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Is Duodenal Ulcer Perforation in Adolescents Different from Duodenal Ulcer Perforation in Adults?

Ali Sayan [1], Mehmet Mert [2,*], Mustafa Onur Oztan [3], Tunc Ozdemir [4] and Gökhan Köylüoğlu [3]

[1] Department of Pediatric Surgery, University Of Medical Sciences, Tepecik Education and Research Hospital, Izmir, Turkey
[2] Department of Pediatric Surgery, University Of Medical Sciences, Van Education and Research Hospital, Van, Turkey
[3] Department of Pediatric Surgery, Katip Celebi University Medical Faculty Hospital, Izmir, Turkey
[4] Department of Pediatric Surgery, Kent Hospital, Izmir, Turkey

[*] *Corresponding author*: Department of Pediatric Surgery, University of Medical Sciences, Van Education and Research Hospital, Van, Turkey. Tel: +90-5362418380, Email: dr.mehmet.mert@outlook.com

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Abstract

Background: Duodenal ulcer perforations (DUP) are missed in the differential diagnosis of acute abdomen because they are less common in children than in adults. Delay in diagnosis may cause morbidity or even mortality. It was aimed to raise awareness about DUP in adolescent by comparing the data of adolescent cases treated in our clinic with the adult cases' data in the literature.
Objectives: We reviewed the clinical characteristics of nine male patients with DUP, ages between 14 and 17 years, admitted to our clinic between January 2007 and June 2020 retrospectively. Literature data on DUP in adults were reviewed.
Methods: The obtained data were compared with the data of adult patients in the literature.
Results: Patients were reported to have symptoms such as abdominal pain and vomiting that lasted for 1-30 days on average in 8 patients, and nonsteroidal anti-inflamatory drugs were used all patients except 2 patients. There was diffuse tenderness at the abdomen in all of the remaining patients and in 7 patients intraabdominal free air was observed. Perforation was repaired with omentoplasty in all patients. Unlike the adult population, DUP adolescents are more related to NSAID use rather than *Helicobacter pylori* infection and complicated surgical techniques were not required because the cases were generally not complicated.
Conclusions: Although it is rarely seen in adolescents and shows certain differences compared to adult patients, the anamnesis and physical examination of the patients should direct the physicians to the DUP. Differences from adult population should be considered in diagnosis and treatment.

Keywords: Adolescent, Duodenal Ulcer Perforation, *Helicobacter pylori*, Nonsteroidal Antiinflammatory Drug, Pneumoperitoneum

1. Background

Peptic ulcer is a disease caused by an imbalance between aggressive factors, such as gastric acid and pepsin and mucosal defense. Although the need for elective surgery has decreased with medical treatments, surgical treatment is required especially after perforation in peptic ulcer. Since duodenal ulcer perforations (DUP) are less common in adolescents than adults, they are not one of the first pathologies that come to mind in the differential diagnosis of acute abdomen. Although there is no clear rate in the literature regarding the incidence of DUP in adolescents, the incidence of peptic ulcer disease in children is reported as 5.4/100.000. Since DUP is not considered a priority in adolescents presenting with abdominal pain, the diagnosis is usually made after clinical deterioration or complications occur. Delays in diagnosis may cause increased morbidity and even mortality. In this study, the etiological features, treatment methods and differences from DUP in adults were examined in the light of literature data in adolescents who were treated for DUP in our clinic.

2. Objectives

The current study aimed to raise awareness about DUP in adolescents. To our knowledge, this study is the first study in the literature that compares DUP in adolescent cases with adult data.

3. Methods

3.1. Ethics Committee Approval

This study was conducted after obtaining ethical approval from the Health Sciences University Tepecik Educa-

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tion and Research Hospital Clinical Research Ethics Committee (approval#14.09.2020/11-39).

3.2. Study Design

The age, gender, drug use history, clinical and radiological characteristics and postoperative follow-up processes of nine patients who were operated on for DUP in our clinic between January 2007 and June 2020 were retrospectively analyzed in the present study. Differences between cases were revealed. Previous studies related to DUP in adult were searched in the biomedical database named National Library of Health of the US National Library of Medicine (PubMed®) and UpToDate®. The data obtained from this research and the data of DUP in the adolescent who operated in our clinic were discussed comparatively.

4. Results

Between January 2007 and June 2020, nine patients were operated on for DUP in our clinic. All of the patients were asthenic males. The average age was 15.2 years (median 15 years). It was learned that the patients had complaints of abdominal pain for 1 - 30 days (median two days), loss of appetite and vomiting. In addition, it was learned that seven patients had a history of nonsteroidal anti-inflammatory drug (NSAID) use in their anamnesis (Table 1).

Eight of nine patients were operated on with a prediagnosis of DUP. Four of these eight patients had widespread abdominal tenderness, two patients had tenderness in the right lower quadrant of the abdomen, and two patients had a wooden abdomen finding. Six of these patients had subdiaphragmatic free air on plain abdominal X-ray, but two patients had no sign of pneumoperitoneum (Figures 1 and 2).

Except for these eight patients, the other patient was brought to the pediatric emergency department with complaints of abdominal pain in the right lower quadrant of the abdomen, tenderness and vomiting that started four days ago. This patient was operated on with a prediagnosis of acute appendicitis in our clinic. Gangrenous appendicitis was detected and an appendectomy was performed. The patient was followed up in the pediatric intensive care unit after surgery. Pneumoperitoneum was detected in the plain abdominal X-ray due to the development of hematemesis and widespread abdominal tenderness on the postoperative 5th day. However, upper gastrointestinal system endoscopy was performed on the patient because it was not possible to clearly distinguish whether intraabdominal free air was a postoperative appearance or gastrointestinal system perforation. When a peptic ulcer, bleeding and perforation were observed in the first part of the duodenum in the endoscopy, the patient was urgently operated on, and surgical repair of the DUP was performed.



Figure 1. Intraabdominal free air on plain abdominal radiography in a patient with duodenal ulcer perforation.

Since all nine patients were operated on under emergency conditions, no preoperative examination was performed for *Helicobacter pylori* infection. In all patients, primary surgical repair was performed to the DUP and omentopexy was performed. The mean postoperative follow-up period of the patients was 11.8 months. In the postoperative follow-up, the patients were serologically examined for *H. pylori* infection by enzyme-immunoassay method, and no antibody developed against *H. pylori* was detected. No complications or recurrence were observed in the postoperative follow-up of the patients.

5. Discussion

A peptic ulcer is a defect in the stomach or duodenal mucosa that begins from the muscularis mucosa and extends to deeper layers. Peptic ulcer disease was the most common indication for adult gastric surgery in the past, but nowadays, it rarely requires surgery. In recent years, the development of potent antisecretory agents and preventing ulcer recurrence with the treatment of *H. pylori* infection has considerably reduced the need for elective

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Table 1. Demographic and Clinical Data of Patients Operated Due to Duodenal Ulcer Perforation

Patient	Age	Duration of Clinical Complaint (Days)	NSAID Usage Period (Days)	Subdiaphragmatic Free Air on Plain Abdominal X-Ray
1	15	2	7	-
2	17	2	0	+
3 [a]	12	4	2	+
4	15	1	4	-
5	14	30	0	+
6	16	3	2	+
7	15	1	7	+
8	17	2	3	+
9	16	2	1	+

Abbreviation: NSAID, nonsteroidal anti-inflammatory drug.
[a] Patient operated for duodenal ulcer perforation 5 days after surgery due to gangrenous appendicitis.



Figure 2. Preoperative plain abdominal radiography of a patient with duodenal ulcer perforation. Although intraabdominal free air is not seen, the air-fluid level in the right lower quadrant of the abdomen is remarkable.

surgery (1). However, complications of peptic ulcers still occur. Since peptic ulcer disease is less common in children than adults, it may be complicated by severe bleeding or perforation more often than adults. All nine peptic ulcer patients who were previously undiagnosed who were treated in our clinic were diagnosed with a perforation after being complicated.

In a prospective cohort study conducted with an adult patient population, no relationship was found between the type of fat intake or the amount of fat intake and the risk of duodenal ulcers (2). However, it was reported that high consumption of fruits and vegetables, fiber diet and vitamin A consumption reduced the risk of ulcer disease. It is noteworthy that all nine patients who underwent surgery for DUP in our clinic were asthenic. When the nutritional characteristics of the patients were questioned, it was learned that the patients did not eat a fatty diet but mostly vegetables. The nutritional characteristics of the patients support the hypothesis that there is no relationship between DUP and fatty nutrition, as stated in the study conducted by Aldoori et al. in an adult patient population (2).

Although clinical symptoms of peptic ulcer disease may vary with age, they are generally asymptomatic. Vomiting, bleeding and perforation are more common in young children. In adolescents, epigastric pain is prominent, similar to adults. The "classic" pain of duodenal ulcers occurs two to five hours after a meal when acid is secreted in the absence of a food buffer and at night (between about 11 PM and 2 AM) when the circadian pattern of acid secretion is maximal (3). Unlike classical symptomatology, patients who underwent surgery for DUP in our clinic had abdominal pain, anorexia and vomiting that lasted between 1 - 30 days (median two days), especially after feeding. It was thought that the fact that the symptomatology of the patients was different from the classical duodenal ulcer clinic caused the late diagnosis of duodenal ulcer, missed diagnosis and complicated duodenal ulcer results.

Helicobacter pylori infection and NSAID use are the two most blamed factors in the etiology of duodenal ulcers. NSAID use and *H. pylori* infection are independent, and at the same time, synergistic risk factors for uncomplicated

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and bleeding peptic ulcer disease. The prevalence of *H. pylori* in both the general population and patients with a peptic ulcer is rapidly decreasing in developed regions due to improved hygiene and reduced transmission risk in early childhood. Cases of duodenal ulcer associated with *H. pylori* infection are less common in children than in adults (4). In a large-scale, prospective multicenter study conducted by Kalach et al., *H. pylori* infection was reported in 27% of children with peptic ulcer (5). Also, no significant relationship was found between *H. pylori* infection, which presented in 27% of children in any of the different European countries, and the location of gastric or duodenal ulcers/erosions (5). In another study reported by Reinbach et al., the findings showed that there was no relationship between *H. pylori* infection and DUP (6). In addition, together with *H. pylori* infection, the use of NSAIDs is considered an important risk factor not only for gastrointestinal mucosal injuries in adults but also in children (5). It has also been stated that DUP has different pathogenesis than chronic recurrent duodenal ulcer disease and should not be seen as a complication of chronic recurrent duodenal ulcer. When these data in the literature have been examined, it has been seen that there has been no consensus regarding the relationship between *H. pylori* infection and DUP, especially in pediatric cases. Since the surgeries of patients who were operated on for DUP in our clinic were performed under emergency conditions, no examinations were performed for *H. pylori* infection before surgery. No specific treatment for *H. pylori* infection was administered to the patients in the postoperative period. In the article published by Reinbach et al., 14C-urea breath tests were also performed on patients with perforated duodenal ulcer 4 - 10 weeks after surgery, and only 49% were positive (6). Enzyme-immunoassay method for *H. pylori* infection in the postoperative period was preferred because it is more practical to use in the pediatric population and has a high diagnostic value. Despite this, the patients were serologically examined for *H. pylori* infection by enzyme-immunoassay method and no antibody developed against *H. pylori* was detected. Despite the small number of cases, our clinical experience supports the view that there is no relationship between *H. pylori* infection and DUP.

The use of NSAIDs is known as the main cause of peptic ulcers in patients without *H. pylori* infection, especially in adult patients. It has been reported that the use of NSAIDs causes a four-fold increase in the risk of peptic ulcer disease (7). In addition, the use of NSAIDs in adults increases the risk of complications in peptic ulcer disease. Ulcers induced by NSAIDs may also be more resistant to conventional treatment (8). While approximately half of the cases of peptic ulcer disease are reported to be idiopathic, it has been reported that peptic ulcers in children younger than 10 years are generally caused by drugs (corticosteroids or NSAIDs) or major stresses (9, 10). 15 - 45% of patients using chronic NSAIDs have asymptomatic ulcers that can also be detected endoscopically. It has been reported that 1 - 4% of patients using NSAIDs for a year may develop severe gastrointestinal complications (10). However, in a study conducted by Collen et al., it was reported that the use of NSAIDs did not cause duodenal ulcer but caused duodenal ulcer complications and worsened the pre-existing duodenal ulcer (11). Seven of the patients who were operated for DUP in our clinic had a history of NSAID use for an average of 3.7 days. It was learned that these patients had no previous diagnosis of peptic ulcer and used NSAIDs regularly due to dyspepsia. The findings suggest that, unlike the adult population, DUP adolescents are more related to NSAID use rather than *H. pylori* infection.

Since the symptoms of DUP in the pediatric population are generally not specific, radiological methods may be preferred for diagnosis. In a study conducted by Yan et al., it was reported that 71.4% of patients with DUP were observed to have subdiaphragmatic free air with plain abdominal X-ray (12). Subdiaphragmatic free air was not detected on a plain abdominal X-ray of two patients in our series. Extra imaging method was not performed because the anamnesis of these patients was compatible with the classic duodenal ulcer symptoms, the history of NSAID use, the presence of wooden abdomen on physical examination and a delayed diagnosis might lead to worse results. The patients were operated and the DUP was detected. Primary surgical repair and omentopexy were performed. In addition, when the indications for surgical treatment in DUP are examined in the guideline published by the World Society of Emergency Surgery in 2020, surgical treatment is recommended for patients with severe pneumoperitoneum or extraluminal contrast extravasation or peritonitis (13). In this context, the absence of pneumoperitoneum with imaging methods does not suggest that the patient does not need surgical treatment. Surgical decisions can be made in accordance with the patient's anamnesis, clinic and physical examination findings. However, this does not mean that no help is obtained from imaging methods. In our case series, it was not possible to say whether the subdiaphragmatic free air in the plain abdominal X-ray of the patient who developed DUP during the follow-up in the pediatric intensive care unit after appendectomy was a postoperative subdiaphragmatic free air or a subdiaphragmatic free air due to DUP. Therefore, after upper gastrointestinal system endoscopy, the patient was diagnosed with DUP and operated on.

In duodenal ulcer perforation, in adult patients, the perforation area is usually covered with a piece of omentum (Graham patch) or treated with pyloroplasty and

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truncal vagotomy for DUP close to pylor (14). In NSAID-associated DUP, it can usually be treated with primary surgical repair, as the NSAID can almost always be discontinued or switched to a COX-2 inhibitor. Bancroft technique or Nissen technique can be performed in complicated or large DUP in adults. Primary surgical repair and omentopexy were performed as a surgical method since the ulcer area was not large (< 2 cm) and uncomplicated perforations in adolescent patients with DUP operated in our clinic. No recurrence or complication was observed in the postoperative follow-up of the patients. Seven of the adolescent patients with DUP in our clinic had a history of NSAID use, and our findings showed that primary surgical repair was sufficient, as in NSAID-associated DUP seen in adult patients. Since DUP detected in adolescents is generally not complicated, our findings suggest that complicated surgical techniques used in adults need not be performed in adolescents.

In cases with DUP, mortality was reported between 6 and 31% in adult studies, while this rate was reported between 3.8 and 12.5% in pediatric studies (15, 16). Morbidity and mortality are high in patients who are diagnosed late, whose treatment is delayed and complicated. Morbidity and mortality were not observed in nine patients who were operated on in our clinic.

Although it is seen rarely in adolescence and shows certain differences compared to adult patients, the history and physical examination of the patients should direct the physician to the DUP. Radiological methods can also help confirm the diagnosis. However, we should note that the absence of subdiaphragmatic free air radiologically does not rule out DUP. Therefore, DUP should always be kept in mind in the differential diagnosis of acute abdomen in adolescents.

As a result, differences from the adult population should be considered in the diagnosis and treatment of DUP, which is rare in the pediatric group. As such comparative studies on DUP increase in the literature, we will have more experience in diagnosis and treatment in the pediatric group.

Footnotes

Authors' Contribution: Concept, A.S., M.M.; Design, A.S., M.M.; Supervision, A.S., M.M., M.O.O., G.K.; Resources, A.S., M.M., M.O.O., T.O., G.K.; Data collection and/or processing, M.M.; Analysis and/or interpretation, A.S., M.M.; Literature search, A.S., M.M.; Writing manuscript, M.M.; Critical review, A.S., M.M., M.O.O., T.O., G.K.

Conflict of Interests: There is no conflict of interest.

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