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Comparative Anatomy and Histopathology of Pediatric Inflammatory Bowel Disease: Crohn's vs. Ulcerative Colitis

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ABSTRACT

Background: Pediatric inflammatory bowel disease (IBD), which includes Crohn's disease and ulcerative colitis, presents significant challenges concerning diagnosis due to overlapping clinical features and different underlying tissue changes. Timely differentiation of these types for proper management and to optimize long-term outcomes remains critical. To compare the anatomical and histopathological features of Crohn's disease and ulcerative colitis in pediatric patients.

Methods: A cross-sectional study was conducted from January 2022 to January 2023 at DI Khan Medical College involving 89 children with confirmed diagnoses of Inflammatory Bowel Disease (IBD). Biopsy specimens were examined for significant histopathological changes, which included the presence of granulomas, crypt abscesses, transmural inflammation, loss of goblet cells, and distortion of mucosal architecture. For this study, data analysis employed the 'chi-square test with a significance threshold set at $p < 0.05$'.

Results: Granulomas and transmural inflammation occurred only in 'Crohn's disease cases ($p < 0.0001$), while crypt abscesses, depletion of goblet cells, and patchy-continuous involvement mucositis were more prevalent in ulcerative colitis ($p < 0.05$)'. The age, gender distribution, BMI percentile, and duration of symptoms were similar across the groups.

Conclusion: Distinct histopathological features can reliably 'differentiate Crohn's disease from ulcerative colitis' in pediatric patients. Accurate early diagnosis based on tissue findings is essential for guiding therapy and improving outcomes.

Keywords: Pediatric IBD, Crohn's disease, Ulcerative colitis, Histopathology, Granulomas, Crypt abscess, Transmural inflammation

INTRODUCTION

In children, inflammatory bowel disease (IBD) is increasingly identified as a significant cause of chronic gastrointestinal conditions. Of the two IBD types, Crohn's disease and ulcerative colitis both pose considerable challenges with regards to diagnosis and management in the pediatric and adolescent populations. Although these two diseases are often characterized by similar symptoms abdominal pain, diarrhea, anorexia and weight loss, as well as rectal bleeding, their underlying pathology is quite different, which has implications for clinical management [1-3].

Crohn's disease is marked by the patchy inflammation that is transmural and can occur anywhere along the gastrointestinal tract, with the terminal ileum and colon being the most common sites. On the other hand, ulcerative colitis is characterized by continuous, colonic, and rectal inflammation which is limited to the mucosa. 'The histological differences are also demonstrated by the presence of granulomas, which are specific to Crohn's disease and crypt abscesses, which are characteristic of ulcerative colitis'. In children, the presentation is often subtle or mixed, which complicates diagnosis [4-6].

Accurate differentiation is essential not just for starting the correct treatment but also for forecasting the disease course, its complications, and how the condition will respond to intervention. Early pediatric cases are especially important to analyze because their earlier onset is typically associated with more severe progression and increased likelihood of requiring surgery later in life [7-9].

This study was conducted to analyze and compare the histopathological and anatomical features of pediatric Crohn's disease and ulcerative colitis. By identifying consistent patterns in biopsy specimens, this research aims to assist in refining the diagnostic process and improving clinical outcomes in children diagnosed with IBD.

METHODOLOGY

The observational cross-sectional study was performed at Pathology Department, DI Khan Medical College for one year, from January 2022 to January 2023. Its primary aim was to assess and compare the anatomy and histopathology changes 'in children with diagnosed Crohn's Disease and Ulcerative Colitis'. Ethical clearance was obtained from the IRB of DI Khan Medical College well before the study started. Information about the participants was kept confidential, and consent was obtained from parents or legal guardians for all subjects.

The investigation included 89 pediatric IBD patients aged between 5 and 16 years who were clinically evaluated and confirmed through histopathological examination. The patients were sub classified into two groups: Crohn's disease patients (n=41) and those with ulcerative colitis (n=48). Diagnosis was established based on a combination of distinct clinical features along with thorough evaluation by endoscopy and histopathological examination of intestinal biopsies.

Inclusion criteria comprised of all children under the age of 17 years with newly diagnosed IBD, validated by endoscopic biopsy. Patients with a history of treated IBD, other co-existing autoimmune diseases, or incomplete records of biopsy were excluded from the study.

Detailed demographic information, including age, gender, duration of symptoms, nutritional status (based on BMI percentiles), and family history of IBD, was recorded using a structured proforma. All patients underwent colonoscopy with segmental mucosal biopsies, which were processed in the histopathology laboratory following standard paraffin-embedding techniques. Hematoxylin and eosin (H&E) stained slides were independently reviewed by two senior histopathologists blinded to the clinical diagnosis.

All participants underwent colonoscopy with multiple segmental mucosal biopsies taken from inflamed and adjacent normal-looking mucosa. Tissue samples were immediately fixed in 10% neutral-buffered formalin and processed using the standard paraffin-embedding technique. Sections of 3–5 μm were cut and stained with Hematoxylin and Eosin (H&E). In selected cases, special stains such as periodic acid–Schiff (PAS) and Ziehl-Neelsen were used to exclude infections or mimicry.

Two senior histopathologists, blinded to the clinical diagnosis, independently evaluated the histological slides. Discrepancies were resolved through consensus. The following histological parameters were assessed: Granulomas (non-caseating), Crypt abscesses, Transmural inflammation, Mucosal architecture distortion, Goblet cell depletion, Basal plasmacytosis, Lamina propria neutrophilic infiltration, Lymphoid aggregates, Skip lesions and Lesion distribution (continuous vs. patchy)

Each feature was scored as present or absent using standardized IBD diagnostic criteria. Representative photomicrographs were captured for documentation.

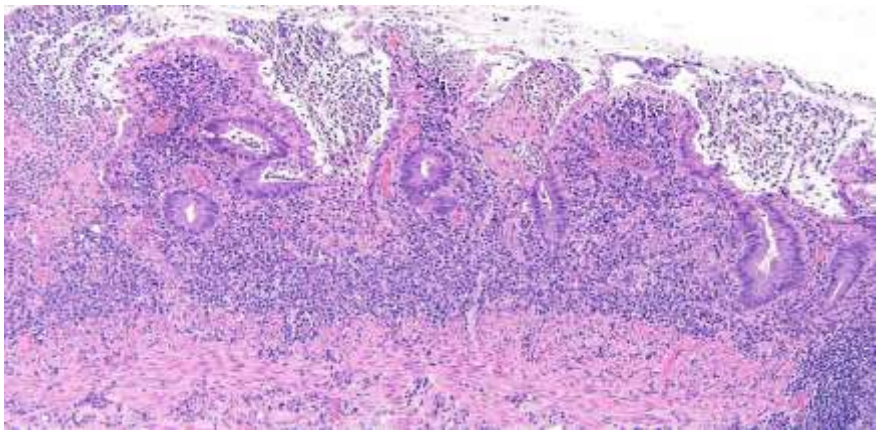

Figure 1: Ulcerative Colitis

Photomicrograph showing mucosal involvement with crypt distortion, crypt abscesses, goblet cell depletion, and dense superficial neutrophilic infiltration classical findings of ulcerative colitis. https://www.pathologyoutlines.com/imgau/colonuchortonhagen05.jpg

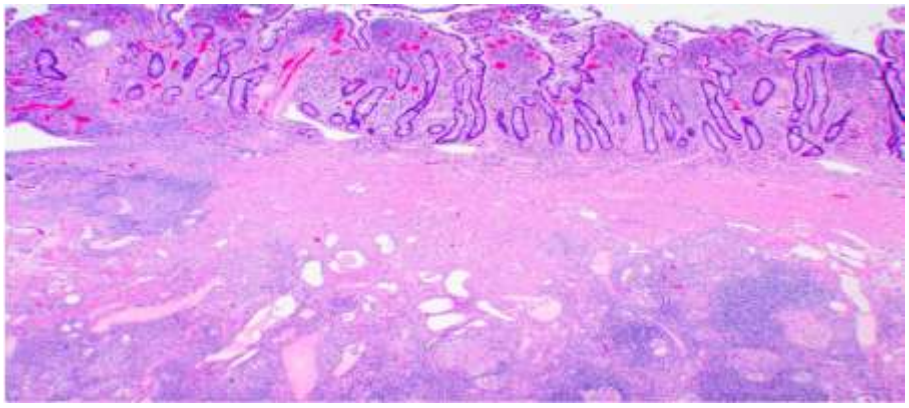

Figure 2: Transmural Inflammation in Crohn's Disease

Low power view showing extensive transmural inflammation with lymphoid aggregates and fibrosis hallmark of Crohn's disease. https://www.pathologyoutlines.com/topic/smallbowelcrohns.html

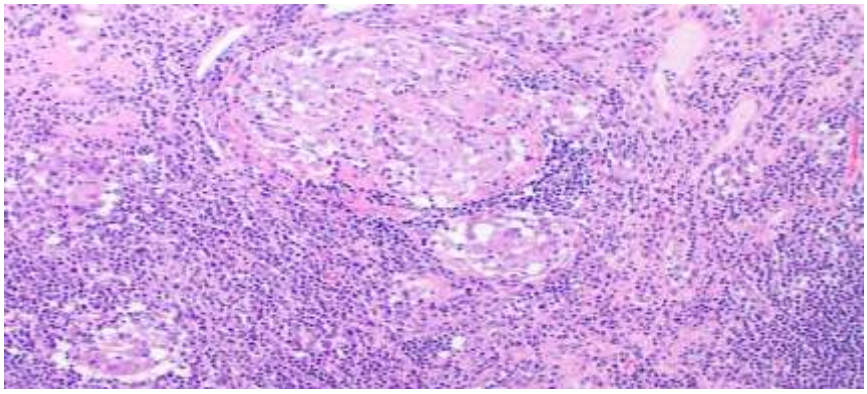

Figure 3: Multiple Non-Caseating Granulomas in Crohn's Disease

High-power H&E image showing well-formed, non-caseating granulomas surrounded by chronic inflammatory cells hallmark of Crohn's disease. https://www.pathologyoutlines.com/topic/smallbowelcrohns.html

The data were analyzed using SPSS version 25. Descriptive statistics were applied for demographic data. Chi-square tests were used to compare 'categorical variables between the two disease groups, while the

independent t-test was applied for continuous variables such as age and BMI percentile'. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In this study comprising 89 pediatric patients diagnosed with inflammatory bowel disease (IBD), the two subtypes, Crohn's disease (n=41) and ulcerative colitis (n=48) were compared on demographic and clinical grounds. The mean age of patients in the Crohn's group was 11.42 ± 3.24 years, while that of the ulcerative colitis group was 11.15 ± 2.49 years, indicating no statistically significant age difference between the two ($p = 0.6631$). Gender distribution was nearly balanced in both groups, with males slightly more represented in both (56.1% in Crohn's vs. 52.1% in UC; $p = 0.8221$). Symptom duration and BMI percentiles were comparable across both cohorts, with no significant variation. Family history of IBD was present in approximately one-third of both groups (31.7% in Crohn's and 31.3% in UC), again without statistical significance ($p = 0.9796$). These findings suggest that the two groups were demographically similar, providing a valid foundation for comparative histopathological assessment.

Table 1: Demographic and Clinical Characteristics of Participants (n = 89)

Variable	Crohn's Disease (n = 41)	Ulcerative Colitis (n = 48)	p-value
Mean Age (years)	11.42 ± 3.24	11.15 ± 2.49	0.6631
Gender (Male)	23 (56.1%)	25 (52.1%)	0.8221
Gender (Female)	18 (43.9%)	23 (47.9%)	
Symptom Duration (months)	8.1 ± 2.3	8.4 ± 1.8	NS
BMI Percentile	45.6 ± 19.4	48.2 ± 17.6	NS
Family History (Yes)	13 (31.7%)	15 (31.3%)	0.9796
Family History (No)	28 (68.3%)	33 (68.7%)	

Distinct histopathological features were observed between Crohn's disease and ulcerative colitis. Granulomas, a hallmark of Crohn's disease, were seen in 61% of 'patients with Crohn's but absent in all UC cases ($p < 0.0001$), strongly supporting their diagnostic value'. Conversely, crypt abscesses were significantly more frequent in UC (47.9%) than in Crohn's (14.6%) ($p = 0.0003$), reflecting the classic mucosal involvement in ulcerative colitis. Transmural inflammation was found exclusively in Crohn's cases (100%) and entirely absent in UC, consistent with the known pathology of deeper intestinal wall involvement in Crohn's ($p < 0.0001$). Similarly, skip lesions were unique to Crohn's disease, while continuous inflammation was observed in all UC patients, with both differences reaching high statistical significance.

Further microscopic features revealed additional contrasts. Distortion of mucosal architecture was more common in UC (75%) than Crohn's (43.9%) ($p = 0.0042$), while goblet cell depletion and basal plasmacytosis were also significantly higher in the UC group ($p = 0.0118$ and $p = 0.0132$, respectively). Neutrophilic infiltration in the lamina propria was observed in two-thirds of UC patients but only a third of those with Crohn's ($p = 0.0053$). Lymphoid aggregates were slightly more common in Crohn's (53.7%) than in UC (41.7%), though this difference was not statistically significant. These histopathological patterns clearly illustrate the differing inflammatory profiles of the two IBD subtypes in pediatric patients.

Table 2: Anatomical and Histopathological Findings

Variable	Crohn's Disease (n = 41)	Ulcerative Colitis (n = 48)	p-value
Granulomas (Present)	25 (61.0%)	0 (0.0%)	<0.0001
Crypt Abscesses (Present)	6 (14.6%)	23 (47.9%)	0.0003
Transmural Inflammation	41 (100%)	0 (0.0%)	<0.0001
Continuous Pattern of Lesions	0 (0.0%)	48 (100%)	<0.0001
Skip Lesions	41 (100%)	0 (0.0%)	<0.0001

Mucosal Architecture Distortion	18 (43.9%)	36 (75.0%)	0.0042
Goblet Cell Depletion	7 (17.1%)	20 (41.7%)	0.0118
Lamina Propria Neutrophils	15 (36.6%)	32 (66.7%)	0.0053
Basal Plasmacytosis (Present)	19 (46.3%)	35 (72.9%)	0.0132
Lymphoid Aggregates (Present)	22 (53.7%)	20 (41.7%)	0.2739

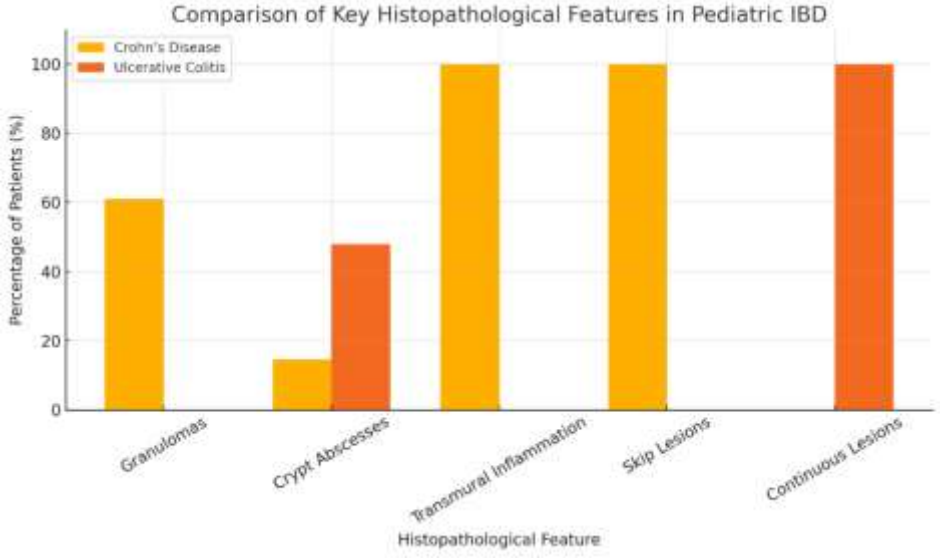

Figure 1: bar graph comparing key histopathological features between 'pediatric patients with Crohn's Disease and Ulcerative Colitis'.

DISCUSSION

The present study aimed to examine and contrast the histopathological and anatomical features of 'pediatric patients with Crohn's disease and ulcerative colitis'. Findings from this study highlight distinct diagnostic features that were consistent with established literature and provide valuable insight into disease differentiation in children [10-12].

One of the most notable differences observed was the presence of granulomas, 'which were significantly more common in Crohn's disease and absent in all ulcerative colitis cases'. This observation was in line with earlier reports emphasizing granulomas as a hallmark of Crohn's pathology, especially in the pediatric age group, where early and accurate classification is critical 13-15]. The granulomatous response indicates a deeper and transmural involvement, which aligns with the finding that all Crohn's cases in our study demonstrated transmural inflammation.

Ulcerative colitis, on the other hand, was characterized by continuous mucosal inflammation with a high frequency of crypt abscesses. These findings were well-supported by previous pediatric studies that describe UC as a mucosa-limited condition, marked by diffuse superficial damage and neutrophilic infiltration into crypts [16-18]. The presence of crypt abscesses in nearly half of the UC patients in our cohort reinforces its diagnostic importance.

Architectural distortion of colonic mucosa, goblet cell depletion, and basal plasmacytosis were significantly more prevalent in ulcerative colitis. These features have been highlighted in multiple histopathological scoring systems as markers of chronic mucosal injury and active inflammation [19]. Interestingly, neutrophilic infiltration in the lamina propria was also notably higher in UC, supporting the concept of active epithelial damage.

The skip lesions and patchy inflammation observed exclusively in Crohn's cases add further weight to the anatomical separation of the two disease entities. While skip lesions are pathognomonic for 'Crohn's disease, the complete absence of this feature in UC cases supports the characteristic continuous inflammatory pattern seen in ulcerative colitis' [20]. These gross and microscopic differences are crucial

in distinguishing these conditions, especially in pediatric patients where clinical overlap often complicates diagnosis.

A point of interest is that lymphoid aggregates, 'although slightly more common in Crohn's disease, were not significantly different between groups'. This suggests that while useful, lymphoid aggregates alone may not be a reliable differentiator in pediatric IBD and should be interpreted in combination with other features.

Overall, the study reinforces the diagnostic relevance of traditional histological markers in pediatric IBD and highlights the importance of comprehensive biopsy assessment in early disease classification.

CONCLUSION

This investigation clearly outlines the major histopathological and anatomical differences between pediatric Crohn's disease and ulcerative colitis. Granuloma formation, transmural inflammation, and skip lesions were exclusive to Crohn's disease, while continuous mucosal involvement, crypt abscesses, and distortion of the mucosal architecture were significantly associated with ulcerative colitis. These results confirm the established pathological pattern and illustrate the importance of meticulous biopsy evaluation in the pediatric IBD diagnosis. Timely and accurate distinctions not only enable precise management but also optimizes the long-term prognosis in children with these conditions. It is suggested that future multi-center studies with more robust sample sizes are needed to confirm these results and advocate for diagnostic framework unanimity in pediatric inflammatory bowel disease.

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