Diagnostic Value Of Ultrasonography On Negative Appendectomy And Perforation In Children

V Adetiloye, S Al'Damegh

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Abstract

We prospectively evaluated the impact of ultrasound (US) in the outcome of appendectomy findings in children. We analyzed the clinical data of 96 consecutive patients who had appendectomy following clinical suspicion of acute appendicitis. Pre-op US was performed in 60 patients while 36 patients had surgery without pre-op US.

The total rate of negative appendectomy for all patients that had pre-op US was 16.7 % (mis-diagnosis and other pathologies not appendicitis; n = 10/60), for misdiagnosis only is 3.3 % and for perforation was 20 %. The rate for negative appendectomy in patients without pre-op US was 33.3 % and perforation rate was 13.9 %.

Statistical analysis revealed a significant association between the use of pre-op US and positive appendectomy (P = 0.001). No statistically significant difference in the rates of perforation (P = 0.630) or rates of negative appendectomy (P =0.105) between the two groups.

In conclusion, pre-op US is essential for the reduction of negative appendectomy rate especially when performed by highly trained and experienced sonologists with a close rapport between the surgeons and sonologists. Unnecessary delay in surgery should be prevented by prompt preparation and performance of pre-op US so as to further reduce the perforation rate.

INTRODUCTION

Acute appendicitis is the commonest cause of abdominal emergency in children requiring immediate surgery ([1]). Often times the clinical diagnosis may be difficult and it has been accepted that it is safer to intervene surgically to present perforation ([2]). Such decision has led to negative appendectomy in up to 20% of cases ([3]). This rate is indeed considered good practice ([4]), but higher rates of negative appendectomies may be experienced in female patients because of the difficult differential diagnosis from acute gynaecological conditions ([5]).

There has been strong evidence that imaging can be of substantial diagnostic value in the diagnosis of acute appendicitis in children, but there is limited information of the impact of imaging on surgical findings ([6]).

We prospectively evaluate the impact of ultrasound (US) in the outcome of appendectomy findings in children.

PATIENTS AND METHODS

Prospective analysis of the clinical data of 96 consecutive patients who had appendectomy following clinical suspicion of acute appendicitis was carried out between June 2000 and December 2001. The patients comprised 56 males and 40 females. The age ranged from 3½ to 17 years with a mean of 12.3years. The surgical findings and histological data in the patients who had pre-operative (pre-op) ultrasound (US) were compared with those who did not have pre-op US.

High resolution US examination was performed on those who had pre-op evaluation, using the graded compression technique ([7], [8]). All examinations were carried out with 7.5 MHz linear array or 5 MHz convex transducers (Aloka machine). Emphasis was laid on scanning the area of maximal tenderness as indicated by the patient, and extended to other parts of the abdomen and pelvis.

Appendicitis was diagnosed if the appendiceal maximal outer diameter (MOD) is > 6mm and/or maximal mural thickness (MMT) is = 3mm in a non-compressible appendix. Also, appendices with luminal dilatation due to a large appendicolith or non-expressible fluid are presumed to be inflamed even with MMT< 3mm.

Statistical comparison of the frequencies of positive and negative appendectomies and of the examinations performed with and without US was done by using an x^2 test in a contingency table format. Results were considered statistically significant at $P < 0.05$.

RESULTS

Pre-op US was performed in 60 patients. 48 patients were diagnosed positive for appendicitis and 12 negative either as a result of other findings or non-visualisation of the appendix. At operation, appendicitis was detected in 50 patients, 12 of which were perforated. Based on surgical findings, appendicitis was correctly diagnosed by US in 46 out of 48 patients diagnosed positive and 4 out of the 12 diagnosed negative. Negative appendectomy (Table 1) was performed in 2 patients for what turned out to be normal appendix on histology and on 8 patients that had other pathologies which were diagnosed by US. The total rate of negative appendectomy for all patients that had pre-op US was 16.7 % (mis-diagnosis and other pathologies not appendicitis; n = 10/60), for misdiagnosis only is 3.3 % and for perforation was 20 %.

Figure 1

Table 1: Results Of Appendectomy Following Pre-Op Ultrasound Decisions

Pre-op Ultrasound	Appendectomy		*Negative appendectomy*	Total
	Positive	Negative *(Misdiagnosis)*	True Neg.	
Performed	50	2	8	60
Not Performed	24	12	-	36
Total	74	14	8	96

Thirty six patients had surgery without pre-op US because of unequivocal diagnosis of appendicitis based on the clinical and laboratory findings. Out of the 36 patients, appendicitis was detected at surgery in 24 with 5 cases of perforation. Negative appendectomy was performed 12 patients. The rate for negative appendectomy was 33.3 % and perforation rate was 13.9 %.

The overall perforation rate was 17.7 % (17 of 96) and negative appendectomy rate was 22.9 % (22 out of 96).

Statistical analysis revealed a significant association between the use of pre-op US and positive appendectomy using 2 x 2 contingency table and Yates continuity correction ($x^2 = 11.959$, df = 1, $P = 0.001$). No statistically significant difference in the rates of perforation ($Z = 0.48$, $P = 0.630$) or rate's of negative appendectomy ($Z = 1.162$, $P = 0.105$)

DISCUSSION

The diagnosis of acute appendicitis is often based on classical history and clinical findings. In recent times, ultrasonography has emerged as a cost effective tool in the diagnostic evaluation of children with suspected acute appendicitis ([6], [9]).

The negative appendectomy rate of 16.7% in patient who had pre-op US, and 33.3% in those who did not are comparable with figures presented in recent studies ([6], [10], [11]). Although, these figures are not statistically significant, the difference between the actual figures are impressive. However, when the wrong diagnoses alone are considered in those with pre-op US, the negative appendectomy rate dropped from 16.7% to 3.3% in our study. When there is lack of consensus between the surgeon and the radiologist (usually a senior resident radiologist in our situation) on the result of US findings, the tendency is for the rate of negative appendectomy to increase as seen in this case (16.7%) which is also the experience of Applegate et al ([3]).

Also, there is no statistically significant difference in the perforation rate in patients who had pre-op US (20%) and those without (13.9%). The perforation in those with pre-op US is comparable to those of similar group in the other studies ([6], [10]). Although, the rates are not statistically significant, the higher perforation rate in the group with pre-op US is probably due to delay to some extent, in surgery necessitated by the need for pre-op US. Since perforation of about 13.9% is encountered in those without pre-op US, it buttresses the submission that a certain perforation rate is unavoidable in age-related risk group whether or not surgery is delayed by as a result of additional imaging evaluation ([10]) . Perforation rates that are age-related have dual peaks with the first occurring in very young patient and the second in the elderly ([12], [13]). This could not be assessed in this study as all the patients are in paediatic age group.

There is evidence that an inverse relationship exists between a negative appendectomy rate and a perforation rate ([14]). This is illustrated in this study where the higher appendectomy rate (33.3%) in the group without pre-op US had a lower perforation rate (13.9%) when compared with the appendectomy rate of 16.7% in patients with pre-op US with a higher perforation rate of 20%.

While sonography is necessary to establish the diagnosis of appendicitis pre-op, it is equally important in differentiating true negative cases which constituted 13.3%

(8 out 60) in this series. The limitation of US, however resulting in 3.3% (2 out of 60) of wrong diagnosis in this series is attributable to the inability to visualize the appendices in 2 cases as a result of overlying bowel gas in relation to a retrocaecal appendix. The high resolution transducer used was therefore inadequate to localize the position of the appendices. The use of low-frequency transducer may equally make diagnosis more difficult because of the lower spatial resolution ($_{7}$).

In conclusion, US is very sensitive and specific for the diagnosis of appendicitis and has a significant association with positive appendectomy. Although there is no statistical difference in the negative appendectomy and perforation rates between patients that had pre-op US and those without, but there is a higher negative appendectomy in patients without, which showed that pre-op US can lower the negative appendectomy rate. Further reduction in the negative appendectomy rate can be achieved if US is performed by highly trained and experienced sonologists with a close rapport between the surgeons and sonologists. Unnecessary delay in surgery should be prevented by prompt preparation and performance of pre-op US so as to further reduce the perforation rate.

CORRESPONDENCE TO

Dr. V. A. Adetiloye,
Dept. Of Radiology,
Faculty Of Clinical Sciences,
College Of Health Sciences,
Obafemi Awolowo University,
Ile-Ife.
Nigeria

References

1. Janik JS, Firor HW, Paediatric appendicitis: a twenty - year study of 1,640 children at Cook County Hospital. Arch Surg , 1979; 114: 717-719
2. Velanovich V, Satava R, Balancing the normal appendectomy rate with the perforated appendicitis rate: implications for quality assurance. Am Surg , 1992; 58: 264-269.
3. Applegate KE, Sivit CJ, Salvator AE, et al, Effect of cross-sectional imaging on negative appendectomy and perforation rates in children. Radiology , 2001; 220: 103-107.
4. Balthazar EJ, Rofsky NM, Zucker R, Appendicitis: the impact of computer tomography imaging on negative appendectomy and perforation rates.
Am J Gasteroenterol , 1998; 93: 768-771
5. Sivit CJ, Newman KD, Boenning DA, et al, Appendicitis: usefulness of US in diagnosis in a paediatric population.
Radiology , 1994; 185:549-552
6. Karakas SP, Guelfguat M, Springer S, Singh SP, Acute appendicitis in children: comparison of clinical diagnosis with ultrasound and CT imaging.
Pediatr Radiol , 2000; 30: 94-98.
7. Puylaert JBC, Acute appendicitis: US evaluation using graded compression.
Radiology , 1986; 158: 255-360
8. Jeffery RB Jr, Laing FC, Lewis FR, Acute appendicitis: high resolution real-time US findings. Radiology , 1987; 163: 11-14
9. Wong ML, Casey SO, Leonidas JC, et al, Sonographic dianosis of acute appendicitis in children.
J Pediatr Sur. , 1994; 29: 1356-1360
10. Puig S, Hormann M, Rebhandl W, et al, US as a primary diagnostic tool in relation to negative appendectomy: six years experience.
Radiology , 2003; 226: 101-104
11. Andersson RE, Hugander AP, Ghazi SH, et al, Diagnostic value of disease history, and inflammatory parameters of appendicitis. World J Surg , 1999; 23: 133-140.
12. Nelson DS, Bate B, Bolte RG, Appendiceal perforation in children diagnosed in a pediatric emergency department.
Pediatr Emerg Care , 2000; 16: 233-237
13. Luckman R, Incidence and case fatality rates for acute appendicitis in California: a population-based study of the effect of age.
Am J Epidemiol , 1989; 129: 905-918
14. Birnbaum BA, Wilson SR, Appendicitis at the millennium.
Radiology , 2000; 215: 337-348

Author Information

V. A. Adetiloye
Department Of Radiology, King Khalid University Hospital

Saleh Al'Damegh, FKSU
Department Of Radiology, King Khalid University Hospital