

# Outcome of diagnosed cases of appendicitis and diagnostic accuracy of ultrasound of the appendix

Bhoj Raj Sharma<sup>1\*</sup>, Nawaraj Paudel<sup>1</sup>, Santwana Parajuli<sup>1</sup>,  
Sushma Singh<sup>2</sup>, Madhu Maya Timilsina<sup>3</sup>

<sup>1</sup>Lecturer, Department of Radiology,

<sup>2</sup>Lecturer/B.Sc, MIT, Program Coordinator, Gandaki Medical College & Teaching Hospital, Pokhara, Nepal,

<sup>3</sup>Medical officer, Urban health promotion Centre, Pokhara Municipality, Nepal

## ABSTRACT

**Background:** Acute appendicitis is the most common condition requiring an emergency ultrasound scan as well as surgery. Several scoring systems for acute appendicitis has been suggested to improve diagnostic accuracy and decrease the negative appendectomy rate. In this study, we have evaluated the diagnostic performance of ultrasound on the diagnosis of acute appendicitis, other appendicular pathology, and correlate with surgical outcome.

**Material and methods:** This retrospective study included 776 cases of ultrasound scan reports in which the appendix was visualized and not visualized or equivocal. Data were collected from October 2014 to April 2019 from different department and wards of Gandaki Medical College Teaching Hospital and Research Center (GMCTHRC). All the cases with diagnosed acute appendicitis, appendicular lump, and appendicular abscess were included and were followed for its surgical outcome. The surgical note or post-operative findings served as the reference standard for determining whether perforation was present or not. **Result:** There were 776 ultrasound scans for suspected appendicitis out of which 423 (54.5%) were diagnosed as appendicular pathology. Out of 423 diagnosed cases, 192 (45.4%) were males and 231 (54.6%) were females, with age ranging from 24 months to 87 years. Sonographic findings, in these positive subjects, suggested acute appendicitis, appendicular lump, abscess, and amount of free fluid in right iliac fossa (RIF) and pelvic cavity. Frank acute appendicitis was present in 378 (89.3%) cases, eight (1.9%) cases had an appendicular abscess, 23 (5.4%) had an appendicular lump and 14 (3.3%) had perforated appendicitis. **Conclusion:** We conclude that ultrasound is a good modality for visualization of appendicitis with other appendicular pathology. We could follow a structured report and identify pathology more specifically. Ultrasound is an easy and non-invasive test to investigate.

**Keywords:** Acute appendicitis, Right Iliac Fossa, Ultrasound, Ultrasonography.

## \*Correspondence to:

Dr. Bhoj Raj Sharma

Department of Radiology,

Gandaki Medical College Teaching Hospital and Research Center, Pokhara

Email: [bhojrajsharma2@gmail.com](mailto:bhojrajsharma2@gmail.com)

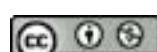
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## INTRODUCTION

The vermiform appendix is considered to be a vestigial organ, its importance in surgery is only due to its tendency for inflammation resulting in the syndrome called acute appendicitis. Acute appendicitis is the most common cause of an acute abdomen in children and adults that requires emergency surgery. Several scoring systems for acute appendicitis has been suggested to improve diagnostic accuracy and decrease the negative appendectomy rate.<sup>1</sup> Appendectomy is the most frequently performed emergency abdominal operation. The lifetime rate of appendectomy is 12% for men and 25% for females.<sup>2</sup> Acute appendicitis is relatively rare in infants, becomes increasingly common in childhood and early adult life, reaching a peak incidence in the teens & the early twenties. Obstruction of appendix lumen is important, some form of luminal obstruction by



either a fecolith or stricture is found in the majority of cases. Obstruction of the orifice by the tumor (carcinoma of the caecum) is a cause of acute appendicitis, in middle age and elderly.<sup>3</sup>

Inflammation of the appendix is associated with obstruction in 50 to 80% of cases, mostly due to fecolith, less commonly due to tumor, gall stone, or worms. There is a continuous secretion of mucinous fluid in an obstructed viscous which leads to an increase in intraluminal pressure sufficient to cause a collapse of draining veins, leading to ischemic injury to the appendix. Ischemia favors bacterial proliferation with additional inflammatory edema and exudation further hampering the blood supply.

Ultrasonography (US) is a preferred modality for diagnosing pediatric appendicitis because of its high diagnostic accuracy, ready availability, noninvasive nature, and lack of ionizing radiation or contrast medium administration.<sup>4</sup> However, recent studies in both adults and children report poor US accuracy for differentiating perforated from non-perforated appendicitis, with published sensitivities ranging from 23% to 48% and specificities ranging from 93% to 100%.<sup>4-5</sup> Although these studies support our hypothesis that US sensitivity for perforated pediatric appendicitis is poor, prospective studies with sufficient patient numbers to allow calculation of reliable test performance measures have not been performed.

## MATERIALS AND METHODS

### Patient data:

Ethical approval for this study was taken from the Institutional review board of Gandaki Medical College teaching hospital and Research Centre (GMCTHRC). The inclusion criteria were US diagnosed cases of acute appendicitis, appendectomy, conservative management of appendicitis, appendicular lump, and abscess. Data were collected from October 2014 to April 2019 from the radiological department, department of anesthesia, surgical postoperative ward, surgical ward, and cabin of GMCTHRC. A total of 776 US reports were available where Appendix measurements were done, which were suspicious of appendicitis in the selected duration of time. Out of 776 US scans, in 353 cases, the appendix was measured to be less than five millimeter or was equivocal at the time of the scan and no surgery was performed, therefore, these were excluded from the study. Thus, the study included 423 diagnosed cases of appendicitis.

### Ultrasound examinations:

Ultrasound examinations were performed with two

scanners (GE C5 and GE logic PE6) by certified radiologists. The graded compression technique was used. The diagnostic criteria for appendicitis were based on previous reports and as per international practice.<sup>6</sup>

The surgical note or post-operative finding served as the reference standard for determining appendicular perforation. When surgical note or post-operative findings suggests it as perforated appendicitis, histopathology report was not taken in consideration to look for perforated appendicitis as it was assumed that pathological specimen may not have included the perforated part of appendix or perforation occurring during handling of the appendix during surgery and after surgery.

### Statistical analysis

All the data were managed and kept in Microsoft excel in 2019. According to the dependent and independent variable, data were analyzed using predictive analytics software (SPSS version 25 IBM Corporation Chicago, IL USA). Descriptive statistics were expressed as a number, frequency, percentage for categorical variables, and as mean, median, minimum-maximum for age variables.

### Result

The study included 423 diagnosed cases of appendicitis. The median age of patients with appendicitis was 26 years ranging from 24 months to 87 years.

Table 1: Distribution of cases according to age group

	Frequency	Percentage
Below 10	45	10.6
10-19	137	32.4
20-29	117	27.7
30-39	43	10.2
40-49	29	6.9
50-59	24	5.7
60-69	12	2.8
70 and above	16	3.8
Total	423	100.0

In our study, the maximum number of patients were children and teens between 10 to 19 years of age i.e., 137 (32.4%), followed by young adults in the second and third

decade of life respectively. In contrast, there were few cases in the upper age group (Table 1). There were 192 (45.4%) male and 231 (54.6%) female patient in our study.(Table 2).

Table 2: Distribution of disease according to gender

Present or Absent	Condition and pathology									
	RIF tenderness		Free fluid		Abscess		Lump		perforation	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Present n (%)	129 (30.49)	129 (32.6)	138 (32.6)	47 (11.1)	51 (12.0)	3 (0.7)	5 (1.1)	12 (2.8)	3 (0.7)	5 (1.1)
Absent n (%)	63 (14.8)	63 (21.9)	93 (34.2)	145 (42.5)	180 (44.6)	189 (53.4)	226 (42.5)	180 (44.6)	189 (44.6)	226 (53.4)
Total n (%)	192 (45.3)	192 (54.6)	231 (45.3)	192 (54.6)	231 (45.3)	192 (54.6)	231 (45.3)	192 (45.3)	231 (54.6)	192 (45.3)

Note: RIF: Right iliac fossa

Similarly, we also accessed Sonographic RIF tenderness (graded compression technique), free fluid in RIF and pelvic cavity, abscess formation, lump formation and perforation of the appendix.

Table 2 shows the presentation of disease in different forms in 423 patients based on their gender. Sonographic tenderness in RIF was absent in 156 (36.9%), 63 male and 93 females, but present in 267 (63.1%), 129 males and 138 females. Similarly, in 325 (76.6%) patients, 145 male, and 180 female, did not have free fluid in RIF while 98 (23.3%) patients, 47 male, and 51 females, had free fluid in RIF. Likewise, there were eight (1.9%), three males and five females, with appendicular abscess and 23 (5.4%), 12 males and 11 females, had an appendicular lump. Further, out of 423 cases of appendicular pathology diagnosed on ultrasound, 378 patients (89.3%) were frank, non-perforated appendicitis, however, 14 cases were perforated appendicitis (3.3%) which were confirmed by postoperative findings.

## DISCUSSION

Acute appendicitis is the most common surgical emergency. Its clinical profile determines whether there is a need for emergent operative intervention or not. Appendicitis is considered as a disease of adolescent age groups.<sup>7,8</sup> In present study maximum number of patients belong to the first and the second decade of life which is in accordance with the study done by Hale et al.<sup>9</sup> where median age was 23 years while ours was 26 years.

Generally, appendicitis is common in children and young adults male as stated by other studies.<sup>1,2,5,7,9</sup> In our study, there were more children and the young adult female

affected by appendicitis consistent with the study done by Lewis et al.<sup>2</sup> where appendectomy was more in female compared to male. In contrast to our findings, there are many studies which suggests that it affects male predominately than female, however there is no such huge difference, just a slight increase in proportion of men at adolescence. This is most likely the influence of active duty population.<sup>2,4,9,10,11</sup>

Once the diagnosis of appendicitis is made, differentiation of perforated from nonperforated appendicitis becomes important. Emergency surgery is indicated for perforated appendicitis, whereas the initial therapy for nonperforated appendicitis may be nonsurgical because nonsurgical treatment has a lower complication rate.<sup>10,12,13,15</sup>

Ultrasound finding of the patients is important to confirm the diagnosis of acute appendicitis. Majority of the patients had probe tenderness on ultrasound evaluation, this is sensitive but not specific of appendicitis, which can be present in all clinical stages of appendicitis.

In our study probe tenderness on ultrasound and free fluid in abdomen/RIF was 63% and 23% respectively. Free fluid in the abdomen or RIF may be due to reactive inflammatory process or it may be secondary to pus discharge, accumulation and rarely due to fecal matter spillage. We found that five percent of our patients had lump formation and 1.9% had abscess formation which is almost similar to Linam et al.<sup>3</sup>, which also has 5.4% cases of lump formation and 2% of cases of abscess formation.

In children with acute appendicitis, the risk of appendiceal perforation ranges from 23% to 73%. Lee et al.<sup>14</sup> reported that perforation occurred with greater incidence in children younger than five years and that abscess formation at presentation occurred more commonly in children older than 10 years and old age more than 60 years. In our study, we found that all perforated appendicitis cases were equally distributed between children, second, fifth, and eighth decade.

There is no statistical correlation between the ultrasound finding to differentiate patients with perforated and non-perforated appendicitis.<sup>3</sup> However, we suggest a clinical correlation with Alvarado Score is mandatory and increases the value if coupled with ultrasound examination.<sup>15</sup>

## CONCLUSION

Ultrasound is useful in the diagnosis of appendicitis and should suffice as the modality of choice whenever the appendix is identified. However, the appendix is not always visualized in all patients with pain at RIF. As the majority of patients had on probe tenderness i.e. graded compression

it is mandatory to perform while accessing for an appendix. The decision to perform an appendectomy or to treat a patient conservatively should be made in association with clinical findings.

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#### **Conflict of Interest:**

None declared

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