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## Accuracy of ultrasonography for diagnosis of pediatric acute appendicitis: The experience of a Senegalese tertiary hospital

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### Abstract

**Introduction:** Acute appendicitis is more frequent in Africa than reported in literature. Its diagnosis can be facilitated by ultrasonography. However, the latter is not fully accurate. The aim of our study is to evaluate its accuracy for patients managed at our hospital.

**Methods:** We conducted a retrospective analytic descriptive study from January 2013 to December 2017, in the service of pediatric surgery of Aristide Le Dantec University Teaching Hospital, in Dakar, Senegal.

**Results:** We included 82 patients who underwent open surgery for acute appendicitis. The majority (61%) were realized in private clinics and radiologist were involved in 36% of cases. The appendix diameter was reported in 45%. In uncomplicated appendicitis, sensitivity of ultrasound was 80%, its specificity 73.3%. Its positive predictive value, 75% while its negative predictive value was 80%. Concerning complicated appendicitis, the sensitivity was 43.2%, its specificity, 91.1% and its positive predictive value and negative predictive value of 80% and 60%, respectively.

**Conclusion:** Ultrasonography is reliable for the diagnosis of uncomplicated appendicitis, but not as much for complicated cases. Studies on factors which impact its accuracy in Sub Saharan Africa are needed.

**Keywords:** Accuracy of ultrasonography, acute appendicitis, children, pediatric

### Introduction

Acute appendicitis (AA) is the most common digestive emergency in pediatric surgery [1, 2]. In LMICs, it is still a challenging disease which still has a higher morbidity and mortality [3]. Acute appendicitis usually depicts a classical clinical presentation. But in certain conditions (infants, late presentations, cases of initial administration of antibiotics, with or without analgesics), the clinical presentation is not sufficient to diagnose it. In these situations, complementary examinations are very useful [4]. Among them, ultrasonography (US) is a considerable adjunct. Its use has improved diagnosis of AA and reduced frequency of negative appendectomies [2]. In our environment, no study has been conducted to evaluate accuracy of US for the diagnosis of pediatric appendicitis. Hence, we conducted this study with that aim.

### Methods

We conducted a retrospective analytic descriptive study in the service of pediatric surgery of Aristide Le Dantec university teaching hospital, in Dakar, Senegal. We considered a five-year period, from January 2013 to December 2017. We included patients of less than 16 years, who underwent an appendectomy for clinically suspected AA. Exclusion criteria were: (a) intraoperative diagnosis of acute peritonitis due to perforated appendicitis and (b) patients without initial US.

The initial diagnosis was based on the history, physical examination and biological exams (full blood count and C-reactive protein). Our study used several variables from the US realization and results: type of US, experience of the US's operator, location of the appendix, its appearance and dimension (diameter and thickness) and the retained diagnosis (non-complicated appendicitis, appendicular abscess or appendicular mass). Studied intraoperative findings were: location of the appendix, its appearance and intraoperative diagnosis.

Data were encoded and analyzed with Sphinx software. We evaluated the sensibility, specificity, positive predictive value (PPV) and negative predictive value (NPV).

## Results

### Profile of the operator

During our study period, we recruited 126 patients of whom 86 were included in our study.

Fifty ultrasounds (61%) were realized in private clinics, with 36% by radiologist, 22% by general practitioners and 42% without mentioning the grade of the operator. All the 32 US made in university teaching hospitals (UTHs) were done by interns and residents in radiology, under supervision of a senior radiologist.

### Findings of the US

Location of the appendix in the abdominal cavity was given in 28 patients (35.5%), with 25 of them (89.3%) done in UTHs. Diameter of the appendix was not reported in 37 patients (45.1%), all realized in private clinics. For the 45 in whom it was reported, it was more than 6mm in 43 and less in two. Thickness of the appendix was measured in 11 patients (13.4%), all greater than 3 mm. All of the 11 patients were all evaluated in UTHs.

Ultrasonographic diagnoses were: non-complicated appendicitis in 40 children (48.8%), appendicular abscess in 20 patients (24.4%) and appendicular mass in a single patient (1.2%). In 21 patients (25.6%), the US report excluded the diagnosis of acute appendicitis.

### Intraoperative findings

The appendix was medial to the caecum in 52 patients (63.5%) as reported in table 1. Intraoperative diagnoses were the following: non-complicated appendicitis in 38 patients (46.3%), appendicular abscess in 37 patients (45.2%) and appendicular mass in 7 patients (8.5%).

**Table 1:** Intraoperative location of the appendix

Appendix Location	Number	Percentage
Mediocaecal	52	63.5
Mesoceliac	1	1.2
Pelvic	3	3.7
Retrocaecal	25	30.4
Subhepatic	1	1.2
Total	82	100

### Accuracy of US

The US diagnosed acute appendicitis in 63 patients, while the intraoperative findings found that all appendixes were pathologic. This means 21 missed diagnosis at US, among whom 16 were complicated appendicitis (13 appendicular abscesses and 3 appendicular masses). The table 2 presents US and intraoperative diagnosis.

In uncomplicated appendicitis, sensitivity of US was 80%, its specificity 73.3%. Its positive predictive value (PPV), 75% while its negative predictive value (NPV) was 80%. Concerning complicated appendicitis, the sensibility of US was 43.2%, its specificity, 91.1% and its PPV and NPP of 80% and 60%, respectively.

**Table 2:** Comparison of US diagnosis and intraoperative diagnosis

	US diagnosis	Intraoperative diagnosis
Absence of acute appendicitis	21	0
Uncomplicated appendicitis	40	38
Complicated appendicitis	21	44
Appendicular abscess	20	37
Appendicular mass	01	07
Total	82	82

## Discussion

The clinical diagnosis of acute appendicitis can be challenging, especially due to its polymorphism. In the early 20<sup>th</sup> century, surgery was indicated just with clinical suspicion, which led to a great frequency of negative appendectomies. Nowadays, biological examinations and clinical findings can be combined to evaluate the probability of acute appendicitis in a patient with right lower quadrant pain.

Besides, US has improved the diagnosis of AA. It is readily available in many tertiary centers of LMICs, where more accurate imaging such as Tomodensitometry are not available and are very expensive. However, US has some limitation: important layer of fat tissue in obese children, digestive distension due to air accumulation and last, but not least, experience of the operator<sup>[5]</sup>.

Overall, sensitivity, specificity, PPV and NPV of US for diagnosis of acute appendicitis in pediatric population have been reported as ranging from 58% to 97.1%<sup>[6-9]</sup>, 41.7 to 97.7%<sup>[6-9]</sup>, 77 to 95%<sup>[6, 7]</sup> and 39 to 61.5%<sup>[6-8]</sup>, respectively. However, authors reported that these results were different when comparing uncomplicated and complicated appendicitis, with lower sensitivity in the latter case<sup>[10, 11]</sup>. In our case, we separately evaluated accuracy of US for diagnosis of uncomplicated and complicated acute appendicitis.

In uncomplicated cases, sensitivity, specificity, PPV and NPV

were 80%, 73.3%, 75% and 80% respectively, which are within the ranges reported in the literature<sup>[6-9, 12-14]</sup>. Taking in account these results, it is necessary to retain the diagnosis basing on both findings of physical examination and US results. For complicated appendicitis, our findings were similar to those reported in the literature, with sensitivity, specificity, PPV and NPV ranging from 37.3 to 46%, 90 to 92.7%, 45.8 to 84% and 60 to 89%<sup>[10, 11]</sup>. Due to its low sensitivity in complicated appendicitis, some authors do not recommend US for the diagnosis of complicated appendicitis<sup>[10]</sup>. This can be attributable to ileus secondary to the appendicular mass or abscess, which make difficult the visualization of the appendiceal lesion.

The wide variation in accuracy of US for the diagnosis of acute appendicitis can be explained by the experience of the operator and duration of symptoms before presentation. In our case, only 36% US were realized by a radiologist. Authors have linked higher accuracy of US with experience of the operator for diagnosis of acute appendicitis<sup>[15]</sup>. In our study, classical findings of US in acute appendicitis were poorly reported: the diameter was reported in 45.1% and the thickness in 13.4%. The use of a standardized report is proven to increase accuracy to diagnose acute appendicitis as reported in the literature<sup>[16, 17]</sup>. The location of the appendix was given in 35.5% of patients. The appendix location is a crucial information which guide the

surgical incision as almost all appendectomies are done in with the open fashion in our environment <sup>[3]</sup>.

### Limitations

For a better understanding of accuracy of US for diagnosing acute appendicitis, some variables could be studied, such as duration of symptoms, use of antibiotics before US examination, kind of transducer and technique used to visualize the appendix during the US examination.

### Conclusion

The diagnosis of acute appendicitis with ultrasonography is feasible. While it is helpful concerning the diagnosis of uncomplicated appendicitis, ultrasonography is still not performant to diagnose complicated appendicitis. Further studies are needed to evaluate factors which impact accuracy of ultrasonography for the diagnosis of acute appendicitis.

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