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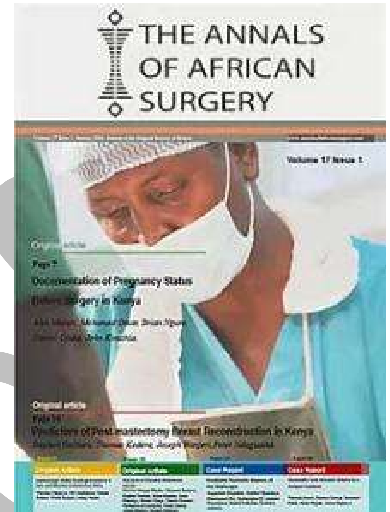
Negative appendectomy rate in urban referral hospitals tanzania: a cross sectional analysis of associated factors.



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Negative appendectomy rate in urban referral hospitals tanzania: a cross sectional analysis of associated factors

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Abstract

Background: Acute Appendicitis has a lifetime risk of 8.3% with consequent 23% lifetime risk of emergency appendectomy. In atypical presentation, making a clinical diagnosis is difficult leading high perforation rate or misdiagnoses and high negative appendectomy rates. This study aimed to establish the negative appendectomy rate, explore associated factors and possible attainable solutions to reduce it in urban referral hospitals in Tanzania.

Methods: This was a cross-sectional study with 91 consecutive patients, aged 10 years and older undergoing appendectomy for suspected acute appendicitis with histological evaluation of specimen. The study was powered to detect the negative appendectomy rate at 95% confidence level and 80% power.

Results: The histological negative appendectomy rate was 38.5% and the perforation rate was 25.3%. Alvarado score was rarely applied (6%), despite demonstrated ability to decrease the negative appendectomy rate by half in this study. Females were 4 times more likely to undergo negative appendectomy compared to males.

Conclusion: The negative appendectomy rate is clinically significant as about a 2 out of every 5patients undergoing emergency appendectomy for suspected acute appendicitis do not require the procedure. Alvarado score is underutilized despite demonstrated ability to decrease negative appendectomy rate. We recommend that Alvarado Score should be in cooperated in management of patients with suspected appendicitis

Keywords: Negative Appendectomy Rate, Sub Saharan Africa, Alvarado Score, Appendectomy, suspected Acute Appendicitis.

Introduction

Acute appendicitis (AA) has a lifetime prevalence between 6.7 to 8.6%, with a corresponding lifetime risk for emergency appendectomy of 12.0 to 23.1% (1). Despite the frequent occurrence, making a correct clinical diagnosis is often difficult in atypical presentation. Delay in diagnosis leads to perforation while a misdiagnosis results in unnecessary appendectomy (2,3).

Low negative appendectomy rate has been traditionally interpreted as being associated with missed early AA, and consequently progression to perforation. By contrast, a high negative appendectomy rate while reducing the risk of missed early AA commonly results in subjecting patients to unnecessary surgery (4). While the relationship described above is still prevalent in resource limited health services, there are imaging technologies available in highly resourced health services that can reduce the negative appendectomy rate (NAR) without increasing the perforation rate (PR) (5, 6). A high NAR leads to unnecessary surgical intervention with its associated risk of morbidities, economic burden with potential adverse consequences of unnecessary anesthesia. (7-11).

The precision of diagnosis of AA is a major determinant of NAR. This can be increased by use of medical imaging, clinical scoring systems and laparoscopy. Diagnostic scoring systems like the Alvarado Score (AS) have parameters with a positive correlation to the diagnosis of AA (12). Using AS, the most established scoring system, a score of less than 5 has been endorsed to have enough sensitivity to virtually rule out AA (13). Medical imaging displays the appendix and associated features of inflammation during acute appendicitis. Diagnostic performance of US for suspected AA yields an overall NAR of about 4.9% to 9.7% (14). Use of computer tomography (CT) results in a NAR of 2.5% to 8.5% (15).

In sub-Saharan Africa (SSA), AA is associated with significant, potentially avoidable morbidities and mortalities. This is due to prehospital delays and in hospital delays caused predominantly by limited human resource, infrastructure and diagnostic capacity (16). Access to Laparoscopy and MRI are limited in this setting. This situation is hypothesized to adversely impact the NAR which ranges from 17% to 33.1% (17,18).

This study was undertaken to establish the baseline NAR, explore associated factors and possible attainable solutions to reduce it in urban referral hospitals in Tanzania. Furthermore, these parameters could serve as measures of performance and as evaluation parameters for future interventions aimed at improving AA case management in this region.

Materials and Methods

This was a cross sectional analytical study, conducted in four urban referral hospitals in Dar es Salaam city, Tanzania from May 2018 to April 2019. Three of the hospitals were public district referral hospitals with fully equipped laboratory and a radiology services offering US service; however, CT was not available. The fourth hospital was private referral level hospital with CT services in addition to the diagnostic capacity of the public hospitals.

Patients who underwent appendectomy or emergency laparotomy for suspected AA above the age of 10 years were included. Pregnant women, those who intraoperatively had alternative diagnoses and those who underwent incidental appendectomy were excluded.

We applied finite population correction of 120. This reflected the total number of appendectomy procedures that would be done during the study period with the outcome of interest. Based on 95% confidence level and power of 80%, using the 33% NAR and a 5% precision level, the minimum sample size required was 89 (18). Given attrition rate and lost data sample size of 95 was targeted

Appendectomy specimens were collected with corresponding data abstraction tools. The surgical specimens were analysed histologically by a consultant anatomical pathologist. All appendix specimens collected underwent histological analysis. Standard quality assurance processes of the pathology laboratory mandated random 10% confirmation by second consultant pathologist.

We collected information on patient demographics, lag time; defined as duration of onset of illness in days until appendectomy, signs, symptoms of the patient during illness along with the WBC count and differentials. AS use, the score assigned as well as medical imaging use and operative findings were acquired. The main outcomes were appendix histological diagnosis.

Acute appendicitis was defined histologically as transmural attendance of acute inflammatory cells, and negative appendectomy lack of transmural attendance of inflammatory cells. The negative appendectomy rate was determined as a ratio of histologically negative appendicitis to the total number of appendectomy specimens. Descriptive statistics such as proportions, means, median, range and standard deviations were calculated. Continuous variables were tested for normality by Shapiro-Wilk test and proportions were compared by chi-square and Fisher's exact tests.

We calculated Alvarado scores for all patients from collected data. Each parameter used to make radiological diagnosis of acute appendicitis for CT abdomen was given a score of 1 when present. The parameters for CT was appendix diameter greater than 7, free fluid in right iliac fossae, fat stranding and presence of appendicolith. As the scores increased the likelihood of acute appendicitis would increase. In a similar manner US features for diagnosis of AA used to create US score were RIF fluid, diameter of appendix greater than 7 mm and the third criteria being presence of appendicolith. These scores were evaluated for association with NAR

Group means for normally distributed variables were compared by students' t test whereas non-normal group medians were compared by non-parametric tests (Mann-Whitney-U and Kruskal-Wallis). Regression analyses were done to identify and quantify true predictors of negative appendectomy, $P \leq 0.05$ was considered statistically significant

The study did not interfere with patient care and management decisions. Participants were not placed at additional risk during participation of study. Permission to conduct the study was sought from the AKU ERB, with reference number of AKU/2017/245/fb and respective hospitals ethical committees.

Consent was sought from participants and material management agreement for the transportation, examination and archiving of the collected appendicular specimen. Collected data were archived by AKU.

Results

Ninety-two eligible candidates underwent appendectomy during the study period. One patient was excluded following undergoing incidental appendectomy following findings of uterine fibroid disease. The total number of participants analyzed was 91. Table 1 summarizes characteristics of the participants.

The physician who evaluated the participants were predominantly medical officers (83.5%). In one center, the medical officers made the decisions semi independently with consultations by their on-call consultants. Sixty-one patients were evaluated from the private health facility, and 30 patients were from the public facility. Full Blood Count (CBC) was not conducted in two participants. US examination was conducted 32 times and CT 61 times in evaluation of AA. Sonographers conducted 53% and medical radiologists conducted 47% of the US evaluations. Two participants did not undergo either imaging modality and 4 participants underwent US then CT.

Surgical access was commonly through Mc Burney's incision 69% (63/91) laparoscopy was not used. Presence of reactive free fluid in right iliac fossa on gross appearance was encountered in 95% of the procedures. The appendix was grossly perforated in in 19.8% and appeared grossly uninflamed in 11% of the cases.

After histological analysis, negative appendectomy rate was 38.5% (35/91), perforation rate was 25.3% (23/91) and non-complicated appendicitis was 36.3% (33/91). Appendicular carcinoma was not encountered. There were two cases of eosinophilic, one case of schistosomiasis and one case of enterobiasis of the appendix inciting a limited inflammatory response that did not meet the histopathological definition of AA. There was one case of foreign body reaction and one case of inflammatory cells confined to the serosa without evidence of mucosal inflammation.

Males had a negative appendectomy rate of 28.0 % (16/57) and females had a negative appendectomy rate of 55.8 % (19/34), this difference was statistically significant (X2 6.960, p- 0.008). There was no statistically significant association between NAR and duration of illness using binary logistic regression. Presence of RIF rebound tenderness was independently negatively associated with NAR (x2 4.242, p- 0.039). Other clinical findings did not have an association with histological outcomes of appendectomy. Those with negative appendectomy had a lower leucocyte count compared to those with acute appendicitis similarly absolute neutrophil count was higher among those with acute appendicitis compared to those with NAR, this difference also being statistically significant on Mann Whitney U test. The clinical and laboratory findings are summarised in table 2.

AS was determined in only 6% of the cases. We computed a calculated AS from collected participants' data. The mean calculated AS in those with negative appendectomy was lower compared to those with acute appendicitis this difference was statistically significant on Mann-Whitney U test (z -3.864, p- 0.000).

Half of those with negative appendectomy had calculated AS of less than 5, compared to one quatre of those with acute appendicitis. The difference was statistically significant. Negative appendectomy did not have an association with US use (P > 0.05), US score (P > 0.05) or level of training of US operator (p>0.05). CT abdomen diagnosis had a statistically significant association to outcomes of appendectomy (x2 9.531, p 0.009). Those with acute appendicitis had higher mean CT score compared to those with negative appendectomy.

A binary regression analysis was conducted assessing factors associated with negative appendectomy. The factors considered in this equation were sex of the participants, calculated AS of less than 5, leukocyte count and CT score. The point of interception of these factors was statistically significantly associated with NAR at a $p < 0.05$ and an odds ratio of 16.358. Of these factors, sex of the participant, leucocyte count and CT score were shown to have a statistically significant association with negative appendectomy rate. The model predicted females are 4 times as likely to have negative appendectomy compared to males, with a 95% confidence interval of 0.938 to 16.12.

Discussion

The negative appendectomy rate in this study was 38% despite medical imaging use. This NAR is concerningly high, as more than third of patients undergoing emergency appendectomy for suspected AA do not require the procedure. This finding is in sharp contrast to the described NAR of less than 5% with use of clinical decision rules and diagnostic imaging (14, 15, 19). Clinical decision rules were rarely used in our setting, the diagnostic accuracies for imaging investigations that were more commonly used in our setting are unknown and hypothesized to be lower than those cited elsewhere in view of our findings. These differences are possible contributors to the observed findings

Female sex was statistically associated with NAR, constituting 54% of those with negative appendectomy. This result is similar to a study by Tesng J, et al that revealed that the female sex contributed in 62% of their NAR (15). Other authors found that female sex to have accounted for 30 to 50% of their determined negative appendectomy rate (3). In our study it was further shown that females were about 4 more times to have negative appendectomy compared to males. This is mainly due to gynaecological diseases processes that may present as acute appendicitis that are not present in males.

AS was used in only 6% of our participants, despite strong recommendations for its use in multiple international guidelines and from studies in the region(13, 20). Nineteen participants who had negative appendectomy, also had an AS of less than 5, had these participants not undergone appendectomy our NAR would have been 17% (16/91).

US use and experience of radiologist did not have a statistically significant association to NAR. This is in contrast to findings by other authors, that reaffirm the sole use US to have ability to decrease the NAR to about 10% (14, 15, 21). US use is associated with inherent subjectivity, hence it is hypothesized the expertise of radiologist has an impact on the accuracy of the investigations (22). In studies citing the role of US in outcomes of appendicitis, most investigations were conducted and interpreted by medical radiologists and consultants which was contrary to the findings in our study (15, 21). The association between experience of the radiologist and NAR was possibly not evident in our study as we did not have sufficient power to detect this difference.

CT scan was shown to be useful in both decreasing NAR and diagnosing AA (x2 9.531, p 0.009). The effect size was moderate, revealing a NAR was 32.8% among those who underwent CT. The ability of CT to decrease the NAR has been well established. Use of CT scan is associated with NAR of 2.7% to 8.7% (14, 15, 19, 23). Despite the use of CT scanning in or study, NAR in those who underwent this modality was still high. It is likely that the diagnostic accuracy in our setting is not similar to that described in literature(24).

Conclusion and Recommendations

The negative appendectomy rate is clinically significant as about a 2 out of every 5 patients undergoing emergency appendectomy for suspected acute appendicitis do not require the procedure. Alvarado score is underutilized despite demonstrated ability to decrease negative appendectomy rate. We are strongly recommending uniform use of AS in patients with suspected AA. This will significantly reduce our negative appendectomy rate. Implementation science research studies are recommended to provide solutions to curb the high NAR in our setting

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Tables:

Table 1: Patient's baseline characteristics

Variable	Frequency	Percentage
Sex		
Male	57	62.2%
Age range (years)		
10-20	19	20.9%
21-30	26	28.6%
31-40	27	29.7%
41-50	10	11.0%
>50	9	9.9%
Duration of illness (days)		
1 to 4	56	61.5%
5 to 8	28	30.8%
>8	7	7.7%
Cadre of assessing physician		
Assistant Medical officer	6	6.6%
Medical intern	8	8.8%
Medical officer	76	83.5%
Medical specialist	1	1.1%

Table 2: Investigation results in those with negative appendectomy compared to those with acute appendicitis

Parameter	Negative appendectomy	Acute appendicitis	P value
Mean Leucocyte Count	8.76K/uL (7.62 to 9.90)	12.02K/uL (10.77 to13.27)	$p < 0.05$
Mean Neutrophil Count	68.94 K/uL (63.10 to 74.69)	78.19 K/uL (75.49 to 80.88)	$p < 0.05$
Mean calculated Alvarado score	5.49 (4.76 to 6.21)	7.33 (6.77 to 7.90)	$p< 0.05$
Calculated Alvarado score of less than 5	54%	23%	$P<0.05$
Mean calculated US score	15.41	15.62	p 0.938
Mean calculated CT score	1.70 (95%CI 1.41-2.28)	2.61 (95%CI 2.36-2.86)	$p< 0.05$