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Original article

Clinical features and treatment outcomes in obese children with appendicitis

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Background: Even developing countries are facing problems of childhood obesity. Diagnosis and treatment of appendicitis in obese children can sometimes be challenging. This study compared clinical features and treatment outcomes between non-obese and obese children clinically diagnosed as appendicitis.

Methods: Children (0 - 15 years) diagnosed as appendicitis between 2007 and 2013 were reviewed. Children were categorized into non-obese and obese groups using weight for height (> 140.0% of ideal body weight) based on the data of the Ministry of Public Health. Demographic data, clinical data, and treatment outcome were studied. Comparisons between non-obese and obese children were carried out. SPSS was used for all statistical analyses. Data are expressed as mean ± standard deviation.

Results: There were 268 children (222 non-obese and 46 obese) pre-operatively diagnosed as appendicitis. All patients underwent open appendectomy. Body mass index (BMI) of non-obese children was 18.3 ± 3.5 kg/m^2 whereas BMI of obese children was 27.2 ± 4.3 kg/m^2, ($P < 0.0001$). There was no difference in age between the 2 groups (non-obese vs. obese, 10.6 ± 2.7 vs. 10.5 ± 2.2 yr., $P = 0.84$). The majority of patients sought medical attention within 24 hours in both groups (67.0% vs. 76.0%, $P = 0.23$). Imaging studies (ultrasound or computed tomography) was used to confirm the diagnosis in 6.3%. There was no difference between non-obese and obese groups regarding operative time (71.3 ± 26.4 vs. 77.9 ± 28.1 min, $P = 0.13$), negative appendectomy rate (6.7% vs. 8.7%, $P = 0.75$), perforation rate (17.1% vs. 9.0%, $P = 0.25$), hospital stay (94 ± 64 vs. 81 ± 39 hr., $P = 0.19$) and wound infection (4.9% vs. 4.3%, $P = 0.99$).

Conclusion: Approximately one-fifth of children undergone appendectomy were obese. Our data suggest that obesity might not be associated with increased difficulty in making the diagnosis of appendicitis in children. However, childhood obesity appears to be associated with potentially more difficult surgery, as the increase in operative times.

Keywords: Obesity, appendicitis, children, complication.

Nowadays, many countries are facing problems of childhood obesity.[1] By 2010, studies showed that 22.0% to 40.0% of children in North American, Eastern Mediterranean, World Health Organization (WHO) regions, Europe, western Pacific, and Southeast Asia were predicted to be overweight or obese.[2,3] In Thailand, the prevalence of childhood obesity also increases by years.[4 – 7] Obesity in children can lead to various complications as adults which is not only the medical problems such as metabolic disease but also the surgical problems.[1,2,8 - 10] One of the most common conditions requiring abdominal surgery in children is appendicitis. The diagnosis and treatment of appendicitis in obese children can sometimes be challenging. This study aims to compare the clinical features and treatment outcomes between non-obese and obese children with clinically diagnosed appendicitis.

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Materials and methods

Medical records of children (0 - 15 years) clinically diagnosed as appendicitis and underwent open appendectomy at King Chulalongkorn Memorial Hospital (KCMH) between 2007 and 2013 were

reviewed. The patients who underwent interval appendectomy were excluded. Then children were categorized into non-obese and obese groups using Thai Growth Reference.[11] The obese group was defined by age- and gender-specific weight-for-height (W/H) more than 2 standard deviation (SD) of mean. Demographic data, clinical data, and treatment outcome were studied. The definite diagnosis of appendicitis was based on the pathology report and classified as perforated or non-perforated appendicitis. Comparisons between non-obese and obese children were carried out. SPSS version 22.0 was used in all statistical analyses. Data are shown as mean ± SD. Fisher's Exact test and unpaired *t* - test were used to compare proportions, and results were considered statistically significant at *P* - value less than 0.05.

This cross-sectional study descriptive was approved by the Institutional Review Board (IRB), Faculty of Medicine, Chulalongkorn University, IRB no. 064/57.

Results

Two hundred and sixty-nine children were admitted to the hospital after doctors diagnosed them with appendicitis, except one who was excluded for undergoing interval appendectomy. Of 268 patients, there were 169 male patients and 99 female patients. When we looked into the demographic and clinical data (Table 1), we found that the mean age of all children was 10.6 years old, mean weight for height (W/H) was 115.3%, and time to presentation was 32.4 hrs. After categorized the children into non-obese and obese groups using Thai Growth Reference,[11] 222 patients (82.8%) were non obese, while 46 patients (17.2%) were obese. For the demographic data, there was no statistical difference of time to presentation, admission body temperature (BT), and white blood cell (WBC) data between the two groups. The mean W/H in the obese group was 160.4% whereas the other group was 105.9%.

For management and outcome (Table 2), we found that there was no significant difference of the number of imaging for diagnosis between the two groups. The overall of the mean operative time was 73.0 minutes and the obese group had significantly longer operative time compared to the non-obese group (80.9 ± 30.0 min vs. 71.3 ± 26.4 min; $P = 0.03$). The pathologic findings showed that 42 patients had perforated appendicitis, which is 38 patients (17.1%) in the non-obese group and 4 (9.0%) in the obese group. Similarly, there was no statistically significant difference of the number of negative appendectomies between both groups (6.7% vs. 8.7%). About post-operative complication, 14 patients had wound infection. The overall length of hospital stay was 91.8 hrs and there was no statistically significant difference between the obese and non-obese groups.

Table 1. Demographic and clinical data.

Demographic and clinical data	Mean ± SD	*P* - value
Age (years)	10.6 ± 2.6	0.84
Non-obese (222)	10.6 ± 2.7	
Obese (46)	10.5 ± 2.2	
Male (%)		0.05
Non-obese (222)	60.4	
Obese (46)	76.1	
Body mass index (kg/m^2)	19.8 ± 4.9	< 0.0001
Non-obese (222)	18.3 ± 3.5	
Obese (46)	27.2 ± 4.3	
Weight for height (%)	115.3 ± 27.9	< 0.0001
Non-obese	105.9	
Obese	160.4	
Time to presentation (> 24 hr) (%)		0.23
Non-obese	73 (33.0)	
Obese	11 (24.0)	
Admission body temperature (^{o}C)	37.5 ± 0.8	0.31
Non-obese	37.6 ± 0.9	
Obese	37.4 ± 0.9	
White blood cell (cells/mm^3)	15,622.1 ± 5,482.7	0.90
Non-obese	15,641.0 ± 5,694.0	
Obese	15,529.6 ± 4,350.1	

Table 2. Management and outcome data between non-obese and obese group.

Management and outcome data	Non-obese (222) (%)	Obese (46) (%)	*P* - value
Operative time (min)	71.3 ± 26.4	80.9 ± 30.0	0.03
Perforated rate	38 (17.1)	4 (9.0)	0.25
Negative appendectomy	15 (6.7)	4 (8.7)	0.75
Ultrasound use	9 (4.1)	3 (6.5)	0.44
Computed tomography use	4 (1.8)	1 (2.2)	0.99
Length of hospital stay (hr)	94.0 ± 64.0	81.0 ± 39.0	0.19
Wound infection	12 (5.4)	2 (4.3)	0.99
Delayed primary suture	8 (3.6)	1 (2.2)	0.99
Wound infection and delayed primary suture	20 (9.0)	3 (6.5)	0.77

Discussion

For the literature review, the perforation rate of appendicitis in children was 12.9% to 38.9%, and the negative appendectomy rate was 2.5 to 13.5%.[9, 12 – 15] Whereas, in our study, there were 15.7% of perforated appendicitis in children and 7.1% of negative appendectomy. The factors that increase the risk of perforation, including the patient's age, the onset of symptoms, family history of appendicitis, health insurance, and also obesity.[9, 14, 16 - 18] In the obesity group, the perforation rate was increasing (11.1% to 45.0%).[9, 13, 14, 19] As well as the incidence of negative appendectomy in obese children, Kutasy B, *et al*.[19] found that the incidence of normal appendectomy was significantly higher in very obese children compared to non-obese children. The increase incidence of perforation and normal appendix might be explained by the difficulty of abdominal palpation because of abdominal circumference and excess adiposity.[20] However, our study found that the perforation rate in the obese group was 9.0% compared to 17.1% in the non-obese group and the negative appendectomy rate was 8.7% in the obese group and 6.7% in the non-obese group which without statistically significant difference of both findings.

Because of the difficulty of the physical examinations in childhood with obesity, several studies have advocated using further imaging in obese patients with clinically suspected appendicitis. Although a nondiagnostic screening ultrasonography has lower accuracy in overweight children [21] and the appendix frequently cannot be visualized in obese children,[22] a non-radiation benefit is one of the main reasons for selecting this technique before computed tomography (CT). Our study found that there were no significant difference of ultrasonography and CT scan use between the obese group and the other.

The operative time showed that the obese group had significantly longer than non-obese group (80.9 ± 30.0 min vs. 71.3 ± 26.4 min; $P = 0.03$) consistent with both laparoscopic and open appendectomy studies.[13, 23] In adult study found that obesity significantly increased operative time for each procedure.[10] This might be explained by the difficulty of peritoneal cavity assessment. However, there was no statistically significant difference in length of hospital stay between two groups. While the other studies [13,23] found that childhood obesity is associated with long hospital stays. The wound infection and delayed primary suture rate were not a significant difference between both groups. Regarding these results, we encouraged to do the primary suture after appendectomy even in perforated appendicitis of an obese child. This technique is a benefit for reducing the experience of pain and anxiety from dressing changed in children.

There are some limitations in our study, including retrospective data, small numbers of children in all groups, particularly in the obese group, and the different definitions of obesity. The classification of the weight status of children is complicated by the fact that height and body composition are continually changing. There were different definitions of obesity in children, some studies use weight for ages, some studies use BMI for age.[9, 13, 14, 19, 23] Our study defined obese children by age- and gender-specific weight-for-height (W/H) more than 2 SD of median according to Thai Growth Reference.[11] This reference might lower estimations of overweight compared to WHO Growth Reference and the International Obesity Task Force.[7] However, some studies [4, 6] suggest that it might be more appropriate to use the W/H. It is also suggested that a sex-specific, BMI for-age growth chart for Thai children be constructed.

Conclusion

Approximately one-fifth of children undergoing appendectomy were obese. Our data suggest that obesity might not be associated with increased difficulty in making the diagnosis of appendicitis in children. However, childhood obesity appears to be associated with potentially more difficult surgery, as the increase in operative times.

Conflict of interest

The authors, hereby, declare no conflict of interest.

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