Paracolic Lymph Nodes: A Novel Diagnostic Sign For Pediatric Perforated Appendicitis?

Parakolik Lenf Nodu: Pediatrik Perfore Apandisitte Yeni Bir Tanı Belirteci Olabilir mi?

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ABSTRACT

Objective: Acute appendicitis is the most common reason for emergency abdominal surgery in pediatric population. Ultrasonography (US) is a widely used modality to diagnose acute appendicitis. Despite its success in diagnosing acute appendicitis, US have been reported to have a poor diagnostic accuracy to detect perforated appendicitis. We have frequently encountered lymph nodes around transvers colon in pediatric perforated appendicitis cases. We mainly aim to evaluate the accuracy of paracolic lymph node presence as a new diagnostic marker for perforated appendicitis.

Material and Methods: We have evaluated the US reports and/or images of the patients referred to radiology department with a clinical suspicion of acute appendicitis. Paracolic lymph node presence and sonographic findings indicating perforated appendicitis were recorded. Patients were divided into three subgroups according to their final diagnosis: Acute appendicitis, perforated appendicitis, others.

Results: Mean age of the population was 14.9±2.3 years. There were 300 acute appendicitis cases, 71 perforated appendicitis cases, and 92 other diagnosis cases (4 lymphoid hyperplasia, 88 normal appendix). Rates of lymph node presence in paracolic area were 41/300 (13.6%) in acute appendicitis subgroup, 58/71 (81.6%) in perforated appendicitis subgroup, and 4/92 (4.34%) in other diagnosis subgroup. A longest diameter of a paracolic lymph node > 8.5 mm seemed to be a good predictor for perforated appendicitis diagnosis (sensitivity 85%, specificity 77%).

Conclusion: We showed a statistically significant association between paracolic lymph node presence and perforated appendicitis. This sign can serve to confirm perforated appendicitis diagnosis over simple appendicitis.

Key Words: Children, lymph node, Perforated appendicitis, Ultrasound

ÖZ

Amaç: Akut apandisit, pediatrik popülasyonda, acil abdominal cerrahinin en sık sebebidir. Ultrasonografi (US) akut apandisit tanısında sık kullanılan bir görüntüleme yöntemi olmakla birlikte, perfore apandisit vakalarını tespit etmede yetersiz kalabilmektedir. Günlük pratikte, perfore akut apandisit olgularında, transvers kolon çevresinde, sıklıkla reaktif lenf nodları tespit etmekteyiz. Bu olgulardan yola çıkarak, pediatrik perfore akut apandisit olgularını tespit etmede, parakolik lenf nodu varlığının yeni bir tanısal US kriteri olabilme ihtimalini araştırmayı amaçladık.

Gereç ve Yöntemler: Retrospektif karakterdeki bu çalışma için, akut apandisit klinik tanısı ile radyoloji birimine yönlendirilen hastaların, US görüntüleri/raporları taranmış, US bulguları ve parakolik lenf nodu varlığı not edilmiştir. Perfore apandisit ile ilişkili parakolik lenf nodu varlığı ve sonografik bulgular kaydedildilmiştir. Hastalar kesin tanılarına göre üç alt gruba ayrıldı: akut apandisit, perfore apandisit ve diğerleri.

Bulgular: 300 akut apandisit vakası, 71 perfore apandisit vakası ve "diğer tanı" grubunda 92 hasta vardı. Her grupta perikolonik lenf nodu varlığı sıklığı şu şekildeydi: Akut apandisit alt grubunda 41/300 (% 13.6), perfore apandisit alt

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Ethics Committee Approval / *Etik Kurul Onayı*: The local institutional review board approved the current retrospective study (Consent number: 2019-16-12/201912).

Contribution of the Authors / Yazarların katkısı*: *UNER C: Study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, ***KARAMAN I***: Critical revision of the manuscript for important intellectual content.

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grubunda 58/71 (% 81.6) ve diğer tanı grubunda 4/92 (% 4.34) hasta bulunmaktaydı. Perfore apandisit tanısı için en az 8.5 mm çapında bir parakolik lenf nodu varlığı iyi bir dianostik kriter olarak belirlendi (duyarlılık% 85, özgüllük% 77).

Sonuç: Parakolik lenf nodu varlığı ile perfore apandisit arasında istatistiksel olarak anlamlı bir ilişki olduğunu gösterdik. Parakolik enf nodu varlığı, perfore apandisit olduğundan şüphelenilen vakalarda tanıyı doğrulamaya yardımcı olabilir.

Anahtar Sözcükler: Çocuk, Lenf nodu, Perfore apandisit, Ultrason

INTRODUCTION

Acute appendicitis (AA) is the most common reason for emergency abdominal surgery in pediatric population. Perforation of appendix is one of the most common complications of AA (1). Perforation rates have been reported between 23%-73% (2). Children younger than 5 years of age were defined to have greater risk for perforation (3). Prompt identification of perforation is important, because AA is treated surgically, meanwhile perforated appendicitis (PA) can be managed conservatively (4).

Ultrasonography (US) is a widely used and successful modality to diagnose AA in children with its high diagnostic accuracy, being easily accessible, noninvasive, and lack of ionizing radiation (5, 6). Despite its success in diagnosing AA, US has been reported to have a poor diagnostic accuracy to detect PA. Sensitivity and specificity of US to differentiate PA from AA has been reported between 23% to 48%, 93% to 100%, respectively (7, 8). Appendix perforation decompresses the appendix, its diameter diminishes, and it becomes more difficult to visualize the appendix. Hence, diagnosing PA becomes more difficult, when appendix cannot be visualized (4). Seeing that, additional sonographic findings become more important in PA diagnosis. In the literature, some additional US findings (e.g. loculated fluid collection, echogenic mesenteric fat, presence of abscess and/or appendicolith, liver echotexture, intraperitoneal fluid etc.) their diagnostic accuracy, as well as the diagnostic accuracy of their combinations, have been evaluated (1, 4).

During our clinical practice, we have frequently encountered lymph nodes around transvers colon especially next to liver in pediatric perforated appendicitis cases. In the current study, we mainly aim to evaluate the accuracy of lymph node presence in paracolic space as a new diagnostic marker for PA.

MATERIALS and METHODS

The local institutional review board approved the current retrospective study (Consent number: 2019-16-12/201912). Informed consent was waived because of the retrospective design. The study data was collected between January 2013 and December 2018.

We have evaluated the US reports and images (if present) of all the patients referred to radiology department with a clinical suspicion of AA. We have excluded the ones without sufficient US information and precise diagnosis. Also, we have excluded the patients who had a confirmed diagnosis to cause paracolic (around transvers colon, especially next to liver) lymph nodes, such as chronic liver disease, inflammatory bowel disease, gastrointestinal infection etc. According to mentioned method, we have evaluated 814 cases and, included 463 cases into the study.

US examinations for appendix is performed in the supine position with 7 MHz linear transducer, with using graded compression, beginning from the point at which the patient indicates maximal pain, and then continuing from the hepatorenal fossa through the right lower quadrant. Examinations of paracolic area performed with both 7 MHz linear and 3.5 MHz convex transducers (iU22 Philips Healthcare, Best, the Netherlands; and Aplio, Toshiba Medical Systems, Japan) (Figure 1-4).

We have also recorded additional US findings (periappendiceal echogenicity, abscess, free fluid in periappendiceal area, and complex free fluid in periappendiceal area) in PA cases (Figure 5).

All AA diagnosis was confirmed pathologically, PA diagnosis was based on radiological reports and clinical follow up data. Normal appendix results were confirmed pathologically and according to clinical follow up data.

Patients were divided into three subgroups according to their final diagnosis: Acute appendicitis, perforated appendicitis, others (lymphoid hyperplasia and normal appendix).

Statistical analysis:

Data were analyzed using Package for Social Sciences (SPSS) for Windows 20 (IBM SPSS Inc., Chicago, IL). Normal distribution of the data was evaluated with the Kolmogorov-Smirnov test. Numerical variables with normal distribution were shown as mean ± standard deviation. The variables not with normal distribution were shown as minimum-maximum values. Consecutive variables were evaluated with student's t test and Mann-Whitney U test. Categorical variables were compared by Chi square test and Fisher exact test. Logistic regression was performed to evaluate the relationship between perihepatic lymph nodes and additional sonographic findings in PA cases. ROC curve analysis was applied for diagnostic performance evaluation of perihepatic lymp node sizes for PA diagnosis. Youden index was used to define predictive values of PA. A two tailed value of $p< 0.05$ was considered statistically

RESULT

According to US results, 301 patients were diagnosed as AA, 67 patients were diagnosed as PA, 95 patients were diagnosed as normal appendix. When final diagnosis was evaluated; there were 300 AA cases, 71 PA cases, and 92 other diagnosis cases (4 lymphoid hyperplasia, 88 normal appendix) were included into the current study.

Mean age of the whole population was 14.9±2.3 years. There were 224 females (48.3%) and 239 males (51.6%) (Table I).

Rates of lymph node presence in paracolic area were 41/300 (13.6%) in AA subgroup, 58/71 (81.6%) in PA subgroup, and 4/92 (4.34%) in other diagnosis subgroup (Table II). Among 4 patients who had a lymph node in paracolic area in other diagnosis subgroup, 2 patients had pathologically confirmed lymphoid hyperplasia of appendix diagnosis.

Mean longest diameter of paracolic lymph nodes was 8.3±2 mm (5-12 mm) in whole population. Mean longest diameter of paracolic lymph nodes were significantly higher in PA subgroup (Table III).

According to regression analysis results; among additional sonographic criteria, presence of complex free fluid in periappendiceal area and presence of periappendiceal abscess increases the possibility of paracolic lymph node presence (OR=1.12, p=0.021; OR=1.97, p=0.001 respectively) (Table IV).

To define the performance of paracolic lymph nodes presence to predict PA diagnosis, ROC curves were created. The AUC estimate was 0.89 (95% CI, 0.80-0.98), the AUC value confirmed the diagnostic efficacy of paracolic lymph nodes. According to Youden's index values, a longest diameter of a paracolic lymph node > 8.5 mm seemed to be a good cut-off point to predict PA diagnosis (sensitivity 85%, specificity 77%).

Table I: Final diagnosis included in other diagnosis subgroup in detail.

Diagnosis	Number
Acute gastroenteritis	25
Familial Mediterranean Fever	8
Mesenteric lymphadenitis	11
Crohn's Disease	4
Pain related to menstrual period	20
Pelvic inflammatory disease	10
Diverticulitis	1
Epiploic appendicitis	3
Omental infarction	6

Table II: Mean age and sex of the population.

	Mean age (years)	Sex	
		Male	Female
Acute Appendicitis	16.8±2.2	163	137
Perforated Appendicitis	12.1±1.7	31	40
Others	14.3±1.9	45	47
Whole population	14.9±2.3	239	224

Table III: Paracolic lymph node presence rates.

	Paracolic lymph node presence (%)
Acute Appendicitis	41/300 (13.6%)
Perforated Appendicitis	58/71 (81.6%)
Others	4/92 (4.34%)
Whole population	103/463 (22.2%)

Table IV: Mean longest paracolic lymph node diameters.

	Mean longest perihepatic lymph node diameter (mm)
Acute Appendicitis	7.8±1.8
Perforated Appendicitis	8.7±2.3
Others	7.6±2.7
Whole population	8.3±1.9

Table V: Correlation between US parameters and paracolic lymph node presence.

	p
Increased periappendiceal echogenicity	0.5
Periappendiceal abscess	0.001
Perforation in appendix wall	0.07
Free fluid in periappendiceal area	0.2
Complex free fluid in periappendiceal area	0.021
p< 0.05 was considered statistically significant	

Table IV: Diagnostic performance of paracolic lymph node and additional sonographic criteria in PA diagnosis

	OR	p
Perforation in appendix wall	1.98	0.023
Periappendiceal abscess	1.47	0.012
Paracolic lymp node presence	1.43	0.032
Complex free fluid in periappendiceal area	1.13	0.04
p< 0.05 was considered statistically significant		

DISCUSSION

We found that PA caused paracolic lymph node presence more frequently than AA. Also, mean longest diameter of paracolic lymph nodes were greater if the diagnosis was PA, rather than AA. The possibility of seeing a paracolic lymph increased, in the presence of complex free fluid in and/or abscess in periappendiceal area. Paracolic lymph nodes greater than 8.5 mm increased the possibility of PA diagnosis.

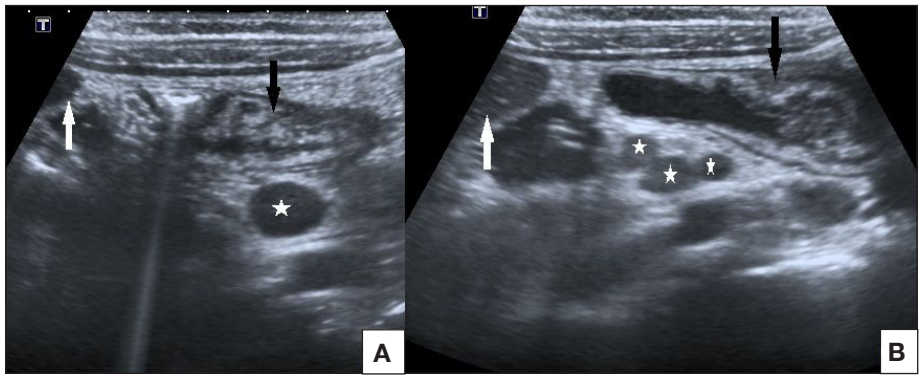

Figure 1: 12 year old male, perforated appendicitis. Paracolic lymph nodes are seen in paracolic area (liver: white arrow, transvers colon: black arrow, lymph nodes: asteriks)

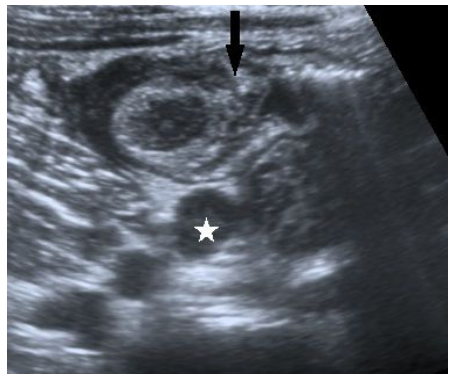

Figure 2: 5 year old female, perforated appendicitis. Lymph node can be seen (asteriks) located inferiorly to transvers colon (black arrow).

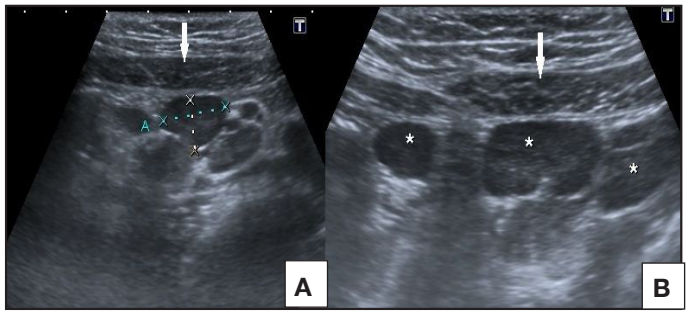

Figure 3: 8 year old female, perforated appendicitis. Lymph nodes (between calipers in a; asteriks in b) are located behind the rectus abdominis muscle (white arrow).

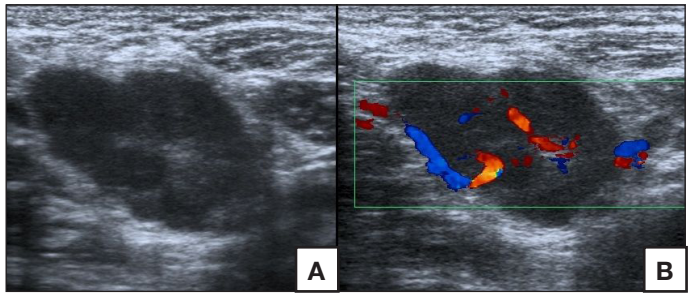

Figure 4: 10 year old male, mesenteric lymphadenitis. Paracolic lymph node (a), and its CDUS examination. Appendix vermiformis cannot be visualized in US examination, caecum and terminal ileum were edematous. Radiological diagnosis was possible perforated appendicitis; the final diagnosis was constituted as mesenteric lymphadenitis.

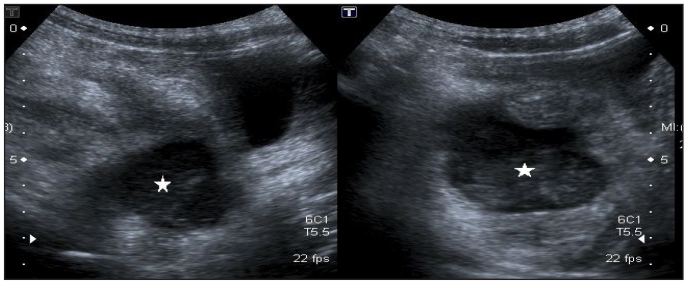

Figure 5: 4 year old male, perforated appendicitis. Abscess in periappendiceal area (asteriks).

Acute appendicitis is a common surgical emergency, and its incidence is four times greater in children than the overall population. Approximately 23-73% of pediatric acute appendicitis cases could be perforated. Most of the perforations occur within 72 hours of symptom onset (2, 9). Perforation is more common in children younger than 5 years of age, and periappendiceal abscess formation is more commonly encountered before 10 years of age (10).

PA is still a well-known diagnostic challenge in the US evaluation of acute abdominal pain in pediatric population. A reliable US examination can guide the treatment without ionizing radiation exposure. In the literature, there are many studies evaluating the diagnostic accuracy/performance of readily known US criteria, however it is still stated that PA is a sonographic diagnostic challenge (4, 11, 12). As far as we know, there is not a recent study to request a new, different US criterion for PA diagnosis. Hence, as proposing paracolic lymph node presence as an alerting factor for PA diagnosis, we contribute to the preexisting literature.

Lymphatic fluid of the appendix drains into iliocolic lymph nodes which are located mainly around the iliocolic artery (13) (Figure 6). It can be inferred that as the inflammation increases, enlargement of the lymph nodes proceeds from lower iliocolic lymph nodes into the upper iliocolic lymph nodes. Since lower lymph node group is situated between intestinal and colonic loops more than upper group, it can be more difficult to detect lymph node enlargement at this level. We think that with the perforation, enlargement of upper lymph nodes becomes more prominent and it becomes easier to detect them around paracolic area.

Perforated appendicitis creates a more prominent inflammation than simple appendicitis both in periappendiceal area and whole body (14). This can also support the high prevalence of paracolic lymph node presence, and having a higher longest paracolic lymph node diameter in PA subgroup.

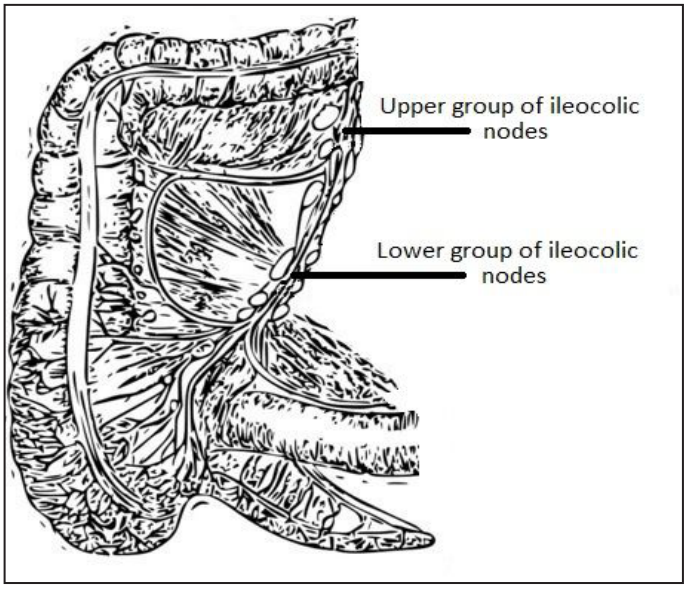

Figure 6: Lymphoid drainage of appendix vermiformis.

Complex fluid collection and abscess in periappendiceal area, both, increases the inflammatory response by the presence of infection (12). We found that the presence of these findings increased the possibility of detecting paracolic lymph nodes, rather than other US criteria. This relationship also supports the possible relationship between the level of infection and presence of paracolic lymph nodes, mentioned before.

According to ROC analysis, longest diameter of paracolic lymph nodes can be used to differentiate perforated appendicitis cases from acute appendicitis. This result supports the idea of using paracolic lymph nodes presence as a novel diagnostic parameter for detecting PA cases.

This study has some limitations. First of all, we have evaluated the diagnostic value of paracolic lymph nodes in patients with a clinical diagnosis of acute appendicitis; also we have excluded the patients having diagnosed pathologies to cause paracolic lymph node. Hence, we have studied in a very homogenized and standardized population; our results do not reflect the entire population successfully. Such as, concurrence of appendicitis and inflammatory bowel disease or chronic liver disease is not subject of the current study. Seeing that presence of paracolic lymph node cannot serve as an independent diagnostic criterion for PA, instead it is only useful in cases, when the radiologist is sure of appendiceal inflammation presence however, he/she cannot find satisfactory evidence to claim perforation over simple appendicitis.

In addition, we did not compare the diagnostic performance of paracolic lymph node presence in comparison with the other US findings of PA; because the US reports did not contain the same additional US findings of PA.

Finally, retrospective nature of the study and limited patient number are some of the limitations to mention. Further prospective studies can enlighten better the diagnostic performance of paracolic lymph node presence.

To conclude; we showed a statistically significant association between paracolic lymph node presence and perforated appendicitis. When the other possible reasons of paracolic lymph node presence are ruled out, this sign can serve to confirm perforated appendicitis diagnosis over simple appendicitis.

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