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

Conflict of Interest / Çıkar Çatışması: On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethics Committee Approval / Etik Kurul Onayı: The local institutional review board approved the current retrospective study (Consent number: 2019-16-12/201910).

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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.}

**INTRODUCTION**

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 lymph 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 significant.
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%).

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.
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.
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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