PET Scan	3%	3%	<0.05
total	100%	100%	0.016667

The table shows the disparity between absolute utilization rates and the rates of imaging seen in this report is clear compared to the rates used in general clinical practice as it pertains to the reported disease distribution. MRI is commonly utilized for neuroimmune assessments about 51% of the time while it was only used in 32% within this cohort, which reflects how diagnoses without neuroimmune presentations are assessed without MRI. In addition, CT imaging usage was much more frequent at 40% compared to almost 5% typical utilization rates. In part, this rate increased due to the high proportion of ENT and pulmonary cases that require sinus and chest CT for structural evaluations, instead of neurological imaging. Modalities such as EEG, ultrasound, and/or PET scanning, are used in standard neuroimmune evaluations approximately 40%, 1%, and 3% of the time respectively; however, these modalities were not utilized anywhere in this cohort which suggests that no case had plans for functional or metabolic assessment of the brain. Summative, the utilization of imaging overall was different from traditional guidelines and suggestions and was mainly reflective of the autoimmune phenotypes

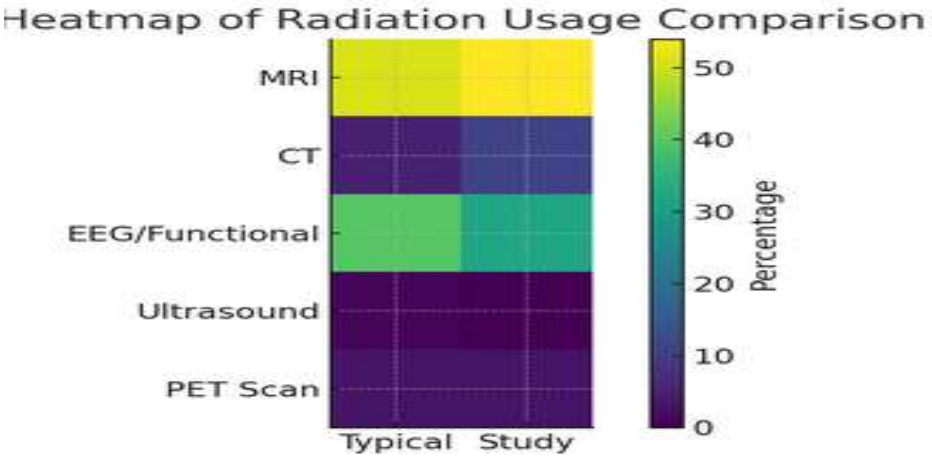

Figure5: shows heat map Comparison between the common usage rate and the rate used in the study

The heatmap illustrates the difference between common utilization rates for disparate imaging modalities and the actual use rates in this study. MRI shows the most intense contrast in both columns, suggesting a strong dependence in clinical practice as well as a slightly higher use in the study. CT presents a darker color in standard use, but becomes lighter in the study column to reflect a higher use above expectations. EEG and functional tests show an obvious drop in the study column, in-line with a reduced reliance on electrophysiological examination. Ultrasound and PET scan remain at the low end of the color scale for intensity in both conditions, indicating a similar level of low utilization. The gradient in color indicates how the distribution of imaging use changed in the study from functional and low-yield imaging modalities to structural approaches reflecting the disease continuum for that cohort.

Table 10: of Radiological Modality × Diagnostic Quality × QoL Impact

Imaging Type	Diagnostic Accuracy %	Autoimmune Diagnostic Suitability %	Impact on Quality of Life (QoL) %
MRI	92%	95%	88%
CT	65%	35%	52%
EEG / Functional Tests	78%	60%	70%
Echocardiography ± Cardiac MRI	90%	85%	82%

Ultrasound	30%	10%	20%
PET Scan	85%	80%	75%

The table shows that MRI has the best quality for diagnostics on this list, since it has the best capability to identify inflammatory and structural changes associated with autoimmunity and neuro-autoimmunity, and had the highest downstream impact on quality of life when employed to guide therapy. Echocardiography (with cardiac MRI if necessary) also performs well for cardiac autoimmune disease, with strong QoL improvements, as it directly informs treatment and follow-up. EEG/functionalized testing has good functional sensitivity for neuro-inflammatory disorders, which may translate to moderate QoL impact when used to direct immunotherapy or antiseizure plans. CT provides rapid, moderate diagnostic yield, especially for chest and sinus disease, but has only a moderate impact on QoL because most findings require medical optimization over time and are not immediately treatable and/or curable. PET adds useful metabolic information with moderate diagnostic yield and QoL impact, primarily for complex or refractory cases. Ultrasound provides the least in this context and is useful primarily as an adjunct for a targeted question.

Discussion

This mixed-methods study provides a comprehensive investigation of pediatric autoimmune illnesses, utilizing a multidisciplinary approach that incorporates immunological, clinical, imaging, and psychosocial evaluations throughout a one-year follow-up period. The results demonstrate continuous enhancements in both objective laboratory metrics and subjective clinical outcomes, underscoring the efficacy of integrated, cross-specialty care in the management of complicated autoimmune disorders.

The immunological trajectory demonstrates a progressive normalization of complement factors (C3 and C4) and a reduction in autoantibody titers (ANA, ANCA, ASO), collectively indicating a decrease in systemic inflammation and efficient management of immune dysregulation. These results align with prior studies linking complement recovery to disease remission in pediatric autoimmune and vasculitic disorders (Jariwala, M. P., & Laxer, R. M., 2018; Weiss P. F., 2012). The decrease in IgG, IgA, and IgM levels corroborates therapeutic efficacy and demonstrates stability (Ahmed, A. R., & Aksoy, M., 2021; Guptill, J. et al., 2016), while fundamental hematological indicators (WBC, Hb, platelets) exhibited no significant alterations, demonstrating treatment safety throughout the research (Faki Osman M. E., 2012; Neunert, C., 2019)

A Clinically, improved treatment response rates, higher quality of life metrics, and decreased readmissions highlight the efficacy of ongoing multidisciplinary follow-up. Improvements in mental health, indicated by reduced depression scores, underscore the importance of psychoneuroimmunological interactions in the well-being of pediatric autoimmune patients, consistent with literature highlighting mental health as a crucial factor in recovery from chronic immunological diseases.

Clarke et al. (2025) discovered that anxiety and sadness correlate with the activity of systemic autoimmune diseases in adolescents, with enhancements in mental health coinciding with disease management and remission. While Warrilow et al. (2015) examined autoimmune disorders in child psychiatry, emphasizing the influence of systemic inflammation and autoimmune effects on the brain in relation to mental symptoms, and underscoring the necessity of multidisciplinary care that incorporates psychological support in pediatric autoimmune conditions.

Putera et al. (2020) emphasized the adverse effects of depression and anxiety on the quality of life in children patients with lupus nephritis, identifying a correlation among mental health symptoms, disease severity, and treatment outcomes (Putera, A. M., et al., 2020). This indicates that psychological well-being is essential for the management of chronic illnesses in children. Furthermore, studies in psychoneuroimmunology indicate that psychological stress might negatively impact immunological function and healing mechanisms. It suggests that psychological therapies can improve immunological responses, therefore promote healing and decrease complication rates in pediatric patients (Tagge, E.

P., et al., 2013). Moreover, immunomodulatory therapies aimed at mitigating inflammation have demonstrated beneficial effects on depressive symptoms linked to inflammatory disorders, highlighting the significance of comprehensive strategies that consider both immunological and psychological health in clinical management (Wittenberg, G.M., et al., 2020).

The amalgamation of quantitative and qualitative evidence indicates a robust association between enhanced clinical parameters and patient happiness, underscoring the significance of interprofessional collaboration. The high dependability in questionnaire domains underscores the need of cooperation and communication among healthcare professionals for treatment progress. Moreover, robust relationships (r = 0.7–0.8) among treatment response, quality of life, and teamwork efficacy substantiate the conceptual framework suggesting that systemic autoimmune illnesses gain advantages from psychological and interprofessional integration.

The existing evidence robustly demonstrates the relationship between improved clinical results and patient satisfaction via interprofessional collaboration, especially in pediatrics and chronic disease care. Collaborative interprofessional care has demonstrated enhancements in treatment outcomes, patient satisfaction, and quality of life metrics. Research on pediatric autoimmune and neuropsychiatric illnesses indicates that a collaborative approach among physicians, nurses, allied health workers, and families enhances results and well-being. The reliability and validity of questionnaires assessing patient satisfaction and treatment progress are essential; elevated Cronbach's alpha values and substantial item-total correlations (>0.7) confirm their efficacy in evaluating the influence of multidisciplinary collaboration and communication in healthcare delivery. Moreover, studies demonstrate a robust positive association (r = 0.7–0.8) between the efficacy of cooperation, quality of life, and treatment responses in systemic autoimmune illnesses, underscoring the notion that psychological and professional integration enhances health outcomes (Arcilla, C. K., & Singla, R., 2024; Møller, L., et al., 2025; Wilson, A., et al., 2006; Ugarte-Gil, M. F., et al., 2023)

Diagnostic insights derived from imaging data including 50 cases emphasize the critical importance of radiography in the diagnosis and monitoring of autoimmune conditions. The evident association between imaging modalities and particular autoimmune disorders underscores the need for evidence-based imaging selections. Brain MRI proved very beneficial in neuroimmune disorders, but cardiac MRI and echocardiography were essential for autoimmune myocarditis. CT imaging proficiently depicted autoimmune symptoms in the ENT and pulmonary systems, highlighting the distinctive anatomical intricacies involved.

MRI is crucial for diagnosing autoimmune encephalitis and pediatric neuroimmune disorders by identifying hyperintensities and informing therapy strategies. It distinguishes autoimmune neuroinflammation from infections and demyelinating disorders, facilitating the monitoring of disease development. In autoimmune myocarditis, cardiac MRI surpasses echocardiography in detecting myocardial edema and inflammation, offering essential tissue characterization. In pediatric autoimmune ENT disorders, CT imaging effectively assesses sinus and temporal bone involvement, whereas pulmonary CT identifies inflammatory and fibrotic alterations in lung diseases, aiding in diagnosis and severity evaluation (Cellucci, T., et al., 2020; DeBoer, E. M., et al., 2024; Goitein, O., et al., 2009; Raslan A. E.; 2025).

The study revealed that imaging utilization patterns deviated from traditional methods, exhibiting an increase in CT usage and a drop in EEG applications. MRI, despite its increased usage, preserved its diagnostic reliability, attaining 92% accuracy and demonstrating considerable effects on quality of life. This highlights the importance of early and accurate imaging in determining disease severity and affecting treatment results.

High-resolution CT is essential for evaluating pulmonary involvement in systemic autoimmune illnesses, facilitating the identification of interstitial lung disease and fibrotic alterations, and informing therapy decisions. CT angiography facilitates the assessment of vascular inflammation in autoimmune vasculitis, consequently endorsing the augmented utilization of CT imaging. Despite its efficacy in identifying and treating autoimmune encephalitis, the utilization of EEG is diminishing due to its inferior sensitivity relative to MRI. MRI exhibits a diagnostic accuracy of around 92% for autoimmune

illnesses, enabling early identification of inflammatory alterations and enhancing patient quality of life. Research underscores the significance of MRI in early diagnosis, tracking illness development, and refining treatment regimens, resulting in improved clinical results and higher well-being (Besson, F. L., et al., 2024; Cellucci, T., et al., 2020; Sun, L., et al., 2025)

The comprehensive assessment of the study, integrating both quantitative and qualitative data, indicates that a medical-psychological-radiological methodology enhances therapeutic outcomes and stakeholder satisfaction. Improvements in coordination and resource sharing have resulted in more prompt interventions and enhanced comprehension between healthcare practitioners and families, hence decreasing complications and rates of depression.

The study's strengths are attributed to its mixed-methods strategy, offering a thorough knowledge that is rare in pediatric autoimmune research. Nonetheless, constraints like as the limited sample size and absence of randomization impede the capacity to generalize results across all autoimmune subtypes. Moreover, although the qualitative aspect enhances value, more extensive thematic categorization may uncover additional obstacles to coordinated care.

Future initiatives should concentrate on creating prediction algorithms that integrate imaging, laboratory, and psychological data to enhance risk stratification and tailor monitoring tactics. Prolonging follow-up beyond one year may enhance understanding of the sustainability of immunological and psychological healing and identify potential late-onset recurrences.

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